MIL-E-24455(SHIPS)
24 September 1971
SUPERSEDING
MIL-E-23457A(SHIPS)(In Part)
(See 6.5)

MILITARY SPECIFICATION

ENGINES, DIESEL, PROPULSION AND AUXILIARY, HIGH SPEED, NAVAL SHIPBOARD

1. SCOPE

1.1 This specification covers propulsion and auxiliary diesel engines rated at 1500 revolutions per minute (r.p.m.) or above. Engines shall be manufacturer's production models modified to be compatible with environmental conditions, maintenance procedures and mission requirements peculiar to Navy applications.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

F-F-351 - Filters and Filter Elements, Fluid, Pressure. Lubricating Oil, Bypass and Full Flow.
F-P-666 - Primer, Pressure, Internal Combustion Engine (Cold Starting Aid) and Primer Cartridges.
O-A-548 - Antifreeze, Ethylene Glycol, Inhibited.
O-I-490 - Inhibitor, Corrosion, Liquid Cooling System.
MMM-A-260 - Adhesive, Water Resistant, (For Sealing Waterproof Paper).
PPP-B-1055 - Barrier Material, Waterproof, Flexible.

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MIL-C-104 - Crates, Wood; Lumber and Plywood Sheathed, Nailed and Bolted.
MIL-P-116 - Preservation, Methods of.
MIL-B-131 - Barrier Material, Water Vaporproof, Flexible, Heat-Sealable.
MIL-R-196 - Repair Parts for Internal Combustion Engines; Packaging of.
MIL-B-233 - Boxes, Repair Parts, Storage.
MIL-S-901 - Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements For.
MIL-A-5092 - Adhesive, Rubber Base, General Purpose.
MIL-C-5584 - Containers, Shipping and Storage, Metal Reusable.
MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5.
MIL-F-7194 - Filter, Reciprocating Engine Induction Air, Aircraft.
MIL-F-8901 - Filter/Separators, Aviation and Motor Fuel, Ground and Shipboard Use, Performance Requirements and Test Procedures For.
MIL-L-9000 - Lubricating Oil, Shipboard Internal Combustion Engine, High Output Diesel.
MIL-C-9959 - Container, Flexible, Reusable, Water-Vaporproof.
MIL-E-10062 - Engines: Preparation for Shipment and Storage of.
MIL-M-10304 - Meters, Electrical Indicating, Panel Type, Ruggedized, General Specification for.
MIL-G-12803 - Gasket Materials, Non-Metallic.
MIL-B-13239 - Barrier Material, Waterproofed, Flexible, All Temperatures.
MIL-M-15071 - Manuals, Technical; Equipment and Systems Content Requirements For.
MIL-P-15137 - Provisioning Technical Documentation for Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).
MIL-M-15337 - Mufflers, Exhaust, Internal Combustion Engine.
MIL-S-15371 - Starter, Engine Electrical (Naval Shipboard Use).
MIL-C-15730 - Coolers, Fluid, Industrial, Naval Shipboard: Lubricating Oil, Hydraulic Oil, and Fresh Water.

MILITARY (cont'd)

MIL-C-[illegible] - Switch, Shipboard Alarm System
[illegible] - Relay, Electrical, Self-Generating, Mechanical, Fixed Mount, Hand Held, and Vibrating Reed.
MIL-I-16910 - Interference Shielding, Engine Electrical Systems
MIL-C-16173 - Corrosion Preventive Compound, Solvent Cutback, Cold-Application.
MIL-L-16884 - Fuel Oil, Diesel, Prime
MIL-P-17326 - Propulsion and Auxiliary Steam Turbines and Gears (Including Repair Parts, Tools, Accessories and Instruments), Packaging of
MIL-I-17214 - Electronic and Electrical Equipment, Accessories and Repair Parts, Packaging and Packing of
MIL-C-19435 - Chargers, Battery, Generator Type
MIL-I-19628 - Inhibitor, Corrosion, Liquid Cooling System (Dichromate Type).
MIL-F-2004 - Flanges, Pipe, Bronze (Silver Brazing)
MIL-F-20627 - Filter Assembly and Filter Elements, Fluid, Pressure (For Engines with Liquid Fuel Injection Systems)
MIL-F-20671 - Flanges, Pipe, Carbon Steel, 150 P S I, W S P. (For Naval Shipboard Use)
MIL-C-21121 - Coolers, Fluid, Industrial, Lubricating Oil and Fresh Water, Naval Shipboard
MIL-L-21260 - Lubricating Oil, Internal Combustion Engine, Preservative and Break-In
MIL-M-24365 - Maintenance Engineering Analysis Establishment of, and Procedures and Formats for Associated Documentation, General Specification for
MIL-I-24453 - Inhibitor, Corrosion, Soluble-Oil
MIL-I-26860 - Indicator, Humidity, Plug, Color Change.
MIL-M-38761/2 - Microfilming and Photographing of Engineering/Technical Data and Related Documents PCAM Card Preparation, Engineering Data Micro-Reproduction System: Microfilm Aperture and Tabulating Cards for Naval Ship Systems.
MIL-I-45208 - Inspection System Requirements
MIL-F-52308 - Filter Element, Fluid Pressure

STANDARDS

MILITARY

MIL-STD-129 - Marking For Shipment and Storage.
MIL-STD-130 - Identification Marking of U S. Military Property.
MIL-STD-167 - Mechanical Vibrations of Shipboard Equipment.
MIL-STD-271 - Nondestructive Testing Requirements for Metals.
MIL-STD-777 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Surface Ships
MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, with Appropriate Test Methods.
MS16142 - Boss, Gasket Seal Straight Thread Tube Fitting, Standard Dimensions for.
MS35802 - Filter Elements, Fluid, Pressure-Oil, Full-Flow.

PUBLICATIONS

MILITARY

NAVSHIPS 0900-003-8000 - Metals, Surface Inspection Acceptance Standards
NAVSHIPS 0900-003-9000 - Radiographic Standards For Production - Repair Welds.
NAVSHIPS 0901-412-0002 - Naval Ships Technical Manual - Chapter 9412 - Diesel Engines Propulsion - General Purpose.

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

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

NATIONAL BUREAU OF STANDARDS
Handbook H28 - Screw Thread Standards For Federal Services.

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

UNIFORM CLASSIFICATION COMMITTEE
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Boulevard, Chicago, Illinois 60606.)

NATIONAL CLASSIFICATION BOARD
National Motor Freight Classification Rules.

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., 1616 P Street N.W., Washington, D.C. 20036.)

3. REQUIREMENTS

3.1 Engine rating. The engine horsepower rating and speed shall be as specified in 6.2 and indicated on the engine identification plate (see 3.26.1). This rated horsepower output, unless otherwise specified in the contract or order, corresponds to full power operation of the boat or ship, or it's equipment under ship trial conditions. This engine rated horsepower shall be not greater than the horsepower value chosen as the 100 percent "rated load" condition for the first unit endurance test specified in 4.4.2.

3.1.1 Acceptance requirements. It is the intent of this specification to procure current production engine models with a demonstrated background of satisfactory service experience under conditions comparable to those to which the procured engines will be subjected. Therefore, in addition to meeting all other requirements of this specification that are applied by the procurement document, the engine at the time of the bid must have met at least one of the following requirements

(a) The engine is essentially identical to an engine which has been accepted by the Naval Ship Engineering Center (NAVSEC) as having met the requirements of this specification at the same or a higher power rating and brake mean effective pressure (bmep).
(b) Unless otherwise specified in the contract or order, the engine shall be a current production item, or a type which the manufacturer will certify and has a background of 5000 hours satisfactory operation on at least one unit. The unit or units considered as verifying this experience factor shall be installed for a rated output at least equal to the rating specified in the procurement involved. The engine supplier shall on specific request, provide detailed information as to where the units are located, who operates them, and insofar as practical, how they are used. This information shall be used when desired to verify the manufacturer's stated compliance with this experience requirement.

3.2 Materials. Corrosion resistant materials shall be used in saltwater system piping and components. Coated or painted cast iron or other ferrous metals are not acceptable in these areas. Materials used in the construction of fuel and lubricating oil coolers and coolant heat exchangers shall be in accordance with MIL-C-21121 or MIL-C-15730 except composition 70-30 copper-nickel alloy is acceptable where composition 90-10 is specified.

3.2.1 Dissimilar metals. Contact between dissimilar metals shall be avoided in order to minimize galvanic corrosion. An interposing material which will minimize or eliminate this galvanic effect may be used.

3.2.2 Aluminum parts. Aluminum parts, other than pistons, blowers and fuel pumps shall be protected from corrosion by one of the following methods:

(a) Exterior parts to be painted shall be anodized or treated with corrosion resistant chemical film.
(b) Exterior parts to be left unpainted shall be anodized.
(c) Interior parts in contact with oil do not require treatment.

3.2.3 Threaded holes in aluminum intended for bolts or screws for components or accessories normally removed or disassembled during routine maintenance or examination shall have steel inserts. Where insufficient basis metal exists, studs can be used without inserts. Dimension, including thread data and length, and complete instructions covering the removal and replacement of all inserts used shall be included in the engine instruction manual.

3.2.4 Magnesium alloys. Magnesium alloy shall not be used.

3.2.5 Coating. No paint, plastic or zinc coating shall be applied to the interior of gear covers, lubricating oil pumps or any other interior surfaces that will be in contact with lubricating, fuel, or hydraulic oil.

3.2.6 Threaded fastenings. All threaded parts shall conform to Handbook H28. Nuts and other threaded fastenings on the engine and accessories shall be secured by wire, lockwashers, cotter pins, clips or other means, in such manner as to positively prevent the part working loose under operating conditions. All drain plugs shall be readily removable with general purpose wrenches.

3.3 Standard operating conditions. The following operating conditions shall be used for the design and testing of the engine and accessories.

Ambient air temperatures	100°F
Barometric air pressure (dry) inches mercury (Hg)	29.92
Fresh water from engine (minimum -190°F (maximum)	160°F
Exhaust back pressure	2 inch Hg
Sea water inlet temperature	90°F
Sea water outlet temperature (maximum)	130°F

Lubricating oil temperature to engine or in gallery

(a) Propulsion engines with engine mounted coolers .... 225°F. (maximum).
(b) All other applications .... 200°F (maximum).

Fuel temperature to engine (maximum)	115°F

3.4 Inclination. The engine, accessory components and piping systems shall be capable of operating in accordance with all the requirements of this specification and without loss of fluids, loss of lubricating oil pump suction, and without the connecting rod and gears dipping into the oil under the following conditions.

(a) When the ship is operating at any angle from 0 to 15 degrees from the horizontal, engine coupling end low.
(b) When the ship is rolling up to 45 degrees either side or pitching up to 18 degrees.

3.5 Reliability and maintainability.

3.5.1 Reliability.

3.5.1.1 The principle of reliability is paramount and no compromise of this principle shall be made with any other requirements nor during evaluation of the accept/reject tests which are too short to insure reliability during the long time intervals between scheduled overhauls.

3.5.1.2 Unless otherwise specified (see 6.2), the reliability and maintainability features shall be predicated on the following missions.

(a) The engine shall carry its rated full load continuously for numerous 48-hour operating intervals in emergencies or combat support missions. Preventive maintenance shall be deferred during this period.
(b) The engine shall carry its rated load and specified partial loads (see 6.2) for at least 1000 hours for a successful typical wartime mission. A minimal amount of shipboard preventive maintenance and a maximum amount of maneuvering is allowed during this period.
(c) The engine shall perform numerous wartime missions without overhaul during at least 4000 operating hours.
(d) The engine shall be designed to operate reliably in accordance with this specification for the specified total design life of 24,000 hours.

3.5.2 Maintainability.

3.5.2.1 Maintainability goals.

(a) Overhaul parts and labor costs shall not exceed 50 percent of acquisition cost.
(b) Overhaul by means of parts replacement shall be accomplishable by onboard personnel and equipment.
(c) Preventive maintenance during the operating intervals (see 3.5.1.2(a)) shall be deferable or eliminated if possible.
(d) The maximum time to effect any repair action or to replace any part, other than the block and crankshaft, shall be less than 24 hours.

3.6 Accessory equipment. Unless otherwise specified (see 6.2), the following accessories shall be furnished with each engine

(a) Sea water pump.
(b) Fresh water pump.
(c) Lubricating oil pressure pump.
(d) Fuel supply pump.
(e) Lubricating oil cooler
(f) Fresh water cooler.
(g) Lubricating oil filter(s).
(h) Lubricating oil strainer (or oil pump screen)
(i) Intake air silencer.
(j) Turbocharger aftercooler.
(k) Fuel oil filter.
(l) Fuel oil strainer (see 3.7.3 2).
(m) Temperature regulator or thermostat.
(n) Governor.
(o) Overspeed trip device or governor.
(p) Starting system.
(q) Blower (2 cycle engines)
(r) Engine mounted controls.
(s) Lubricating oil low-pressure alarm switch.
(t) Fresh water high-temperature alarm switch.
(u) Reverse/reduction gear (propulsion only).
(v) Fuel oil booster pump (if required).
(w) Engine barring device.
(x) Turbocharger (if used).
(y) Emergency shutdown device.

Other accessories or engine attached piping necessary for satisfactory engine operation but which are not specified herein or in the contract or order shall be furnished by the engine manufacturer. Unless otherwise specified in the contract or order, piping, including fitting and flanges, alarm systems, wiring, or mechanical linkage required to connect detached accessories, instruments, and controls to the engine, or to cooling water, fuel, starting air, electrical, exhaust, or lubrication systems, shall be furnished by the installing activity.

3.6.1 Engine crankcase and air box explosion protective devices or design. All diesel engines with cylinder bore diameter of 6 inches or greater shall be protected from the hazard of crankcase or air receiver explosions by one of the procedures specified in 3.6.1.1 through 3.6.1.5.

3.6.1.1 If the crankcase can be demonstrated by test to withstand an internal gas pressure of 100 pounds per square inch gage (psig) without rupture, it is considered to be acceptably safe to contain a crankcase explosion and no other protection devices is required. For the purpose of this demonstration, the term crankcase shall be interpreted to include the entire engine structure that would be exposed to internal gas pressure in the event of a crankcase explosion.

3.6.1.2 If the integrity of the engine crankcase and related volume cannot be demonstrated as specified in 3.6.1.1, the engine shall be provided with spring loaded explosion relief valves in each cylinder crankpit, to provide a total relief area of at least 1-1/2 square inches, for each cubic foot of total crankcase volume. These relief valves shall be designed to be fully open at a crankcase pressure of 20 psig, and to close and seal the crankcase from air when the pressure has been relieved. The entire crankcase system in the terms of 3.6.1.1, including any access covers, shall be designed to withstand an internal pressure of at least 25 psig without failure when explosion protection devices are used.

3.6.1.3 The air receivers of the fuel oil tanks (only) of 6 inch diameter or larger cylinder sizes, shall also be protected from air receiver explosions. If the air receivers, including all piping and structure that would be subject to gas pressure in event of air explosion, can be demonstrated to withstand 125 psig internal gas pressure, no other air receiver explosion protection device is required.

3.6.1.4 If the pressure integrity requirements of 3.6.1.1 cannot be met, the air receiver shall be provided with an explosion relief valve or valves, having at least 1-1/2 square inches of relief area per cubic foot of total air receiver system volume. These relief valves shall be designed to be tight at maximum air receiver operating pressure and to be fully open at 20 psig pressure above that operating pressure level. The valves shall be designed to relieve the explosion and reset tightly. When these explosion relief valves are used, the entire receiver structure, covers, etc., which would be subject to the pressure of an air receiver explosion shall be designed to withstand at least 5 psig above the pressure at which the relief valve is fully opened.

3.6.1.5 Explosion relief valve design requirement. All crankcase or air box explosion relief valves, if used, shall be provided with internal oil wetted screen type flame arrestors and blast deflectors which will direct explosion forces away from personnel who might be alongside the machinery.

3.6.2 Accessibility. Engine attached accessories such as pumps, blowers, coolers, filters, strainers and silencers, shall be designed and secured in such a manner as to permit maximum accessibility to the accessories and the engine.

3.7 Fluid piping systems.

3.7.1 Piping. Engine attached piping shall be strapped and supported by the engine structure to prevent vibration and resist shock. Pipe couplings of the hose type or lengths of nonmetallic composition tubing may be used when installed in a visible and accessible location. Take-down joints in fuel systems shall be kept to a minimum to reduce leaks. If used, flange connections may be either commercial or Navy type. If commercial flanges are supplied, each connection to ship's piping systems shall be provided with a companion flange for welding to ship's piping. Navy type flanges for steel or nonferrous piping and fittings shall conform to MIL-F-20b70 or MIL-F-20042, as applicable.

3.7.1.1 Flexible hose. If used, flexible hose for fuel service and engine and transmission lubricating oil service shall be polytetrafluoroethylene inner tube with corrosion resistant steel braid outer covering. The hose shall be supported internally by a corrosion resistant steel flat coil spring for 3/4 inch tube size and larger. Fittings shall be of the reusable type which do not require the use of special tools. The hose assembly shall be capable of operating at a pressure equal to 5 times the oil pump relief valve setting at temperatures between minus 40°F. and plus 450°F. Burst pressure shall be 20 times the relief valve setting minimum.

3.7.1.2 Pipe thread data. (Applicable only when high shock resistance is required) (see 6.2).

3.7.1.2.1 Taper pipe threads are not permitted in piping systems or between piping, machinery or valves except in the following areas:

(a) Pipe plugs in sizes of 3/4 inch and below used for applications where pressures do not exceed 50 pounds per square inch (psi). Plugs shall be seal welded or brazed, if possible.
(b) Instrumentation, controls, vent, filling and drain connections where pressures do not exceed 50 psi and where fluids handled, (a) are not toxic, (b) are not dangerous, (c) would not cause atmospheric contamination, (d) would not create a fire hazard, and which would not cause, in the event of failure, a major breakdown of equipment nor create a hazard to the surrounding area nor affect the operation of other vital equipment.
(c) Exposed pipe plugs on the engine and accessories used to close core support holes and drilled passages, and plugs used to close unused optional connections and accessory holes.
(d) Pipe plugs internal to the engine.
(e) Threaded connections in the engine components and accessories used for tubing and flexible hose adaptors, except for connection to the ship's systems as described in 3.7.1.2.2(a). Taper pipe thread adaptors 3/4 inch or less in size for connecting tubing for remote reading temperature and pressure gages are acceptable. Taper pipe thread water drain cocks are acceptable.

3.7.1.2.2 Taper pipe threads are not permitted for the following:

(a) All connections from the engine to the ship's systems; i.e., exhaust, fuel inlet and return, and raw water supply and discharge. The foregoing connections shall be in accordance with MIL-STD-777.
(b) All threaded pipe.

3.7.1.2.3 Straight thread connections as required in lieu of taper threads prohibited by 3.7.1.2.2 shall be in accordance with MS16142.

3.7.2 Cooling water system. Water cooled engines shall be designed to operate with a closed fresh water cooling system.

3.7.2.1 Inhibitors. Engines shall be satisfactory for operation using coolant inhibitors conforming to MIL-I-19528 (chromate type), MIL-I-24453 (nontoxic soluble oil type) and O-I-490 (compatible with ethylene glycol antifreezes).

3.7.2.2 Cooling water pumps. Fresh and sea water pumps shall be the centrifugal type driven by the engine with the drive arrangement designed to prevent water leakage into the engine lubricating oil system. The pumps shall be so mounted or provided with a continuous vent to prevent the trapping of air When specified (see 6.2), self priming centrifugal or positive displacement seawater pumps shall be used for small boat propulsion engines or where pump lift requirements demand such a pump Means shall be provided to completely drain water pumps by the use of petcocks or with minimum effort and by the use of common tools. Engine manuals shall contain complete instructions for draining all water pumps. Seawater pumps shall be constructed of noncorrosive materials compatible with salt water. The use of cast iron in contact with salt water is not acceptable.

3.7.2.3 Heat exchangers. Unless otherwise specified (see 6.2), heat exchangers shall be engine mounted and shall be in accordance with MIL-C-21121 or MIL-C-15730 except hose connections are acceptable and the repair parts and drawing requirements stated herein shall apply (see 3.29 and 3.31). The use of heat exchanger cores installed in expansion tanks or other enclosed areas in the cooling system are acceptable provided the core construction and materials meet the requirements of MIL-C-21121 or MIL-C-15730. The use of composition 70-30 copper-nickel alloy in lieu of composition 90-10 is acceptable. The shockproof requirements of MIL-F-15730 shall apply only when high shock testing is specified for the engine.

3.7.2.4 Coolant filter and conditioner. When specified (see 6.2), a bypass type water filter/conditioner shall be provided. Shutoff valves shall be provided on both sides to permit element changing and cleaning without engine shutdown. Element changing shall be accomplished without disconnecting attached lines and by the use of common tools. Spin-on disposable filters are acceptable. All filter and element materials, including chemicals, shall be compatible with antifreezes conforming to O-A-548. If a sacrificial metal is used, the sacrificial metal shall not go into solution throughout the cooling system and shall not produce chromates or magnesium oxides in the cooling system. The filter shall incorporate sufficient sump area to collect and retain foreign matter not contained by the element. Filter capacity shall be sized to provide a minimum of 600 hours of useful element life.

3.7.2.4.1 Performance. The filter shall remove all scale, rust, core sand, and other solid contaminants over 100 microns in size. Chemical agents shall be provided to accomplish the following in the entire fresh water system:

(a) Provide buffering action to maintain a pH range of 8.5 to 10.0.
(b) Provide a nonchromate rust proofing film over all metal surfaces.
(c) Effluent water from softener shall have a hardness value of less than 150 parts per million (ppm) (as Ca CO_3) when used with dockside water or 0.01 ppm (as Ca CO_3) when used with distilled water.

3.7.2.5 Temperature control. Circulating water temperature shall be controlled automatically by means of an engine mounted by-pass type thermostatic valve. Operating temperatures shall be as specified in 3.3.

3.7.2.6 Gaskets and packing. Gaskets and packing used in the cooling system shall be of material resistant to deterioration when any of the following are added to the coolant water:

(a) Antifreeze compounds conforming to O-A-548.
(b) Corrosion inhibitor compounds conforming to MIL-I-19528, MIL-I-24453 or O-I-490.
(c) Preservative compounds conforming to MIL-C-16173 and MIL-L-21260.

3.7.3 Fuel system. Engines shall be capable of operating on diesel fuel corresponding to MIL-F-16884 or grade JP-5 of MIL-T-5624. The fuel system shall include the following:

(a) Positive displacement type supply pump
(b) Relief valve connected to discharge into pump suction or supply tank.
(c) Filter(s).
(d) Necessary piping, valves and fittings.

3.7.3.1 Fuel pump. The engine driven positive displacement fuel pump shall be capable of lifting the fuel up to 48 inches.

3.7.3.2 Filtration. The fuel system shall be protected by a primary filter (strainer) ahead of the engine mounted fuel pump and a secondary filter ahead of the fuel injection pump or unit injectors. If the fuel system is of such a design that the filter must be positioned on the suction side of the fuel pump, only the secondary filter is required. Filters shall be constructed of brass, bronze, or other metals which are not readily corroded by sea water contaminated fuels. Coated steel or untreated aluminum are not acceptable. Filters shall include vents to permit the expulsion of air. Manually operated drain valve shall be provided to completely drain the filter without the use of tools.

3.7.3.2.1 Primary filter. Primary filters (strainers) shall be the simplex metal edge type with 0.003 to 0.0035 inch spacing, enclosed manually operated cleaning device and sediment drain. The term "metal edge" is defined as stacked metal discs or helically wound flat metal wire or metal ribbon media. Wire cloth, screen, sintered metal or perforated plate media are not acceptable for simplex strainers.

3.7.3.2.2 Filter. As specified (see 6.2), the filter shall be either the simplex or duplex type employing disposable elements. Duplex filters will normally be specified when the parent engine is required to operate in excess of 200 hours without shutdown.

3.7.3.2.2.1 Simplex filters. Filters and filter elements shall be in accordance with MIL-F-20627.

3.7.3.2.2.2 Duplex filters. Duplex filters shall consist of two filter units connected to a common head equipped with a three way plug valve, disposable filter elements, and suitable mounting arrangement. The lever operated valve shall direct the fuel flow through one side to permit element change and cleaning of the other side without interruption of flow. Each side shall be sized to accommodate the full flow of the engine fuel pump and employ drain plugs to permit complete draining. Filter elements and materials used for metal parts and gaskets shall be in accordance with MIL-F-20627.

3.7.3.2.3 Fuel/water filter/separator. When specified (see 6.2), a filter separator consisting of a housing, coalescer and separator stages, drain valve, air vent, sight gage, and suitable mounting arrangement shall be furnished, preferably on the pressure side of the fuel pump. The unit shall meet the performance requirements and tests of MIL-F-8901 and shall be sized to accommodate 150 percent of the flow to the engine mounted fuel supply pump.

3.7.3.2.3.1 Coalescer element. The coalescer element shall be qualified under MIL-F-52308.

3.7.3.2.3.2 Separator stage. The separator media shall be polytetrafluoroethylene coated nickel copper aluminum alloy screen. This stage may be in the form of a separate element, canister, or divider between the coalescer stage and the filter outlet. In any case, 100 percent of the effluent shall flow through the separater stage.

3.7.3.2.3.3 Sight gage. The sight gage shall be the bullseye type and be positioned as near the bottom of the sump as practical and shall contain a colored ball which will float at the fuel-water interface.

3.7.3.3 Fuel inlet temperature. The fuel temperature at the engine supply pump inlet shall not exceed 115°F. The shipbuilder, by the use of coolers or other means, shall insure this requirement is met. Coolers, if used, shall be saltwater cooled. Cooler materials shall be in accordance with 3.2.

3.7.3.4 Fuel supply tank. The preferred Navy installation can be expected to provide, by the use of a day tank or other arrangement, a positive head of fuel pressure on the engine primary pump suction connection. The fuel systems of some engines may be so designed that combustion space flooding would result when this positive head is applied during engine

shutdown. In such cases, the engine supplier shall furnish all necessary devices, such as float tanks, valves, etc., which he recommends to protect the engine and insure proper operation.

3.7.4 Lubricating system. Lubricating oil shall conform to symbol 9250 of MIL-L-9000 for ambient conditions above 20°F. The same grade or symbol number of lube oil shall be used in the engine, accessories, transmission and other driven equipment. Engines shall be provided with an oil level indicator, filling opening and accessible sump drain connection or a sump pump to drain or clean the engine oil pan Bayonet type oil level indicators shall be shielded to permit accurate readings while the engine is running.

3.7.4.1 Lubricating oil pumps. Pressure pumps, scavenging pumps and piston cooling oil pumps shall be of the positive displacement type, driven by the engine. When the engine provides lubricating oil to driven components, the scavenging pump capacity shall be approximately 1-1/4 times the capacity of the pressure pump and shall maintain sufficient oil flow to scavenge the engine from idle to rated speed. If the pump suction incorporates a check valve, means shall be provided to prevent excessive pressure build-up in the suction line in case the engine and pump are rotated backwards.

3.7.4.2 Coolers Lubricating oil coolers shall conform to MIL-C-15730 except hose connections are acceptable and the repair parts and drawing requirements specified in 3.29 and 3.31 shall apply. If the engine manufacturer chooses, the use of cooler cores installed in a suitably enclosed area of the fresh water system is acceptable provided the material and performance requirements of MIL-C-15730 are met. The shockproof requirements of MIL-C-15730 shall apply only when high impact shock testing is specified for the engine (see 6.2)

3.7.4.3 Lubricating oil filters Engines shall be designed to use full flow filter elements qualified under type IV of F-F-351 and MS35802. The filter relief valve shall be designed to bypass the full oil flow when the pressure drop across the filter is between 20 and 25 psi. The valve closing pressure shall be not less than 20 psi. If internal, the relief valve shall be located level with or above the top surface of the elements(s) and shall be designed so that sump sediment will not discharge into the engine oil system during starts or operation. The filter inlet shall be internally baffled or so designed to prevent the oil flow from impinging directly on the filter elements. A manually operated drain valve shall be provided to completely drain the filter without the use of tools

3.8 Air intake systems The combustion air shall be taken from the engine compartment or from shipbuilder (boatbuilder) provided ducts to the weather, as specified (see 6.2).

3.8.1 When it is specified that the engine will take its combustion air from the engine compartment, the engine shall be provided with an effective air intake silencer and with a cleanable filter or screen necessary to protect the equipment from ingesting dirt. Oil bath filters or media that would support combustion or produce toxic fumes during a fire in the engine space are not acceptable. Suppliers wishing to offer media other than a metallic type or flameproof paper should recieve NAVSEC approval before receipt of an order or invitation to bid. Filters shall incorporate a device which shall indicate when the element requires changing or cleaning. The intake system shall be directed or extended as necessary to avoid unnecessary heat transfer to combustion air from hot engine parts such as exhaust manifolds and turbocharger turbine casings.

3.8.2 When specified in the contract or order that the engine will take combustion air from shipbuilder provided ducts directly to the engine intake, the following equipment shall be furnished with the engine

(a) Provide an air filter using filter media in accordance with MIL-F-7194 installed close to the engine and between the engine and the intake air by-pass valve. This by-pass valve may be provided in some installations to permit engine air to be taken from either engine compartment or the weather. The filter elements shall be designed to withstand a uniformly distributed pressure of 5 psi over the engine surface of the element. The area of the filter element shall be such that the air velocity at the face of the filter does not exceed 2000 feet per minute, or the pressure drop across the clean filter be more than 4 inches of water at rated output. A manometer or signal device shall be connected across the element to indicate when cleaning is required. The filter housing shall permit removal of the element for cleaning. The filter element shall be installed at an angle 90 degrees or less to the direction of air flow in order that impinging dirt will drop to the bottom of the duct on the upstream side of filter element.

3.8.3 Blowers and air receivers. Means shall be provided for draining pockets in the blower housing and air receiver where oil or water may accumulate

3.9 Exhaust systems Exhaust headers shall be fresh water cooled. Exhaust mufflers, when required to be furnished with engines, shall be in accordance with MIL-M-15337 with the type as specified (see 6.2).

3.9.1 Exhaust emission The engine shall be designed to keep exhaust smoke emission to a minimum. The Ringlemann smoke chart shall be the standard of comparison. During normal, constant operation at rated speed the smoke opacity shall not exceed Ringlemann #1. During a speed change, smoke opacity may exceed Ringlemann #2 for 5 seconds, then gradually return to less than Ringlemann #1 in less than 30 seconds

3.10 Starting systems. As specified (see 6.2), the engine shall be started by means of either compressed air, hydraulic or electric starting systems.

3.10.1 Air starting The air starting system shall consist of the starting motor, inlet relay valve, manually operated control valve and the necessary lines, connections and fittings. When specified (see 6.2), the system shall include a device to automatically shut off the starting air when the engine starts Air reducing valves shall be furnished on the basis of one valve for each engine room.

3.10.2 Hydraulic starting The hydraulic starting system shall consist of the starting motor, accumulator(s), engine driven charging pump, hand operated charging pump, reservoir, control valve, dumping valve, pressure gage, filter and the necessary lines, connections and fittings The system shall be designed to be self-contained and nondependent on any other ship system Interconnecting lines and fittings shall be furnished by the installing activity The following pressure ratings shall apply

(a) Working pressure - 3000 psi ±100 psi
(b) Accumulator proof pressure - 6000 psi
(c) Accumulator burst pressure - 12,000 psi
(d) Accumulator fuse blow-out pressure - 4700 +300 psi
(e) Hose and fitting proof pressure 4500 psi -12,000 psi

The engine driven charging pump shall be capable of charging the system from zero pressure to the working pressure within 20 minutes with the engine running at rated speed. After the system is fully charged, the engine driven charging pump and pressure regulator shall maintain the system at the specified working pressure The hand operated charging pump(s) shall be capable of fully charging the system from zero pressure within 20 minutes at temperatures between 50° and 90°F

3.10 2.1 Accumulators Accumulators shall be of a type which will quickly relieve the pressure when the shell becomes initially distorted as a result of impending rupture. Accumulators shall be mountable in either a horizontal or vertical position and shall contain a blow-out fuse. Accumulators shall be capable of being connected in parallel and shall have sufficient oil volume to meet the cold start requirements (see 3.10 4 and 4.4 4). All accumulator shells shall be liquid penetrant and radiographically inspected in accordance with MIL-STD-271, prior to assembly Acceptance standards shall be in accordance with 0900-003-8000, grade 1, for liquid penetrant inspection and 0900-003-9000, grade I, for radiographic inspection The accumulator shall be made of a design, material and construction which has been approved by the U S Coast Guard Accumulators identical to a design previously approved need not be individually certified.

3.10 3 Electric starting. The electrical starting system shall be 24-volt, ungrounded, two wire consisting of starting motor, contactor, battery charging alternator, voltage regulator, ammeter and starter button The electrical equipment shall be fungi and corrosion resistant Starting batteries are not required unless specified (see 6.2)

3.10.3 1 Starting motor The starting motor shall conform to MIL-S-15371 except for the shifting mechanism The shifting mechanism shall be the totally enclosed, solenoid actuated overrunning clutch type that will provide positive pinion and ring gear engagement before the power is applied It shall not disengage due to intermittent engine starting and shall prevent the engine from driving or overspeeding the motor.

3.10.3 2 Battery charging unit. The battery charging unit shall consist of a three-phase alternating current (a.c.) generator, rectifier and control unit conforming to MIL-C-18438, type II Rated wattage and voltage shall be as specified (see 6.2).

3.10.3.3 Ammeter. The battery charging generator ammeter shall conform to MIL-M-10304. The meter shall register discharge to the left of zero and charge to the right of zero. The meter shall be self-contained, a 2-1/2 inch diameter, flush mounted luminous dial, wide flange, metal case with transparent heat resistant window. The meter shall be hermetically sealed. The rear of the case shall be provided with conventional terminals. Zero correction is not required.

3.10.3.4 Interference shielding. Electrical equipment and interconnections shall be interference shielded in conformance with MIL-I-16165.

3.10.4 Cold starting. When tested in accordance with 4 4 4, the engine shall fire and continue to operate within 10 seconds after the starting mechanism is set in operation without the use of cold starting aids.

3.10 5 Extreme starting. When specified (see 6 2), engines shall be capable of being started at a temperature of minus 20°F. (see 4 4.5) Ether primer cold starting aids, if used, shall conform to F-P-666.

3.11 Speed governing system. Engines shall be equipped with a speed governing system and over-speed device Governor type shall be as specified (see 6 2)

3.11.1 Type I (constant speed governors). Type I governors shall be furnished for constant speed engines.

3.11.1.1 Steady-state stability. When operating at all loads up to rated load, the speed for any constant load shall be so controlled that the periodic or aperiodic oscillations of speed shall be not greater than plus or minus 0.50 percent of rated speed.

3.11.1 2 Momentary speed surge. The response of the governor shall be such that upon sudden application or loss of rated load, the maximum momentary decrease or increase in speed shall not exceed 7 percent of rated speed. In addition, the engine r.p.m. shall return to and remain within 1 percent of the final steady state speed in not more than 5 seconds following a change in load.

3.11.2 Type II (hydraulic or electronic variable speed governors). Type II governors shall incorporate a steady-state stability so that when operating at all speeds and loads within the range of the engine application, the periodic or aperiodic oscillations of speed shall be not more than plus or minus 1.0 percent of operating speed.

3.11.2.1 Momentary speed surge. The maximum deviation from normal speed when full or partial rated load is applied or removed suddenly, shall not exceed 10 percent of operating speed. The speed shall return to plus or minus 1 percent of operating speed in not more than 15 seconds following the change in load.

3.11.3 Parallel operation. Type I and II governors for engines which are required to operate in parallel on a single propulsion shaft system shall be provided with a steady-state speed regulation mechanism, adjustable up to 5 0 percent, of rated speed. Governors for generator drive engines required to parallel shall be equipped with a reversible synchronizing motor when control is from a remote operator's station.

3.11.4 Type III (mechanical variable speed governors). Type III governors shall be capable of holding the engine speed to within 8.0 percent of the throttle setting for steady-state conditions over the speed range of the engine.

3.11.5 Type IV (limiting speed governors). Type IV governors shall control the engine at idle and at rated speed and limit the overspeed to 108 percent of rated speed.

3.11.6 Overspeed protection. As protection against dangerous engine overspeed due to failure of the regulating governor, its linkage or other engine malfunction, each engine shall be equipped with a separate and independent speed limiting device that will control the engine when it attempts to exceed 115 percent of its full rated speed. The control effected shall be as indicated in 3.11.6.1 or 3.11.6.2.

3.11.6.1 When specified (see 6.2) for propulsion engines, the speed limiting device when actuated by engine overspeed shall take control to reduce the fuel injection output to the idle fuel rate. When the engine speed is controlled to idle speed the speed limiting device will automatically disengage and return engine control to the normal speed regulating governor.

3.11.6.2 For auxiliary engines, the speed limiting device shall take control at overspeed and stop the engine completely by reducing the fuel injection output to zero or by blocking the engine's combustion air supply or both. This device shall require manual resetting. The speed limiting device shall not attempt to control the engine by any system that cuts off the fuel supply to the engine fuel pump.

3.12 Instruments and controls.

3.12.1 Instruments. When specified (see 6.2), the following instruments shall be furnished.

(a) Tachometer
(b) Engine oil pressure gage
(c) Gear oil pressure gage (for hydraulically actuated gear only).
(d) Fresh water temperature gage
(e) A meter
(f) Engine oil temperature gage
(g) Hour meter

3.12.1.1 Instruments shall be weatherproof and shall be of the flush mounting type. Capillary tubing lengths shall be so specified in the contract or order. Instruments for propulsion engines shall be furnished loose for mounting at the operator's station. Auxiliary engine instruments shall be furnished on a panel mounted on the engine. Unless otherwise specified (see 6.2) tachometers shall be mechanical. Mechanical and electrical tachometers shall conform to MIL-I-16049 and shall be self-illuminating. Electrical tachometers shall be type IC/1FB. Electrical instruments shall be of the two wire ungrounded type.

3.12.1.2 Hour meter. An hour meter having a totalizing capability of not less than 9999.9 shall be furnished to register the number of hours of engine operating time. The hour meter and tachometer may be combined.

3.12.2 Alarms. A low lubricating oil pressure alarm switch, connected to the remote end of the lubricating oil system, and a cooling water high temperature alarm switch with actuating bulb installed in the cooling water outlet, shall be provided for all auxiliary applications. Switches shall conform to MIL-S-16032 and shall be suitable for 115 volts (a.c. or d.c.) or 24 volts (d.c.).

3.12.3 Emergency shutdown device. Engines shall be provided with an emergency shutdown device, operable by a pull cable, which will trip the fuel racks or shut off the air and stop the engine within 60 seconds. The pull cable shall be furnished by the installing activity and shall be operable from a location adjacent to the access to engine compartment. The device shall be of a type which requires manual resetting before the engine can be restarted. This device may be combined with the speed limiting device (see 3.11.6.2) for auxiliary engines.

3.13 Safeguards.

3.13.1 Guards and shields. Guards and shields shall be furnished as specified in 3.13.2 and 3.13.3.

3.13.2 Guards. Guards for protection of personnel shall be provided for flywheels and other exposed moving parts. Where there are no feasible means for attaching the guard to the equipment, the guards shall be furnished by the engine builder and the installing activity shall accomplish the installation.

3.13.3 Shields. All hot machinery surfaces shall be shielded or insulated so that no external surface of the machinery shall exceed a temperature of 400°F. All fuel and lubricating oil lines or fittings, including gage lines, shall be located or shielded so that any leaks cannot drip or spray on any component with a surface temperature of 400°F. or higher.

3.14 Turbochargers. Turbochargers (if used) shall be capable of containing within the housing any part of the rotating members which may become fragmented due to loosening, shattering or overspeeding. The supplier shall satisfy the Defense Contract Administration Service (DCAS) that this requirement is met by actual destructive testing or certified documented proof of prior testing.

3.15 Crankcase fumes. The engine builder shall provide a system to dissipate through the engine intake or exhaust system all oil fumes generated by the engine in the crankcase and other areas.

3.16 Timing marks. Means shall be provided to permit checking of valve and injection pump timing. Means for timing and barring the engine over by hand shall be incorporated in the engine design.

3.17 Crankshaft. Nuts on coupling flange bolts shall be accessible and locked or keyed in place. Provision shall be made on the free end of the crankshaft for attaching a torsiograph drive.

3.18 Reverse-reduction gear. Unless otherwise specified (see 6.2), propulsion engines shall be furnished with an attached hydraulically actuated reverse-reduction gear. The unit shall be designed to transmit full engine rated horsepower both ahead and astern. The reduction gear ratio shall be as specified (see 6.2) The unit shall be capable of absorbing the full ahead and astern propeller thrust. Reverse-reduction gears shall be provided with their own lubricating oil system and shall use the same grade of oil as the engine. Means shall be provided, as necessary, to insure that the oil does not exceed safe temperature limits.

3.19 Auxiliary drive. Engines shall be equipped with a standard V-belt pulley for auxiliary drive. The number and diameters of pulleys per engine shall be determined by the requirements of the driven equipment. One extra pulley sheave shall be included for future use by engine user.

3.20 Propeller shaft coupling. Propeller shaft coupling shall be as specified (see 6.2).

3.21 Resiliently mounted equipment. When resiliently mounted equipment is specified (see 6.2), the following information shall be submitted on a drawing headed "Mounting Installation Design Data":

(a) Speed range (for propulsion machinery and d.c. generators) or synchronous speed (for a.c. generators of the unit).
(b) Total weight of the mounted assembly in the operating condition. The weight shall include weight of subbase, service fluids, piping filters and all other attached accessories.
(c) Location of the unit center-of-gravity in at least two planes.
(d) The moments of inertia and products of inertia of the mounted unit about three mutually perpendicular axis with the origin at the unit center of gravity and the orientation of the axis indicated with respect to the equipment and ship.
(e) The six natural frequencies (in cycles per second (c.p.s.)) of the unit.
(f) The type mounting used in performance of the calculation. For mounting other than approved Navy type, information relative to mount natural frequency, static load deflection and transmissibility is required.
(g) List of assumptions made in calculating natural frequencies.

3.22 Torsional vibration. The engine manufacturer shall furnish a torsional vibration analysis in accordance with MIL-STD-167 except that the actual torsiograph test is not required in cases where the engine manufacturer does not furnish the engine driven equipment.

3.23 Shock resistance. When specified (see 6.2), the engine shall be designed to meet the requirements of MIL-S-901. Shock resistant requirements pertaining to piping systems are specified in 3.7.1.2 through 3.7.1.2.3.

3.24 Dimensions and weight. The dimensions and weight shall be as specified in 3.24.1, 3.24.2 and 6.2.

3.24.1 Dimensions. The specified dimensions shall include projections of attached accessories, levers and piping.

3.24.2 Weight. The specified weight shall be interpreted as the maximum weight of the engine in operating condition and shall include the weight of attached and detached accessories and service fluids.

3.25 Painting. Engines shall be painted in the same manner as for commercial delivery. Internal oil-wetted surfaces shall not be painted.

3.26 Designating and marking. Engines, components and parts shall be marked for identification in accordance with MIL-STD-130.

3.26.1 Engines shall be provided with an identification plate secured to the engine in a visible and convenient location. Identification plates shall be of metal and shall show the following

(a) Engine type
(b) Serial number.
(c) Federal stock number
(d) Contract number.
(e) Model number
(f) R p m
(g) Bhp
(h) Rotation
(i) Bore
(j) Stroke
(k) Dry weight

3.26.2 Complete accessory components such as vendor furnished pumps, coolers, filters, governors, electrical and starting equipments shall be provided with identification plates showing manufacturer's name, model or part number, and capacities or ratings where applicable.

3.26.3 A plate with an arrow showing direction of rotation shall be secured to the engine at the power take-off end of the engine

3.26.4 Repair parts shall be marked with the manufacturer's part number by casting, stamping, or etching. Where it is not practical to mark parts by any of these methods, the parts shall be identified by tags or printed description on the package

3.27 Plans for maintenance When specified (see 6.2) the supplier shall furnish a maintenance engineering analysis (see 3.27.1) including a plan for maintenance (see 3.27.1.1).

3.27.1 Maintenance engineering analysis. The supplier shall conduct a critical engineering analysis of the engine or system to be supplied in accordance with MIL-M-24365. The supplier shall determine the type and rate of degradation of the various materials and parts involved in the design and the most effective and efficient procedure for performing necessary maintenance and the logistics resources required to support the equipment supplied when operating under the condition outlined in the plan for use (see 3.28).

3.27.1.1 Plan for maintenance The supplier shall prepare a plan making specific recommendations for shipboard, tender and shore repair parts including replaceable assembly tools (both standard and special), test and support equipment for shipboard maintenance and overhaul. The plan shall summarize on a time schedule all maintenance actions (examination, tests adjustment , replacement of parts and overhaul) which should be taken, all parts which should be replaced (and all other parts which should be available to allow replacement if examination so indicates) The plan shall provide detailed maintenance procedures and logistic requirements at all maintenance levels to provide for the reconditioning or replacement of each item subject to continuous degradation before the degradation results in failure The plan shall specify any required examination, storing and testing requirements on stocked parts, and periodic replacement where shelf-life is a factor.

3.27.1.2 If a plan for maintenance for use of the item for a similar system requirement has been previously submitted, resubmittal is not required. Instead the supplier shall reference the previous approval letter and shall propose any changes considered appropriate because of the additional like items which will not enter the system. If a previous plan for maintenance for the item was developed for a plan for use varying from that presently specified, appropriate adjustments shall be made (the plan for a propulsion unit may differ from that for an emergency generator set.)

3.28 Plan for use. Unless otherwise specified (see 6.2), the following plan for use shall apply.

(a) The engine will be operated in accordance with the test schedule shown in 4.3, under the conditions specified in 3.3, using fuel in accordance with MIL-T-5624, grade JP-5.
(b) There will be one engine start for each 8 hours of engine operation.
(c) The engine will be operated 2000 hours per year if it is a propulsion engine.
(d) The engine will be operated 500 hours per year if it is driving an emergency generator set

(e) The engine will be operated 3000 hours per year if it is driving a ship's service generator.
(f) The engine will be operated 1000 hours per year for other uses.

3.29 Drawings. Drawings of production or existing parts, components or equipment applicable to a contract or order shall consist of manufacturer's commercial shop drawings.

3.29.1 Installation drawing. After award of contract and within the time specified in the contract or order, the prime supplier shall submit an installation drawing covering the exact engine, driven equipment, detached components, accessories and controls to be furnished to the contracting officer. Unless otherwise specified (see 6.2), a reproducible drawing of the installation drawing shall be furnished. The prime supplier shall furnish one reproducible copy of the installation drawing to NAVSEC. Installation drawings shall include the following.

(a) Overall dimensions for the complete assembled unit.
(b) Foundation bolting dimensions.
(c) Wet and dry weights, including detached accessories.
(d) Center of gravity in at least 2 planes.
(e) Both minimum and desirable clearance for removal of parts such as cylinder heads, pistons, liners, cooler tube bundles, camshafts, pumps and blowers.
(f) Bill of material describing make, model and quantity of equipment and accessories being furnished.
(g) Capacity of blowers and pumps at rated engine speed and volume of exhaust gases at rated speed and load specifying pressure and temperatures for which data apply.
(h) Show brake horsepower (bhp), bmep, and r.p.m.
(i) Location and size of pipe connections to engine and accessories.
(j) For engines having detached accessories
  (1) Diagrammatic sketches of piping systems, indicating pipe sizes, type of fittings and relative location of coolers, filters, valves, strainers, thermometers and gages. Supplier furnished piping shall be shown by solid lines and shipbuilder furnished piping by broken lines
(k) Heat balance chart (unless shown in the operators manual).
(l) Rotation at power output.
(m) Gear reduction.
(n) Engine fluid capacities (including gear if furnished).
(o) Air consumption

3.29.2 Microfilm. A complete set of engine drawings on microfilm aperture cards shall be furnished by the supplier. Included shall be installation and assembly drawings together with detail drawings of all parts of the engine, gear and accessories not exempted herein. Drawings of items on Qualified Products Lists and standard hardware that are fully described in bills of material and drawings of pieces used in the fabrication of welded parts shall not be included. Microfilm aperture cards shall be in accordance with MIL-M-38761/2

3.29.2.1 Accessory drawings. The following accessory drawings shall be furnished.

(a) A cross-section drawing with bill of material shall be sufficient for the following:
  (1) Regulating and overspeed governors.
  (2) Cold start device.
  (3) Lube oil filter.
  (4) Thermostats or temperature regulators
  (5) Starting system components.
  (6) Air intake filter/silencer.
  (7) Pneumatic control devices.
  (8) Fuel oil filter and strainer.
  (9) Mufflers.
  (10) Coolers.
  (11) Water filter.
(b) An outline drawing shall suffice to complete drawing requirements for the following accessories:
  (1) Tachometer.
  (2) Tachometer generators.
  (3) Pressure gages
  (4) Thermometers.
  (5) Thermocouples.
  (6) Flexible exhaust hose
  (7) Expansion tanks.
  (8) Valves (relief safety, throttling, regulating, reducing, and similar types).

3.30 Manuals. A technical and parts manual in accordance with MIL-M-15071, type I, shall be furnished for equipment procured under this specification. In addition to the requirements of MIL-M-15071, the following information shall be included:

(a) Engine installation drawing.
(b) Table of normal clearances, diameters and thickness for new parts and maximum allowable clearances and wear limits for all wearing parts.
(c) Torque settings of important threaded hardware.
(d) For a complete propulsion or generator unit including one or more engines, couplings, generator or reverse reduction gear, the manual shall include complete and comprehensive alignment instructions for the entire plant. The instruction shall cover original alignment procedure with maximum limits for radial and axial deviation and information for alignment checks after installation. A machinery layout sketch showing locations of measurements and space for recording measurement shall be provided.

3.30.1 The quantity of manuals required and the delivery point(s) shall be as specified (see 6.2).

3.31 Repair parts. Repair parts shall be furnished in accordance with MIL-P-15137 (see 6.3).

3.31.1 The engine supplier shall determine and forward his recommendations as to the repair parts, gaskets, and all other consumables except fuel and lubricants, which would be required to support each engine unit with all it's components and equipment for a period of 90 days. This recommendation shall assure that operation during the 90 days is at a constant 80 percent load, 100 percent speed condition, and the materials list shall include not only the items to be replaced because of error or breakage, but also all items such as gaskets, filters, etc., which are consumed in the course of the examination adjustments and maintenance operations he recommends for the proper care of the equipment.

3.31.2 In addition to the requirements of 3.31.1, the supplier shall list the insurance items which he recommends to be carried onboard ship which would in his opinion, provide an optimum "get home" capability during the above same 90 day operation (mission).

3.31.3 Subject to the requirements of 3.31.1 and 3.31.2, the following criteria shall be used in determining recommended onboard repair parts and related consumables.

(a) Demand based items (items having a predicted usage of at least one unit in 90 days for all installations onboard a ship).
  (1) Provide an effectiveness (filling of demands onboard) of 90 percent for a period of 90 days.
  (2) Be predicated on combat consumption rates wherever such rates can be ascertained.
(b) Insurance items (items which do not have a predicted usage onboard ship of at least one in 90 days).
  (1) Only those insurance items essential to end item performance and vital to the support of the primary mission of a ship or unit or vital to the safety and welfare of personnel onboard ship shall be provided.
  (2) Insurance items shall be included in minimum depth (either unity or minimum replacement unit to meet potential 90 day combat requirements).

3.32 Workmanship. Castings shall have a workmanlike finish and shall be free from sand, shrinks, cold shuts, cracks, harmful porosity, and other defects which make the castings unsuitable for the intended purpose. Runners, risers, fins and other cast-on pieces shall be removed. Sharp edges or projections shall be removed from stamping or forgings in the finished part. Machined surfaces shall have sharp edges, broken or chamfered. Weld shall be free of weld spatter or slag. Forgings shall be free from seams, cracks, scale, fins, porosity, hard spots or excessive inclusions, segregations or other defects.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Inspection system. The supplier shall provide and maintain an inspection system acceptable to the Government for supplies and services covered by this specification The inspection system shall be in accordance with MIL-I-45208 (see 6.2 and 6.3).

4.2 Visual and dimensional examination. Each engine shall be subjected to a thorough visual and dimensional examination to ascertain that the material, workmanship, and construction are in conformance with the requirements of this specification not involving tests and contract drawings. The rigorous examination shall apply equally to service components and repair parts.

4.3 First unit tests. Tests shall be conducted on the first application of an engine by the command or agency concerned. Where a supplier has previously conducted first unit tests in accordance with the requirements of this specification and the identical engine has been accepted by the command or agency concerned, a test report of the previous tests will be acceptable in lieu of actual tests. If the engine for which extension of first unit testing is proposed, is not part for part identical to the engine previously tested, the supplier shall submit for review a list of those parts which are not identical. Part number and nomenclature of both old and new parts and reasons for making the change shall be included. The Government reserves the right to require complete retesting after review of the changes Auxiliary engines shall also be tested in accordance with the combined unit specifications. Tests shall be conducted as specified in 4.4.

4.3.1 Test conditions. The dynamometer load for the engine shall be such as to insure that the engine identification plate output as specified in the contract or order can be obtained under standard conditions. The dynamometer load necessary to satisfy this requirement shall be determined using the following formula

$$BHP_d = \frac{BHP}{29.92\sqrt{\frac{P_o}{\frac{T_o}{560}}}}$$

Where:

BHP_d = Dynamometer load (observed)

BHP = Engine identification plate output.

P_o = Observed ambient pressure (dry barometer).

T_o = Observed ambient temperature (absolute).

The correction factor shall be applied for all dynamometer test loads.

4.3.1.1 The exhaust back pressure at the engine exhaust outlet for rated load and speed shall be adjusted to 2 inches Hg by use of an orifice or restriction in the exhaust line. The restriction shall remain during all tests.

4.3.1.2 The temperature of the raw water to the engine shall be a minimum of 90°F. The engine fresh water shall be treated to prevent corrosion.

4.3.1.3 Fuel used during the tests shall be fuel corresponding to grade JP-5 of MIL-T-5624 with a maximum cetane number of 52.

4.4 Test procedures.

4.4.1 Torsiograph tests. When required (see 6.2), torsiograph tests shall be conducted in accordance with MIL-STD-167.

4.4.2 Endurance test. Engines shall be run for 125 eight hour cycles as follows

(a) 2 hours at rated load and speed.
(b) 1 hour at 85 percent load and rated speed.
(c) 10 minutes at minimum idling load and speed.
(d) 1 hour and 50 minutes at rated load and speed.
(e) 10 minutes at minimum idling load and speed.
(f) 30 minutes operation at 50 percent load and 75 percent rated speed. (Propulsion engines shall be operated in reverse.)
(g) 10 minutes at minimum idling load and speed
(h) 10 minutes at 85 percent load and rated speed.
(i) 1 hour and 50 minutes at 110 percent rated load at rated speed
(j) 10 minutes shutdown (minimum between each cycle)

Engines may be shut-down, as required, between each complete cycle or full cycles may be run on a continuous basis.

4.4.3 Fuel consumption test. Fuel consumption tests of 1/4 hour duration with sufficient time intervals between each run for stabilization of operating conditions, shall be made on propulsion engines at 100, 90, 70, 50 and 30 percent rated speed for each load of 0, 40, 80, 100 and 110 percent of rated horsepower. If the engine cannot be operated continuously at 30 percent rated speed, the lowest safe operating speed shall be substituted. For speeds below rated speed, 100 percent bhp shall be defined as maximum bhp which the engine can carry safely and meet the exhaust emission limits of 3.9.1 with a clear exhaust. Fuel consumption shall be corrected for the difference in high heat value of the fuel actually used during the test and the standard 19,350 British thermal unit (B.t.u.) per pound.

4.4.4 Cold starting tests. Engines shall be subjected to a cold starting test. Prior to the test, the engine shall have been shut-down for at least 12 hours. Cold water at a temperature not exceeding 35°F. shall be circulated through the engine for at least 1 hour or until all parts of the engine are cooled to a reasonable uniform temperature. The engine shall fire and continue operating within 10 seconds after the starting mechanism is set in operation without the use of cold starting aids. Where air starting is used, the minimum quantity of air expressed in cubic feet of free air at 14.7 psi and 68°F. for the start shall be determined.

4.4.5 Extreme cold starting tests. When specified (see 3.10.5 and 6.2), an engine shall be shipped to a Government laboratory for tests under conditions of extreme cold. Laboratory recommendations as to starting systems, starting aids or accessories shall be included in subsequent engines when specified by the command or agency concerned.

4.4.6 Normal starting. Immediately following the cold start test (see 4.4.5), nine consecutive starts shall be made under normal ambient conditions. The average time required to start the engine, and the minimum starting r.p.m. shall be determined. The engine shall fire and continue operating within 5 seconds after the starting mechanism is engaged.

4.4.6.1 If air starting is used, the following data shall be obtained.

(a) The minimum quantity of air, expressed in cubic feet of free air at 14.7 psi and 68°F., necessary for each of 10 successive starts, including the cold start
(b) The minimum air starting pressure at which the engine will start within the 5 second time limits.

4.4.6.2 When electric starting is used, the break-away and rolling starting motor current and voltage shall be recorded.

4.4.6.3 If hydraulic starting is used, the supplier shall satisfy the DCAS that the requirements specified in 3.10.2 and 3.10.2.1 are met. The following shall be recorded:

(a) Time to charge system from zero pressure by engine driven pump.
(b) Pressure of system after nine starts.
(c) Indicated working pressure.
(d) Ambient temperature.

4.4.7 Regulating governor. Tachographic records of engine speed changes shall be made to determine compliance with 3.11.

4.4.7.1 Overspeed governor. During the overspeed governor test, the regulating governor shall be made inoperative. The engine speed shall be increased above rated speed until the overspeed governor acts to determine the r.p.m. at which the overspeed governor is set.

4.4.8 Shock. When specified (see 6.2), the engine shall be tested for grade A shock resistance in accordance with MIL-S-901. Engines shall be tested alternately running at idle speed and at stand still. After testing the engine shall be returned to the engine manufacturer to determine any material or structural damage, leaks, malfunction of the engine or accessories. The engine shall be run for 20 eight hour cycles as described in 4.4.2. Acceptability will be determined by the results of the above examination inducting no shock damage and the engine operation during the above test indicating no impairment of its function.

4.4.8.1 Disposition of shock test sample. After successful completion of the shock test the engine manufacturer shall completely disassemble the engine and thoroughly examine each part for damage. Results of this examination and any corrective action required shall be documented and submitted with the required shock test reports.

4.4.9 Spectrometric oil analysis. Lubricating oil samples shall be taken from the lube oil scavenge line before the lube oil filter with the engine running The oil must be circulating and at operating temperature. Samples shall not be taken from a gage line

4.4.9.1 Sampling intervals. Samples shall be drawn during the 2 hours at rated load and speed period of the first and last cycle specified in 4 4.2 and during the same period of each ten cycles during the test (total 14 samples).

4.4.9.2 A spectrometric analysis of each oil sample taken in accordance with 4.4.9.1 shall be made. The concentration of elements in ppm of oil wetted wearing parts shall be recorded. The analysis shall identify and measure the following elements, as applicable, in ppm with the degree of accuracy indicated in 4.4.9.3

(a) Iron (Fe).
(b) Lead (Pb).
(c) Copper (Cu).
(d) Chromium (Cr).
(e) Aluminum (Al).
(f) Nickel (Ni).
(g) Silver (Ag)
(h) Tin (Sn).
(i) Silicon (Si).
(j) Magnesium (Mg).

4.4.9.3 Degree of accuracy The degree of accuracy shall be as follows

Standard reference specimen (Range in ppm)	Standard deviation (Maximum in ppm)
3-9	1.5
10-19	2
20-49	3
50-99	5
100-199	8
200-500	15

4.5 Test data. Test data shall be submitted on supplier's test forms or on large sheets with lines for folding to 8 by 10-1/2 inches for filing.

4.5.1 All temperature and pressure readings necessary for complete evaluation of the engine performance including ambient room temperature, barometric pressure and relative humidity, shall be entered on the test sheets Fuel consumption in pounds per hour shall be entered for all runs of sufficient duration for engine conditions to become stabilized. All additions of lubricating oil and oil changes shall be recorded. Readings of instruments shall be recorded at intervals not exceeding 1 hour. When a phase of a test is of such short duration that operating temperatures cannot be stabilized, no reading is required.

4.5.2 Fuel consumption. The recorded data shall be submitted in tabular form, and in the form of curves as follows

(a) Specific fuel consumption in pounds per hour, exhaust gas temperature, injection pump rack position (if practical), and air box pressure versus bhp. Data shall include all speeds and loads specified in 4.4 3.
(b) Fuel consumption at no load in pounds per hour versus speed
(c) With bhp as the ordinate and rpm as the abscissa, draw lines of constant bmep, and superimpose curves of constant fuel consumption
(d) To determine the control of the load limiter (when applicable) on engine output, a curve of maximum bhp or bmep versus rpm for the operating range of the engine shall be furnished

4.5 3 Spectrometric analysis. The following information/data shall be provided

(a) List of oil wetted wearing parts and corresponding wear metal elements.
(b) Recommended limits in ppm of the wear elements/metals listed in 4.5 3(a). It is the intent to use these values as a basis to segregate normal from abnormal operating machinery.

(c) Tabulation of the analysis data recorded in accordance with 4.4.9.2. Tabulation shall include such related and pertinent data as chemical and physical characteristics of the lubricating oil used during the test, initial quantity of oil in the system, hours of operation from start of test at which oil was added/changed and applicable quantity of oil added/changed.

4.6 Post trial examination. After completion of all tests, the engine shall be disassembled and examined For this purpose, all cylinders shall be opened, pistons pulled and the cylinder bores, pistons, piston rings, wrist pins, and crankpin bearings examined for defects and measured for wear. Gear train covers and all crankcase covers shall be removed for examination of internal parts. The engine shall be barred over during examination to determine extent of backlash in gear trains. The reverse-reduction gear, if furnished shall be examined and measured for wear. Mating surfaces of gears and all bearings shall be checked for distress such as pitting and galling. Excessive wear, broken or damaged parts, scored cylinders, burned valves or signs of severe stress or excessive wear shall be cause for rejection of the unit. Excessive wear is defined as wear in excess of the manufacturer's published wear limit for the particular part. Cavitation erosion of cylinder liners or cylinder blocks to the extent that such distress would cause premature replacement of the part shall be cause for rejection of the unit.

4.6.1 Special tools furnished with the engines shall be tried out on the engine during the post trial examination, before examination can be considered complete. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)).

4.7 Complete test report. In addition to the documented results of the post trial examination (see 4.6), the complete first unit test report shall include the following data:

(a) Air requirements for cold start when applicable (see 4 4.4).
(b) Air requirements for normal start when applicable (see 4.4.6.1).
(c) Current and voltage requirements for electric start when applicable (see 4.4.6.2).
(d) Data required for hydraulic starting when applicable (see 4.4.6.3).
(d) Regulating and overspeed governor data (see 4.4.7).
(f) Results of post shock examination when applicable (see 4.4.8).
(g) Fuel consumption (see 4.5.2).
(h) Spectrometric analysis (see 4.5.3).

Final approval will be made by NAVSEC after review of the report.

4.8 Duplicate engine tests. Production engines, duplicates of one which has been satisfactorily tested, may be tested in accordance with the manufacturer's standard commercial production procedure.

4.9 Auxiliary engines shall also be tested in accordance with the combined unit test specifications.

4.10 Validation The supplier shall be responsible to validate or have validated the information contained therein for all manuals supplied. In those cases where validation is performed at a subsupplier's plant, the prime supplier is responsible for the quality of the technical manual information and shall provide verifiable evidence of the adequacy of the validation performed. Validation shall be completed and all corrections made and validated prior to presentation of the technical manual to the Government for verification. Personnel performing the validation shall be on a technical level equivalent to the intended user of the technical manual. All technical manuals or any part of a technical manual that has been validated for any other Government requirement need not be re-validated. Validation shall include the following

(a) All written information, engineering drawings and art work in the manual shall be compared to the related physical equipment or system to assure that they do, in fact, actually delineate that equipment or system.
(b) Demonstrate by actual performance all instructions and procedures in the manual on the equipment supplied except for the following:
  (1) Destructive testing or destructive disassembly is not required.
  (2) Boring, grinding or other shaping repair procedures need not be actually executed.
  (3) Checking for accessibility may be determined by measurement, observation and reference to drawings.

4.10.1 A validation page shall be included in each manual supplied, inserted immediately after the title page, including the following information:

(a) Supplier's full identification (if other than prime, full identification of both must be indicated).
(b) Contract number(s).
(c) Chapters and sections validated and the date each was accomplished.
(d) Chapters and sections not validated.
(e) Name, signature and authority of validating officer.

4.11 Validation of engine dimensional clearances. The supplier shall be responsible for validating the external systems (i.e., starting, cooling water, fuel, lubricating oil, air intake, exhaust, and drive systems, and mechanical or electrical accessories (of each engine and provide minimum and desirable dimensional clearance requirement data to facilitate access to various parts of each engine when adjustments, inspections, or repairs are needed.

4.12 Validation of special tools dimensional clearances. The supplier shall validate the correct operation of all special tools associated with each engine and provide minimum and desirable dimensional clearance data required for each special tool to optimize accessibility in performing the necessary maintenance and repair function.

4.13 Inspection of preparation for delivery. Preparation for delivery requirements shall be inspected for compliance with section 5 of this document.

5. PREPARATION FOR DELIVERY

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

5.1 Preservation-packaging. Preservation-packaging shall be level A or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Basic engine unit. The basic engine unit including driven equipment shall be cleaned and preserved in accordance with type P, method II, of MIL-E-10062 to the extent specified. Manifolds, pumps, turbochargers and other attached accessories shall not be removed from the engine during cleaning or preservation unless the removal is considered essential for complete coverage of the preservative.

5.1.1.1.1 Lubricating oil, fresh and sea water systems. Preservative type 1, grade 30, in accordance with MIL-L-21260, shall be used throughout the engine lubricating, fresh water, sea water and lubricating oil systems in lieu of the P-2, P-3, and P-4 preservative specified in MIL-E-10062. When required, engine manufacturer's may supplement MIL-L-21260 with a maximum zinc content limit. Clean filter elements shall be installed in the fuel and lubricating oil system after preservation is complete. In addition, the fresh water system with thermostats removed, shall be drained and completely dried with warm air prior to preservation. If it is impractical to perform a draining-out procedure, the cooling system shall be flushed with a soluble oil conforming to MIL-L-10841, which will emulsify the water and remove it on draining. The system shall then be flushed with the specified preservative and the thermostats replaced.

5.1.1.1.2 Fuel oil system. Preservative MIL-L-21260, type 1, grade 10, shall be used throughout the fuel system. A substitute, satisfactory to the command or agency concerned, may be used for those fuel systems where passages and orifices are so small as to prevent pumping of the preservative throughout the system. A mixture of four parts diesel fuel and one part P-10 is satisfactory. Injectors shall not be removed from engine for the purpose of preservation.

5.1.1.1.3 Valve mechanism. Access covers shall be removed and all surfaces within the valve compartment, including rocker mechanisms, valve stems, springs, guides, push rods and the inside face of the cover plate, shall be coated with P-10 preservative.

5.1.1.1.4 Transmission and train for gear. Transmission and train for gear and all other gear trains not lubricated by the main engine lubricating system shall be drained of lubricant and all surfaces within the housing coated with P-10.

5.1.1.1.5 Packaging Engine units shall be individually unit protected in accordance with MIL-P-116, method II. As specified (see 6.2), one of the following three packaging methods shall be used

(a) Method II a - nonreusable floating bag. The flexible barrier bag shall conform to the requirements of MIL-P-116 and MIL-B-131, class 1. Humidity indicators shall conform to MIL-I-26860, (plug type). All projections and sharp corners of the engine unit shall be cushioned as specified in 5.2.4. Wherever hold down bolts go through the barrier bag, gaskets fabricated of material conforming to G-1123 of MIL-G-12803 shall be secured to both the inside and outside of the bag with adhesive conforming to MMM-A-260 for fiber gaskets and MIL-A-5092 for rubber gaskets. Desiccant shall be uniformly distributed throughout the package to obtain optimum effectiveness.

(b) Method II a - reusable floating bag. A reusable container conforming to MIL-C-4959, type III, shall be used.

(c) Method II d - metal reusable container. Metal containers will be specified under certain conditions where engines are procured for stock and when available will be furnished as Government Furnished Material (GFE). Containers when furnished by the engine supplier shall be in accordance with MIL-C-5584, as modified. These containers will be procured as a separate line item on the contract or order which will contain complete specifications and dimensional requirements

5.1.1.2 Detached instruments, accessories, repair parts, and tools Detached instruments, accessories, repair parts and tools shall be preserved-packaged level A in accordance with the commodity specification, MIL-P-196 or MIL-E-17555, as applicable Unless used in sets, pairs, or quantity greater than one or as specified in the contract or order, detached instruments, accessories, repair parts and tools shall be individually preserved-packaged. When specified, onboard repair parts and tools shall be packed in repair parts stowage boxes conforming to type M or W of MIL-B-233 (see 6.2).

5.1.1.2.1 Index list An index list shall be inserted in each shipping container containing repair parts or tools accompanying the equipment or procured as a set or kit. The list shall be placed in a transparent waterproof bag and heat sealed. The list shall be placed in the index list support located on the interior side of the repair parts box cover or suitably placed in the inside of the box for quick accessibility. The list shall completely itemize the contents of the container

5.1.1.2.2 Cushioning Contents of repair parts boxes and unit packages shall be cushioned in accordance with the applicable commodity specification and as specified in 5.2.4.

5.1.2 Level C Preservation-packaging of engine units, detached components, accessories, repair parts and tools shall afford protection against corrosion, deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use

5.2 Packing Packing shall be level A or C, as specified (see 6.2)

5.2.1 Basic engine unit.

5.2.1.1 Level A. Each unit shall be packed in a reusable plywood sheathed crate conforming to type II, class 2, style a or b of MIL-C-104. Each unit shall be anchored, blocked and braced within the shipping container to resist shock and prevent damage during shipment and storage. Anchoring, blocking and bracing shall be in accordance with 5.2.4 herein and the appendix to MIL-C-104. Crates shall be provided with an inspection port for use in viewing the humidity indicator mounted in the barrier material. The rubbing strip of MIL-C-104 shall be three inch in lieu of two inch thick material. Engines packaged in metal containers require no crate.

5.2.1.2 Level C Packing shall be accomplished in a manner which will insure acceptance by common carrier, at lowest rate, and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight or National Motor Freight Classification Rules or other carrier regulations, as applicable to the mode of transportation

5.2.2 Detached instruments, accessories, repair parts and tools. Detached instruments, accessories, repair parts and tools shall be packed level A or C, as specified (see 6.2) in accordance with the applicable commodity specification, MIL-E-196 or MIL-E-17555, as applicable. Rough handling test as specified in MIL-E-17555 is not required. Repair parts and tools shall be separately packed and shipped concurrently with the basic equipment, set or system. Detached instruments and accessories shall be packed separately and secured in the engine shipping crate or metal container.

5.2.3 Repair parts boxes. Repair parts boxes (see 5.1.1.2) when required, shall be packed in accordance with MIL-P-17286.

5.2.4 Anchoring, blocking, bracing and cushioning. Anchoring, blocking, bracing and cushioning of engine units, detached components, accessories, repair parts and tools shall be in accordance with MIL-STD-1186 and the applicable commodity or container specification and appendix thereto. In addition, the following is mandatory for cushioning materials when used:

(a) Use of loose excelsior or shredded newspaper is prohibited unless such are enclosed in a sealed, waterproof barrier conforming to PPP-B-1055 or MIL-B-13239.

(b) Polystyrene "loose-fill" material, for level A packaging or level A packing applications such as cushioning, filler, dunnage, etc., is prohibited. Unless approved by the procuring activity (see 6.2), use of polystyrene "loose-fill" for packaging and packing under 5.1.2, 5.2.1.2 and 5.2.2 (level C) for applications such as cushioning, filler, dunnage, etc., is prohibited. When approved for use under 5.1.2, 5.2.1.2 and 5.2.2 (level C) packages and container (interior and exterior) shall be marked or labeled as follows:

"CAUTION

Contents cushioned, etc., with polystyrene (loose-fill) material.
Not to be taken onboard ship.
Remove and discard loose-fill material before shipboard storage.
If required, recushion with cellulosic material bound fiber, fiberboard, or transparent flexible cellular material."

5.3 Marking.

5.3.1 Standard markings. In addition to any special marking or instructions required herein or by the contract or order (see 6.2), unit and intermediate packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

5.3.2 Special markings.

5.3.2.1 Method II. Method II packages shall be marked in accordance with MIL-STD-129.

5.3.2.2 Shipping containers. Shipping containers shall have the following markings:

(a) Adjacent to method II markings:

"STORE RIGHT SIDE UP - WARNING - SEE UNPACKING INSTRUCTIONS."

(b) Apply adjacent to the identification marking on the side of the container:

"CAUTION - THIS EQUIPMENT MAY BE SERIOUSLY DAMAGED UNLESS UNPACKING INSTRUCTIONS ARE CAREFULLY FOLLOWED. UNPACKING INSTRUCTIONS ARE LOCATED (state where located)."

(c) "REUSABLE INTERIOR AND EXTERIOR CONTAINER (when applicable)."

(d) Handling and structural markings as applicable (see MIL-STD-129 and appendix to MIL-C-104).

5.4 Special instructions.

5.4.1 Preserved engines. All engines preserved level A shall be tagged as follows.

"The fluid systems of this engine have been preserved with type P-10 preservative. No special depreservation procedures are required with the exception of fresh water system. Depreservation of the fresh water system shall be in accordance with chapter 9412, paragraph 9412.118 of NAVSHIPS 0901-412-0002."

5.4.2 Depreservation. The equipment supplier shall provide any additional depreservation instructions for systems or accessories when such instructions would not be applicable to 5.4.1 or would be necessary due to design peculiarities of his equipment Instructions shall be packaged in a transparent waterproof plastic bag, minimum 4 mil thick. Closure shall be by heat sealing The shipping container in which the instructions are packed shall be marked to so indicate

5.4.3 Unpacking Unpacking instructions shall be provided for complex equipment or systems and floating bag type packs, the instructions shall contain the following information

"To unpack, remove the top and sides, leaving the unit resting on the bottom of the packing case Remove the packing case and slip the unit off the base. In unpacking the item, the following precautions shall be observed to prevent possible damage

(a) Observe the arrows marked on the shipping container. These point to the cover which can be removed most readily.
(b) Remove nails with a nail-puller only.
(c) Remove screws with a screwdriver only
(d) Never pound or hammer the shipping container.
(e) Keep all levers and crowbars away from the interior of the container."

5.4 3.1 These instructions shall be placed in a sealed waterproof envelope prominently marked "UNPACKING I STRUCTIONS" and firmly affixed to the outside of the shipping container in a protected location, preferably adjacent to the identification marking. If the instructions cover a set of equipment packed in multiple containers, the instructions shall be affixed to the number one container of the set or system.

5.4.4 Technical manuals. Depending on the type of packaging specified for the engine unit, the accompanying technical manuals shall be packaged as specified in 5 4.4 1 through 5.4.4 4.

5.4.4.1 Nonreusable bag Manuals shall be packaged in transparent plastic bags, minimum 4 mil thick and heat sealed Manuals shall not be placed within the sealed MIL-B-131 bag used to encase the engine unit but placed on the inside of the plywood crate. Packing list shall indicate the approximate location of the manuals. The container shall be marked "Manuals Enclosed". For ease of removability, the location of the manual(s) shall be such that they are readily accessible when the container is opened.

5.4.4.2 Reusable bag. Technical manuals shall be placed in the pocket provided on the outside of the reusable bag The pocket(s) shall be marked "Manuals Enclosed".

5.4 4 3 Metal container. Technical manuals shall be packaged as specified in the container specification contained in the contract or order.

5 4 4 4 Bulk shipment. Technical manuals shipped in bulk quantities shall be packaged and packed in accordance with the requirements of MIL-M-15071.

6. NOTES

6.1 Intended use The engines are intended for use in Naval ships, boats and landing craft as propulsion or powering auxiliary equipments such as generators, pumps, compressors and deck equipments This specification covers two or four stroke cycle engines, liquid cooled, naturally aspirated, supercharged or turbocharged.

6.2 Ordering data Procurement documents should specify the following

(a) Title, number and date of this specification.
(b) Engine rating and speed (see 3.1).
(c) Additional or different mission requirements (see 3.5.1 2).
(d) Additional accessory requirements (see 3.6).
(e) Whether pipe thread data requirements are applicable (see 3 7 1.2).
(f) Type of seawater pump (see 3 7.2.2).
(g) Mounting of heat exchangers (see 3.7.2 3)

(h) Whether water filter and conditioner are required (see 3.7 2.4).
(i) Whether simplex or duplex fuel filter is required (see 3.7.3 2.2).
(j) When fuel/water filter separator is required (see 3 7.3.2.3)
(k) Whether shockproof requirements of MIL-C-15730 apply (see 3.7 4.2).
(l) Source of engine intake air (see 3 8).
(m) Type of muffler, if required, for exhaust system (see 3.9).
(n) Type of starting system required (see 3.10).
(o) Whether automatic shutdown valve is required (see 3 10.1).
(p) Whether starting batteries are required (see 3.10 3).
(q) Alternator wattage and voltage (see 3.10.3.2).
(r) Whether extreme cold starting test is required (see 3.10 5 and 4.4.5).
(s) Type of governor required (see 3.11).
(t) Whether speed limiting device is required for propulsion engines (see 3 11.6.1).
(u) Whether instruments are to be furnished (see 3 12 1)
(v) When electrical tachometer is required (see 3 12.1 1).
(w) Whether reverse-reduction gear is required, and if so, gear ratio (see 3 18).
(x) Type of propeller shaft coupling (see 3.20).
(y) When resiliently mounted equipment is required (see 3 21)
(z) When shock resistance is required (see 3.23 and 4 4 8).
(aa) Dimensions and weight (see 3 24).
(bb) Whether maintenance engineering analysis is required (see 3 27).
(cc) Plan for use, if other than as specified (see 3.28)
(dd) Whether a reproducible drawing is required (see 3 29 1).
(ee) Quantity of manuals required and the delivery point (see 3 30.1).
(ff) Quality assurance requirements (see 4.1.1).
(gg) Whether torsiograph tests are required (see 4.4.1).
(hh) Level of preservation, packaging, and packing required (see 5.1 and 5.2).
(ii) Packaging method required (see 5 1.1 1.5)
(jj) Whether stowage boxes are required for repair parts and special tools, and whether type M or W (see 5.1 1.2).
(kk) Level of packing required for detached instruments, accessories, repair parts and tools (see 5.2.2).
(ll) When polystyrene (loose-fill) material is approved (see 5.2 4).
(mm) Special marking required (see 5.3.1)

6.3 Management control system documents. The following management control system documents should be included on DD Form 1660

(a) MIL-P-15137 (see 3.31).
(b) MIL-I-45208 (see 4.1 1).

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

6.5 Supersession data. This specification supersedes that part of MIL-E-23457A(SHIPS), dated 4 January 1965 and Amendment-2 thereto, dated 6 February 1967 pertaining to type B engines.

Preparing activity
Navy - SH
(Project 2815-N118)

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost Comments and the return of this form will be appreciated Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated in reverse hereof)*

SPECIFICATION

ORGANIZATION *(Of submitter)* | CITY AND STATE

CONTRACT NO | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT $

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1 HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2 COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3 IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4 REMARKS *(Attach any pertinent data which may be of use in improving this specification If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)* | DATE

DD, FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863 WHICH IS OBSOLETE 0101 807 2000

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