INCH-POUND
MIL-F-18602B(SH)
12 February 1991
SUPERSEDING
MIL-F-18602A(SHIPS)
1 August 1963
(See 6.10)

MILITARY SPECIFICATION

FANS, VANEAXIAL, FORCED DRAFT, STEAM TURBINE DRIVEN, NAVAL SHIPBOARD SERVICE

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

1. SCOPE

1.1 Scope. This specification covers steam turbine driven forced draft vaneaxial fans, alternately referred to as forced draft blowers, complete with drivers and controls, for supplying combustion air to the main steam boilers on naval ships.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4140

SPECIFICATIONS

FEDERAL

QQ-S-700	- Steel Sheet and Strip, Medium and High Carbon.
QQ-S-763	- Steel Bars, Wire, Shapes, and Forgings, Corrosion Resisting.
QQ-S-766	- Steel, Stainless and Heat Resisting, Alloys, Plate, Sheet and Strip.
TT-P-28	- Paint, Aluminum, Heat Resisting (1200°F).
TT-P-645	- Primer, Paint, Zinc Chromate, Alkyd Type.
PPP-F-320	- Fiberboard; Corrugated and Solid Sheet Stock (Container Grade), and Cut Shapes.

MILITARY

MIL-S-901	- Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-E-2036	- Enclosures for Electric and Electronic Equipment.
MIL-C-2212	- Controllers, Electric Motor A.C. or D.C. and Associated Switching Devices.
MIL-T-8504	- Tubing, Steel, Corrosion-Resistant (304), Aerospace Vehicle Hydraulic Systems, Annealed, Seamless and Welded.
MIL-P-15024	- Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5	- Plates, Identification.
MIL-E-15090	- Enamel, Equipment, Light-Gray (Formula No. 111).
DOD-P-15328	- Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric).
MIL-C-15730	- Coolers, Fluid, Naval Shipboard: Lubricating Oil, Hydraulic Oil, and Fresh Water.
MIL-T-16049	- Tachometers: Electrical; Self-Generating; Mechanical, Fixed Mounting and Hand Held; and Vibrating Reed.
MIL-M-17060	- Motors, 60-Hertz, Alternating Current, Integral Horsepower, Shipboard Use.
MIL-T-17286	- Turbines and Gears Shipboard Propulsion and Auxiliary Steam; Packaging of.
MIL-L-17331	- Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-T-17523	- Turbine, Steam, Auxiliary (and Reduction Gear) Mechanical Drive.
MIL-G-18997	- Gauge, Pressure, Dial Indicating.
MIL-P-19131	- Pumps Rotary, Power Driven, Miscellaneous.
MIL-L-19140	- Lumber and Plywood, Fire-Retardant Treated.
MIL-T-19646	- Thermometers, Remote Reading, Self-Indicating Dial, Gas Actuated.
MIL-S-22698	- Steel Plate, Shapes and Bars, Weldable Ordinary Strength and Higher Strength: Structural.
MIL-V-24578	- Valves, Globe, Pressure Instrument, Stem Test Connection, Union End.

MILITARY (Continued)

DOD-F-24669/7 - Forgings and Forging Stock, Steel Bars and Billets, Corrosion Resisting; Naval Steam Turbine Parts Use. (Metric)

MS33656 - Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.

MILITARY

MIL-STD-109 - Quality Assurance Terms and Definitions.

MIL-STD-167/1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).

MIL-STD-271 - Requirements for Nondestructive Testing Methods.

MIL-STD-278 - Welding and Casting Standard.

MIL-STD-721 - Definitions of Terms for Reliability and Maintainability.

MIL-STD-740-1 - Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment.

MIL-STD-740-2 - Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment.

MIL-STD-769 - Thermal Insulation Requirements for Machinery and Piping.

MIL-STD-777 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships.

MIL-STD-1472 - Human Engineering Design Criteria for Military Systems, Equipment and Facilities.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

810-1385850 - Piping, Instrument, Pressure, for All Services.

810-1385797 - Valves, Steel, Flanged Globe, Combined Exhaust Relief Valve.

810-1385798 - Valves, Steel, Flanged Angle, Combined Exhaust Relief Valve.

810-4433336 - Shutters, Automatic, 30 In. Width x 23-1/4 In. Height For Forced Draft Blowers.

(Application for copies should be addressed to: Commander, Portsmouth Naval Shipyard, Naval Engineering Drawing Support Activity, Code 202.2, Portsmouth, NH 03804-5000.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

PTC 10 - Compressors and Exhausters.

(Application for copies should be addressed to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 167 - Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip. (DoD adopted)

A 276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

A 473 - Standard Specification for Stainless and Heat-Resisting Steel Forgings.

A 516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service. (DoD adopted)

A 569 - Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality. (DoD adopted)

A 570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103).

ITT BARTON INSTRUMENTS CO.

Dwg. No. D4224E005 - ITT Barton Instrument Drawing.

(Application for copies should be addressed to the ITT Barton Instrument Co., 900 S. Turnbull Canyon Road, City of Industry, CA 91749.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

mounting dimensions but is not required to be shock resistant

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.2 Performance.

3.2.1 Rated capacity. The rated capacity and rated discharge pressure shall be as specified (see 6.2) and shall be the capacity and pressure delivered by the blower when operating at the specified steam inlet and exhaust conditions and at the rating conditions indicated in table I. The rated capacity shall be the maximum volume flow rate of air required to be delivered by the blower when operating at the maximum required discharge pressure (rated discharge pressure). The rated capacity shall be expressed in cubic feet per minute (ft^3/min) at the air inlet conditions of table I. The rated discharge pressure shall be the static discharge pressure and shall be expressed in inches of water, gauge (w.g.). The blower speed at rated capacity and rated discharge pressure shall be the rated speed.

TABLE I. Blower rating conditions.

Condition	Rating
Intake air temperature	68°F
Ambient air temperature	140°F
Intake air relative humidity	50%
Intake air pressure	14.7 lb/in^2 absolute
Cooling water inlet temperature (seawater)	95°F
Ambient air relative humidity	100%

3.2.2 Rated steam conditions. The normal operating steam inlet pressure and inlet temperature (and percent moisture where applicable) at the inlet to the steam turbine governing valve and the normal operating exhaust pressure at the turbine exhaust flange shall be the rated steam conditions under which the turbine, under control of the governing system, shall deliver the required horsepower for blower performance at rated capacity. The rated steam conditions shall be as specified (see 6.2).

3.2.2.1 Emergency steam conditions. The blower shall operate at rated capacity and pressure under the following emergency steam conditions; however, one hand-controlled nozzle valve shall be provided to achieve rated blower performance with minimum inlet and maximum exhaust conditions as indicated in items (b) and (c).

[redacted]

rated values.

(b) Steam pressure 20 percent lower than rated, other conditions at rated values.

(c) Exhaust pressure 25 pounds per square inch gauge (lb/in^2), other conditions at rated values.

3.2.2.2 Maximum and minimum steam conditions. Maximum and minimum steam inlet pressures and temperatures (and percent moisture where applicable) at the inlet to the governing valve and the maximum and minimum exhaust pressures shall be as specified (see 6.2). Blower performance and design requirements under the maximum and minimum steam inlet and exhaust conditions or any special conditions such as cruising or full power, shall be as specified (see 6.2).

3.2.3 Blower-turbine efficiency. When operating at rated capacity and the rated steam conditions, the combined blower-turbine efficiency shall not be less than that indicated in table II. The combined blower-turbine efficiency shall be determined in accordance with the following:

(a) Combined blower-turbine efficiency, in percent =

$$\frac{\text{Adiabatic air horsepower HP} \times \text{theoretical steam rate } \frac{\text{LB}}{\text{HP-HR}} \times 100}{\text{Actual steam flow lb/h}}$$

(b) The adiabatic air horsepower shall be the power required to isentropically compress the air delivered by the blower.

(c) The theoretical steam rate shall be the theoretical pounds of steam required per horsepower-hour under the steam conditions specified in the contract or order.

TABLE II. Combined blower-turbine efficiency.

Rated static discharge pressure (inches w.g.)	Combined blower - turbine efficiency (percent)		
	Rated capacity 20,000 ft^3/min	Rated capacity 30,000 ft^3/min	Rated capacity 40,000 ft^3/min
120	----	36.0	37.5
110	----	33.0	34.5
100	----	30.5	32.0
80	26.5	28.0	29.0
60	25.0	26.5	27.5
40	23.5	25.0	26.0

3.2.4 Stall margin. When operating at rated capacity and with the rated speed held constant, throttling of the blower's discharge air flow, thereby reducing capacity and raising discharge pressure, shall not cause the blower to go into surge or stall until the flow has been reduced to 82.5 percent or less.

3.2.5 Parallel operation. Each blower with its speed regulating Governor shall permit operation throughout the speed range from minimum speed (15 percent of rated) to rated speed in parallel with one or more additional identical blowers - all discharging through separate ducts to a common plenum. Each blower shall be brought from a minimum speed into stable parallel operation with one or more other identical blowers operating at approximately rated capacity and at a speed developing 45 percent of rated discharge pressure, without the speed of the oncoming blower exceeding that of the operating blower and with all blowers

continuing to operate stably in parallel with the speed difference between blowers not exceeding 300 revolutions per minute (r/min). Once in parallel operation, equal control signal inputs to each blower shall produce equal speed increments in each blower.

3.2.5.1 Operation in unstable region. Under the methods of operation on naval ships, blowers shall operate in parallel at speeds less than 45 percent of rated speed with one or more, but not all, blowers operating in an unstable (stall) performance region continuously. Additionally, blowers shall operate in parallel at minimum speed of 15 percent of rated speed for indeterminate periods of time. Each blower shall incorporate performance and durability characteristics for satisfactory operation under these conditions.

3.2.6 Performance and design limitations.

(a) With the blower operating at rated capacity, the steam leakage from the turbine glands shall not exceed 370 pounds per hour (lb/hr) and the amount of air entering the shaft glands and exhausted by the gland exhaust system shall not exceed 80 lb/hr under the following operating conditions:

(1) 20 lb/in^2 gauge turbine exhaust pressure.
(2) 10 inches of water vacuum (w.v.) at the turbine gland exhaust connection.
(3) Gland seals worn to twice the design clearance, or at the manufacturer's recommended maximum service clearance; whichever is largest.

(b) The static discharge pressure for single stage blowers shall not exceed 60 inches w.g.

(c) When operating at rated capacity and rated steam conditions, the lube oil temperature rise in each blower bearing shall not exceed 35 degrees Fahrenheit (°F), the lube oil temperature leaving each bearing shall not exceed 165°F, and the load carrying surface temperature of the blower bearings shall not exceed 200°F as measured by thermocouples imbedded in the bearing material.

3.2.7 Noise limits. The blower airborne noise levels shall not exceed the noise limits indicated in table III. Structureborne noise shall not exceed the levels specified in MIL-STD-740-2 for type 2 equipment.

TABLE III. Maximum permissible airborne noise levels (decibels refer to the base of 0.0002 microbar).

Octave band, center frequency (hertz)	Sound pressure level (db)
31.5	90
63	85
125	80
250	80
500	75
1000	75
2000	75
4000	75
8000	

3.2.8 Reliability. The blower shall achieve a performance reliability as demonstrated by passing the reliability test specified in 4.4.1.

3.2.9 Service life. The blower shall have a service durability of 30 years and a service life of not less than 100,000 actual operating hours. All parts requiring periodic replacement as a result of wear and aging shall have a minimum service life of 12,000 actual operating hours and a minimum service durability of 4 years.

3.2.10 Environmental performance. The blower shall operate and perform its function without deleterious effects on reliability and wear rate when installed and operated onboard Navy ships under the following shipboard arrangements and environmental conditions which may prevail simultaneously or occur in any combination.

(a) Orientation. The blower shall be suitable for installation by the shipbuilder in either the athwartships or the fore-and-aft orientation as directed.
(b) Marine environment. The blower will be constantly exposed to a marine environment with constantly changing ambient temperatures, high humidity in a sea salt laden atmosphere, and high incidence of conditions for electrolytic action of dissimilar metals.
(c) Range of operating conditions. The blower will be exposed to the range of ambient and inlet air conditions and seawater conditions as follows:

Inlet air temperature	40 to 140°F
Ambient air temperature	40 to 160°F
Inlet air relative humidity	50 to 100 percent
Seawater supply temperature	28 to 95°F
Seawater supply pressure	20 lb/in^2 gauge to 175 lb/in^2 gauge

(d) Vibration. Blowers shall meet the type I and type II vibration requirements in accordance with MIL-STD-167-1.
(e) Ship inclination. The blower will be exposed to the permanent or cyclic surface ship inclinations.

lowing ... level 2 drawings is normally requested or level 3 drawings and shall contain the toll

	Degrees displacement
Permanent trim by bow or stern	5
Permanent list	15
Rolling from vertical	45
Pitching from horizontal	10

NOTE: Trim and list conditions and roll and pitch conditions occur simultaneously.

3.2.11 Shock resistance. Each blower shall be shock resistant and shall pass a type A shock test for grade A class I equipment in accordance with MIL-S-901.

3.2.12 Operating duty cycle. The blower shall continuously operate uninterrupted and unattended, operating alone or in parallel as specified throughout the full range of performance from idling speed to rated speed, and under manual or automatic control of a shipboard pneumatic control system furnished by others. Each blower shall have rapid speed acceleration and deceleration between idling and rated speed during ship maneuvering.

3.3 Design. Design requirements of the blower and components shall be as specified in 3.3.1 through 3.3.9 (see 6.3).

3.3.1 Safety. Procedures for installing, operating, inspecting, maintaining and adjusting the blower shall be accomplished in a safe manner. In addition to the special design and precautionary features to prevent lube oil leakage and spillage specified in 3.6, the blower shall incorporate, as a minimum, the following additional safeguards to protect personnel from hazards and accidents:

(a) Exposed moving and rotating parts shall be covered by removable guards of expanded metal or similar sturdy serviceable material.
(b) Components with exposed operating surface temperatures in excess of 125°F shall be insulated in accordance with MIL-T-17523.
(c) Exposed edges shall be generously rounded and made smooth to prevent cutting edges and sharp corners.
(d) Insulated connectors and plugs of all electric current carrying conductors shall not constitute an electrical shock or residual discharge hazard when they are disconnected for maintenance and repair.
(e) Components of heavy or unwieldy nature shall not fall, topple, or slide and drop when their mounting fasteners are removed. Lifting the component for mounting/dismounting or assembly/disassembly shall constitute a separate action apart from removing the mounting fasteners.
(f) Pressurized components and systems shall be safeguarded against sudden and catastrophic rupture by:

(1) Hydrostatic proof testing (see 3.3.5.4).
(2) Nondestructive testing of welds and joints (see 4.5.5).
(3) Selection of material to prevent interchangeability between low and high strength components (see 4.5.3).
(4) Avoidance of stress concentrations (see 4.5.4 and 4.5.8).

3.3.2 Human engineering. MIL-STD-1472 shall be used as a guide for the application of the human engineering science relative to features of an operational, control and surveillance and maintenance nature and which involve the structural and performance interaction of equipment and humans.

3.3.3 Ease of maintenance. Ease of maintenance shall be a controlling blower design parameter. Blower maintenance operations shall be made straightforward and simple with proper regard given to the fact that maintenance often will be performed under adverse conditions with the ship at sea far from normal sources of supply and performed by shipboard maintenance personnel utilizing special tools furnished with the blower (see 3.4).

3.3.3.1 Parts standardization. The blower shall standardize, so far as practicable, on those components, fasteners, and items used in manufacture to reduce the number of sizes and kinds of items which are generally similar. For example, a design incorporating grade 8, 1/4-20 UNC 2 inch bolts in one location and grade 5, 1/4-20 UNC 2-1/2 inch bolts in another location should standardize on grade 8, 1/4-20 UNC 2-1/2 inch bolts. Wherever practicable the manufacturer shall design for the use of standard, commercially available parts.

3.3.3.2 Interchangeability. All identical components shall be interchangeable without hand fitting and additional machining. Components which are functionally interchangeable shall be, as far as practicable, physically, electrically, or mechanically interchangeable, as applicable, and this provision shall apply not only to wearing parts but also to major components such as coolers and shaft seal housings. However, when two similar items are not functionally interchangeable, they shall not be physically interchangeable and shall differ significantly so that their non-interchangeability is obvious. For example, it shall not be possible to mount the fan impellers in reverse order or in a reverse position; where dowels are employed, they shall be unequally spaced.

3.3.3.3 Configuration control. Components and parts shall be such that replacement parts can be replaced without additional machining, handfitting, scraping, welding, or otherwise customizing. Engineering designs of blower components shall establish datums, datum targets, and tolerances of form, location, and position such that interface relationships and parts interchangeability are clearly delineated and can be verified by parts inspections.

3.3.3.4 Accessibility for maintenance and repair. A minimum of disassembly shall be required for maintenance and repair of blowers. The location and configuration of access plates and access areas and openings for replacement of wearing parts and for making periodic inspections shall avoid the need for removing intervening obstructions such as piping and other appurtenances. Disassembly and reassembly methods shall require the use of standard tools wherever possible. Cutting, welding, brazing, and allied processes shall not be required for blower disassembly and reassembly associated with maintenance.

3.3.3.5 Portability. Proper design consideration shall be given regarding the maximum weight, bulk size, and shape which maintenance personnel can lift and transport safely during blower repair onboard ship. Major components which are not easily transported because of weight, shall be provided with padeyes or lifting lugs (see 3.4.3).

3.3.4 Materials. Materials of construction shall be as specified in the sections as for the specific components. Where materials are not specified, the material shall be as accepted by NAVSEA in the design evaluation and during tests and examinations. The use of alternate materials shall not be permitted unless such alternate materials have been accepted by NAVSEA as alternate materials for the specific service. All materials shall be identified on the drawings in a manner so that the physical and chemical properties and chemical composition are established and defined without ambiguity. Patented materials and processes are not permitted.

3.3.5 Assembly processes.

3.3.5.1 Component alignment. Blower components and assemblies that are alignment-critical shall be positively held in place by dowel pins, fitted bolts, keys, rabbeted or tongue and groove joints, or other indexing means. The alignment shall not be disturbed and undue stresses shall not be set up in any part associated with the vibration and contraction and expansion of steam turbines and auxiliary machinery. Supports of blower components such as the steam turbine casing and oil piping shall accommodate longitudinal and radial forces caused by temperature changes during normal operating conditions.

3.3.5.2 Fasteners, dowels, and locking devices. Threaded fasteners, dowels and locking devices shall conform to the requirements for steam turbines in 3.6.2. Threads of lock nuts on rotating shafts shall be counter to the direction of normal shaft rotation. Tap bolts and cap screws shall not be used unless specific, written approval has been received from NAVSEA. Thread standards shall be in accordance with FED-STD-H28.

3.3.5.3 Welding and allied processes. Welding and allied processes shall be in accordance with MIL-STD-278.

3.3.5.4 Pressure containing components. Pressure containing components, assemblies and piping systems which will be exposed to working pressures of three atmospheres or above shall be hydrostatically tested at 1-1/2 times the system design pressure (that is, maximum system pressure possible, abnormal conditions considered).

3.3.5.5 Cleaning requirements. Components, castings, weldments, machined parts, and piping shall be thoroughly cleaned and inspected for soundness, cleanliness, and performance acceptability prior to assembly of the blower. After assembly the blower shall again be cleaned, particularly internal passages of fluid and control systems. Internal passages shall be purged free of manufacturing debris and foreign matter and the openings shall be covered and sealed as necessary to prevent subsequent recontamination.

3.3.6 General assembly. The blower shall be a complete unitary assembly with lube oil system, operating and surveillance controls, and all required appurtenances for reliable and safe operation under the specified environmental conditions when installed onboard a Navy ship. The blower shall include a single or multistage vaneaxial fan driven by an integral, noncondensing turbine, mounted in tandem. All blower components except the motor controllers and remotely installed instruments shall be mounted on a common, horizontal bedplate. The bedplate shall be sufficiently rigid to facilitate shipping and handling of the

blower and to insure that the blower components and subassemblies are maintained in alignment. The bearing and seating surfaces of the bedplate shall be machine finished. The blower shall be operationally ready for service as furnished, with controls and control points adjusted and factory set. After successful completion of the specified production tests the blower shall be preserved and packed as indicated in section 5.

3.3.7 Capacity control. The blower shall be provided with a capacity control system whereby the blower output is controlled by regulating the speed of the blower. Prerotation inlet vanes and discharge dampers shall not be used. The speed of the blower shall be regulated by means of an inlet steam control valve (governor valve) under control of a speed regulating governor. The governor and governor valve shall be suitable for automatic and manual speed setting in response to pneumatic control signals from a combustion control system or a manual sending station. The speed control shall be positive and substantially linear between minimum speed and rated speed relative to the pneumatic control signal inputs. The governor and governor valve shall have the necessary operational stability to bring the blower from minimum speed into stable parallel operation with companion blowers already in operation as specified in 3.2.5. The pneumatic controls shall be compatible with the air pressure ranges employed in the combustion control system. The air pressure ranges shall be as specified (see 6.2). A pneumatic signal air lock valve with local manual release shall be provided to maintain blower speed at the prevailing setting on failure of the actuating air supply.

3.3.7.1 Speed regulating governor. The speed regulating governor shall be of the mechanical/hydraulic, compensated constant speed type with an integral air head and low oil pressure shutdown piston to close the governor valve and shut down the blower on loss of system oil pressure (see 3.5). The governor shall have a self-contained oil system but use the lubricating oil of the blower as the cooling medium if governor hydraulic fluid cooling is required.

3.3.7.2 Governor valve. The governor valve shall be of a balanced design compatible with the power characteristics of the governor. Hydraulic power assist shall not be required to position the valve. The valve shall be flanged to the turbine. The valve shall comply with the steam turbine requirements of MIL-T-17523 except that valve seats shall be welded into the body.

3.3.8 Overspeed protection. The capacity control speed regulating governor and governor valve shall also function as a speed limiting governor and shall prevent the blower from exceeding a speed of 107-110 percent of rated speed.

3.3.9 Speed indication. Each blower shall be provided with an electrical tachometer system which shall consist of a type 1C/EFC or 1C/EFD-A tachometer with two indicators. The tachometer system shall be in accordance with MIL-T-16049. One indicator shall have a nominal dial diameter of 4-1/2 inches and shall be installed on the blower instrument panel (see 3.4.5). The second indicator shall be furnished for installation remote from the blower and shall have a nominal dial diameter as specified (see 6.2). The blower shall have an accessible point or area on the rotor for the application of a hand-held tachometer type 1C/APB in accordance with MIL-T-16049.

3.4 Blower configuration design. The blower rotor shall consist of the vaneaxial fan impellers and turbine wheel, mounted on a common stiff shaft. The rotor shall be supported by no more than three sliding contact radial bearings with one separate or combined thrust bearing. The rotor bearings and the bearings and drives for the main lube oil pump and the governor shall be lubricated by an integral forced feed lubricating system (see 3.5). The process air shall enter the vaneaxial fan through a bellmouth at one end of the blower, flow axially through the compression stage and be discharged, through turning vanes, from an oblique discharge elbow between the fan assembly and the turbine. The air casing and turbine casing shall be horizontally split and flanged at the centerline to permit lifting of the upper casing halves for inspection and to permit the rotor with attached impellers and turbine wheel to be vertically lifted free for repair or replacement. Bearing housings and shaft steam seal housings shall also be split at the horizontal centerline, as components separate from the blower and turbine casings, to facilitate inspection and replacement of bearings and seals without disturbing the casings. The steam chest shall be integral with or mounted on the lower half of the turbine case in a manner not to interfere with lifting of the upper half turbine case. The steam control or governor valve shall not be integral with the steam chest but shall be mounted on the steam chest by means of flanges to permit valve removal for shop repair. A combined turbine exhaust and casing relief valve shall not be furnished but will be furnished by others (see 3.4.2). Blower envelope restrictions, if required, shall be as specified (see 6.2).

3.4.1 Air inlet and discharge connections. The connection for attaching the air inlet of the blower to the air supply plenum and the orientation and angle of the blower air discharge shall be as specified (see 6.2). The air discharge elbow and air duct connecting flange shall be sufficiently rigid for the intended service, but it may be assumed that forces and moments from shipbuilder connected air ducts will be negligible. The air discharge flange shall have a flat mounting plane for airtight bolting to companion flanges and shall be in accordance with figure 1.

3.4.2 Steam and drain connections. The steam inlet connection from the ship's steam supply system, made by the installer, will be at the inlet to the steam strainer furnished with the blower. Turbine exhaust and gland exhaust and drain piping shall originate in the lower half of the turbine case and lower halves of the steam seal housings. The connections to the ships piping systems shall be flanged and shall have the flanges located outside the turbine lagging line. A right side and left side turbine exhaust connection shall be provided for mounting a combined exhaust/relief valve on either side of the turbine as desired by the installer. One permanent flange cover with gasket and bolting shall be provided. The turbine exhaust flanges shall be designed and oriented for convenient mounting of an exhaust/relief valve conforming to Drawing 810-1385797 or 810-1385798, as specified (see 6.2). Steam piping shall conform to the requirements of MIL-T-17523.

3.4.2.1 Steam pressure gauge root connections. Steam pressure gauges shall not be furnished but will be provided by the installer and installed remote from the blower. The blower shall be provided with root connections and root valves for use with a steam inlet and a steam exhaust pressure gauge. The root connection for the steam inlet pressure gauge line shall be located on the steam chest body or comparable turbine component downstream of the governor valve. The

exhaust steam pressure gauge line root connection shall be on the lower turbine casing half. The root valves shall be located outside the insulation lagging line. Each root connection for the steam pressure gauges shall include a 3/8-inch nominal pipe size (nps), schedule 80, root nipple, a root valve with a 1/4-inch outside diameter (od) outlet bushing, and terminating in a metallic face type (internal pressure C-seal ring) union with a dead-end cap or blank. It shall be possible to remove the blank and permit attachment of a 1/4-inch od gauge line with its own tail piece and union nut. The root connections and associated parts shall be in accordance with Drawing 810-1385850.

3.4.2.2 Gland exhaust test connections. Each gland exhaust housing or gland exhaust discharge root connection shall be provided with a 1/4-inch flared tubing male-end test connection conforming to MS33656. The test connection shall incorporate an air- and steam-tight seal with a threaded cap permanently tethered to the gland housing or root connection by means of a lanyard or chain. A positive locking device shall prevent the cap and seal from loosening due to vibrations.

3.4.3 Lifting and handling provisions. Suitable provisions shall be made on each blower for applying lifting gear and cables as necessary for steady handling, hoisting, and lifting the assembled blower as a complete unit to facilitate shipboard installation and removal for shop repair. In addition, means such as lifting eyes shall be provided for applying lifting gear and cables as necessary on components and assemblies weighing 35 pounds or more which must be moved or lifted for inplace blower inspection or maintenance and which by reason of configuration or susceptibility to damage cannot readily attach to lifting cables without the use of lifting lugs or eyes.

(a) The upper halves of the fan and turbine casings, the steam chest as applicable, and the steam chest cover and bearing and seal housings (if individual weighing 35 pounds or more) shall be provided with integral lifting lugs.

(b) Suitable guides and guide posts shall be provided for lifting and reinstallation of the upper-half blower casings and the blower rotor, and shall include provisions for the employment of dowelled casings supports of a height to clear the blower rotor. Casings and rotor lifting guides, casings supports, special lifting eye bolts for the blower rotor, and all required separate lifting lugs and flange jacking bolts sufficient for one blower shall be included in the special tool set (see 3.8). Instructions for the use of these special lifting tools and a sketch for fabrication of a blower rotor support saddle shall be included in the special tool set.

3.4.4 Thermal insulation and lagging. The thermal insulation and lagging for the steam piping and turbine shall be in accordance with MIL-STD-769 and shall provide maximum maintenance access to bearings, seals, controls, for the removal of inlet and exhaust valves, for the removal of access covers, and for the lifting of blower casings-halves. The insulation shall be comprised of a lower segment that shall remain in place during normal blower service, and an upper segment comprising the removal maintenance access elements. The manufacturer shall design the configuration of the entire insulation envelope, the configuration of the

removable/replaceable elements, and shall provide the means for attaching the insulation to the blower components. Areas of insulation that may become exposed to lube oil leakage shall be amply protected with shielding to prevent oil soaking into the insulation with consequent risk of fire.

3.4.5 Instrument panel. An instrument panel shall be provided on each blower for mounting lube oil system pressure and temperature indicators (see 3.5.4), pressure gauge and pressure switch calibration valves (see 3.5.7.1), and the tachometer indicator. The location and mounting of the instrument panel on the blower and the routing of pressure gauge and temperature sensing lines shall permit locating the panel on either longitudinal side of the blower. The instruments shall be logically arranged on the panel to enhance service use. Each instrument shall be identified by an engraved bronze label plate mounted immediately underneath the instrument to insure that it cannot be mistaken as the label for another instrument.

3.5 Lubricating system design. The blower shall be lubricated with petroleum lubricating oil, Navy symbol 2190 TEP, conforming to MIL-L-17331. The lubricating system shall be of the forced feed type and shall promote long bearing life and provide adequate bearing lubrication for continuous uninterrupted blower operation under all specified modes and conditions of operation. The blower shall start and operate at low speed with an oil temperature of 60°F in the reservoir. The lubricating system shall incorporate a lube oil reservoir, a shaft-driven main lube oil pump, an electric motor-driven auxiliary lube oil pump, a manual lube oil pump for emergency blower starting, a seawater cooled lube oil cooler with a thermostatically controlled lube oil bypass, and a lube oil filter with an external differential pressure bypass. Check valves shall be installed where necessary to prevent backflow of oil through an idle pump. A direct hydraulic pressure signal to the steam turbine governor shall shut down the blower on oil pressure failure. The set point for this signal shall be lower than the set point for start-up of the auxiliary lube oil pump (see 3.5.1). A sight flow indicator shall be installed in the drain line of each bearing. A flow control orifice shall be installed in the supply line of each bearing. The sight flow indicators shall be located for direct line-of-sight visibility. Spray nozzles shall not be used in the lubricating system. All oil system components shall be located away from hot surfaces. Where oil piping is near hot surfaces, ample space for lagging the hot surface shall be provided. Oil piping shall not be lagged to hot surfaces.

3.5.1 Lube oil pump performance and control. The main and the auxiliary lube oil pump shall be self-priming and shall not lose suction under the ship motion and inclination specified in 3.2.10(e). Each pump operating alone shall provide full lubrication to the blower with the blower operating at rated capacity. The main lube oil pump shall provide adequate lubrication throughout the blower speed range of 10 to 100 percent of rated speed regardless of the rotational direction of the blower shaft and shall maintain lube oil flow to the bearings automatically when the blower shaft rotation is reversed from clockwise to counterclockwise and vice versa. The main lube oil pump and the auxiliary oil pump shall each take suction from the oil reservoir and shall each discharge through separate check valves to a common manifold from which the oil shall flow to the oil cooler, oil filter, and the lubricating system, in that order. The main and the auxiliary oil pump shall be in accordance with MIL-P-19131. The

auxiliary pump motor shall receive power through a motor controller with a manual ON-OFF pushbutton station with indicator lights. When the ON pushbutton is depressed the auxiliary oil pump shall be under the operating control of electrically independent oil pressure switches. The interaction of the main and auxiliary lube oil pumps shall incorporate the following features:

(a) The auxiliary pump shall provide adequate bearing lubrication for blower start-up and shutdown.
(b) The auxiliary pump shall automatically shut down at approximately 12 percent of rated speed when the main pump develops adequate pressure and capacity to supply the system independently.
(c) The auxiliary pump shall automatically start up when the system pressure drops to a specified level, indicating that system oil pressure is approaching the minimum level for safe blower operation. This set point shall be above the set point for blower oil pressure failure shutdown by the steam turbine governor (see 3.5).
(d) Operation of the blower at a speed close to the point where the auxiliary pump starts up or shuts down shall not cause the auxiliary pump motor to cycle at a rate greater than one cycle per minute.
(e) Automatic shutdown of the blower by the governor due to loss of lube oil pressure shall also result in shutdown of the auxiliary pump.
(f) During normal blower shutdown, sufficient pressure shall be maintained to the system to prevent activation of the governor oil shutdown until the blower is secured and the auxiliary pump is manually turned off.

3.5.2 Lube oil cooling. Lube oil cooling shall be by means of seawater supplied from a ship's system at the pressures and temperatures indicated in 3.2.10(c). The oil cooler shall be of the shell and tube type conforming to type A, class 2 in accordance with MIL-C-15730 and shall be provided with a lube oil bypass line and a thermostatic control valve at the junction of the bypass line and the oil cooler oil discharge line. The thermostatic valve shall maintain the oil temperature to the lubricating system at 120 to 130°F by regulating the amount of oil which bypasses the oil cooler. The thermostatic valve shall not, under any failure condition, cut off the flow of oil to the bearings. The seawater piping shall be in accordance with the requirements for seawater category D-1 of MIL-STD-777. No seawater shutoff valves shall be provided. The seawater inlet and discharge connections to the ship's piping shall be flanged and shall be located at the periphery of the blower envelope.

3.5.3 Lube oil filtration. The lube oil filter shall have full flow filtration of the lubricating oil. The filter shall be of the rotatable plate edge type with internal bypass and shall remove particles of 40 microns and larger. The internal bypass shall be sized for full flow and shall be set to open at the maximum differential pressure which will both protect the filter from damage and prevent blower trip out on low lube oil pressure due to a clogged lube oil filter. The bypass set point shall be at least 10 lb/in^2 above the full flow pressure drop across a clean filter. Vent and drain connections shall be of the straight thread, O-ring type. A differential pressure gauge with internal differential pressure switch in accordance with ITT Barton Instrument Drawing D4224E005 shall be installed across the filter. The gauge shall show a red area

for differential pressures of 2 lb/in^2 above and below the bypass valve setting. When the gauge reading reaches the red area, the differential pressure switch shall actuate, lighting an on-off flashing red indicating lamp at the blower gauge board. Connection for a remote indicating lamp shall be provided. A drip pan shall be provided under the filter to catch all spillage of oil that may occur during filter draining or removal. The drip pan shall have a capacity of twice the filter housing volume. The drip pan shall have a drain cock with spring action closure so it cannot be left inadvertently in the open position.

3.5.4 Lube oil system pressure gauges and thermometers. Pressure gauges and thermometers shall be provided to monitor lube oil pressure and temperature at the specified system locations indicated.

(a) Thermometers. The lube oil thermometers shall be of the gas actuated distant reading type, class C in accordance with MIL-T-19646 and shall have a temperature range of 20 to 240°F. The indicating dials shall have a nominal diameter of 4-1/2 inches. Oil temperature sensing points shall be installed at the following locations:

(1) In supply main, upstream of oil cooler.
(2) In the bearing supply main, downstream of thermostatic control valve.
(3) In discharge line at each bearing.

(b) Pressure gauges. The lube oil pressure gauges shall have a pressure range where the maximum normal operating pressure at the system sensing point is approximately 60 percent of the full scale range. Each pressure gauge shall have a manually adjustable non-operating red colored pointer, to serve as a marker, in addition to the pressure indicating pointer. The red pointer (marker) shall be set at approximately the maximum normal operating pressure. Pressure gauges shall be in accordance with MIL-G-18997 and shall have an indicating dial with a nominal diameter of 4-1/2 inches. Oil pressure sensing points shall be installed at the following locations:

(1) Main lube oil pump discharge, upstream of check valve.
(2) Auxiliary lube oil pump discharge, upstream of check valve.
(3) In supply main, upstream of oil cooler.

3.5.5 Lube oil purification system. A lubricating oil purification system separate and independent from the main lubricating system shall be provided. The purification system shall consist of an oil pump, a centrifugal separator and an automatic water drain system. The oil to the oil separator shall be delivered at a minimum pressure of 60 lb/in^2 gauge by a separate oil pump driven by an electric motor. Oil purification shall take place by centrifugal action induced in the separator by oil pump discharge pressure. The oil pump shall take suction from the sump of the main oil reservoir. The purified oil shall be returned to the reservoir at a point above the high oil level mark of the reservoir. The oil separator shall be contained in a housing located and configured to insure that oil spillage, including oil leakage resulting from purifier malfunctioning, can

drain by gravity into the main oil reservoir. The drain shall be sized for this purpose. When a separate oil pump is provided, a failsafe pressure sensing device shall be incorporated to deenergize the separator oil pump on loss of system pressure. Shutoff valves shall be provided in the suction line and the oil drain line to permit isolation of the purification system. Instruments required for operational monitoring of the purification system such as pressure gauges shall be installed locally on a purifier gauge board. The oil pump motor shall be under control of a remotely installed motor controller with a manual ON-OFF pushbutton station. Control wiring shall be included in the forced draft blower terminal board.

3.5.5.1 Separator pump. The separator oil pump shall be in accordance with MIL-P-19131 and shall have a capacity of 4 gallons per minute (gal/min) at a minimum discharge pressure of 75 lb/in^2 when pumping lube oil at a supply temperature of 150°F. The motor and controller and associated electrical controls shall comply with 3.6.3.

3.5.5.2 Centrifugal separator. The separator shall be of the centrifugal, jet reaction, type and shall remove a minimum of 750 cubic centimeters (cm^3) of free water per hour when supplied with 2190 TEP lube oil saturated with fresh water. The oil/water mixture shall be supplied to the centrifugal separator at a rate of gal/min, a pressure of 60 lb/in^2 gauge, and temperature of 150°F. The separator shall also have the capacity of holding a minimum of 2 pounds of dirt without interfering with the water removal capability of the separator. The oil inlet, water drain connections, and the vent plugs shall be of the straight thread, O-ring design. The oil drain shall be unobstructed and shall permit gravity to drain to the forced draft blower sump at atmospheric pressure. All separator materials shall be compatible with 2190 TEP oil and fresh water. The separator shall withstand and perform under high impact shock (see 3.2.11).

3.5.5.3 Separator automatic water drain system. The water drain system shall automatically drain off the water accumulated in the separator to an external connect to the ship's oily waste tank through an open funnel provided by the installers. This system shall consist of a differential pressure switch to determine the amount of water in the separator, a drain solenoid valve to open the drain valve on signal from the pressure switch, and a time delay relay to close the valve after the water has drained. The pressure switch shall be in accordance with MIL-C-2212.

3.5.6 Lube oil reservoir. The oil storage or holding capacity of the reservoir when at the maximum oil level shall be at least two times the number of gallons circulated per minute when the blower is operating at rated capacity. The oil reservoir location with respect to the turbine and the arrangement of steam piping and drains shall insure that condensate cannot enter the reservoir during blower operation and when secured. Access openings with in-place covers and gaskets shall be provided to permit manual cleaning of the reservoir in all areas and pockets and to permit inspection and cleaning of the oil pump inlet strainers. A bayonet type oil level indicator, with the low-normal-high level marks indelibly engraved, shall be provided. A lube oil reservoir breather (or vent to atmosphere), to limit oil vapors, shall be of adequate size for steam turbine service and shall be located sufficiently high above the oil reservoir level to prevent oil spillage under all specified conditions of ship and inclination. The

breather shall also serve as the oil reservoir filling connection and shall prevent oil spillage during filling. The oil level indicator and the vent and oil filler cap shall be secured by quick disconnect means against coming adrift under shock and vibration. The reservoir shall incorporate a low point sump which shall have a drain connection with a locked closed drain valve suitable for complete reservoir drainage and for taking oil samples when the blower is operating. The reservoir shall be constructed of corrosion resistant steel, class 304L or 316L in accordance with QQ-S-763 or QQ-S-766, respectively.

3.5.7 Lube oil piping, valve and fittings. Lube oil piping shall be supported to prevent damage from vibration and shock and shall be routed to facilitate ease of maintenance. Piping located where it forms a convenient step-up for operators or maintenance personnel shall be protected by suitable guards or covers. All connections shall be welded except take-down joints required for normal blower overhaul and maintenance. Lube oil piping, valves, gaskets, and fittings shall be in accordance with MIL-STD-777, category F-1. Valve trim and internal working parts of lube oil system components shall be of suitable and compatible corrosion-resistant material for service with lube oil contaminated with water. Lube oil system manually operated stem type valves shall be of the backseated type and shall include a positive method to prevent the valve stem from backing out of the bonnet and the bonnet from backing out of the valve body when the valve is being opened or closed.

3.5.7.1 Gauge piping. Gauge piping shall comply with the configuration requirements of Drawings 810-1385850, except that the material of the 1/4-inch od pressure sensing lines shall be in accordance with MIL-T-8504. Whenever a pressure gauge and a pressure switch monitor oil pressure at the same sensing point in the system, the pressure gauge and pressure switch shall be served by a common root valve and a common sensing line, branching to the pressure gauge and pressure switch at the instrument panel. Each pressure gauge and each pressure switch shall be provided with a gauge valve having a through-the-stem test connection whereby the gauge and the pressure switch can be isolated from the system and individually calibrated or adjusted in place by means of test instruments without the need to disconnect the gauge or switch from the sensing line. The differential pressure switch shall have a gauge valve in each sensing line. The gauge valves shall be in accordance with MIL-V-24578. The gauge valves shall be mounted on the instrument panel as shown on Drawing 810-1385850.

3.6 Component design.

3.6.1 Vaneaxial fan components.

3.6.1.1 Materials. Materials for the fan components shall comply with the requirements of table IV.

TABLE IV. Fan component materials.

Application	Material and form	Applicable documents 1/ 2/
Casings, inlet cones, diffuser	Carbon steel - Plate	MIL-S-22698, class U ASTM A 516
	- Sheet	QQ-S-700 ASTM A 569 (carbon 0.15%) ASTM A 570 (carbon 0.25%)
	Corrosion-resistant steel - Plate, sheet, and strip	ASTM A 167, types 302 and 304
Impeller hubs	Corrosion-resistant steel - Bars, shapes, forgings	QQ-S-763, class 410 ASTM A 473 (forgings) type 410 ASTM A 276 (bars and shapes) type 410
Impeller blades	Corrosion-resistant steel - Bars and forgings	DOD-F-24669/7, class 403 condition HT
Stationary blades	Corrosion-resistant steel - Bars and forgings	DOD-F-24669/7, class 403 condition HT QQ-S-763, classes 302, 304, or 410
	- Precision cast 12 Cr or 18-8	

1/ Materials used may be in accordance with either the Government or ASTM specifications listed, or equivalent material to another recognized industry standard specification, at the manufacturer's option.

2/ Detail drawings and lists of material shall reference the specifications actually used in each case, and shall include the class, type, grade, and condition of the material, as applicable.

3.6.1.2 Impellers. Impellers shall be positioned on the blower shaft by means of a shoulder on the shaft. They shall be secured to the shaft by keys and locknuts. The threads of locknuts shall be counter to the direction of normal shaft rotation. Provisions shall be made for removing the impellers from the shaft by means of jack screws or similar devices.

3.6.1.3 Casings, diffusers, inlet cones and guide vanes. Casings, diffusers, inlet cones, guide vanes and other air end stationary components constructed of carbon steel shall be galvanized by the hot-dip process, or other process specifically approved by NAVSEA. Surfaces subjected to temperatures of 750°F or more shall not be galvanized.

3.6.2 Steam turbine component. The steam turbine shall be non-condensing and shall have one pressure stage and not more than two velocity stages. The shaft seals shall be of the labyrinth type. Steam turbine components shall conform to the requirements of the applicable sections of MIL-T-17523. Steam turbine components shall not be galvanized. Alternate materials are allowed only with NAVSEA approval.

3.6.2.1 Rotors. The complete assembled forced draft blower rotor shall be dynamically balanced to conform to the residual unbalance limits for type II vibrations specified in MIL-STD-167-1. The first critical speed of the rotor shall not be less than 140 percent of the blower rated speed.

3.6.2.2 Shafts. The blower shafts shall comply with the shaft requirements for the steam turbines in 3.6.2.

3.6.2.3 Bearings. The bearings shall comply with the bearing requirements for the steam turbines in 3.6.2.

3.6.2.4 Steam seals. The steam seals shall comply with the requirements in 3.2.6(a) and 3.6.2. The manufacturer shall also furnish the calculated leakage rates at design and twice design clearance. The design leakage rate will be verified during performance the capacity testing specified (see 4.4.2).

3.6.3 Electrical components.

3.6.3.1 Terminal boards. Terminals and terminal boards shall be in accordance with MIL-C-2212. Terminal board enclosures mounted on the blower shall be watertight and shall be in accordance with MIL-E-2036.

3.6.3.2 Motor controllers. Motor controllers and associated pressure switches, indicating lamps, and wiring shall be in accordance with MIL-C-2212. The controllers and switches shall have the following characteristics:

(a)	Enclosure	Dripproof
(b)	Operation	Magnetic
(c)	Ambient temperature	122°F
(d)	Insulation	Class B
(e)	Performance	(See 3.5)
(f)	Control function	Motor starting
(g)	Type	Across the line full voltage non-reversing
(h)	Protection	Low voltage release (LVR) Overlay relay (OL)
(i)	Duty	Same as motor
(j)	Switches required	(See 3.5)
(k)	Switch enclosure	Watertight
(l)	Switch location	Remote

3.6.3.3 Motors. Electric motors shall be in accordance with MIL-M-17060 and the following:

(a)	Service	Navy A
(b)	Voltage and current	440 Vac, 3-phase, 60 hertz
(c)	Enclosure	Totally enclosed fan cooled with labyrinth type, non-rubbing seals
(d)	Ambient temperature	122°F
(e)	Duty	Continuous
(f)	Speed	Constant
(g)	Insulation	Class B or F
(h)	Bearings	Ball

3.6.4 Identification plates. The blower shall be provided with two identification plates. One shall be mounted on the blower instrument panel; the second mounted on a visible lower surface of blower not covered by insulation. The identification plates shall be made of bronze and shall be secured to equipment with corrosion-resistant metal fasteners electrolytically compatible with the bronze plates. Blower components such as the auxiliary lube oil pump, the electric motor, and the controllers shall be provided with identification plates as specified in the component specifications. The identification plates shall be in accordance with MIL-P-15024 and MIL-P-15024/5, type A or type D. The blower identification plates shall include the following information:

(a) Name of Equipment: Main Forced Draft Blower
(b) Manufacturer's name and address
(c) Manufacturer's model, type and size (as applicable)
(d) Manufacturer's serial number of the blower
(e) Date of manufacture
(f) Government or shipbuilder's contract or purchase order number
(g) Rated capacity - ft^3/min
(h) Rated static discharge pressure - Inches W.G.
(i) Rated speed - r/min
(j) Rated steam inlet pressure - lb/in^2 gauge
(k) Rated steam inlet temperature - °F
(l) Rated turbine exhaust pressure - lb/in^2 gauge
(m) Steam flow at rated capacity - lb/h
(n) Brake horse power at rated capacity - bhp
(o) Governor speed limiting setting - r/min
(p) Low lube oil pressure trip setting - lb/in^2 gauge
(q) NAVSEA Technical Manual Number
(r) Section for DCAS Stamp.

3.7 Painting.

3.7.1 Criteria for painting. Exterior metallic surfaces of the blower including the base plate, supports and all appurtenances and piping, but not including the components herein excepted, shall be cleaned and painted to protect the blower from the elements and to enhance appearance. Paint and primer coats shall not be applied to identification plates, bearings and bearing surfaces, plastics, indicating dials, and windows, faying surfaces such as flange faces and spot faces for bolting, rotating parts, internal surfaces of oil, steam and water containing areas, and surfaces protected by galvanizing or plating.

3.7.2 Pretreatment cleaning. All surfaces to be painted shall be thoroughly cleaned to remove oil, grease, dirt, scale, rust, weld beads, and slag and sand core residues. Cleaning by acid pickling and by shot or grit blasting shall be accomplished on the components prior to blower assembly. Grit or sand blasting shall not be done on an assembled blower. Following assembly of the blower and final surface cleaning a determination of acceptable surface conditions for painting shall be made.

3.7.3 Surfaces not exceeding 300°F. After pretreatment cleaning, ferrous surfaces shall be given one coat of pretreatment primer conforming to DOD-P-15328, followed within 8 hours by one coat of zinc-chromate primer conforming to TT-P-645. After cleaning and after annodizing of aluminum components, nonferrous surfaces including annodized aluminum surfaces shall be given one coat of zinc-chromate primer conforming to TT-P-645. The metallic exterior surfaces with a maximum surface temperature not exceeding 300°F shall then be given one finish coat of light gray equipment enamel conforming to MIL-E-15090. Surfaces under attachments, such as nonfraying mounting brackets and identification plates and under thermal insulation and lagging shall also be cleaned, primed, and painted as specified herein.

3.7.4 Surfaces above 300°F. After pretreatment cleaning, exterior surfaces having a working surface temperature above 300°F shall be given two coats of heat resistant paint conforming to TT-P-28. The metallic surfaces under thermal insulation and lagging shall be similarly cleaned and painted with heat resistant paint.

3.8 Special tools. Special tools shall be those tools and apparatus needed for adjustment and maintenance of the forced draft blower but which are items that are not listed in the Federal Supply Catalogue. A copy of this catalogue is available for review in the local office of the Defense Contract Administration Services Management Area. Special tools as necessary for safe, reliable and efficient performance of maintenance operation onboard ship at sea shall be furnished in sets, designated as Onboard Special Tools. The number of sets to be furnished with any quantity of blowers shall be as specified (see 6.2). The manufacturer shall review the procedures and tool requirements for all maintenance operations, including bearing and steam seal wear and clearance measurement, rotor position and thrust clearance measurement, and the removal and replacement of turbine wheels, impellers, stators, thrust collars, bearings, labyrinth seals, studs, and bolts. The review shall establish a definitive list of the required special tools which shall comprise a set of Onboard Special Tools (see appendix C). Onboard Special Tool sets shall include the lifting, guiding and support apparatus for turbine casings and rotors, and the separate lifting lugs, eye bolts, and jacking bolts specified in 3.4.3(b).

3.9 Repair and replacement parts. The requirements of this specification apply to all repair and replacement parts purchased under acquisition for complete forced draft blowers. For the selection, identification, and quantity of repair parts for shorebased and replenishment stocks see 6.7.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Terms and definitions. Quality assurance terms used herein are defined in MIL-STD-109 and MIL-STD-721. The supplier shall utilize and uniformly adhere to the terms and definitions as specified.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.4).
(b) Quality conformance inspection (see 4.5).

4.2.1 Government acceptance. Prior to the offering of any forced draft blower for acceptance by the Government, an identical production unit shall have successfully undergone first article inspection as described herein. The contractor shall notify NAVSEA prior to the start of the scheduled tests.

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.4 and 4.5.

4.4 First article inspection. One blower out of each type or size on a contract or order shall be selected for performance of the first article inspection, when specified (see 3.1). Two blowers shall be selected for the parallel operation test (see 4.4.3). This inspection shall consist of the examinations, tests, and demonstrations specified in 4.4.1 through 4.4.8 (see 6.3 and appendix B).

in addition to the requirements in table I. 3.4.2 Aluminum alloy. Aluminum alloy sh

4.4.1 Performance reliability test procedure. The blower shall be installed in a testing laboratory in a manner simulating shipboard installation and operation, and shall discharge air through an expansion joint and an automatic shutter to air discharge pressure control and air flow measuring devices in accordance with ASME PTC 10. The automatic shutter shall be in accordance with Drawing 810-4433336. Each main journal bearing and one thrust bearing segment shall be fitted with a thermocouple embedded in the bearing babbitt and instrumented for measurement of the bearing temperature. Each main bearing housing shall be fitted with a proximity eddy current, type vibration probe and instrumented for vibration amplitude and frequency measurement. Throughout the test the blower shall be under the control of the speed regulating governor responding to manual pneumatic signal inputs. Prior to and after completion of the operating portion of the test, the blower shall be disassembled as necessary for inspection of all parts subject to wear and service deterioration. The condition of these parts shall be examined and noted, wearing surfaces shall be measured to determine the nature and amount of wear. The blower shall be operated for a total of 500 operating hours, of which 250 operating hours shall be at approximately rated capacity and rated discharge pressure. The remaining 250 operating hours shall include operating periods at full power, cruising, or other conditions specified in the order. The 250-hour run at rated capacity shall be interrupted by six rest periods of not less than 8 hours each. The upper half turbine case shall be lifted twice (at approximately 250 hours and 350 hours) and replaced to show casing joint integrity. A minimum of thirty start-stop cycles shall be performed during the course of the test. During the 500-hour operating period the following additional test evolutions shall be performed:

(a) The blower shall be operated for 8 hours continuously at idling speed with the blower air discharge shutter locked closed. The blower shall not overheat and lube oil bearing temperatures shall remain within the limits specified in 3.2.6(c). Vibrations shall remain within the permissible amplitude limits specified in MIL-STD-167-1.

(b) The blower shall be operated for 30 minutes at rated capacity and rated pressure with steam supplied at the emergency conditions specified in 3.2.2.1. The blower shall operate satisfactorily without drop-off in blower capacity and without attaining the speed limit setting of the governor.

(c) The blower shall be caused to operate at a sudden speed increase from 50 percent of rated to the speed setting of the speed limiting governor. This evolution shall be repeated ten times during the course of the 500-hours test, but not in uninterrupted succession. Successful functioning of the governor without failure and without excessive overspeeding as specified in 3.3.8 (including overshoot) shall be demonstrated.

(d) The blower shall be operated for 30 minutes continuously at 125 percent of rated speed. During this test the blower may be operated at reduced power. The amplitude of vibrations shall remain within the limits specified in MIL-STD-167-1 for type II vibrations.

(e) After two of the 8-hour rest periods, the blower shall be started with the sump oil temperature at 60°F. Performance of the lube oil system, the action and operation of the lube oil pressure and

differential pressure switches and the pressure, temperature and flow indicators shall be observed and monitored and the findings and performance recorded. The lube oil filtration and filter bypass devices and the low lube oil pressure protection devices shall be caused to function randomly ten times, to demonstrate reliable performance and failure protection as specified in 3.5. There shall be no spurious shut downs from malfunctioning of protective devices.

(f) The lube oil purification system shall be operated during the entire 500-hour performance reliability test and the amount of water removed shall be recorded. The centrifugal separator shall not be cleaned during the performance reliability test.

4.4.1.1 Instrumentation and recorded data. Instrumentation for the reliability test shall be in accordance with ASME PTC 10, but shall include such other instrumentation necessary to measure and monitor the quantitative data pertaining to the specific criteria required in the test agenda. Data shall be taken and recorded at the start and conclusion of each test run or test evolution, and at regular operating time intervals appropriate to the specific test but not exceeding 1 operating hour. The data shall include all pertinent information mandatory in accordance with established engineering practice for evaluation and confirmation of the degree of compliance with the specified operating, reliability, and performance requirements. All data shall be available for review by the Government on request.

4.4.1.2 Acceptance criteria. The blower shall be considered acceptable with respect to performance reliability and anticipated service life if all of the following conditions have been met:

(a) The measurement of wear and operating clearances is within design limits and there is no indication of deterioration or impending failure of any of the blower components.

(b) The blower has performed without unscheduled stoppages or shutdowns, and without the need to repair or replace any part or component of the blower.

(c) The blower has demonstrated the performance capabilities and operating characteristics in compliance with the following:

(1) Satisfactory operation with emergency steam conditions..... 3.2.2.1
(2) Operation in unstable region..... 3.2.5.1
(3) Lube oil and bearing temperature limits..... 3.2.6(c)
(4) Self-generated vibrations..... 3.2.10(d)
(5) Capacity control..... 3.3.7
(6) Lube oil system performance..... 3.5

4.4.2 Performance capacity test procedure. The performance capacity test shall be conducted before and after the performance reliability test. The test shall establish the performance characteristics of the blower and shall determine whether the blower has the rated capacity which is specified in the contract or order. The test shall be a type I test in accordance with the procedures set forth in ASME PTC 10. Provisions shall be made for measuring the gland seal steam leakage and the air exhausted from the gland seals in accordance with 3.6.2.4.

The stall margin at rated capacity shall be determined as specified in 3.2.4. The full capacity test shall be conducted with air inlet conditions based on a specific weight equivalent to the air and moisture mixture specified in table I and 3.2.1. The number of test runs and data points shall be sufficient to establish the following blower performance curves:

(a) Air inlet conditions as in table I.

(1) Capacity versus static discharge pressure at 100, 80, 60, 40 and 30 percent of rated speed; from free delivery to shut off or stall point.
(2) Blower surge or stall line.
(3) Brake horsepower versus capacity at 100, 60, and 30 percent of rated speed; from free delivery to stall point.
(4) Combined blower-turbine efficiency at rated speed (see 3.2.3), from free delivery to stall point.

(b) Air inlet conditions of 100°F, 40 percent relative humidity.

(1) Capacity versus static discharge pressure at rated speed, from free delivery to stall point.

4.4.2.1 Instrumentation and recorded data. Instrumentation and recorded data shall be in accordance with ASME PTC 10.

4.4.2.2 Acceptance criteria. The blower shall be considered acceptable with respect to performance capacity if the stipulated rated capacity and rated discharge pressure is attained, if the combined blower-turbine efficiency conforms to that specified in table II of 3.2.3, if the stall margin requirements in 3.2.4 have been met, and if the air and steam leakage rate limits specified in 3.6.2.4 have not been exceeded.

4.4.3 Parallel operation test procedure. The parallel operation test shall be conducted with two blowers installed as specified in 3.2.5, discharging into a common system in accordance with ASME PTC 10. The blowers shall be operated and controlled from one manual pneumatic signal sender sending a common signal to both blower governors and separate, but not necessarily equal, signals to one or both blower governors. The blowers shall be operated as specified in 3.2.5 throughout the full speed range and repeatedly brought from idling speed into parallel operation with the second blower. Ten evolutions from idling speed to parallel operation shall be performed with each blower. The speed indicators of each blower shall be closely monitored, if necessary by recording instruments, to ascertain that the blowers maintain steady operation without hunting and with equal load sharing.

4.4.3.1 Acceptance criteria. The blower shall be considered acceptable with respect to parallel operation if compliance with the specified paralleling requirements of 3.2.5 has been demonstrated.

4.4.4 Shock test procedure. The test shall be a type A shock test for grade A, class I equipment in accordance with MIL-S-901. When the shock test is conducted on a medium-weight shock machine, six blows shall be applied as

described in MIL-S-901, with the mounting platform in a horizontal position and the blows applied under the approximate center of gravity of the assembled unit. The blower shall be tested running and at standstill on alternate blows. The blower shall be run at minimum speed (15 percent of rated) during shock test. In addition, the test shall be repeated with the unit inclined at 30 degrees to the rotor axis. When a shock platform is required, the blower shall be mounted flat and run at minimum speed on alternate blows.

4.4.4.1 Examination after shock test. Examination of the forced draft blower after the shock test shall be conducted as follows:

(a) Examine the unit carefully and note the extent of any external damage.
(b) Jack the blower over several times by hand to ensure that all working parts are free and ready for starting.
(c) Run the blower at minimum speed for a short time and note any mechanical peculiarities. (Bolting may be tightened to original torque if leakage is noted.)
(d) Slowly increase speed to rated speed and carefully check for any undue noises, excessive vibration, or other nonconformances.
(e) Secure the blower and disassemble for complete examination.
(f) Observe and record all effects of the shock test on the various blower components.

4.4.4.2 Acceptance criteria. The forced draft blower shall be considered to have passed the shock test if the following conditions have been met.

(a) No breakage of any part, including mounting bolts, has occurred.
(b) There has been no distortion or dislocation of any components or appurtenances, rendering the blower inoperative or unsafe for continued service.
(c) The amplitude of vibration at rated speed measured after the shock test does not exceed the limits specified in MIL-STD-167-1.
(d) The low lube oil pressure and overspeed protection devices and systems continue to function as specified.

4.4.4.3 Disposition of shock-tested equipment. Equipment which has successfully passed the shock tests will be considered acceptable for such service as designated by NAVSEA. The supplier shall thoroughly recondition such units, correcting any minor imperfections or deformations, and shall place the equipment in satisfactory working order. All bearing and shaft seals (oil, air, and steam) shall be replaced. After reconditioning, the equipment shall be tested as specified (see 4.5.9).

4.4.4.3.1 Shock test failure. Equipment which has been subjected to high-impact shock tests and has failed will not be accepted, either in whole or in part, until the causes of such failure have been corrected by the supplier and the complete equipment has been retested.

4.4.5 Vibration test procedure. The vibration test shall be conducted to measure the residual vibration amplitude for type II vibrations. The test shall be conducted in accordance with the vibration test specified in MIL-STD-167-1,

except that the amplitudes of vibration shall be measured on the bearing housings. Measurements may be confined to the first order of vibration, unless residual vibrations are evident at higher orders of vibration. The vibration test may be conducted concurrently with the reliability test.

4.4.5.1 Acceptance criteria. The forced draft blower shall be considered acceptable with respect to the vibration requirements of 3.2.10(d) if the vibration amplitude limits specified in MIL-STD-167-1 for type II vibrations have not been exceeded.

4.4.6 Noise test procedure. The noise tests shall be performed to measure the airborne and structureborne noise level of the blower. The tests shall be conducted in accordance with MIL-STD-740-1 and MIL-STD-740-2 (see 6.3).

4.4.6.1 Acceptance criteria. The blower shall be considered acceptable with respect to noise levels if the limits specified in 3.2.7 have not been exceeded.

4.4.7 Inclined operation test procedure. The blower shall be inclined 15 degrees from the horizontal plane in the four principle directions, two inclinations to either side with the blower shaft remaining in the horizontal position and two inclinations with the blower shaft at an angle of 15 degrees to the horizontal plane. The blower shall be operated in each position for 30 minutes at rated speed. The test shall demonstrate the performance of the lubricating system and associated controls when the blower is subject to the ships motion and inclination specified in 3.2.10(e). The purification system shall be operational during each test run and shall be observed. All lube oil pressure gauges, thermometers, sight flow indicators, and automatic drains and overflow devices shall be observed and the findings recorded.

4.4.7.1 Acceptance criteria. The blower shall be considered acceptable with respect to inclined operation if the lube oil pumps have not lost suction, the oil supply to the bearings has not been interrupted, there has been no oil spillage and leakage, the lube oil system controls and protective devices have functioned as required without spurious shutdown, and the oil temperatures and pressures have remained at normal levels in accordance with the lube oil system design and specifications as defined by the manufacturer and confirmed by tests.

4.4.8 Safety, human engineering and ease of maintenance examination. The elements of safety, human engineering, and ease of maintenance shall be demonstrated.

4.4.8.1 Acceptance criteria. The blower shall be considered acceptable with respect to safety, human engineering, and ease of maintenance if compliance with the requirements of 3.3.1 through 3.4, and 3.8 has been demonstrated.

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in 4.5.1 through 4.5.9 (see 6.3 and appendix B).

4.5.1 General procedures for quality conformance tests and examinations. The quality conformance tests and examinations shall be performed during the production and at the completion of production of each blower and its components. The sequence of performance and the timing of these inspections shall conform to and be an integral part of the production process.

4.5.2 Hydrostatic test procedure. A hydrostatic test, which consists of applying water under steady maintained pressure, shall be applied to all components and assemblies subjected to pressurized service in accordance with 3.3.1(f) and 3.3.5.4. The pressure shall be maintained for a period of not less than 30 minutes.

4.5.2.1 Acceptance criteria. The component shall be considered to be acceptable with respect to the hydrostatic test requirements if the component has not exhibited leakage, deformation, or rupture.

4.5.3 Material verification procedures. The manufacturer shall verify that all materials used in the production of each blower are in accordance with 3.3.4. Where ASTM specifications or commercial specifications are used, the manufacturer shall furnish, upon specific request, affidavits certifying the chemical and physical properties of the materials purchased. The certification shall include the actual test, examination, or other verifiable data.

4.5.3.1 Acceptance criteria. Acceptance criteria for materials verification shall be the manufacturer's furnishing, upon specific request by NAVSEA or the procuring agency, affidavits certifying the material.

4.5.4 Nondestructive inspection procedures. Nondestructive inspections shall be conducted in accordance with MIL-STD-271.

4.5.4.1 Acceptance criteria. Acceptance criteria for nondestructive inspections shall be in accordance with MIL-STD-271.

4.5.5 Welding inspection procedures. Welds shall be inspected in accordance with MIL-STD-278.

4.5.5.1 Acceptance criteria. Acceptance criteria for welding inspections shall be in accordance with MIL-STD-278.

4.5.6 Configuration control procedures. Configuration control of blower components shall be practiced by the manufacturer as specified in 3.3.3.3. Components shall be inspected for adherence to tolerances with respect to established datums and datum targets, dimensional tolerance, and tolerances of form, location and position.

4.5.6.1 Acceptance criteria. Each component shall be considered acceptable with respect to configuration control requirements if the component is within all tolerances specified.

4.5.7 Purchased components inspection procedures. When components or processes for use on the blower are not manufactured or performed at the manufacturer's facility but are contracted by the manufacturer to vendors, the manufacturer's quality program procedures shall include, as a minimum, the following:

(a) Examination upon receipt, consistent with practicability, to detect damage in transit.
(b) Inspection to determine that components comply with applicable specifications and standards.

(c) Inspection prior to installation on the blower to determine that the components suffered no deterioration or deleterious effects during storage or damage from handling.
(d) Functional testing, either prior to or after installation on the blower to determine satisfactory operation.
(e) Identification and protection from improper installation or use.

The Government reserves the right to inspect, at source, these components or processes contracted by the manufacturer to vendors.

4.5.8 Finished parts inspection procedures. Finished parts inspection shall be performed by the manufacturer's trained quality control inspectors to determine that each finished part and assembly, including the finished blower, is inspected for, as a minimum, the following:

(a) Dimensions. All dimensions shall be within tolerance (see 3.3 and 4.5.6). Care shall be taken that assembly of components within tolerances does not result in stacked up tolerances out of the assembled tolerance. Dimensional inspection shall also include verification or proper tubing inside diameters (id's), od's, and wall thicknesses.
(b) Material. Materials shall be verified for proper identification.
(c) Cleanliness. Assemblies shall be clean as specified in 3.3.5.5.
(d) Missing parts. The assembled blower shall be inspected for completeness of all parts and appurtenances.
(e) Fit. The assembled blower shall be inspected for positional tolerances of fit and running clearances.
(f) Alignment. The assembled blower shall be inspected for alignment and run-out tolerances.
(g) Preservation. The assembled blower shall be inspected to verify that painting and preservation is as specified in 3.7 and section 5.

4.5.8.1 Acceptance criteria. The blower shall be considered acceptable with respect to the finished parts inspection requirements if all inspections cited in the preceding subsections verify that the observed conditions and measured values comply with the engineering data specified.

4.5.9 Production unit test procedures. The production unit test shall be an operational test performed on each blower to determine that each blower operates satisfactorily in accordance with the requirements of this specification and the contract or order; that the safety, control, surveillance, and monitoring devices and systems are properly adjusted; and that each blower functions in every respect as specified without failure. During this test, fresh water may be used in lieu of seawater. The operational test shall be conducted in accordance with the following evolutions:

(a) The blower shall be started from cold conditions with lube oil of 70°F in the oil reservoir. The lube oil and capacity control system devices shall be adjusted and control points set until all operating, safety, and indicating devices function as designed and as required for satisfactory blower operation.

(b) The blower shall be operated through the full speed range under control of a manual pneumatic signal sender, from minimum idling speed to the speed limiting setting of the governor. A minimum of eight speed variation evolutions, through the full speed range with increasing and decreasing pneumatic signal increments, shall be conducted. Throughout their speed manipulation tests, the blower shall perform steadily without hunting and the speed changes shall be approximately linear with the changes in pneumatic signals.

(c) The blower shall be operated continuously for 2 hours at a minimum idling speed and for 2 additional hours at rated speed. During the 2-hour test at rated speed, the blower shall operate for not less than 10 minutes at rated capacity and rated discharge pressure. The lubricating oil filter shall be fully clean prior to commencement of this test.

(d) The blower shall be operated for 30 minutes continuously at 125 percent of rated speed. During this test the blower may be operated at reduced power. Vibration amplitude measurements shall be taken on the main bearing caps or housings. The amplitude of vibrations shall remain within the limits specified in MIL-STD-167-1 for type II vibrations.

(e) After test completion the filter shall be disassembled and inspected for the presence of debris. If wear debris or manufacturing debris is present, the lubricating system shall be flushed and the operating test repeated, including filter inspection, until there is evidence of a clean lube oil system. During the test runs the blower shall operate smoothly and reliably without perceptible abnormal vibrations and without stoppage or distress. All oil temperatures and pressures shall be normal and within specified limits and there shall be no spurious shutdowns.

(f) Inspect bearings and seals for abnormal wear after completion of test.

4.5.9.1 Production unit test acceptance criteria. The blower shall be considered acceptable if the individual test evolutions have demonstrated satisfactory blower operation and if the acceptability criteria set forth in each test evolution have been achieved.

4.5.9.2 Production unit test deficiency findings. If, during the production unit test, any individual test evolution has revealed a blower deficiency, the deficiency shall be investigated and a determination made as to whether it is a material deficiency, a random material failure, or whether the deficiency is design or workmanship related. The implication that all blowers may be equally deficient shall be investigated and NAVSEA shall be apprised of the investigation and the findings. Corrective action shall have NAVSEA concurrence. After correction, the tests related to the corrective action shall be re-conducted.

4.6 Inspection of packaging. Sample packs, and the inspection of the preservation, packing, and marking for shipment, storage, and stowage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.8.)

5.1 Packaging requirements. Forced draft blowers, accessories, and technical data shall be preserved level A, or C, packed level A, B, or C as specified (see 6.2) and marked in accordance with MIL-T-17286 and shall include bar codes and applicable packaging acquisition options therein as specified (see 6.2). In addition, for Navy acquisitions, the following applies:

(a) Navy shipboard stowage fire-retardant requirements.

(1) Treated lumber and plywood. Unless otherwise specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping containers and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.
Category 1 - general use.
Level C - Type I - non-weather resistant.
Category 1 - general use.

(2) Fiberboard. Unless otherwise specified (see 6.2), fiberboard used in the construction of class-domestic, non-weather resistant fiberboard and cleated fiberboard boxes including interior packaging forms shall meet the flamespread and the specific optic density requirements of PPP-F-320.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The vaneaxial forced draft fans herein specified are intended for combustion air service to main steam boilers onboard Naval ships.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(c) When first article is required (see 3.1).
(d) Rated capacity, ft^3/min (see 3.2.1).
(e) Rated discharge pressure, in w.g. (see 3.2.1).

(f) Rated steam conditions (see 3.2.2):

Inlet pressure	lb/in^2
Inlet temperature	°F
Inlet moisture	percent
Exhaust pressure	lb/in^2

(g) Maximum and minimum steam conditions (if applicable) (see 3.2.2.2).
(h) Performance and design requirements under maximum and minimum conditions (if applicable) (see 3.2.2.2).
(i) Performance at other special conditions (if applicable) (see 3.2.2.2).
(j) Pneumatic signal pressure range (proportional or inverse) (see 3.3.7).
(k) Actuating air supply pressure (if applicable) (see 3.3.7).
(l) Dial diameter, remotely installed tachometer indicator (see 3.3.9).
(m) Blower envelope restriction (if applicable) (see 3.4).
(n) Blower air inlet connection (see 3.4.1).
(o) Blower discharge air elbow orientation (see 3.4.1).
(p) Configuration of combined exhaust/relief valve (angle or straight) (see 3.4.2).
(q) Number of sets of special tools (see 3.8).
(r) Level of preservation, packing, and marking required (see 5.1).
(s) When fire-retardant treated materials are not required (see 5.1).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3 and appendix A	DI-DRPR-80651	Engineering drawings	----
4.4, 4.5, and appendix B	DI-MISC-80653	Test reports	----
4.4.6	DI-HFAC-80272	Equipment airborne sound measurements test report	----
4.4.6	DI-HFAC-80274	Equipment structure-borne vibration acceleration measurements test report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first ___ production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.4. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, military specifications and standards that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract. Technical content should be included as given in appendix C.

6.6 Definitions.

(a) The blower. The term "the blower" as used in this specification shall be understood to mean the steam turbine driven vaneaxial forced draft fan, complete with all specified appurtenances and controls.

(b) Operating at rated capacity. The expression "when operating at rated capacity" shall be understood to mean blower performance at the rated capacity, rated discharge pressure, and rating conditions specified in the contract or order.

(c) Parallel operation. The expression "parallel operation" or "operating in parallel" shall be understood to mean the mode of operation of two or more blowers jointly delivering air to a common plenum or boiler casing via individual, separate air ducts.

(d) The drawings. The term "the drawings" shall be understood to mean the drawings which shall be available to the Government for review and inspection and, if specified in the contract or order, which shall be furnished to the Government.

6.7 Provisioning. Provisioning technical documentation (PTD), spare parts and repair parts should be furnished as specified in the contract.

6.7.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

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

6.9 Subject term (key word) listing.

Bearings, journal
Bearings, thrust, kingsbury
Blades, compressor, axial flow
Blades, turbine, axial flow
Blower, forced draft
Governor, speed sensing
Seals, labyrinth, air
Seals, labyrinth, oil

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 4140-N057)

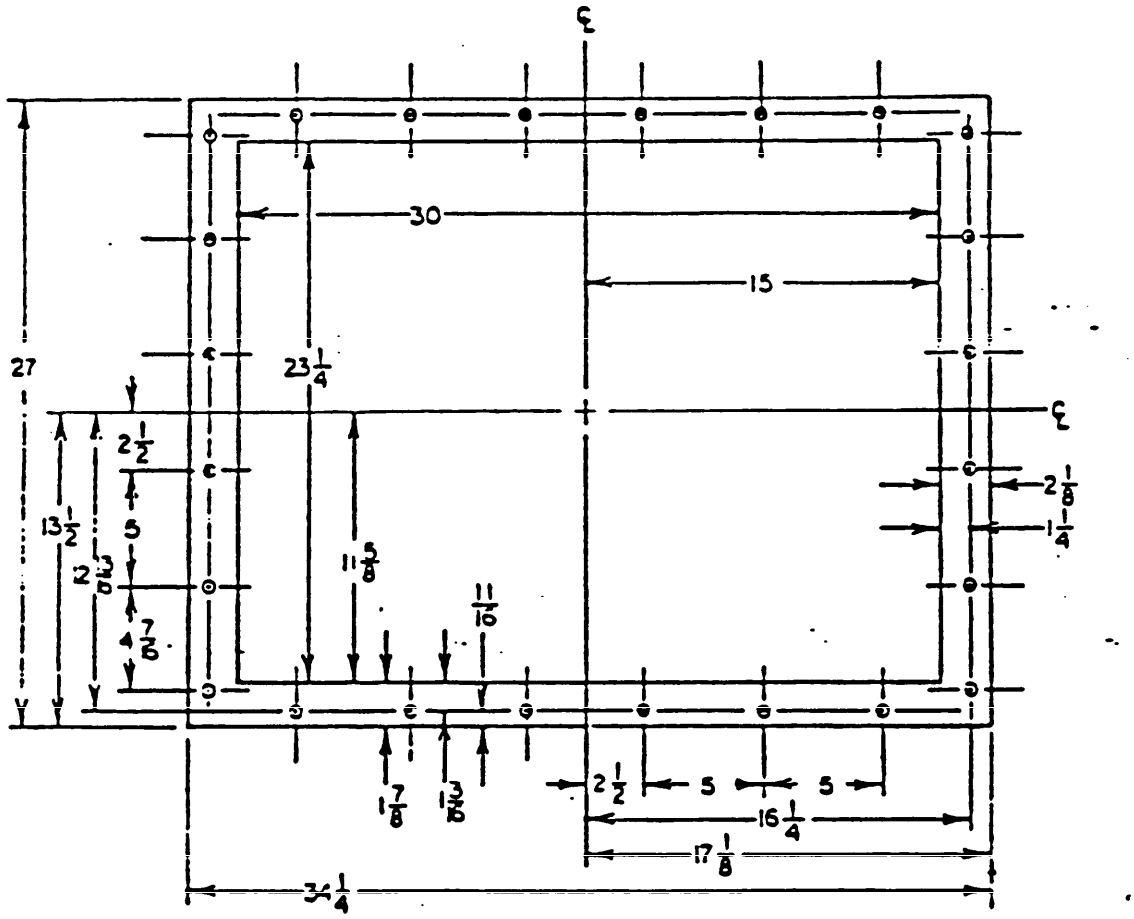

FIGURE 1. Forced draft blower air discharge flange.

APPENDIX A

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included on drawings when required by the contract or order. This appendix is mandatory only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DRAWINGS

30.1 Drawings. When required by the contract or order, drawings shall contain the following information:

(a) The manufacturer's prescribed method of lifting the blower as a complete unit, the manufacturer's prescribed use of lifting guides and supports for the blower casings and rotor, and the location of all integral lifting lugs and tapped lifting lug holes, and the size, depth, and thread designation of the tapped lifting lug holes (see 3.4.3).
(b) The design of thermal insulation and lagging and the method and provisions for attachment to the blower components and surfaces and the required insulation oil shielding; complete details for the insulation envelope to permit fabrication and application of the insulation by others during blower installation; and mechanical devices on the blower for attaching insulation.
(c) The functional design of the gauge valves with respect to through-passages in the closed and open position.
(d) The procedure for dynamic balancing of the rotor, including the method and locations for removing or adding weight.
(e) Tolerances with respect to established datums and datum targets; dimensions; form, location, and position; fit and running clearances; and alignment and run-out.
(f) Completeness of all parts and appurtenances.
(g) Proper identification of materials.

depression shall be made in the bare metal (before painting) on the outer periphery of brackets

APPENDIX B

TEST REPORTS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included in test reports when required by the contract or order. This appendix is mandatory only when data item description DI-MISC-80653 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST AND INSPECTION REPORTS

30.1 Individual test reports. An individual test report shall be prepared for each test and examination this specification requires. Test reports shall be permanent, certified, accurate records of tests as performed and shall present the test data to enable NAVSEA and the contracting activity reviewers to determine with certainty whether or not the design and performance of the tested and inspected blower conforms to the specified acceptance criteria and the specifications and contract requirements, as applicable.

30.2 Assembled test reports. The test reports shall be assembled into two binders. One binder will be titled Quality Conformance Inspection and the other First Article Inspection. The cover or front page of these assembled reports shall specify manufacturer, size and type of blower, contract or order number, serial number, and ship equipment number. One copy of the Quality Conformance Inspection test report shall be packed with the blower.

30.3 Parallel operation test report. The test report for the parallel operation test shall contain the agenda for the test runs, the speed operation, and the performance curves.

APPENDIX C

TECHNICAL MANUAL TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included in technical manuals when required by the contract or order. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TECHNICAL MANUAL CONTENTS

30.1 Technical manual contents. When required by the contract or order, technical manuals shall contain the following information:

(a) The manufacturer's prescribed method of lifting the blower as a complete unit, the manufacturer's prescribed use of lifting guides and supports for the blower casings and rotor, and the location of all integral lifting lugs and tapped lifting lug holes, and the size, depth and thread designation of the tapped lifting lug holes.
(b) The definitive list of Onboard Special Tools comprising one set and a drawing for each tool, to permit the ship's personnel to make the tool in an emergency.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
3. DOCUMENT TITLE		

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Technical Point of Contact (TPOC): Mr. H. Brown (SEA 56Y22) PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON TPOC: 703-602-9711
c. ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command Department of the Navy (SEA 55Z3) Washington, DC 20362-5101	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340