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MILITARY SPECIFICATION

COMPRESSORS; AIR, GAS TURBINE TYPE

GENERAL SPECIFICATION FOR

This specification was approved by the Departments of the Army, the Navy, and the Air Force.

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1. SCOPE

1.1 Scope.- This specification covers the general requirements for gas turbine air compressors.

1.2 Classification.- Gas turbine driven air compressors shall be of the following types and models as specified in the model specification.

Type I - Compressed air bled from the compressor proper. 1/
Type II - Compressed air bled from the compressor and mixed with combustion products. 2/
Model - As established by the procuring agency.

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS, AND DRAWINGS

2.1 The following publications, of the issue in effect on date of invitation for proposals, shall form a part of this specification to the extent specified herein:

2.1.1 Specifications.-

Federal

QQ-M-151	Metals General Specifications for Inspection of
QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-C-3162	Cable; Ignition, High-Tension
MIL-C-5544	Compound; Anti-Seize Graphite-Petrolatum
MIL-C-7992	Compressors, Air, Gas Turbine Type, Model Specification for (Outline and Instructions for Preparation)
MIL-D-5028	Drawings and Data List, Preparation of (for Engines, Accessories, and Other Auxiliary Equipment)
(R) MIL-E-5007	Engines, Aircraft, Turbojet, General Specification for
MIL-E-5557	Enamel; Heat Resisting, Glyceryl-Phthalate, Black
MIL-E-5607	Engine; Preparation for Storage and Shipment of Aircraft Gas Turbine, Process for
MIL-F-5572	Fuel, Aircraft Reciprocating Engine
MIL-F-5624	Fuel, Aircraft Turbine and Jet Engine, Grades JP-3 & JP-4
MIL-F-7024	Fluid; Calibrating, for Aircraft Fuel Metering Controls
MIL-P-5633	Packaging and Packing of Aircraft Material in Steel Shipping Containers
MIL-H-3136	Hydrocarbon-Fluid, Standard Test
MIL-I-6181	Interference Limits and Tests; Aircraft Electrical and Electronic Equipment
MIL-I-6865	Inspection, Radiographic
MIL-I-6866	Inspection; Fluorescent Penetrant, Method of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-M-3171	Magnesium Alloy; Processes for Corrosion Protection of
MIL-O-6081	Oil; Lubricating, Jet Engine
MIL-P-6889	Primer; Zinc-Chromate, for Aircraft Use
MIL-S-7742	Screw Threads, Standard, Aeronautical

1/ Referred to herein as compressor bleed.
2/ Referred to herein as mixed bleed.

MIL-T-7042	Thermocouple; Chromel-Alumel, Range 0 to +1,000° Centigrade
MIL-X-6141	X-ray Laboratories; Procedure for the Certification of (For Inspection of Aircraft Components)
JAN-A-669	Anti-Seize Compound, White Lead Base, General Purpose (for Threaded Fittings)

Air Force-Navy Aeronautical

AN-QQ-A-696	Anodic-Film; Corrosion-Protective (for) Aluminum Alloys
AN-B-9	Bulletins; Contractor Service (for Airframes, Engines, and Accessories)

Navy Department

General Specification for Inspection of Material

Bureau of Aeronautics

SR-154	Fire Extinguishing and Detecting Systems Aircraft Engine (Fixed Installations)

Nongovernmental Specifications

Society of Automotive Engineers (Aeronautical Material Specifications)

AMS 2640	Magnetic Particle Inspection
AMS 2645	Fluorescent Penetrant Inspection

(Copies of AMS Specifications may be obtained from the American Society of Automotive Engineers, 2 West 39th Street, New York 18, N.Y.)

2.1.2 Other Publications.-

Air Force-Navy Aeronautical Bulletins

No. 166	Colors; List of Standard Aircraft Glossy
No. 182	Material Changes and Substitutions; Aircraft Engine Parts (Production Contracts)
No. 343	Specifications and Standards Applicable to Aircraft Engines and Propellers - Use of
No. 391	Changes; Engineering, to Aircraft Engines, Propellers, and Aeronautical Equipment in Production and Service

National Advisory Committee for Aeronautics

NACA Report No. 218 Standard Atmosphere - Tables and Data

(Copies of the above publication may be obtained from the National Advisory Committee for Aeronautics, 1724 F St., NW Washington, D. C.)

American Society of Mechanical Engineers

ASME PTC 19.5; 4-1949 Power Test Codes

(Copies of the ASME publication may be obtained from the American Society of Mechanical Engineers, 29 West 39th St., New York 18, N.Y.)

2.1.3 Drawings.-

Air Force-Navy Aeronautical Standard Drawings

AN6271	Hose Assembly Hydraulic and Pneumatic, Detachable End Fitting Type, Swivel Fittings, for AN-H-24 Hose
AND10398	Metals - Definition of Dissimilar

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

3. REQUIREMENTS

3.1 Materials.-

3.1.1 Critical Materials.- The use of critical materials shall be held to a minimum. The estimated weight of each of the following materials, based on the finished parts plus manufacturing scrap losses, required in the construction of the gas turbine air compressor, shall be specified in the model specification.

(a) Chromium
(b) Cobalt
(c) Columbium
(d) Molybdenum
(e) Nickel
(f) Tungsten
(g) Natural Rubber

3.1.2 Dissimilar Metals.- The use of dissimilar metals in contact, as defined on Drawing AND10398, shall be avoided wherever practicable.

3.1.3 Materials, Processes, and Products.- Materials, processes and products used in the manufacture of gas turbine air compressors shall be of high quality suitable for the purpose, and shall conform to applicable specifications selected in accordance with ANA Bulletin No. 343. Where contractor's specifications are used for materials and processes which affect performance or durability of the finished product, such specifications shall be subject to release by the procuring agency. The use of non-governmental specifications shall not constitute waiver of Government inspection.

3.1.3.1 AN, JAN, or MIL Standard Parts.- AN, JAN, or MIL Standard parts shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc, may be used, provided they possess suitable properties and are replaceable by the AN or JAN Standard parts without alteration, and provided the corresponding AN or JAN part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding AN, JAN, or MIL Standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.2 Design Standards.- MS and AND Design Standards shall be used wherever applicable.

3.3 Model Specification.- A gas turbine air compressor model specification conforming to Specification MIL-C-7992 shall be submitted by the contractor for approval. Unless otherwise specified by the procuring agency a revision of the model specification and drawings forming a part thereof, shall be submitted to the procuring agency after qualification approval of the unit.

3.4 Qualification and Acceptance.-

3.4.1 Qualification.- The qualification of any complete gas turbine air compressor as a service type or model shall be predicated on the satisfactory completion of a Qualification test in accordance with the requirements of Appendix I of this specification.

3.4.2 Acceptance Requirements.- An acceptance test shall be conducted on each production gas turbine air compressor and shall consist only of those requirements specified in Appendix II of this specification.

3.5 Performance Characteristics.- The gas turbine air compressor performance characteristics shall be as specified in the model specification. These performance characteristics shall be determined under the conditions specified in the model specification with MIL-F-5624 grade JP-4 fuel and MIL-O-6081 oil, unless other fuels and oils are approved by the procuring agency. These performance characteristics shall be determined under the sole control of the automatic control system furnished on the unit.

3.5.1 Fuel Contamination.- The compressor shall function satisfactorily when using fuel contaminated to the extent of 80 grams of foreign matter per 1,000 gallons of fuel. Contaminant shall be considered to consist of not less than 68 percent SiO_2 and shall have a particle-size analysis as follows:

Particle Size Microns	Percent of Total
0-5	39 ±2 by weight
5-10	18 ±3 by weight
10-20	16 ±3 by weight
20-40	18 ±3 by weight
Over 40	9 ±3 by weight
Through a 200-mesh screen	100 by weight

Demonstration of the foregoing requirement on the complete unit by the contractor shall not be required unless so specified in the model specification. If a filter is required, it shall be a part of the unit, and the filter element shall be of sufficient capacity to permit a minimum of 10 hours continuous operation at normal rated output without being cleaned.

3.5.2 Lubrication.- No change in lubricants shall be required for operation throughout the complete ground temperature range.

3.5.3 Ratings.- The performance ratings shall be as specified in the model specification. The specified ratings shall be predicated on the minus tolerance of the control system variation.

3.5.4 Estimates.- The estimated performance shall be as specified in the model specification.

3.5.5 Oil Consumption.- The oil consumption shall not exceed the amount specified in the model specification.

3.5.6 Altitude - Temperature Limits for Starting and Operating.- The compressor starting and operating altitude and temperature limits shall be defined in the model specification.

3.5.7 Altitude Conditions.- The compressor shall function satisfactorily under any one of the following attitude conditions:

(a) Normal horizontal level position.
(b) Level position with the unit inclined 20 degrees to either side.

(c) Zero to 45 degrees negative displacement of the fore and aft axis with up to 10 degrees inclination on either side.
(d) Zero to 45 degrees positive displacement of the fore and aft axis with up to 10 degrees inclination on either side.
(e) Ten seconds during negative "g" conditions.

3.5.8 Ambient Temperature Conditions.- The complete gas turbine compressor shall perform satisfactorily under sea level static conditions from no load to maximum output under the following conditions.

3.5.8.1 The compressor shall suffer no detrimental effects, and shall start and operate successfully after being subjected to:

(a) A soaking period of 8 hours at an ambient temperature of 160°F when supplied with fuel at 110°F and inlet air at 130°F.
(b) A soaking period of 72 hours at an ambient temperature of -67°F when supplied with fuel at -67°F and air at -67°F.

3.5.9 Reduced-Speed Idle Operation.- Means or provisions for reduced-speed idle operation shall be as specified in the model specification. Operation under load at reduced speed is not required by this specification.

3.5.10 Stability.- Under steady-state conditions, within the operational range defined in the model specification, bleed output pressure oscillation shall not exceed ±1.5 percent of the bleed output absolute pressure at a given loading condition.

3.5.11 Gas Temperature Limits.- Gas temperature limits shall be automatically controlled to prevent the maximum allowable temperature from being exceeded under any condition of operation specified.

3.5.11.1 Measurement.- Provision shall be made for the measurement or determining of gas temperature during overhaul tests. Temperature sensing and indicating devices shall not be furnished with the unit.

3.5.12 Starting.-

3.5.12.1 Starter.- Unless otherwise specified by the procuring agency, the unit shall be equipped with a direct-current electric starter capable of starting the unit in not more than 30 seconds at +60°F and not more than 60 seconds at -67°F. Unless otherwise specified in the model specification, the starter shall be suitable for operation over a voltage range of 14 to 30 volts, dc. Starting under load is not required by this specification.

3.5.12.2 Starting Power.- The starting power shall be specified in the model specification.

3.5.12.3 Automatic Starting.- The starting system shall be suitable for complete automatic starting from a remote location. Components required for automatic starting and not furnished with the unit shall be specified on the contractor's specification control drawings.

3.5.12.4 Special Starting Fuel.- Unless specifically approved by the procuring agency, special fuel for starting at low temperatures is not to be used.

3.6 Drawing and Data.-

3.6.1 Before Contract.- The contractor shall furnish copies of preliminary drawings in duplicate showing information listed below, if practicable, to the procuring agency with submission of the model specification and proposal.

(a) Preliminary assembly
(b) Preliminary outline
(c) Fluid flow diagram(s) including air, oil, and fuel systems
(d) Preliminary wiring diagram
(e) Preliminary control system schematic diagram (if not clearly shown on the other drawings listed above)

3.6.2 After Contract.- As soon as practicable after the award of the service type or model contract, but in no case after delivery of units has begun, the contractor shall furnish to the procuring agency drawings showing the information listed below, and the photographs listed below. The drawings shall be submitted in duplicate, one set reproducible, and one set of prints made therefrom. Photographs shall be submitted in duplicate.

(a) Gas Turbine Driven Air Compressor Assembly - (complete except for components not furnished with the unit.)
(b) Gas Turbine Driven Air Compressor Outline - (including removal clearance for maintenance changes.)
(c) Fuel system diagram
(d) Ignition system diagram
(e) Lubrication system diagram
(f) Gas flow diagram
(g) Control system diagram
(h) Photographs showing front, rear, top, bottom and both sides.

Complete detail drawings, including assemblies and subassemblies, shall be furnished to the procuring agency before one-half of the units on contract have been delivered, unless the latest revision of these drawings have been previously submitted. These drawings shall be submitted in duplicate, one set reproducible, and one set of prints made therefrom.

3.6.2.1 Microfilm Drawings.- As soon as practicable after the award of a contract, the contractor shall submit to the procuring agency microfilm of all drawings and photographs covered by paragraph 3.6.2, including complete detail drawings.

3.7 Design and Construction Changes.-

3.7.1 Material Substitutions.- Temporary material substitutions shall be made in accordance with ANA Bulletin 182.

3.7.2 Changes in Design.- No changes shall be made in the design or materials of parts listed in an approved gas turbine air compressor parts list except where such changes are approved in accordance with the provisions of ANA Bulletin 391.

3.7.2.1 Class I Changes.- Class I changes are of a nature affecting contract requirements covering weight, performance, cost, interchangeability, or affecting durability of either parts or complete gas turbine air compressors.

3.7.2.2 Class II Changes.- All other changes shall be classified as class II changes.

3.7.2.3 Approval of Changes.- Approval of changes does not relieve the contractor from full responsibility for the results on any gas turbine air compressor characteristics.

3.7.3 Service Bulletin.- When specified by the procuring agency at the time of approval of a change, the contractor shall submit a service bulletin prepared in accordance with Specification AN-B-9 in order to permit procuring agencies to incorporate the change in units previously delivered.

3.7.4 Parts List.- The parts list for the gas turbine air compressor which successfully completes the Qualification test shall constitute the approved parts list for subsequent units of the same model. Changes to the approved gas turbine air compressor parts list shall be governed by the requirements specified in paragraph 3.7.2.

3.8 Interchangeability.- Insofar as practicable, all parts having the same contractor's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Matched parts or selective fits will be permitted where required. Changes in contractor's part numbers shall be governed by the drawing requirements of Specification MIL-D-5028.

3.9 Installation.- To facilitate installation and removal of the unit from its installation, service connections (such as fuel line(s), hydraulic line(s), fire extinguisher line(s), electrical lead(s), and other connections where furnished for load control and reduced speed,) shall be contained on a readily accessible connection panel on the enclosure. The connection panel shall be permanently marked to identify all connections grouped on the panel. Air inlet, cooling air outlet, turbine exhaust, and bleed air ports, oil fill, and all drain and mounting provisions may be located separately, and if practicable, shall be permanently marked or identified.

3.10 Accessibility.- Insofar as practicable, parts of the unit requiring routine service checking, adjustment, or replacement, shall be made readily accessible for servicing without tear down of the unit and removal of any major part, component, or accessory, other than removal of access provisions and locking devices. Particular attention shall be paid to access for the removal or replacement of such items as fuel nozzles, replaceable parts of the ignition system, oil pressure relief valve, oil vent, oil filter connections, control system, air intake screens, drain plugs, and in addition, sufficient clearance shall be provided for connecting and removing any separately supplied external fittings and lines.

3.11 Disassembly with Tools.- Wherever practicable, nuts and screws shall be removable with standard tools. In any case, gas turbine air compressor and tool design shall be such as to permit disassembly and assembly of the unit without undue difficulty. A minimum of bolt sizes shall be used. If practicable, not more than three sizes shall be used for external assembly.

3.12 Environmental Conditions.- The unit shall not suffer any detrimental effects when inoperative and exposed to the temperature range of -100°F to +275+F. The design of the unit shall provide satisfactory operation during and after exposure to any combination of the following conditions in world-wide operation: Humidity, fungus, sunshine, rain, snow, sleet, hail, ice-fog, fog, mildew, salt spray, ice, ozone, smoke, wind, sand, and dust.

3.13 Electrical Components.-

3.13.1 Standard Parts.- AN, JAN, or MIL Standard electrical parts suitable for the purpose shall be used if available.

3.13.1.1 Other electrical parts shall be designed and developed to meet the requirements of applicable Military specifications, unless otherwise authorized by the procuring agency.

3.13.1.2 The unit contractor shall group in the parts list, all the electrical equipment including standard and special parts used.

3.13.2 Explosion Proof.- If practicable, electrical components shall be explosion-proof so as not to ignite any explosive mixture surrounding the electrical components.

3.13.3 Electrical Interference.- Electrical components, except during the starting cycle, shall not cause electrical interference beyond the limits specified in Specification MIL-I-6181, unless otherwise specified in the test requirements.

3.13.4 Voltage Range.- Unless otherwise specified by the procuring agency, all components using electrical power from a source external to the unit shall operate satisfactorily with input voltage at the unit connection panel in the range from 14 to 30 volts, dc.

3.13.5 Electrical Power.- The unit electrical power requirements which must be supplied from sources external to the unit shall be as specified in the model specification.

3.13.6 Connectors and Cable.- At a temperature of -67°F, it shall be possible to connect or disconnect electrical connectors and to flex electrical conductors, as necessary for routine maintenance without damage to these items.

3.14 Dry Weight.- The dry weight of the unit shall not exceed that specified in the model specification.

3.14.1 Weights of Additional Equipment.- The estimated weights of items which are not components of the gas turbine compressor but which are furnished with it shall be listed in the model specification. These items shall not be included in the dry weight of the compressor.

3.15 Over-All Dimensions.- The over-all dimensions of the complete unit, and allowance for expansion, shall not exceed those specified in the model specification.

3.16 Mounting Provisions.- The number, type, and location of the mounting provisions through which the unit is to be mounted, shall be clearly shown on the gas turbine air compressor outline drawing.

3.16.1 Handling Supports.- The unit shall incorporate provisions for hoisting, and for resting on level ground. These provisions shall be shown on the unit outline drawing.

3.17 Flight Maneuver Forces.- The unit and its mounting provisions shall withstand without permanent deformation or failure any one of the following conditions:

(a) Linear acceleration (acting at the center of gravity of the unit)

(1) 5.0g acting downward
(2) 3.0g acting downward in combination with gyroscopic load due to a negative pitching velocity of two radians per second at maximum unit speed.
(3) 10.0g acting upward
(4) 8.0g acting upward in combination with gyroscopic load due to a positive pitching velocity of two radians per second at maximum unit speed.
(5) 5.5g acting in any horizontal direction.

NOTE: Positive pitching velocity is obtained in pull-up.

3.17.1 Simulated Flight Maneuver Loads.- The unit and its mounting provisions shall not fail when subjected to static loads equivalent to 1-1/2 times the values specified in paragraphs 3.17 and 3.17.3.

3.17.2 Ditching Loads.- The gas turbine air compressor and its mounting provisions shall be designed not to disintegrate, but may undergo permanent deformation, when subjected to any one of the following acceleration loads:

(a) 15g in the vertical plane
(b) 20g in the horizontal plane

Operation of the unit during or after exposure to these loads shall not be required.

3.17.3 Gyroscopic Moments.- At maximum rated gas turbine air compressor speed, the unit shall withstand a gyroscopic moment imposed by a steady angular acceleration of 3.5 radians per second in yaw of the unit for a period of 30 seconds.

3.17.4 Demonstration of Loads.- Demonstration of any of the loads specified in paragraph 3.17 or any of its subparagraphs, shall not be required unless so specified in the contract.

3.17.5 Identification of Forces.- The forces, loads, and accelerations quoted herein are defined as stated below, and shall be identified by axes indicated on the contractor's outline drawing.

Force Acting	Direction	Axis
horizontal	longitudinal	x
horizontal	transverse	y
downward or upward	vertical	z

3.18 Polar Moment of Inertia of Compressor-Turbine System.- The polar moment of the complete rotor about the rotor axis shall be as specified in the model specification.

3.19 Compressed Air Product.-

3.19.1 Compressor Bleed.- The unit shall provide for extraction of compressed air from the compressor in the quantity, pressure, and temperature specified in the model specification.

3.19.2 Mixed Bleed.- When so specified in the model specification combustion chamber products shall be mixed with compressor bleed air to raise the temperature to the value specified in the model specification, and provisions for the mixing of compressor bleed and combustion chamber products shall be furnished.

3.19.3 Bleed Air Connection.- The bleed air connection shall be of the quick-disconnect type and shall be shown on the unit outline drawing. The maximum permissible shear load, axial load, and overhung moment for the bleed air connection shall be as specified in the model specification.

3.20 Enclosure.- A stainless steel enclosure surrounding the entire unit shall be provided. A connection panel as specified in paragraph 3.9 shall be furnished on the enclosure.

3.20.1 Enclosure Temperature.- No point on the surface of the enclosure shall exceed the temperature of compressor discharge air by more than 100°F under any operating condition specified in the model specification. The maximum enclosure temperature shall be specified in the model specification. Cooling air shall be provided by the unit, if necessary to meet the foregoing requirement.

3.20.2 Fire Detecting and Extinguishing Systems.- The unit shall include mounting provisions for a fire detecting device, and the connection panel shall include mounting provisions for the fire detecting device electrical receptacle. The connection panel shall also include a fitting suitable for connection to a CO_2 fire-suppressant system which meets the requirements of Specification SR-154. The suppressant system, fire detecting device, wiring, receptacle, and nozzle for dispersion of the CO_2 shall not be furnished with the unit.

3.21 Air Intake.- The air intake size and location(s) shall be shown on the gas turbine air compressor outline drawing which shall be a part of the model specification.

3.21.1 Air Intake Screen.- A four-mesh screen shall be provided at the inlet air port(s) to preclude the ingestion of foreign objects of dimensions equal to, or greater than, a 0.25-inch sphere.

3.21.2 Duct Attachment.- Provisions for intake duct attachments shall be as shown on the unit outline drawing. The maximum permissible shear load, axial load, and overhung moment for the attachment provisions shall be as specified in the model specification.

3.21.3 Inlet Air Pressure Drop.- The maximum allowable inlet air pressure drop which will permit operation of the unit without adverse effects shall be specified in the model specifications.

3.22 Exhaust System.-

3.22.1 Turbine Exhaust.- Provisions for quick-disconnect type attachments shall be furnished for the turbine exhaust system to permit ready removal of the unit from its installation. These provisions shall be shown on the outline drawing. The maximum allowable shear load, axial load, and overhung moment shall be specified in the model specification.

3.22.1.1 Turbine Exhaust Pressure Drop.- The maximum allowable exhaust pressure drop which will permit operation of the unit without adverse effects shall be specified in the model specification.

3.22.2 Cooling Air Discharge.- Provisions for quick-disconnect type attachments shall be furnished at the cooling air outlet port(s) if an air outlet port(s) is provided. These provisions shall be shown on the outline drawing. The maximum allowable shear load, axial load, and overhung moment shall be specified in the model specification.

3.22.2.1 Cooling Air Discharge Pressure Drop.- The maximum allowable cooling air pressure drop which will permit operation of the unit without adverse effects shall be specified in the model specification.

3.23 Lubricating System.- The lubricating system shall adequately lubricate the gas turbine air compressor throughout its operating range.

3.23.1 Lubrication Points.- All points in the unit requiring pressure lubrication shall be lubricated from the unit lubricating system. No lubricating from an external source shall be required.

3.23.2 Oil Interruption.- The unit shall be capable of operating continuously, with no detrimental effects during and after operation, when air only is supplied to the inlet of the oil pump for a period of 10 seconds.

3.23.3 Oil Drainage.- Provisions shall be made to prevent oil drainage into the turbine.

3.23.4 Oil Filter.- A suitable AN-type oil filter element shall be provided as a component of the unit.

3.23.5 Scavenging System.- If a scavenging system is used it shall adequately scavenge the basic gas turbine and compressor for extended periods of time, under the operating conditions specified herein including negative "G" operation for a period of 10 seconds. The scavenge pump shall operate satisfactorily during the low temperature starts specified.

3.23.6 Oil Pressure.-

3.23.6.1 Oil Pressure.- The oil pressure pump shall maintain not less than the specified oil pressure for all operating speeds and all altitudes up to and including the absolute altitude specified in the model specification.

3.23.6.2 Oil Pressure Connection.- Provisions shall be made for the measurement of oil pressure. The connection for this measurement shall be shown on the unit outline drawing. The oil pressure indicator shall not be furnished with the unit.

3.23.6.3 Pressure Adjustment.- The lubricating system shall be arranged to provide oil pressure throughout the operating range specified in the model specification. If oil pressure adjustment is required during normal service operation, it shall be readily adjustable without parts change during operation.

3.23.6.4 Pump Relief Valve.- The oil pump relief valve shall be so designed that it will be unnecessary to change adjustment of the valve when operating under any condition specified in the model specification.

3.23.6.5 Oil Bypass.- The lubricating system shall be so arranged that oil bypassed from the pressure pump shall not be returned to the oil tank by a separate line.

3.23.7 Oil Drain.- The unit shall be provided with an oil drain at the lowest point(s) in the system so that the installation may be adequately drained with the unit in a horizontal position and in any position within 15 degrees from the horizontal position.

3.23.7.1 Insofar as practicable, all designed oil drainage shall be collected at the single point specified in the model specification.

3.23.8 Oil Tank.- The oil tank shall be a component part of the unit. Satisfactory functioning of the unit shall be provided under any of the conditions specified in paragraph 3.5.7 when the oil level in the tank contains 20 percent of its usable quantity as defined in paragraph 3.23.8.2.

3.23.8.1 Cleaning.- The oil tank design shall be such that internal contours will permit ease of cleaning by means of flushing methods. Provisions shall be made for flushing or for cleaning the interior of the tank.

3.23.8.2 Capacity.- The oil tank capacity shall provide for the following:

(a) A quantity equal to the residual capacity of the basic gas turbine driven air compressor system exclusive of the oil tank.
(b) A quantity of usable oil sufficient for a minimum of 10 hours of continuous operation under any condition specified herein. The quantity of oil shall be determined from the contractor's specified oil consumption.
(c) A minimum expansion space, between the maximum level to which the tank can be filled and the total oil tank volume, which shall be 15 percent of the oil tank capacity.

3.23.8.3 Filler Cap.- A filler cap and adapter shall be provided and shall close and seal the oil tank. It shall be possible to install and remove the cap by hand without the use of tools. The cap and adapter shall be such that water cannot collect and drain into the tank and shall be so located that the tank can be filled without the use of special funnels, and so that the oil tank expansion space cannot be filled. The cap shall be fully seated and locked by turning the cap not more than 90 degrees. The cap shall be fastened to the adapter by means of a chain or its equivalent. The outside of the cap shall be painted black with a fuel and oil resistant

paint and marked in yellow with the following information: "Oil Cap _____ US Gal" (which shall be filled in with the oil tank capacity).

3.23.8.4 Oil Tank Filler Opening.- The oil tank filler opening and location shall be such that under normal conditions the entire tank can be filled in one operation in not more than 1 minute. The filler opening shall be located and sealed so that liquids from the opening shall not spill into the enclosure or spill on any of the unit accessories. If necessary, filler spill basins with adequate drains shall be provided to accomplish the foregoing.

3.23.8.5 Sump.- A removable sump shall be provided in the bottom of the oil tank at the oil tank drain. The sump shall be of sufficient capacity to collect normal accumulations of condensate and sediment likely to be encountered during operation under the conditions specified and shall incorporate a standpipe which shall be the oil outlet. A 1/4-inch straight-thread self-locking drain valve shall be provided in the sump to drain the condensate and sediment.

3.23.8.6 Vents.- If oil tank vent lines are provided, they shall be installed in such a manner that no liquid trap exists. Provisions shall be made for efficient separation of entrained air from the oil, if required.

3.23.8.7 Oil Level Gage.- The oil tank shall be provided with a level cock, dipstick, or other means acceptable to the procuring agency for determining the normal oil level in the tank when the unit is in the horizontal attitude defined by the contractor's drawings. The gage shall be in such a position that it is readily discernible or readily accessible on the unit, depending on the type.

3.23.9 Oil Cooler.- An oil cooler shall be furnished as a component of the lubricating system where provisions for cooling of the oil are required. The oil cooler may be integral with the oil tank.

3.23.9.1 Type.- The oil cooler may be of the air-cooled type.

3.23.9.2 Design Conditions.- If a fuel-cooled oil system is used, the following oil cooler design conditions shall apply:

(a) For cooling, the hot fuel temperature of 110° ±5°F shall apply.
(b) For low temperature and oil congealing consideration, a cold fuel temperature of -65°F shall apply.
(c) Fuel used for cooling shall not be returned to the fuel tank.
(d) If an automatic oil temperature control is provided, it shall include fuel or oil bypass provisions for both oil cooling and anticongealing. Where applicable, surge protection shall be provided for the oil cooler.

3.23.10 Breather.- If a single breather is provided, the breather system shall be so designed that oil in liquid form will not be lost through the breather when operating the unit in any attitude or condition specified herein. The size and location of the outlet connection shall be as specified in the model specification.

3.24 Fuel System.-

3.24.1 Performance.- The gas turbine air compressor fuel system shall perform satisfactorily and shall be capable of supplying the required amount of fuel at the required pressure, under all conditions specified in the model specification, with a fuel temperature of 80°F above the ambient temperature but not in excess of 110°F, when the fuel pressure at the unit fuel inlet connection at the panel is from a minimum of 5 psi above the Reid vapor pressure up to a maximum of 40-psi gage.

3.24.2 Valves.- Valves, where furnished with the unit, shall close completely without visible dripping from the minimum operating fuel pressure to 110 percent of maximum operating fuel pressure.

3.24.3 Pressure Protection.- A means shall be provided to limit the fuel pump discharge pressure.

3.24.4 Fuel Pressure Connection.- A fuel pressure connection for use with a fuel pressure indicator shall be provided as specified in the model specification. The fuel pressure indicator shall not be furnished with the unit.

3.24.5 Filtering Provisions.- Filtering provisions, if required, shall be as specified in paragraph 3.5.1.

3.24.6 Fuel Drains.- Provisions shall be made for automatically clearing the combustion chambers after shutdown with the unit in a level position, 15 degrees positive displacement from the level position, and 20 degrees negative displacement from the level position. Where practicable, all fuel drainage shall be collected at a single common point on the enclosure as specified in the model specification.

3.24.7 Lines and Fittings.- The fuel lines shall be as short as practicable and shall contain no water-collecting traps. Fuel lines external to the basic gas turbine which convey fuel shall be flexible or adequately supported to eliminate the effects of destructive vibration, and shall be contained within the enclosure. If external hose assemblies are used, they shall conform to Drawing AN6271 or equal assemblies, or shall be of stainless steel.

3.24.8 Fuel Resistance.- The materials and designs used in the gas turbine driven air compressor fuel system components shall be satisfactory for operation with MIL-F-5624 grade JP-4 fuel with any and all concentrations of aromatics and alkylates permissible under that specification. If testing is required by the model specification, fuels conforming to Specification MIL-F-3136 type I and type III shall represent the extremes for test purposes.

3.25 Ignition System.- The ignition system, excluding the electrical power source, shall be mounted entirely on or within the enclosure. The system shall provide for satisfactory ignition during starting and restarting under all of the operating conditions specified. The ignition system shall meet the foregoing requirements when the voltage supply to the unit at the connection panel is as low as 14 volts, dc, or as high as 30 volts, dc. At least two igniters shall be provided if the unit is of a multiple combustion chamber type. Multiple combustion chamber units may include cross-fire tubes. Continuous ignition is not mandatory where combustion can be self-maintained after accomplishment of a successful start.

3.25.1 High-Tension Ignition Cable.- High-tension ignition cable, when used, shall conform to Specification MIL-C-3162.

3.25.2 Lead Assembly.- If high-tension ignition is used, the lead assembly shall be equipped with AN-type high altitude type terminals where a disconnect is necessary. Other types, if used, shall be approved by the procuring agency. It shall be practicable to install or remove igniter(s) on the unit, at -65°F without mechanical or electrical failure of the ignition lead assembly. A rewirable lead assembly is desired.

3.25.3 Connections.- The ignition system connections shall be as specified in the model specification.

3.26 Control Systems.-

3.26.1 Primary Controls.- The gas turbine air compressor primary controls

shall provide for complete automatic control of the unit, including remote automatic starting when manually initiated, and for bleed control for compressor bleed or mixed bleed, by controlling such variables as are necessary to insure satisfactory operation of the unit. Means for reduced-speed idle control shall be provided. Reduced speed shall be as specified in the model specification. Load control shall be furnished if specified in the model specification.

3.26.2 Emergency Controls.- The unit emergency controls shall incorporate such "fail safe" emergency controls as necessary to prevent failure of the unit in the event that accidental over-temperature, flame-out, fuel supply failure, electrical failure, etc, are encountered. The emergency controls shall be specified in the detail specification.

3.26.3 Control Adjustments.-

3.26.3.1 Bleed Air Operational Controls.- Where compressor bleed, or combinations of compressor bleed and mixed bleed are provided, adjustment shall be provided to maintain variables within the limits established in the model specification.

3.27 Accessory Drives.- When specified in the model specification, special purpose drives for such accessories as generators, tachometer-generator, cooling fans, etc, shall be provided.

3.28 Counting Devices.- An hour meter or similar device for indicating the total elapsed operating time shall be furnished with the unit.

3.29 Cover Plates.- Cover plates for covering all accessory drive openings where the accessory is not mounted for gas turbine air compressor shipment shall be supplied with each unit. Suitable provision for covering or plugging all other connection openings shall be made for shipment and storage.

3.30 Screw Threads.-

3.30.1 Straight Screw Threads.- All conventional straight screw threads shall conform to the requirements of Specification MIL-S-7742.

3.30.2 Tapered Pipe Threads.- Tapered pipe threads may be employed only for permanently plugging drilled or cored openings.

3.30.3 Special Screws Threads.- Special thread forms when used for fastenings and approved by the procuring agency shall be acceptable if requirements warrant their use.

3.30.4 Coating Threaded Parts.- When aluminum or aluminum-alloy threaded parts are treated at the time of assembly with anti-seize compound, the compound shall conform to Specifications MIL-C-5544 or JAN-A-669.

3.30.5 Inserts.- Threads in aluminum or magnesium alloys for fittings having a thread major diameter of less than 3/4-inch and subject to removal for routine maintenance purposes shall be provided with inserts.

3.31 Identification of Product.-

3.31.1 Gas Turbine Air Compressor Data Plate.- A data plate shall be attached to the unit and shall include only the following infomation:

COMPRESSOR; AIR, GAS TURBINE TYPE
Model
Manufacturer's Model No.
Manufacturer's Serial No.
Manufacturer's Name and Trade-Mark
Government contract number

The data plate or any other plates attached to the unit shall be secured in a manner that minimizes corrosion in the presence of a salt atmosphere. The data plate or plates shall be so located on the enclosure as to be readily seen, and that if detached will not cause failure of the unit.

3.32 Protective Treatments, Coatings, and Paint Finishes.- Protective treatments, coatings, and paint finishes shall be in accordance with applicable specifications listed in ANA Bulletin 343.

3.32.1 Protective Treatment and Coatings.-

3.32.1.1 Steel Parts.- With the exception of the parts listed below, all exterior steel parts, and other steel parts subject to corrosion and not in contact with oil, shall be treated to resist corrosion by cadmium plating in accordance with Specification QQ-P-416, parkerizing, bonderizing, granadizing, or by a process approved by the procuring agency.

(a) Corrosion-resisting steel parts.
(b) Cable.
(c) Tin-coated wire.
(d) Members or portions of members which act as bearings or journals.

3.32.1.2 Aluminum Parts.- With the exception of the parts listed below, all exposed aluminum-alloy parts shall be treated to resist corrosion by anodizing in accordance with Specification AN-QQ-A-696 where practicable, or by a process acceptable to the procuring agency. Other parts may be excepted where application of treatment is considered impractical or unnecessary.

(a) Metal sprayed surfaces.
(b) Surfaces in contact with oil.
(c) Accessory pads and port covers.
(d) Unalloyed aluminum and aluminum-clad aluminum alloy.
(e) Parts fabricated from 2S, 3S, 52S, and 61S, aluminum alloys (when painted).

3.32.1.3 Magnesium Parts.- All magnesium-alloy parts shall be surface-treated to resist corrosion in accordance with Specification MIL-M-3171 where practicable, or by a process approved by the procuring agency.

3.32.2 Paint Finishes.- With the exception of the parts listed below, all exposed metal surfaces shall be painted with one coat of primer and a minimum of two full wet finish coats, applied in such a manner that no pinholing, holidays, sags, or runs are encountered; and with the further exception that magnesium-alloy parts shall receive two coats of primer and a minimum of two finish coats as described above. Additional parts may be excepted where application of paint finishes or any part thereof is considered impractical or unnecessary.

(a) Metal sprayed surfaces.
(b) Corrosion-resisting steel, brass, copper, or bronze parts.
(c) Cable.
(d) Working surfaces.
(e) Threads.
(f) Oil holes.
(g) Cadmium-plated parts (or equivalent treatment).
(h) Unalloyed aluminum and aluminum-clad aluminum alloy.
(i) Parts fabricated from 2S, 3S, 52S, and 61S aluminum alloy.
(j) Surfaces of casting or forging identification pads when treated to resist corrosion by other means.

3.32.2.1 Primer Coat.- The primer coat shall be in accordance with Specification MIL-P-6889 and shall be applied as soon as possible after prior surface treatments or coatings. The primer coat shall be thoroughly dried prior to application of the finish coat(s) in order to prevent any consolidation of the primer or finish coats. When the primer coat is soiled or damaged by intervening operations between priming and finish coats, it shall be thoroughly cleaned and another light coat of primer added before the finish coat is applied.

3.32.2.2 Finish Coat.- The finish coat for the unit and components shall be in accordance with Specification MIL-E-5557 or shall be aluminum-pigmented varnish. Enamel other than that of aluminum color, shall match the applicable color of the Air Force-Navy aircraft color standards (glossy) in ANA Bulletin No. 166.

3.33 Workmanship.- The workmanship and finish on all parts shall be in accordance with high-grade aircraft practice for equipment of this type.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Qualification and Acceptance Tests.- Gas turbine air compressors shall be subjected to the Qualification and Acceptance tests specified in Section 3 and described in Appendixes I and II.

4.2 General.- Gas turbine air compressors, components, and all material entering into the construction thereof shall be subject to inspection during course of manufacture and upon completion by authorized Government Inspectors who shall be given reasonable facilities to determine conformance to this specification.

4.2.1 Previous Approval.- Previous acceptance or approval of material or release of any design by the Government shall in no case be construed as a guaranty of the acceptance of the finished product.

4.2.2 Responsibility for Tests.- Unless otherwise specified, all tests specified herein shall be conducted by the contractor and shall be witnessed by a Government Inspector.

4.2.2.1 Laboratory Facilities.- Contractors not having available laboratory facilities shall engage the services of a commercial testing laboratory acceptable to the Government.

4.2.3 Government Inspection.- If a Government specification requirement is such that Government inspection prior to delivery ascertains compliance in every detail, the contractor will not be held responsible for any deficiency attributable to the requirement in question. The contractor will not be held responsible for deficiencies of articles, parts, or components furnished by the Government.

4.2.4 Navy Department Inspection.- When procurement is inspected under the supervision of the Navy Department, the general inspection procedures shall be in accordance with the Navy Department General Specifications for Inspection of Material.

4.3 Tests and Test Methods.-

4.3.1 Material Tests.- Samples of all materials used in the gas turbine air compressors and components shall be selected in the manner and quantity specified in the material specification, and subjected to the required tests.

4.3.2 Magnetic Inspection.- The following parts shall be subject to magnetic particle inspection in accordance with Specification MIL-I-6868 or AMS 2640 if made of magnetic materials:

(a) All magnetic parts constituting the compressor-turbine rotor assembly, including threaded fastenings.

(b) Other highly stressed magnetic parts.
(c) All accessory drive and vibration or friction dampener springs.
(d) Starter jaw.
(e) All gears.
(f) All quill and accessory drive shafts.

4.3.3 Fluorescent Penetrant Inspection.- The following nonmagnetic parts shall be subject to fluorescent penetrant inspection, in accordance with Specification MIL-I-6866 or AMS 2645:

(a) Turbine disk.
(b) Turbine blades.
(c) Turbine nozzle vanes and assemblies.
(d) All other highly stressed parts.

4.3.3.1 Hydrostatic Testing.- Very bulky and intricately shaped parts may be hydrostatically tested by the contractor's approved method in lieu of fluorescent testing when specifically approved by the procuring agency.

4.3.4 Excepted Parts.-

4.3.4.1 Commercial and AN Standard Parts.- Commercial and AN Standard parts, such as cotter pins, pal-nuts, washers, and similar low-stressed parts are not required to be inspected by the magnetic or fluorescent methods.

4.3.4.2 Anti-Friction Bearings.- Assembled ball or roller bearings shall not be inspected by the magnetic or fluorescent methods.

4.3.4.3 Additional Parts.- In the case of special units or where service experience of the procuring agency warrants, the list of parts specified above may be extended or supplemented to include additional parts by contract negotiation.

4.3.5 Radiographic or Ultrasonic Inspection.- The following parts shall be subject to radiographic or ultrasonic inspection for defects or soundness to a degree of inspection on each article as agreed between the contractor and the procuring agency:

(a) The compressor impeller or rotor(s), if it is nonmagnetic.
(b) The turbine rotor(s), if it is nonmagnetic.
(c) Highly stressed magnesium and aluminum castings.

4.3.5.1 Radiographic Inspection.- Radiographic inspection of materials shall be in accordance with Specification MIL-I-6865. Laboratories performing radiographic inspection shall be certified in accordance with Specification MIL-X-6141.

4.3.6 Control Tests.- All production acceptance bench testing of components of the compressor fuel system shall be accomplished with calibrating fluid meeting the requirements of Specification MIL-F-7024.

5. PREPARATION FOR DELIVERY

5.1 Application.- The requirements specified herein apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation, Packaging, and Packing.-

5.2.1 Preservation.- The gas turbine compressor, components, and accessories, shall be preserved in accordance with Specification MIL-E-5607.

5.2.2 Packaging and Packing.- The gas turbine compressor, components, and accessories shall be packaged and packed in contractor-furnished reusable metal shipping containers in accordance with the requirements of Specification MIL-P-5633.

5.2.3 Packing List.- The contractor shall furnish a packing list with each unit. All parts, accessories, components, and tools, which are not installed on the unit, but which are shipped with the unit, shall be included on the packing list.

5.3 Marking of Shipments.- Identification marking shall conform to the requirements of Specification MIL-E-5607. Marking of shipments shall be in accordance with Standard MIL-STD-129.

6. NOTES

6.1 Intended Use.- The gas turbine air compressors covered by this specification are intended to provide compressed air for airborne or ground-pneumatic starting systems of aircraft, or for other consumers of compressed air.

6.2 Superseding Data.- This specification supersedes Specification MIL-C-7712(Aer) except Appendix I which contained Outline for Preparation of Model Specification and which is being issued separately as Specification MIL-C-7992.

6.3 Definitions.-

6.3.1 Government.- The term "Government" as used in this specification shall be interpreted to mean the procuring agency.

> NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:
Army - Transportation Corps
Navy - Bureau of Aeronautics

Other interest:
Navy - ShS

APPENDIX I

COMPRESSORS; AIR, GAS TURBINE TYPE, QUALIFICATION TESTS FOR

10. SAMPLING, INSPECTION, AND TEST PROCEDURES

10.1 General.- Gas turbine air compressors, components, and test apparatus shall be subject to inspection by authorized Government Inspectors who shall be given reasonable facilities to determine conformance with this appendix. Calibration and endurance tests conducted at the contractor's plant shall be subject to witnessing by authorized representatives of the procuring agency. Except as specified herein, or otherwise authorized by the procuring agency, all tests of this appendix shall be conducted at the contractor's plant.

10.1.1 Reports of Tests.- When the Qualification tests are conducted at the contractor's plant for approval of a new type or model, three copies of the report thereon shall be forwarded to the Bureau of Aeronautics, Attention: Power Plant Division, Department of the Navy, Washington 25, D. C., the qualifying agency. Reports of tests shall contain essentially the items listed on the attached form (figure 1).

10.1.2 Accuracy of Data.- All instruments and equipment shall be calibrated often enough to insure that reported data shall have a static accuracy within 2.0 percent of the value obtained at the maximum output of the unit, except for rpm, which shall be accurate within ±0.5 percent of the value obtained at the maximum output of the unit.

10.1.3 Temperature Measurements.- The points of application for all temperature measuring devices shall be as defined in an outline to be submitted by the contractor and approved by the procuring agency. Gas temperatures shall be measured with chromel-alumel thermocouples calibrated in accordance with Specification MIL-T-7042, or iron-constantan thermocouples where temperatures are in a suitable range, unless otherwise specified by the contractor and approved by the procuring agency. Other temperatures may be measured by calibrated mercury thermometers, or calibrated electrical resistance type thermometers. All temperature measurements shall be recorded in degrees Fahrenheit.

10.2 Gas Turbine Driven Air Compressor Qualification Test.-

10.2.1 Test Apparatus.-

10.2.1.1 Air Flow.- Air flow measurements shall be made in accordance with the procedures outlined in ASME Power Test Code PTC 19.5; 4-1949 part 5, chapter 4, or by a method acceptable to the procuring agency.

10.2.1.2 Unit Speed.- The unit speed for performance check runs during those periods when readings are being taken shall be determined by means of a positive counter which will actually count the revolutions for a period of not less than one minute; by an indicating tachometer and matching stroboscope disk energized by a controlled frequency source; or by other means acceptable to the procuring agency. At all other times, speed may be measured by means of an indicating tachometer.

10.2.1.3 Fuel Flow.- Fuel flow measurements shall be made by either the volume or weight method. The quantity selected for the volume or weight method shall be such that each reading will cover an elapsed time of at least one minute. Flow meter readings may be used for calculations of specific fuel consumption when the flow meter has been calibrated by the volume or weight method in accordance with paragraph 10.1.2 of this appendix.

10.2.2 Test Methods.-

10.2.2.1 Test Units.- Two identical units, "A" and "B," shall be used for the Qualification tests. Unit "A" shall be used for preliminary runs, unit calibration, endurance test, and recalibration. Unit "B" shall be used for the miscellaneous tests described in paragraphs 10.2.2.6.1, 10.2.2.6.2, and 10.2.2.6.3 of this appendix.

10.2.2.2 Weight and Other Data.- The unit weight, if not previously obtained, photographs, and other pertinent data shall be obtained preferably at the time the unit is being prepared for test.

10.2.2.3 Unit Calibration.- The order of conducting calibration of unit "A" shall be at the option of the contractor. The procedure shall be such as to establish the performance characteristics of the complete unit prior to the endurance run. Performance shall meet the values specified in the model specification. Operating time during this test shall be limited to the minimum practicable. Calibration shall be conducted to obtain the data required in paragraph 10 of form (figure 1).

FORM OF REPORT

1. Title page
2. Index
3. Object
4. Summary
5. Conclusions and Recommendations
6. Description (Under this heading shall be prepared a brief general description of this unit and components and a detailed description of all features which differ from a previous model.)
7. Method of Test (General description of test equipment and methods used in conducting the test.)
8. Record of Test (Chronological history of all events in connection with all of the testing)
9. Analysis of Results (A complete discussion of all phases of the test, such as probable reasons for failure and unusual wear, comparison in performance with previous models, and analysis of general operation.)
10. Calibration and Recalibration Data: The following data in both corrected and uncorrected form shall be shown by suitable curves. Unit performance data shall be corrected to standard sea level conditions, as defined in paragraph 10.2.2.7.9

    (a) Bleed air flow (weight flow) versus turbine inlet temperature.
    (b) Bleed air pressure versus turbine inlet temperature
    (c) Bleed air temperature versus turbine inlet temperature
    (d) Bleed air power versus turbine inlet temperature
    (e) Unit fuel consumption versus turbine inlet temperature

11. Data: Sufficient readings shall be recorded during the endurance test to obtain the data required for the tabulated data where applicable.

    (a) Bleed air flow (lb per min)
    (b) Bleed air total pressure (in. Hg abs)
    (c) Bleed air total temperature (°F)
    (d) Compressor inlet total pressure (in. Hg abs)
    (e) Compressor inlet total temperature (°F)
    (f) Turbine inlet total temperature (°F)
    (g) Turbine exhaust static pressure (in. Hg abs)
    (h) Turbine exhaust total temperature (°F)
    (i) Fuel flow (lb per hr)
    (j) Fuel inlet pressure (psig)
    (k) Fuel pump discharge pressure (psig)
    (l) Oil consumption (lb per hr)
    (m) Oil pressure (psig)
    (n) Oil tank temperature (°F)
    (o) High speed bearing temperature (°F)
    (p) Enclosure skin temperature (°F)
    (q) Turbine speed (rpm)
    (r) Barometer (in. Hg abs)

FIGURE 1.

10.2.2.4 200-Hour Endurance Test.- Following the calibration run, the unit shall be subjected to 200-Hour Endurance test in accordance with the following schedule. The schedule shall be followed in the order given unless otherwise specified by the procuring agency. The time for changing output shall not be deducted from the duration time at maximum output.

10.2.2.4.1 Sequence.- The 200-Hour Endurance test shall be conducted as follows:

30 hours	60 cycles consisting of 25 minutes at no load (idle) and 5 minutes of maximum output.
10 hours	Normal output.
.5 hours	110 percent rated speed at no load.
29.5 hours	59 cycles consisting of 25 minutes at no load and 5 minutes at maximum output.
30 hours	6 cycles consisting of 2.5 hours at normal output and 2.5 hours at 75 percent normal output.
30 hours	6 cycles consisting of 2.5 hours at normal output and 2.5 hours at 50 percent normal output.
30 hours	6 cycles consisting of 2.5 hours at normal output and 2.5 hours at 25 percent normal output.
30 hours	60 cycles consisting of 25 minutes at no load (idle) and 5 minutes at maximum output.
10 hours	Normal output.

10.2.2.4.2 Starts.- A minimum of 100 starts shall be made during the Qualification test. There shall be at least 30 starts each preceded by a minimum of 30 minutes shut-down. All starts accumulated during testing of the unit including preliminary runs may be credited to the total required. If necessary, additional starts required to bring the total to 100 may be made at the end of the endurance run.

10.2.2.5 Recalibration.- After completion of the 200-Hour Endurance test, a calibration check run in accordance with paragraph 10.2.2.3 of this appendix shall be made on unit "A" during which running time shall not exceed 1 hour at or above 90 percent of normal output. During this run, the output shall not be less than 95 percent of the rated values, and the fuel consumption shall not exceed 105 percent of the rated values. The unit shall meet all other specified performance requirements which can be checked by the calibration procedure. This check run may be preceded by a run-in period during which the cleaning and adjustment procedure recommended by the contractor for field use may be applied.

10.2.2.6 Miscellaneous Tests.- The following miscellaneous tests shall be conducted. Tests on unit "B" may be conducted at a Government laboratory under the supervision of the procuring agency if no other facilities are available.

10.2.2.6.1 Extreme Temperature Tests.-

10.2.2.6.1.1 High Temperature Test.- Unit "B" shall be exposed to an ambient temperature of 160 ±5°F for a period of not less than 4 hours. It shall then be started and operated for 1 hour at maximum allowable turbine inlet temperature. During this operation period the unit shall be supplied with air at a temperature of 130 ±5°F, and fuel at a temperature of 110 ±5°F. The fuel shall be supplied at the unit connection panel at a minimum pressure of 5 psi above the Reid vapor pressure of the fuel at that temperature.

10.2.2.6.1.2 Low Temperature Test.- Unit "B" shall be exposed to an ambient temperature of -67°±5°F for a period of not less than 72 hours. It shall then be started and operated for 1 hour at maximum allowable turbine inlet temperature. During this operation period the unit shall be supplied with air and fuel at a temperature of -67°±5°F.

10.2.2.6.2 Test of Overspeed Control.- With the normal speed governing system rendered inoperative, unit "B" shall be overspeeded at no load until the overspeed control functions. This test shall be repeated until the overspeed control has demonstrated, on 10 consecutive trials, ability to limit the unit speed to the maximum permissible value shown in the model specification.

10.2.2.6.3 Alternate Fuel Test.- Unit "B" shall be subjected to an alternate fuel test using fuel conforming to Specification MIL-F-5572 of the grade having the specified maximum lead content. This alternate fuel test schedule shall be as specified in paragraphs 10.2.2.4, 10.2.2.4.1, and 10.2.2.4.2 of this appendix, except that the times of running at each condition shall be proportionately reduced so that the total duration of the alternate fuel test is 50 hours and the number of starts required is 25; with 10 starts each preceded by a 30-minute shut-down. Performance ratings shall not apply to operation on fuel conforming to Specification MIL-F-5572.

10.2.2.6.4 Lubrication Check.- Unless otherwise specified by the procuring agency, observations of unit oil pressures shall be made to determine conformance with applicable requirements of the specifications under which the unit was built.

10.2.2.6.5 Oil Drainage.- After completion of the 200-hour Endurance test on unit "A," conformance with the oil drainage requirements of paragraph 3.23.7 shall be determined.

10.2.2.7 Test Operating Conditions.-

10.2.2.7.1 Except as specified herein, tests shall be run at prevailing ambient laboratory conditions; the fuel and oil used, the conditions of loading, and the rated loads shall be as specified for the unit ratings in the model specification.

10.2.2.7.2 Disassembly of the unit prior to final tear-down inspection shall be at the option of the procuring agency.

10.2.2.7.3 The oil system shall be drained and filled with new oil at the start of the 200-Hour Endurance test and thereafter shall be maintained in accordance with the requirements of the contractor as approved by the procuring agency.

10.2.2.7.4 Intervals of endurance test operation of less than 1/2-hour duration terminated by any unit failure shall not be credited to the required test time. Endurance test time shall not be credited by increments shorter than 30 minutes except when shorter periods are a test requirement.

10.2.2.7.5 Wet and dry bulb air temperature readings shall be taken at intervals not exceeding 3 hours.

10.2.2.7.6 The room barometer shall be read and recorded at intervals not exceeding 3 hours.

10.2.2.7.7 The date, operating schedule, unit model designation, and serial number shall be recorded on each log sheet.

10.2.2.7.8 Notes shall be placed on the log sheets of all incidents of the run, such as leaks, vibration, and any other irregular functioning of the unit or the equipment, and corrective measures taken.

10.2.2.7.9 Correction.- Readings of air flow, fuel flow, gas pressures, and gas temperatures shall be corrected NACA standard sea level atmospheric conditions, as defined in NACA Report No. 218 by the method specified in the model specification outlined in Specification MIL-C-7992.

10.2.2.7.9.1 The barometer shall be corrected for temperature.

10.3 Components Test.- The following components tests shall be conducted. Approval of the components tests shall be obtained prior to the acceptance of the gas turbine compressor or auxiliary power plant as a service type or model. All components shall be substantially identical with those used on the 200-Hour Endurance test.

10.3.1 Previous Component Approval.- All gas turbine compressor or auxiliary power plant components requiring testing as specified herein may have these requirements waived at the option of the procuring agency, if the component has been previously approved for service use on another unit. All such components must be substantially identical with the components previously approved, with the exception of the mounting provisions. If such a waiver is granted, information on the components for which previous approval was obtained shall be provided in the Qualification test report prior to approval of the gas turbine compressor or auxiliary power plant.

10.3.2 Simulated Operational Tests.- The following tests pertain only to fuel system, all controls, and ignition system components, except that tests of additional components shall be conducted when specified in the contract.

10.3.2.1 Test Conditions.- All components shall be cleaned of oil, grease, or other corrosion-preventative compound prior to the start of any testing. Insofar as practicable, components shall be mounted in their normal positions as mounted on the gas turbine compressor or auxiliary power plant. Test assemblies or components shall be subjected to operating loads simulating those encountered on the gas turbine compressor or auxiliary power plant. Sufficient instrumentation shall be provided to indicate the performance of each component and to indicate that the functional relationships of components are maintained as required by the applicable test schedule. Functional checks shall be performed at the end of each test or group of tests, and at other times at the option of the contractor, to indicate that no calibrated component has changed its calibration beyond allowable service limits and that the function of uncalibrated components is unimpaired.

All components shall be supplied with such fluids as they normally handle or contact, except that components normally in contact with fuel shall be supplied with the test fluids specified below. There shall be no traces of external fluid leakage from any component.

10.3.2.1.1 Test Cycles.- Unless otherwise specified, appropriate test cycles, consistent with the following requirements, shall be used for these tests.

(a) Each component shall pass through its maximum range of function at least once during each cycle.

(b) Components in test assemblies shall function in approximately their normal sequence of operation on the gas turbine compressor or auxiliary power plant.

(c) Cycling shall be controlled by varying simulated inputs to the test assembly or component. Gas turbine compressor or auxiliary power plant supplied inputs shall be varied in their usual relations to component outputs insofar as practicable.

(d) Input variables substantially independent of other control inputs, such as ambient temperatures and pressures, shall be cycled at a rate faster or slower than the basic functional cycle so that every component shall eventually have accomplished each part of its function at each value of the independent variable.

(e) Components designed to prevent the gas turbine compressor or auxiliary power plant from exceeding its operating limits, but which are not actuated by simulated normal operation, shall be actuated at least once during each cycle by causing their input variables to reach the necessary range of values.

10.3.2.2 Component Calibration.- Prior to the initiation of the Simulated Operational tests, each component for which the establishment of input-output relationships is a function of the component shall be subject to a calibration. The calibration shall be extensive enough to cover the entire steady state and dynamic ranges of operation of the component on the gas turbine compressor or auxiliary power plant and shall indicate conformance with the design tolerance range of the component. Components not subject to calibration shall be operated under normal operating conditions to demonstrate satisfactory functioning. Each calibration shall be recorded. Calibrations shall be conducted using test fluid in accordance with Specification MIL-F-7024.

10.3.2.3 Procedures.- All Simulated Operational tests shall be conducted on the same test assemblies, consisting of groups of related components arranged and interconnected so as to simulate their normal relationship and function on the gas turbine compressor, or auxiliary power plant, except where otherwise specified. However, subassemblies or components of a system may be tested separately at the Contractor's option if such separation does not prevent simulation of the complete function of the components or subassemblies. At the option of the Contractor and with the approval of the procuring agency, alternate testing of components or subassemblies may be conducted on gas turbine compressors or auxiliary power plants substantially like the 200-Hour Endurance test compressor or power plant in lieu of all or part of the test specified hereunder.

10.3.2.3.1 Accelerated Aging.- Upon completion of the component calibrations all nonmetallic components shall be placed dry, in an air oven, and maintained in an ambient temperature of not less than 160°F for a minimum period of 168 hours. Components are not required to be aged in test assemblies.

10.3.2.3.2 Salt Water.- Upon completion of the Accelerated Aging test, necessary test assemblies shall be assembled. Each fuel- and control-system test assembly shall undergo functional cycling for 30 minutes while supplied with test fluid conforming to Specification MIL-H-3136, type III. At the end of this period 1 pint of salt water conforming to the requirements of the paragraph entitled "Salt Solution" of Specification QQ-M-151 shall be introduced into the inlet of each test assembly. After the introduction of salt water, the supply of test fluid shall be resumed and the functional cycling shall be continued for a 20-minute period. The cycling shall then be stopped and the entire test set-up allowed to remain idle for 72 hours. During this period, the test fluid shall not be drained from any component. Control of the ambient or fluid temperature shall not be required during this test.

10.3.2.3.3 High Temperature.- Upon completion of the Salt Water test, each test assembly or component shall be maintained in an ambient temperature above 200°F or 105 percent of the maximum Fahrenheit ambient temperature which it will encounter in normal service use, whichever is higher. After reaching and remaining at this temperature for at least 1 hour, each test assembly or component shall be operated as specified below.

10.3.2.3.3.1 Fuel and Control Systems.- Each fuel- and control-system test assembly or component shall be operated according to an appropriate test cycle for a period of 50 hours or 3,000 cycles, whichever represents the longer period. Components normally in contact with fuel shall be supplied with fluid conforming to Specification MIL-H-3136, type III, at a temperature of 110° ±5°F. Other fluids, as required, shall be maintained at a temperature of 110°F ±5°F.

10.3.2.3.3.2 Ignition System.- Ignition system test assemblies shall be operated in accordance with the following schedule until a total of 300 hours of such operation has been accumulated. During the first 150 hours of the test the input voltage to the system shall be 29 volts dc. For the second 150 hours of the test the input voltage shall be 14 volts dc.

(a) 23 hours of periods of 30 minutes each. Each period shall be divided as follows:

2 minutes - ignition on
3 minutes - ignition off
2 minutes - ignition on
23 minutes - ignition off

(b) 2 hours of alternate periods during which the ignition system shall be on for 5 minutes and off for 55 minutes.

10.3.2.3.4 Room Temperature Endurance.- Upon completion of the High Temperature test, each fuel system and control system test assembly shall undergo functional cycling for at least 400 hours, or 24,000 cycles, whichever shall represent the longer period. Test assemblies containing components normally in contact with fuel shall be supplied with fluid conforming to Specification MIL-H-3136, type I. After 250 hours of cycling, the fluid entering the system shall be contaminated with at least 8 grams per 1,000 gallons of the contaminant specified in the paragraph entitled "Fuel Contamination" of Specification MIL-E-5007 for 150 hours, except that the last 2 hours shall be performed with fluid containing 80 grams per 1,000 gallons. During the testing covered by this paragraph, the fuel filter shall be cleaned as recommended by the gas turbine compressor or auxiliary power plant manufacturer, but at intervals representing a cumulative fuel flow equivalent to not less than that obtained in 10 hours operation at normal output. Control of ambient or fluid temperatures shall not be required during this test. During this test, the inlet fuel pressure at the pump in each test assembly shall not exceed 15 psi absolute. Following the test period, the pumps shall be operated at the maximum flow and discharge pressure required by the gas turbine compressor or auxiliary power plant until 400 hours at these conditions has been accumulated, including the time during the cycling period. The time accumulated on pumps at the specified conditions during cycling may be included in the total test time required for the pump. By the end of this test, all pumps shall have been exposed to fluid conforming to Specification MIL-H-3136, type I, for at least 400 hours.

10.3.2.3.5 Low Temperature.- Upon completion of the Room Temperature Endurance test, each test assembly or component shall be soaked in an ambient temperature of lower than -65°F for a period of 72 hours. Upon completion of soaking, this temperature shall be maintained while each assembly or component is operated as detailed below. During the entire Low Temperature test, fluid conforming to Specification MIL-H-3136, type I, shall be present in each test assembly or component containing parts normally in contact with fuel.

10.3.2.3.5.1 Fuel and Control Systems.- At least 10 simulated gas turbine compressor or auxiliary power plant starts shall be performed. Each start shall be preceded by a soaking period sufficient to reduce the fluid temperature below -65°F. Each start shall be followed by a maximum of 2 hours of functional cycling or 120 cycles, whichever represents the longer period. During each cycling period, the test fluid inlet temperature may gradually rise until it reaches -30°F. If -30°F is reached before completion of the cycling period, the cycling shall be stopped and a start shall be made when the fluid temperature has been returned to below -65°F. The cycling time of the test shall total 20 hours or 1,200 cycles, whichever represents the longer period.

10.3.2.3.5.2 Ignition System.- While at a temperature of below -65°F, each ignition system test assembly shall successfully start and operate at least six times. Each start shall be preceded by a minimum 3-hour soaking period followed by 3 minutes of continuous operation. Half of the starts shall be made when the system is supplied with 14 volts dc and the remainder when the system is supplied with 29 volts dc.

10.3.2.3.6 Cavitation - Fuel Pump.- The fuel system from the inlet of the gas turbine compressor or auxiliary power plant to the pump shall be simulated in the test assembly. This assembly will include lines, fittings, filter, and any other pumps that are part of the gas turbine compressor or auxiliary power plant fuel system. The filter shall have had fluid passed through it at normal compressor or power plant fuel flow for 2 hours contaminated with at least 80 grams of foreign matter as defined in Specification MIL-E-5007 per 1,000 gallons of fuel for fuel contamination. Clean fluid may be used to conduct the test. Test fluid shall be high vapor pressure fuel. The pumps shall be operated for 50 hours at maximum output and at the maximum flow and discharge pressure required by the gas turbine compressor or auxiliary power plant. The fluid-to-vapor ratio at the compressor or power plant inlet shall be maintained at not less than 0.45, and the fluid temperature shall be at least 100°F. At the beginning of the test and after each 10 hours of testing, a sample shall be taken from the test fluid to insure that the vapor-liquid ratio does not fall below the value specified above.

10.3.2.3.7 Recalibration.- Upon completion of the Low Temperature test, component calibrations shall be repeated and shall indicate that no component has changed its calibration beyond allowable service limits. Components not subject to calibration shall be operated under normal operating conditions to demonstrate satisfactory functioning. During recalibration, the same fluids shall be used as in the calibration. All components shall then be disassembled. All parts shall show no indication of failure or of unusual wear. Each calibration shall be recorded.

10.3.3 Electrical Interference Test.- The electrical system shall be tested as outlined below for conformance to the radio interference limitations of Specification MIL-I-6181.

(a) The radiated interference level shall be tested at frequencies up to 150 megacycles.

(b) The test antenna shall be located at the maximum radiated interference level at a distance of 6 feet from the unit.

(c) Radiated and conducted interference tests shall not be conducted during the starting cycle.

10.4 Tear-Down Inspection.- Prior to the calibration test and after completion of the recalibration run on unit "A," and before and after the alternate fuel test on unit "B," the unit and components shall be completely disassembled for examination of all parts, and for measurements as necessary to disclose excessively worn, distorted, or weakened parts.

10.4.1 Oil Tank.- If an external oil tank is furnished as a component part of the unit, the tank with filler cap installed shall be subjected to a positive minimum internal air pressure of 15 psig, or twice the tank operating pressure, whichever is greater, for 10 minutes. No signs of leakage shall appear when the tank is submerged in water, with the internal air pressure as above.

10.5 General Inspection.- At convenient times prior to the tests and during tear-down inspections, the unit and components shall be examined to determine if they conform to all requirements of the contract and specifications under which they were built. At no time during the test shall any part of the unit be removed, disassembled for examination, or adjusted without prior approval of the witnessing representative of the procuring agency.

10.6 Parts Failures.- If, during the Qualification tests, a part fails, a new Qualification test may be started on a new unit with a redesigned part or one of different material, or the witnessing representative of the procuring agency may authorize the installation of a new part of original design and material for one which failed due to faulty material or workmanship. The Qualification test on each unit shall be considered complete when every major part of the unit has been subjected to the complete test. At the discretion of the procuring agency, redesign and retesting may be required of any part which fails, or indicates weakness after completing its Qualification test.

10.6.1 Components.- The above procedure shall apply in the event of parts failure during qualification of components except that, at the discretion of the procuring agency, a re-run of the component Qualification test or the unit Qualification test, or any portion thereof, may be waived.

APPENDIX II

COMPRESSORS; AIR, GAS TURBINE TYPE ACCEPTANCE TESTS FOR

20. SAMPLING, INSPECTION, AND TEST PROCEDURES

20.1 General.- Gas turbine air compressors, components, and test apparatus, and the material entering into the manufacture thereof shall be subject to inspection by authorized Government Inspectors who shall be given reasonable facilities to determine conformance with this appendix. All instructions for the testing of units shall be submitted to the Inspector for his information and guidance. Previous acceptance or approval of material, or release of any design by the procuring agency, shall in no case be construed as a guaranty of the acceptance of the finished product.

20.2 Test Conditions.-

20.2.1 Test Apparatus.-

20.2.1.1 Unit Speed.- The unit speed for performance check runs at normal and maximum ratings shall be determined by means of a positive counter which will actually count the revolutions for a period of not less than 1 minute, by an indicating tachometer and matching stroboscope disk energized by a controlled frequency source, or by other means acceptable to the procuring agency. At all other times, speed may be measured by means of an indicating tachometer.

20.2.1.2 Fuel Flow.- Fuel flow measurements shall be made by either the volume or weight method. The quantity selected for the volume or weight method shall be such that each reading will cover an elapsed time of at least 1 minute. Flow meter readings may be used for calculations of specific fuel consumption when the flow meter has been calibrated by the volume or weight method in accordance with paragraph 20.2.3 of this appendix. Fuel flow quantities shall be reported on the weight basis. The specific gravity of the fuel shall be noted on the Acceptance Test Log Sheet.

20.2.1.3 Air Flow.- Air flow measurements shall be made in accordance with the procedures outlined in ASME Power Test Code PTC 19.5; 4-1949 Part 5, Chapter 4, or by a method acceptable to the procuring agency.

20.2.1.4 Temperature and Pressure Measurements.- All temperature measurements shall be recorded in degrees Fahrenheit. Gas temperature measurements shall be accomplished using the type, number, and location of temperature sensing elements as specified in the model specification. All oil and fuel pressures shall be recorded in pounds per square inch gage. All air or gas pressures shall be recorded in inches of mercury absolute or pounds per square inch gage, whichever is applicable.

20.2.2 Fuel and Oil.- Fuel and oil used for all testing including preliminary runs shall be as specified in the model specification.

20.2.3 Accuracy of Data.- All instruments and equipment shall be calibrated often enough to insure that reported data shall have a static accuracy within 3 percent of the value obtained at the maximum output of the unit.

20.3 Preliminary Runs.- The nature and extent of the running-in prior to the Acceptance test shall be determined by the contractor.

20.4 Acceptance Test.- Each production unit shall be subjected to the Acceptance test, which shall consist of the following tests.

20.4.1 Functional Test.- The complete unit with all controls operating shall be operated in accordance with the following schedule.

(a) Start and accelerate to governed speed.

(b) 15 minutes at no load.

(c) 15 minutes at normal rated output.

(d) 15 minutes at 25 percent of normal rated output.

(e) 5 minutes at maximum rated output.

(f) 15 minutes at 50 percent of normal rated output.

(g) 15 minutes at 75 percent of normal rated output.

(h) 10 minutes at normal rated output.

20.4.1.1 Functional Test Data.- For each run at the loadings specified for the Functional test, instrumentation shall be provided, readings shall be taken, and the necessary calculations shall be made to obtain the following data.

These data shall be corrected for the effects of ambient conditions to NACA standard sea level day performance by the method specified in the model specification.

The corrected data shall be recorded on the Acceptance test report.

(a) Bleed air flow - lb per min

(b) Bleed air total pressure - in. Hg abs

(c) Bleed air total temperature - °F

(d) Bleed air power - ft lb per min

(e) Fuel consumption - lb per hr

(f) Maximum oil temperature during run - °F

(g) Duration of turbine inlet temperature in excess of maximum permissible value specified in the model specification - sec.

(h) Maximum and minimum oil pressure during run - psig

(i) Compressor inlet air total temperature - °F.

(j) Barometric pressure - in. Hg abs.

(k) Unit speed - rpm.

20.4.2 Overspeed Test.- With the normal speed governing system rendered inoperative, the unit shall be overspeeded at no load until the overspeed control functions. This test shall be repeated until the overspeed control has demonstrated on five consecutive trials, the ability to limit the unit speed to the maximum permissible value shown in the model specification.

20.4.3 Radio Interference Level.- All first production units shall be subjected to a radio interference level test as outlined below to demonstrate compliance with the radio interference limitations of Specification MIL-I-6181, until 10 consecutive units have passed the test without reworking. Thereafter the Inspector shall select at random one unit from each lot and subject it to the test. A lot shall consist of 10 consecutive units of the same model or models, provided identical electrical systems are used on each model in the lot.

20.4.3.1 When a unit modification is made which might affect the radio interference level, all units incorporating the modification shall be tested as outlined below until 10 consecutive units have passed the test without reworking. Thereafter, the Inspector shall select at random 1 unit from each lot and subject it to the test.

20.4.3.2 The following test conditions shall apply to the Radio Interference Level tests:

(a) The radiated interference level shall be tested at frequencies up to 150 megacycles.

(b) The test antenna shall be located at the maximum radiated interference level at a distance of 6 feet from the unit.

(c) Radiated and conducted interference tests shall not be conducted during the starting cycle.

20.4.4 Automatic Start Test.- Each unit shall demonstrate satisfactory functional operation of automatic start controls by five consecutive successful automatic starts at no load. These starts may be accomplished during the Functional test.

20.4.5 Additional Tests.- In addition to the tests above, tests shall be conducted on production units to demonstrate satisfactory operation of any emergency or special controls as described in the model specification.

20.4.6 Stoppages.- Stoppage from any cause may, at the option of the Inspector, require a repetition of the particular period during which the stoppage occurred, or a penalty run not exceeding the length of the Functional test. Fuel and oil leaks will be considered as stoppages. If on close inspection at the completion of the Functional test, fuel or oil leaks are discovered, a check run at normal-rated output, after sealing the leak, shall be made at the discretion of the Inspector.

20.5 Criteria for Acceptance.- A production unit shall have passed the Acceptance test if the following requirements have been met.

20.5.1 Functional Test Performance.- The corrected performance data shall demonstrate that the unit meets the performance ratings specified in the model specification. In addition, the operating gas temperatures, oil temperatures, oil pressures, and unit speed shall be within the permissible limits specified in the model specification.

20.5.2 Overspeed Test.- At no time during the overspeed tests shall the unit speed exceed the maximum allowable value specified in the model specification.

20.5.3 Radio Interference Tests.- The radiated and conducted interference levels of the unit when tested as specified above shall not exceed the permissible limits specified in Specification MIL-I-6181.

20.5.4 Automatic Start Tests.- A successful start shall be defined as continuous acceleration from actuation of the start switch to idling speed within the times specified in the model specification.

20.5.5 Inlet Temperature.- The maximum turbine inlet temperature shall not exceed the maximum permissible transient and steady-state values specified in the model specification.

20.6 Additional Tests.- Satisfactory performance in any additional tests shall be defined as demonstration of conformance with the requirements for that component or control specified in the model specification.

20.7 Retest.- Whenever, in the opinion of the Inspector, there is evidence of insufficient output or other malfunctioning of the unit, the difficulty shall be investigated and its cause corrected to the satisfaction of the Inspector before the test is continued. If such investigation requires disassembly involving any internal moving part of the unit proper, the portion of the test in which the difficulty was encountered shall, at the option of the Inspector, be repeated.

20.7.1 When any unit fails to pass the Radio Interference Level test, all subsequent units shall be tested until 10 consecutive units have passed the test without reworking. Units which have been rejected may be reworked to correct the defects and resubmitted for testing. Before resubmitting, full particulars concerning previous rejection and action to correct the original defects shall be furnished the Inspector.

20.8 Maximum Hours of Running.- If any unit, other than an experimental unit, requires more than 15 hours of running under its own power at 50 percent of normal-rated output or above, in connection with its test under this appendix, including preliminary runs or running-in when performed, it shall stand rejected. Parts and components from these rejected units may be used in other units being built provided these parts and components are not worn or defective to an extent which will prevent their being reconditioned sufficiently to enable them to pass the detailed inspection required for similar unused parts or components. Parts and components from rejected units shall not be resubmitted for inspection without full particulars being given to the Inspector concerning previous rejection of the unit.

20.9 Acceptance Test Log.- The contractor shall prepare Acceptance Test Log Sheets for each unit, the two copies of which shall be supplied to the procuring agency.

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