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20 November 1951
Superseding
MIL-T-7101(Aer)
15 September 1951

MILITARY SPECIFICATION

TRANSMISSION; POWER, CONSTANT SPEED: GENERAL SPECIFICATION (AIRCRAFT USE)

This specification has been approved by the Bureau of Aeronautics, Department of the Navy.

1. SCOPE AND CLASSIFICATION

1.1 Scope.- This specification establishes the requirements for power transmissions which provide constant output speed for driving aircraft accessories from variable speed aircraft engines, gear boxes or auxiliary engines.

1.2 Precedence.- When the requirements of the contract, detail specification and/or drawing, this general specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

Contract.- The contract shall have precedence over any specification.

Detail Specification and/or Drawing.- The detail specification and/or drawing shall have precedence over this specification.

This General Specification.- This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by the Bureau of Aeronautics.

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS, AND DRAWINGS

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

2.1.1 Specifications.-

Federal

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

Military

MIL-D-5028	Drawing and Data Lists; Preparation of (For Engines, Accessories and other Auxiliary Equipment)
MIL-P-5633	Packaging and Packing of Aircraft Material in Steel Shipping Containers
MIL-I-6181	Interference Limits and Tests; Aircraft Electrical and Electronic Equipment
MIL-L-6880	Lubrication of Aircraft; General Specification for
MIL-M-3171	Magnesium Alloy; Processes for Corrosion; Protection for
MIL-T-5091(Aer)	Transmission, Power, Constant Ratio: General Specification
MIL-S-3151	Noise Measuring Equipment
MIL-P-6906	Plates; Information and Identification
MIL-S-7742	Screw-Threads; Standard, Aeronautical
AN-QQ-A-696	Anodic Films; Corrosion-Protective (for aluminum alloys)

2.1.2 Other Publications.-

AN Aeronautical Standard Drawing

AND10398 Metals; Definition of Dissimilar

Air Force-Navy Aeronautical Bulletin

ANA Bulletin No. 143 Specifications and Standard; Use of

Military Standards

MIL-STD-129 Marking of Shipments

2.1.3 Availability of Specifications, Other Publications and Drawings.- Copies of this specification and applicable specifications and drawings may be obtained upon application to the Commanding Officer, U.S. Naval Air Station, Johnsville, Pennsylvania, Attention Technical Records Division.

3. REQUIREMENTS

3.1 Materials.- Materials used in the manufacture of transmissions shall be of high quality, suitable for the purpose and shall conform to applicable Government specifications. Materials conforming to contractors' specifications may be used provided the specifications are approved by the Government and contain provisions for adequate tests. The use of the contractor's specifications will not constitute waiver of Government inspection.

3.1.1 Corrosion Resistance.- Materials shall be of a corrosion-resisting type or suitably processed to resist corrosion.

3.1.2 Dissimilar Metals.- Unless otherwise suitably protected, dissimilar metals such as brass, copper, or steel, shall not be used in intimate contact with magnesium, aluminum or their alloys. Dissimilar metals are defined in Drawing AND10398. When protection is used, it shall be of such type that a low-impedance path is offered to radio frequency currents.

3.1.3 Selection of Materials.- Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with ANA Bulletin No. 143, except as provided in the following paragraph.

3.1.3.1 AN or JAN Standard Parts.- AN and JAN standard parts shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part number. 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 case there is no suitable corresponding AN or JAN standard part in effect on the date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.2 Operating Conditions.- The transmission shall be designed to operate in aircraft for 1000 hours under any of the following conditions or natural combination of conditions.

3.2.1 Pressure Altitude.- Barometric pressure ranging from 30 inches of mercury down to 1.68 inches of mercury (approximating an altitude of 65,000 feet). The pressure may remain constant, or may vary at a rate as high as 0.5 inch of mercury per second.

3.2.2 Temperature.- Temperature range from -55° to + 71°C (-67° to 160°F). See figure 1.

3.2.3 Humidity.- Relative humidity ranging up to 100 percent including conditions wherein condensation will take place on the equipment.

3.2.4 Sand Resistance.- Under conditions of airborne sand particles.

3.2.5 Resistance to Salt Spray.- Atmosphere containing salt-laden moisture.

3.2.6 Fungus.- When exposed to fungus growth as encountered in tropical climate.

3.2.7 Operating Position.- When installed with the rotational axis in any direction.

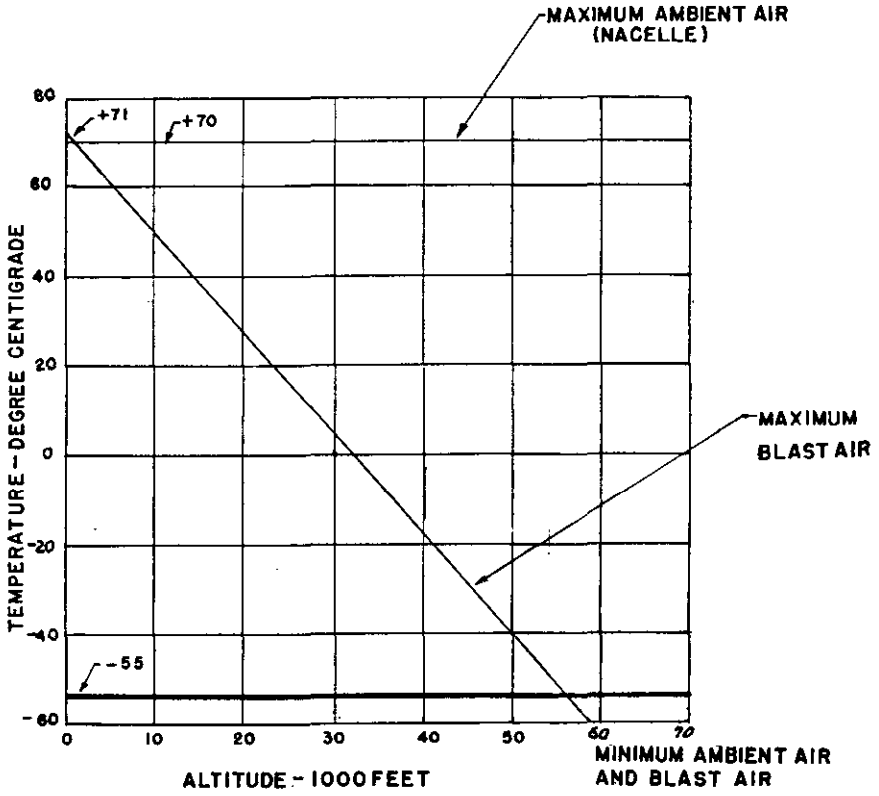

FIGURE 1 TEMPERATURE AND ALTITUDE
RANGE OF TRANSMISSION OPERATION

3.3 Design and Construction.-

3.3.1 The transmissions shall conform to the requirements specified on the applicable BuAer transmission drawing hereafter termed applicable drawing.

3.3.2 Simplification.- Simplicity of design resulting from use of the same part for as many applications as possible in a given transmission and in transmissions of different ratings is highly desirable. For example, two ball bearing assemblies in transmissions could be identical and the same assembly used in transmissions of several configurations.

3.3.3 Fluids and Lubricants.-

3.3.3.1 Fluids.- Where fluids are used for power transmission, the fluid shall be of a non-inflammable type subject to approval by the procuring agency and suitable for proper operation at the extremes of temperature specified herein.

3.3.3.2 Lubricants.- Lubrication of the transmission shall be in accordance with Specification MIL-L-6880. The main engine oil system shall not be considered for transmission lubrication.

3.3.3.3 Replenishment of Fluid or Lubricant.- The transmission shall not require replenishment of fluid for power transmission or lubrication during continuous operation of at least 240 hours, and it is extremely desirable that the transmission require no replenishment of fluid for power transmission or lubrication for 1000 hours of operation. All parts of the transmission requiring replenishment of fluid or lubrication as allowed above shall be provided with fittings so as to be readily accessible. The minimum number of fittings shall be used and, if possible, only one fitting shall be used for lubricating the entire transmission and/or one port for filling with fluid for power transmission.

3.3.4 Mounting Provisions.- Mounting flanges and supporting provisions shall be in accordance with the applicable drawing.

3.3.5 Coupling Spline.- The coupling splines shall be in accordance with the applicable drawing.

3.3.6 Torsional Vibrations.- The transmission shall introduce no torsional vibrations between its input and the accessory nor shall it increase the amplitude of any torsional vibrations applied to the input end.

3.3.7 Torque Limiting.-

3.3.7.1 Shear Torque.- The transmission shall be provided with a shearing section or safety disconnect in the input end which shall be easily replaceable or resettable without requiring any major disassembly or the use of special tools. Shear or decoupling shall occur within the torque values specified on the applicable drawing.

3.3.7.2 Reverse Torque.- The transmission shall incorporate provisions whereby it is prevented from impressing a reverse torque at the input, under conditions of an over-running output, in excess of that equivalent to 10% load at minimum rated input speed specified on the applicable drawing.

3.3.8 Leakage.- When fluid is used for either lubrication or power transmission, the total loss of fluid shall not exceed more than 2cc per hour under any of the operating conditions covered in this specification.

3.3.9 Clearance Requirements.- The clearance required by the transmission shall be as indicated on the applicable drawing.

3.3.10 Direction of Rotation.- The transmission shall operate in a clockwise direction of rotation when viewed from the accessory end.

3.3.11 Intermittent Overload.- The transmission shall be capable of intermittent overload operation as specified on applicable drawing. The overload shall be considered as recurring at one hour intervals.

3.3.11.1 Overheat Indicator.- The transmission shall incorporate a suitable device to indicate prolonged overload operation over the time specified herein, such that continued operation of the overload condition will considerably reduce its operating life or possibly result in damage to the transmission. The design shall be such that the device may be removed without impairing proper functioning of the transmission when it is determined after service use that it is no longer required.

3.3.12 Remote Speed Adjustment.- The transmission shall be capable of speed adjustment from a remote location electrically using AN standard electrical components. The amount of speed control

adjustment shall be 7% of the rated output speed and controlled in steps of less than 0.1% of rated output speed.

3.3.13 Starting Time.- The unit shall be so designed that constant output speed will be within the range specified on the applicable drawing within a period not to exceed five seconds after the minimum input speed for constant output speed is reached with no sort of pre-energization prior to the five second period.

3.3.14 Blast Cooling.-

3.3.14.1 Blast Cooling Inlet Tube.- When blast cooling is required, the transmission shall include provisions for entrance of external air through an inlet tube as specified on the applicable drawing.

3.3.14.2 Amount of Cooling.- The rating of the transmission may be based on air blast through the blast cooling inlet tube of paragraph 3.3.14.1. The pressure available will not be more than 5.31 inches water when the transmission is being provided a quantity of air equal to 130% of the basic cfm as determined from Figure 2 at volumes of 130% basic cfm and less the pressure available at the transmission based on a pressure of 7" H_2O static plus velocity head at the entrance of the cooling duct and pressure drops in the cooling duct determined by a pressure drop of 1.69" H_2O at 130% basic cfm and 1" H_2O at basic cfm. Blast air temperature will be in accordance with Figure 1.

3.3.15 Service Life.- The transmission shall be designed so that when operating under any condition or natural combination of conditions described in this specification, the useful life without replacement or reprocessing of major parts shall be 1000 hours or more.

3.3.16 Pre-energization.- Energizing of auxiliary equipment of the transmission system shall not be dependent upon other aircraft systems without specific written approval of the procuring agency.

3.3.17 Electrical Accessories.- When any electrical devices are used in the construction of this device, additional requirements applicable to electrical equipment will be made effective. When electrical energy is required for the proper operation of the transmission, it cannot be assumed to be available until provided by the generator driven by the transmission, and the type and amount shall be subject to approval of the procuring agency.

3.3.18 Parallel Operation.- The transmissions shall be capable of parallel operation unless otherwise specified in the contract. The design of the transmission shall be such that paralleling components may be removed or added without impairing proper functioning of the transmission.

3.3.19 Construction.- The transmission may be of any type construction such as mechanical, hydraulic or pneumatic which meets the requirements of the specification.

3.4 Interchangeability.- All parts having the same manufacturer's part number shall be directly and completely interchangeable with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028.

3.5 Screw Threads.- Screw threads shall conform to the requirements of Specification MIL-S-7742

3.6 Safety Wiring and Staking.- Accidental loosening of screws and screw parts and other connections shall be prevented by safety wiring (0.032 inch minimum OD) where practicable, staking or other approved method. Washers and cotter pins, where used, shall be assembled in a manner which prevents rotation of washers and movement of cotter pins under conditions of vibration.

3.7 Finish.-

3.7.1 Aluminum Alloy Parts.- Where practicable, aluminum alloy parts shall be anodically treated in accordance with Specification AN-QQ-A696, or approved equivalent. The aluminum oxide film deposited by this treatment shall be removed from the actual contact area of all surfaces required to act as a path for electrical current and from the local areas under screws, nuts, or the like used for assembly or mounting purposes to provide an adequate bonding connection.

3.7.2 Magnesium Alloy Parts.- Wherever practicable, magnesium alloy parts shall be surface treated in accordance with Specification MIL-M-3171 to provide protection against corrosion.

3.7.3 Protective Coating.- Any protective coating that will crack, chip, or scale with age or extremes of atmospheric conditions, or that will affect the performance of the transmission, shall not be used.

3.7.4 Plating.- Cadmium plating shall be in accordance with Specification QQ-P-416.

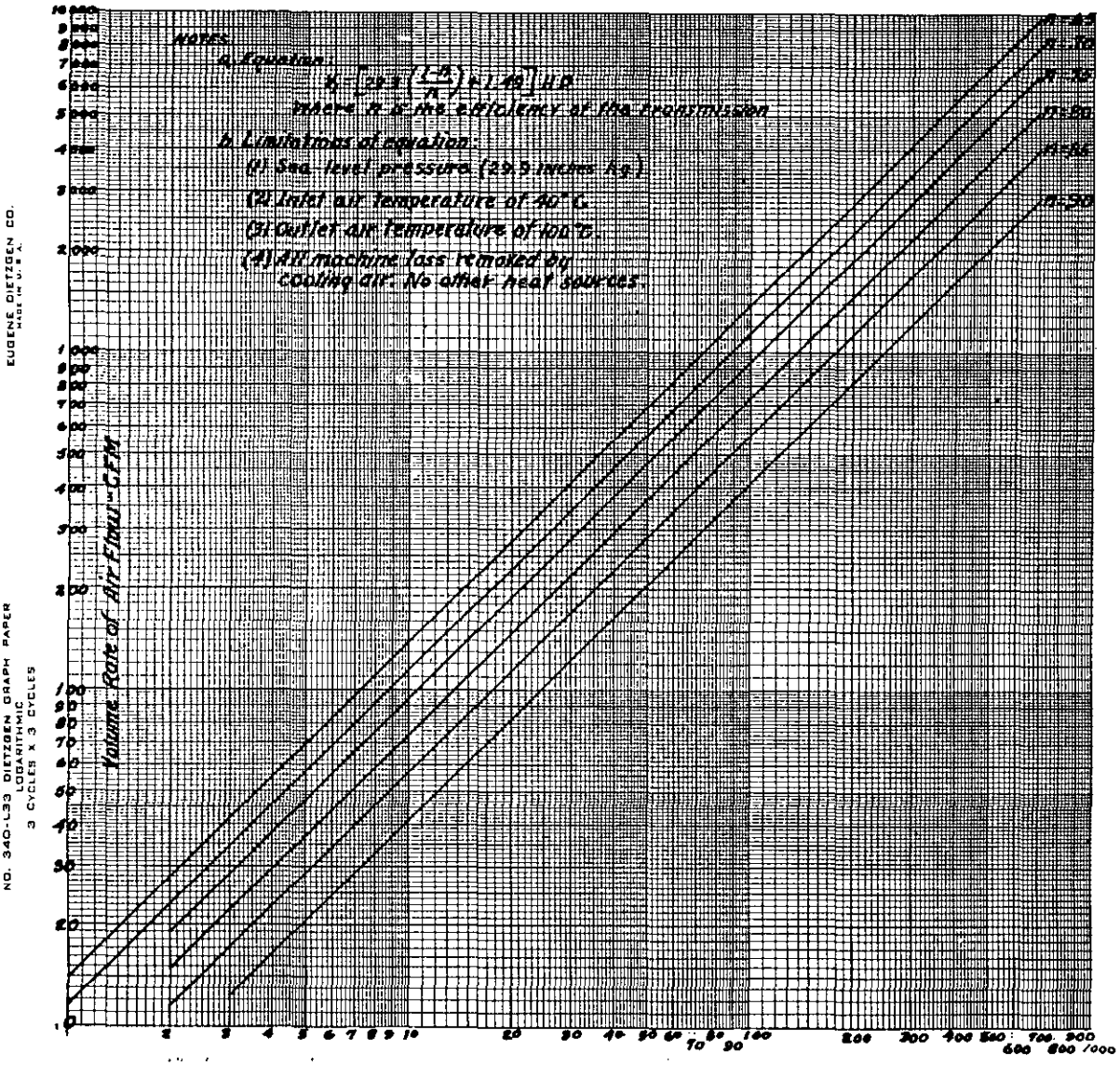

FIGURE 2.

3.8 Performance.- The transmission shall satisfy the performance requirements specified in section 4 when subjected to the tests headed as follows:

(a) Temperature
(b) Endurance
(c) Continuous Operation
(d) Leakage
(e) Torsional Vibration
(f) Torque Limiting
(g) Overspeed
(h) Efficiency
(i) Overload
(j) Speed Regulation
(k) Stability
(l) Parallel Operation
(m) Radio Interference
(n) Acceleration
(o) Shock
(p) Vibration
(q) Audio Noise
(r) Altitude Performance
(s) Operating Position
(t) Humidity
(u) Salt Spray
(v) Sand Resistance
(w) Fungus

3.9 Marking.-

3.9.1 Rotation Marking.- Direction of rotation shall be plainly indicated by an arrow.

3.9.2 Flow Diagram.- Attached to the inside of the control box cover or other surfaces, when practicable, there shall be a simple interconnection diagram for installation and maintenance use with a legend describing the components of the equipment. The diagram shall be legible, protected against humidity and not easily removed.

3.10 Identification of Product.- Parts and sub-assemblies of transmissions shall be marked with the part number and the manufacturer's name or trade mark when practicable.

3.10.1 Nameplate.- Each transmission nameplate shall be in accordance with Specification MIL-P-6906 and shall contain the following information:

Transmission, Constant Speed Power (Aircraft Use)

Part Number_____Stock Number_____

Specification MIL-T-

Input Speed Range_____Output Speed_____

H.P._____

Lubricate every_____hours

Manufacturer's Part No._____

Manufacturer's Serial No._____

Manufacturer's Name or Trademark (Omit Address)

Order or Contract No._____

Acceptance Stamp_____

3.10.1.1 Manufacturer's Part Number on Nameplate.- The manufacturer's part number indicated on this plate shall be the number of the contractor's assembly drawing which includes sub-assembly ordering data. Any additional nameplates with proprietary data shall be attached to the transmission by means of easily removable screws.

3.10.1.2 Restriction on Size of Trademark.- The manufacturer's name or trademark shall not be in letters larger than other letters appearing on the nameplate.

3.10.1.3 Stock Number.- The stock number shall be as specified by the Bureau of Aeronautics.

3.10.2 BuAer Designations.- BuAer designations shall not be used on a product until notification has been received from the Bureau of Aeronautics that the product has been approved for aeronautical use by the Bureau of Aeronautics.

3.11 Installation Instructions.- The contractor shall pack, with each transmission, one set of instructions with illustrations and diagrams covering the installation of the transmission. Instructions shall be printed on 8-1/2 x 11 inch durable paper, and contained in an envelope.

3.12 Workmanship.- All machine surfaces shall have a smooth finish and all details of manufacture, including the preparation of parts and accessories, shall be in accordance with the best practice for high-quality equipment. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, marking of parts, plating, lacquering, riveting, clearance between soldered connections, and ruggedness.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Classification.- The inspection and testing of the transmissions shall be classified as follows:

a. Qualification Tests.- Qualification tests are made on samples submitted for qualification as satisfactory products.

b. Inspection Tests.- Inspection tests are made on transmissions submitted for acceptance under contract.

4.2 Qualification Tests.-

4.2.1 Sampling Instructions.- Qualification test samples shall consist of three transmissions and three shear sections if used. These transmissions shall be accompanied by two reproducible copies of outline and detail assembly drawings thereof and by two printed copies of simple instructions with illustrations and diagram, if necessary, covering the installation of the transmission. Samples shall be forwarded to a laboratory designated by the Bureau of Aeronautics, Department of the Navy, Washington 25, D.C., plainly identified by securely attached durable tags marked with the following information:

"Sample for Qualification Test"
Constant Speed Power Transmission (Aircraft Use)
BuAer Part No.
Name of Manufacturer
Manufacturer's Part Number
"Submitted by (name)(date) for qualification test in accordance with the requirements of Specification MIL-T-_____ and BuAer Drawing _____ under authorization (reference authorizing letter)"

4.2.2 Qualification Tests.- The qualification tests of transmissions shall consist of all the tests of this specification. The qualification tests may, at the option of the Procuring Agency, be supplemented with tests under actual service conditions to determine suitability for aircraft application. The tests shall be conducted substantially in the order listed for each transmission. When electrical components are a part of the transmission, additional tests as applicable shall be conducted.

Transmission No. 1

Examination of Product	Audio Noise
Operating Position	Altitude Performance
Continuous Operation	Torsional Vibration
Overspeed	Humidity
Overload	Speed Regulation
Temperature	Stability
Acceleration	Parallel Operation
Radio Interference	Efficiency
	Leakage

Transmission No. 2

Examination of Product	Operating Position
Continuous Operation	Vibration
Overspeed	Shock
Overload	Sand Resistance
Speed Regulation	Fungus
Stability	Salt Spray
Parallel Operation	Torque Limiting
Acceleration	Efficiency
Radio Interference	Leakage

Transmission No. 3

Examination of Product	Overload
Continuous Operation (Part A Only)	Endurance
Overspeed	Leakage

4.2.2.1 Disassembly and Inspection.- At the conclusion of the qualification tests, the transmissions will be disassembled and inspected for excessive wear and defects.

4.2.2.2 Retest of Qualification Samples.- Units which have been rejected or returned to the manufacturer for any reason during qualification tests, may be reworked or have parts replaced to correct defects. Before resubmitting the unit, full particulars concerning the rejection, findings and corrective action taken by the manufacturer must be submitted by the manufacturer in writing to the test activity and to the Bureau of Aeronautics. Tests shall not be resumed until this report is received.

4.3 Inspection Tests.- The contractor shall be responsible for accomplishing the inspection tests specified herein. When inspection is conducted at the contractor's plant, all inspection and testing shall be subject to the approval of the Government Inspector. Contractors not having laboratory testing facilities satisfactory to the Government shall engage the services of a commercial testing laboratory acceptable to the Government Inspector. The contractor shall maintain a record available to the Inspector, showing the results of all inspection tests and signed by an authorized representative of the contractor or laboratory. Acceptance or approval during the course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished product.

4.3.1 Sampling.- Each transmission shall be subjected to the tests specified in paragraph 4.3.2.

4.3.2 Tests.- The inspection tests shall consist of the tests described in paragraphs headed as follows:

Examination of Product

Continuous Operation (Part A Only)

Overspeed

Overload

Leakage (during Inspection Tests)

Parallel Operation

Speed Regulation (Part A Only)

In addition, the transmission shall be subject to any other tests specified herein which the Inspector considers necessary to determine conformance with the requirements of this specification and detail specification or applicable drawing.

4.3.3 Retests of Inspection Samples.- Transmissions which have been rejected may be reworked or have parts replaced to correct the defects, and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the Inspector. Units rejected after retest shall not be resubmitted without the specific approval of the procuring agency.

4.4 Test Conditions.- Unless otherwise specified, each test in this section shall be made under the following conditions.

4.4.1 Loading.- The transmission shall be coupled to a suitable loading device having the wr^2 indicated on the applicable drawing and capable of loading the transmission over the rated load and speed range. The rotational axis of the transmission shall be horizontal.

4.4.2 Ambient.- Unlessotherwise specified the ambient temperature shall be 25° ± 15°C (77° ± 27°F) for all tests wherein ambient temperature does not directly affect the results of the tests. If blast cooling is required, the blast air temperature shall not be more than 5°C (9°F) lower or 15°C (27°F) higher than the existing ambient temperature and in no case shall the blast air temperature exceed 40°C (104°F).

4.4.3 Altitude.- The tests shall be run at approximately sea level altitude.

4.4.4 Location of Load.- The load for the transmission shall be so arranged that it will not appreciably affect the ambient temperature of the transmission.

4.4.5 Warm-Up.- Prior to each test, the transmission shall be operated at rated load at average rated input speed for sufficient time to reach a substantially constant temperature and the load and speed shall be maintained unless otherwise indicated in the particular test.

4.4.6 Auxiliary Equipment.- All additional equipment such as intercoolers, coolants, etc., indicated by the manufacturer as necessary to meet the requirements of this specification and included in the weight and dimensions of the applicable drawing shall be used.

4.4.7 Cleaning.- Before testing any transmission, all corrosion preventive oil or grease or any other corrosion resistant compound shall be removed.

4.4.8 Pre-Test Operation.- Prior to formal testing, the transmission shall not require operation of more than two hours at any speed or speeds or procedures recommended by the manufacturer subject to approval of the procuring agency to assure that the mechanism is free from dirt and functioning properly. The manufacturer shall make certain that the mechanism is free of dirt and functioning properly when submitted for the approval of the procuring agency. Operation of the mechanism by the manufacturer for any length of time to accomplish the above shall be at the manufacturer's option.

4.5 Test Measurements and Instructions.- The use of approved constant recording instruments is desirable but not mandatory for the following test measurements:

4.5.1 Temperature.- Input and output air and oil temperatures as applicable shall be recorded every 15 minutes, and the room temperature recorded every hour, during all operation unless otherwise indicated.

4.5.2 Speed.- The transmissions input and output speeds in revolutions per minute shall be recorded every 15 minutes during all operations.

4.5.3 Leakage.- External fluid or lubricant leakage shall be checked at the end of each speed cycle and/or load change during all testing. Total leakage which appears to be excessive (over 2 cc per hour) shall be measured.

4.6 Test Methods.-

4.6.1 Examination of Product.- Each transmission, sub-assembly, and part shall be examined as the Inspector may deem necessary to determine conformance with this specification and the applicable drawing with respect to materials and workmanship, standard parts, simplification, mounting provisions, coupling spline, removable drive spline, lubrication, clearance requirements, protective coating, interchangeability, marking, BuAer designations, installation instructions, dimensions and weight.

4.6.2 Temperature.-

4.6.2.1 High Temperature.- The transmission shall be subjected to an ambient temperature of 71° ± 2°C (160° ± 4°F) for at least 12 hours before operating. At the end of this period and while still subjected to the ambient temperature, the transmission shall be operated carrying rated load at average rated input speed for five hours. The transmission shall complete the above test without failure or impairing subsequent performance.

4.6.2.2 Low Temperature.- The transmission shall be subjected to an ambient temperature of -55° ± 5°C (-67° ± 9°F) for at least 72 hours before operating. At the end of this period and while still at the ambient temperature, the transmission shall be started and accelerated to minimum rated input speed as specified on the applicable drawing in a period not to exceed one minute and then run for five minutes at minimum rated input speed, all without applied load. Rated output speed shall be attained within 5 seconds after attaining minimum rated input speed. This test shall be repeated for a total of 25 consecutive times except eliminating soaking period allowing at least five minutes

between the end of each run and the start of the next run. Starting torque shall not exceed 200% of full load torque during this test.

4.6.3 Endurance.- The transmission shall be tested for endurance carrying at least 50 percent of rated full load for 100 hours with input installed on an aircraft engine with or without a constant ratio transmission per MIL-T-5091(Aer) as applicable. During this test the transmission input shall be run at speed in excess of the minimum rated speed specified on the applicable drawing. Upon completion, it shall exhibit no signs of structural weakness, wear that will interfere with the operating condition of the transmission, or indication of flaws or failure, any of which shall be cause for rejection of the transmission.

4.6.4 Continuous Operation.- The transmission shall satisfactorily complete the test schedule as specified in Table I. During this test schedule standard test conditions shall be maintained. All measurements indicated by the test schedule shall be made and recorded where applicable.

4.6.4.1 Underspeed Operation.- The transmission shall satisfactorily carry reduced loads directly proportional to input speeds for continuous operation below the minimum input speed for maximum continuous power output as specified on the applicable drawing.

4.6.5 Leakage.- The total external leakage rate shall not exceed 2 cc per hour during any of the tests of this specification.

4.6.6 Torsional Vibration.- The input of the transmission shall be connected to a universal joint torsional vibration machine which has a flywheel of at least 20 times the wr^2 of the connected load as indicated on applicable drawing. Testing procedures shall be as follows:

a. 100 hours with $\pm$ 1 degree torsional amplitude input to the transmission at critical frequencies.
b. 50 hours with $\pm$ 2 degrees torsional amplitude input to the transmission.
c. 15 minutes with $\pm$ 2 degrees torsional amplitude input to the transmission at critical frequencies.

During a, b, and c above, when operating the transmission below maximum rated input speed indicated on the applicable drawing, the amplitude of the torsional vibration present in the output shall not exceed that applied to the input.

4.6.7 Torque Limiting.-

4.6.7.1 Shear Torque.- The transmission shear section shall be tested to determine the torque required for decoupling or failure of the shearing section. The torque required shall be less than the shear torque specified on the applicable drawing.

4.6.7.2 Reverse Torque.- The transmission shall be "overrun" and the reverse torque tested at the input end when the input speed is maintained constant. The reverse torque shall not exceed 10% of the rated torque at minimum rated input speed specified on the applicable drawing.

4.6.8 Overspeed.- This test shall be made while the transmission is hot as a result of testing and shall be made at no load at the input overspeed specified on the applicable drawing. Output speed governors, speed limiters, or equivalent devices which would prevent or affect the results of testing at overspeed shall be rendered inoperative during this test. The transmission shall demonstrate its ability to operate at input overspeed conditions for five minutes without mechanical failure or impairing subsequent performance.

4.6.9 Efficiency.- The efficiency shall not be less than that specified on the applicable drawing during any of the running tests of this specification within the rated load and speed range.

4.6.10 Overload.- The transmission shall demonstrate its ability to operate at 150% full load for 5 minutes and 200% full load for 5 seconds at the speeds specified on the applicable drawing without failure or impairing subsequent performance. The output speed shall remain within the limits specified on the applicable drawing during the above overload operation.

4.6.11 Speed Regulation.- The output speed shall be measured under the conditions listed below. For each temperature condition the transmission shall be operated at 50% rated load until the output speed stabilizes after which the output speed shall remain in the limit specified on the applicable drawing for the specified conditions of the tests.

a. Speed regulation at 25° $\pm$ 15°C (77° $\pm$ 27°F)

1. At minimum rated input speed for constant speed output and full load operation as specified on the applicable drawing the load shall be varied from no load to full load. The load shall be suddenly removed and applied for each observation.

2. At average rated input speed, the preceding test shall be repeated.

3. At maximum rated input speed, the preceding test shall be repeated.

4. At no load, the input speed shall be gradually varied from minimum rated input speed to maximum rated input speed and returned. The data need be recorded only at minimum and maximum input speed conditions.

5. At 50 percent rated output load, the preceding test shall be repeated except that in addition the load shall not be adjusted.

6. At 100 percent rated output load, the preceding test shall be repeated.

7. While the transmission is operating at input speeds through the range between the minimum rated input speed and the minimum input speed for maximum continuous power rating as specified in the applicable drawing, the load shall be varied from no load to loads as specified in the applicable drawing.

b. Speed regulation at -55°C (-67°F) - Repeat parts 1 through 7 under a. at -55° ± 5°C (-67° ± 9°F). The transmission shall be subjected to ambient temperature without soaking and started and accelerated up to minimum rated input speed as specified on the applicable drawing in a period not to exceed one minute and then run for five minutes at no load before applying 50% rated load.

c. Speed regulation at 71° C (160°F) - Repeat parts 1 through 7 under a. at 71° ± 2°C (160° ± 4°F).

4.6.12 Factors Affecting Output Speed.-

4.6.12.1 Determination of Total Deviations.- Prior to each of the tests (a) through (d) below, the output speed shall be at some value termed "standard" for the purpose of this test and which lies between the limits specified on the applicable drawing. The maximum deviations of speed in both positive and negative directions from the "standard" shall be recorded for each test.

a. Ambient Temperature.- The ambient temperature shall be decreased from 25° ± 15°C (77° ± 27°F) to -55° ± 5°C (-67° ± 9°F), then increased to 71° ± 2°C (160° ± 4°F) and then decreased to 25° ± 15°C (77° ± 27°F). Each temperature shall be held for at least one hour or until the output speed stabilizes as indicated by readings taken at 10 minute intervals. The ability of the transmission to continuously deliver rated output speed at each ambient shall be demonstrated, and the values of output speed recorded. Tests will be made at any other ambient temperature between the limits specified, at the option of the Qualifying Agency.

b. Altitude.- The pressure altitude shall be varied from approximately sea level to conditions approximating 65,000 feet. Tests shall be made at intermediate altitudes at the option of the Qualifying Agency. Each altitude shall be held until the output speed stabilizes. The ambient and blast air temperatures shall be within 5°C of the maximum shown on Figure 1.

c. Position.- The transmission (or control elements if rotation of transmission is not feasible) shall be rotated by increments of no more than 90 degrees from the normal horizontal position 360 degrees about each major axis, except the vertical axis.

d. Warm-Up.- Only the larger deviation values as obtained from either (1) or (2) below shall be used in computing total deviation.

(1) The transmission shall be subjected to an ambient temperature of -55° ± 5°C (-67° ± 9°F) for at least 72 hours before operating following which the transmission shall be started and accelerated to minimum rated input speed in not more than one minute and full load applied. Readings of output speed shall be recorded immediately after starting and every two minutes until output speed stabilizes. The reading at the start of acceleration to minimum rated speed prior to addition of load shall not be considered.

(2) Repeat (d) (1) above with no load on the transmission. The above tests shall not be construed to be indicative of continuous operating requirements but merely a device with which to compute a simulated speed regulation.

The four values of maximum positive deviations recorded from tests (a) through (d) above shall be added together and the five values of maximum negative deviations shall be added together. To these sums add respectively the maximum positive and the maximum negative deviations due to changes in load and input speed at room ambient which were recorded during the test under paragraph 4.6.11a (1), (2) or (3). The total positive and the total negative deviations thus obtained shall then be

added algebraically to the "standard" value output speed separately. The transmission shall be considered acceptable if the output speed values thus obtained remain within the limits specified on the applicable drawing.

4.6.12.2 Regulation at Worst Indicated Conditions.- If the transmission is found to be not acceptable under the total deviation test above, further tests shall be run to determine regulation at the worst natural combination of indicated conditions as follows:

a. Temperature, altitude, operating position, input speed, and magnitude of load to be used for this test shall be those conditions in the tests of paragraphs 4.6.12.1 and 4.6.11a (1), (2) or (3) where the transmission was found to have the maximum positive output speed deviations. The transmission shall be placed in the worst indicated operating position and soaked for at least 72 hours (not operating) at the worst indicated ambient temperature, after which the pressure altitude shall be adjusted to its worst indicated value. Following this, the transmission shall be started and accelerated to worst indicated input speed in not more than one minute and the worst indicated load shall be immediately applied. Readings of output speed shall be recorded immediately after starting and every 2 minutes until the output speed stabilizes. The reading taken immediately after start of acceleration to the indicated input speed prior to addition of load shall not be considered. The reading taken immediately after loading will be permitted to be below the lower limit shown on the applicable drawing but all other readings shall be within the specified limits.

b. Repeat (a) above for conditions found to have maximum negative output speed deviations. The output speed shall be adjusted to the same value used in (a) above prior to starting this test. If the output speed remains within the specified limits during each test of (a) and (b) above, the transmission shall be considered to have staisfactorily fulfilled the requirements of the test for Factors Affecting Output Speed, even though the output speed values as computed by using the total deviations in paragraph 4.6.12.1 did not remain within the specified limits.

4.6.13 Stability.- The stability of the drive shall be investigated under conditions of input speed and output load variation when operating a device capable of loading the transmission and having a wr^2 within the range specified in the applicable drawing.

4.6.13.1 Speed Stability.- The input speed, after being stabilized at approximately the minimum input speed for maximum continuous power output, shall be increased to the maximum rated input speed and then decreased to the minimum input speed above at approximately the acceleration rates specified on the applicable drawing with the transmission carrying zero (device at no load), half load and full load. During these tests the output speed shall not deviate from the steady state value by more than $\pm$ 4% and shall return to and remain within 0.5% of the steady state value within 0.6 second. Evidence of sustained oscillations shall be cause for rejection.

4.6.13.2 Load Stability.- Rated transmission load shall be suddenly applied and removed with the input speed at minimum, average and maximum rated value. During these tests, the output speed shall not deviate from the steady state value by more than $\pm$ 4% and shall return to and remain within $\pm$ 0.5% of the steady state value within 0.6 second. Evidence of sustained oscillations shall be cause for rejection.

4.6.14 Parallel Operation.- These transmissions shall be capable of operating two or more aircraft AC generators in parallel under the following conditions:

4.6.14.1 Steady State Paralleling.- Under actual or simulated service conditions, including load variation, the transmission shall demonstrate that the real loads on drive generators of equal capacity shall not differ by more than 10% of the rated capacity of the generator.

4.6.14.2 Transient Paralleling.- Transient paralleling tests as follows shall be made with two transmissions driving generators having wr^2 values within the range specified by the applicable drawing, and operating generators capable of loading the transmissions to full rated capacity.

a. With no load on the generators and one prime mover adjusted to provide average rated input speed to the transmission, the other prime mover shall be accelerated and decelerated as described in paragraph 4.6.13.1.

b. With loads on the generators equivalent to 50% and then 100% rated transmission loads, the above test shall be repeated. During parts (a) and (b) neither drive shall either absorb or deliver more than the percentage as specified on the applicable drawing of the drive rating above or below its normal share of this connected load.

4.6.15 Radio Interference.- The transmission shall be designed to minimize the generation of radio interference. Enclosing case construction shall provide continuity of electrical shielding with a low radio frequency impedance path to ground and across all mechanical discontinuities.

4.6.15.1 Conducted Interference.- Conducted interference produced by operation of the unit at both full load and no load shall not exceed the requirements of MIL-I-6181 over the frequency range 0.15 to 20 mcs. The test procedures and any of the applicable test instruments listed in MIL-I-6181 shall be used.

4.6.15.2 Radiated Interference.- Radiated interference produced by operation of the unit at both full load and no load shall not exceed the requirements of MIL-I-6181 over the frequency range of 0.15 to 150 mcs. The test procedures and any of the applicable test instruments listed in MIL-I-6181 shall be used.

4.6.16 Acceleration.-

4.6.16.1 Linear.- All those portions of the transmission that might be effected by gravitational forces shall be tested by applying a sustained force equal to 10 gravitational units in both directions along each major axis of the critical part or assembly. The operation of the transmission shall not be affected in any way when these conditions are applied.

4.6.16.2 Angular.- The transmission input shall be accelerated and decelerated from the minimum input speed for maximum continuous power rating to the maximum rated input speed and back to the minimum input speed for maximum continuous power rating at the rate of 1000 rpm per second while carrying approximately full rated load as specified on the applicable drawing. The transmission shall demonstrate its ability to complete 1000 of the above cycles without failure or impairing subsequent performance.

4.6.17 Shock.- The transmission shall be mounted and ten "10G" shocks shall be applied along each of the three major axes and in both directions (60 shocks total). The transmission shall be checked for fractures, etc., the presence of which shall be cause for rejection. During this test, the maximum weight and overhung moment allowed on the applicable drawing shall be mounted in the output end.

4.6.18 Vibration.- The equipment subjected to this vibration test shall be those components of the transmission normally mounted on the airframe structure (not the engine mounted components), plus the maximum weight and overhung moment allowed by the applicable drawing attached to the output and of the transmission. This equipment shall hereafter be termed the test specimen. The transmission shall be operated at average rated input speed and rated output speed with the test specimen mounted on a suitable vibration apparatus capable of subjecting the test specimen to simple harmonic or circular motion throughout the frequency range. Whenever practicable, the functioning of the test specimen shall be checked concurrently with the operation of scanning the frequency range for resonant frequencies. The test specimen shall be mounted in a position dynamically similar to the most severe mounting likely to be encountered in service. The frequency range shall consist of varying the frequency from approximately 5 to 200 cycles per second and back to 5 cycles per second. The vibration amplitude shall be 0.025 inch (0.050 inch maximum excursion) up to 10 cycles per second, 0.015 inch (0.030 inch maximum excursion) from 10 to 50 cycles per second; above 50 cycles per second the acceleration shall be limited to 10 gravitational units. The frequency of vibration shall be continuously varied in periods between 1 and 5 minutes in length when practicable; otherwise, the frequency shall be varied in steps of approximately 10 cycles per second in periods of 5 minutes in length with additional check points to accurately determine resonant frequency points. Resonant frequencies shall be determined by varying the frequency of the applied vibration throughout the frequency range at the specified amplitudes and vibratory accelerations along three mutually perpendicular axes of the test specimen. When a resonant frequency is encountered, the test specimen shall be vibrated successively along three mutually perpendicular axis for 5 hours. When more than one resonant frequency is encountered with vibration applied to any one axis or with circular motion in any one plane, the test period shall be carried out at the most severe resonance or the period divided among the resonant frequencies, whichever is considered the most likely to produce failure. Damage or failure of any component of the test specimen that will impair proper functioning or reduce the specified life of the test specimen shall be cause for rejection.

4.6.19 Audio Noise.- The maximum allowable overall acoustical noise level of any part of the transmission shall be as low as practicable and when operating in the background of 90 decibels shall not increase the overall acoustical level by more than that indicated on the applicable drawing. The ratio R of the noise level for any octave to the overall noise level as specified above shall not exceed the values listed in Table II. Acoustical noise level measurements shall be obtained with noise level measuring equipment in meeting the requirements of Specification MIL-S-3151 or equivalent.

Table II

Frequency Octave CPS	R
75	.98
75-150	.94
150-300	.92
300-600	.90
600-1200	.84
1200-2400	.79
2400-4800	.73

4.6.20 Altitude Performance.- All those portions of the transmission that may be directly effected by altitude operations, such as cooling, lubrication and pressurization shall be tested under conditions simulating altitudes of 65,000 feet. Failure of the transmission to function properly under these conditions is cause for rejection. (Note - Figure 1 is to be considered the applicable temperature altitude reference for carrying out this test.)

4.6.21 Operating Position.- During the course of other tests it shall be ascertained that the operation of the transmission in any position does not adversely affect power input, heating, lubrication, and other operating characteristics. Full operating life shall be attainable in any position.

4.6.22 Humidity.- The relative humidity for this test shall be 95 ± 5%. The equipment shall be subjected to the test condition at 71° ± 2°C (160° ± 4°F) for six hours. The heat source shall be turned off for 16 hours without changing the total moisture content in the test space except moisture change incidental to the admission of air as the temperature drops. During the 16-hour period, the temperature must drop to 38°C (100°F) or less. Repeat a minimum of five times allowing a two-hour period to stabilize to 71°C (160°F). Check for corrosion, distortion, and general deterioration. Immediately following this test, the transmission shall be tested in accordance with Part (A) of "Normal Operation" test schedule. Failure to pass this test is cause for rejection.

4.6.23 Salt Spray.- The transmission shall be subjected to a 50-hour salt spray test in accordance with Specification QQ-M-151. Following the test, the transmission shall be washed and dried for 15 to 20 hours, then shall be tested in accordance with Part (A) of "Normal Operation" test schedule. Failure to pass this test is cause for rejection.

4.6.24 Sand Resistance.-

4.6.24.1 Apparatus.- The test apparatus shall consist of a chamber capable of maintaining uniform internal temperatures within the range of 21° and 50°C (70° and 122° F) and a relative humidity of not more than 10 percent. Maximum air velocities within the chamber shall not exceed 100 feet per minute. A sand and dust concentration of 1 ± 0.1 gram per cubic foot shall be maintained throughout the test chamber.

4.6.24.2 Test Dust.- The sand and dust used in the test shall have the following characteristics: (This sand and dust is known commercially as 140 mesh silica flour.)

(1) Particle size distribution:

100 percent of the sand and dust shall pass through a 100-mesh screen U.S.Standard Sieve Series.
98 ± 2 percent of the sand and dust shall pass through a 140 mesh screen U.S.Standard Sieve Series.
90 ± 2 percent of the sand and dust shall pass through a 200 mesh screen U.S.Standard Sieve Series.
75 ± 2 percent of the sand and dust shall pass through a 325 mesh screen U.S.Standard Sieve Series.

(2) Chemical Analysis:

Substance	Percent of Total Weight
SiO_2	97 to 99
Fe_2O_3	0 to 2
Al_2O_3	0 to 1
TiO_2	0 to 2
MgO	0 to 1
Ign Losses	0 to 2

4.6.24.3 Procedure.- The transmission shall be located within the test chamber in any position. The sand and dust concentration throughout the test chamber shall be maintained at 1 ± 0.1 gram per cubic foot. The maximum relative humidity shall not exceed 10 percent. The ambient temperature shall not be in excess of 50°C (122°F) nor below 21°C (70°F). Sand and dust laden air velocity shall not exceed 100 feet per minute. The transmission shall be tested for a total of 8 hours. The test cycle shall be composed of 30 minute operative (no load) and 90 minute inoperative periods. At the end of the test, the transmission shall be thoroughly inspected. The working parts of the mechanism shall be completely free of sand and dust that might effect the operation of the transmission. Any presence of sand and dust in the working mechanism of the transmission shall be cause for rejection.

4.6.25 Fungus.- The relative humidity for this test shall be 95 ± 5%. The temperature for this test shall be 30 ± 3°C (86° ± 5°F). The transmission shall be subjected to one fungus from each of the following groups:

Group I	Chaetomium globosum USDA 1042.4 or Myrothecium verrucaria USDA 1334.2
Group II	Rhizopus negricans S.S. 32 or Aspergillus niger USDA Tx215-4247
Group III	Aspergillus flavus AMC No. 26 or Aspergillus terreus PQMD82j
Group IV	Penicillium luteum USDA 1336.1, Penicillium sp. USDA 1336.2 or Penicillium citrinum ATCC 9848
Group V	Mennoniella echinata AMC No. 37 or Fusarium Moniliforme USDA 1004.1

Substitutions for any of the above fungi may be made if specified in detail specifications. The transmission will be either dipped in or sprayed with a spore suspension before exposure to test condition. Duration of test shall be 28 days. Any evidence of destruction or deterioration on the transmission following the test shall be cause for rejection.

4.7 Material Test Specimens.- Test specimens shall be furnished when requested by the Government for check tests at an acceptable Government laboratory to determine conformance with the applicable specification.

5. PREPARATION FOR DELIVERY

5.1 Application.- The packaging, packing, and marking requirements specified herein apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation, Packaging and Packing.- The transmissions shall be preserved and unit packaged in accordance with Specification MIL-P-5633.

5.3 Marking.- Each container shall be marked in accordance with MIL-STD-129, plus "Packed with dehydrating agent in accordance with Specification MIL-P-5633 (date)."

6. NOTES

6.1 Weights and Dimensions.- The weight and dimensions of the transmission as shown on the applicable drawing shall include the weight and dimensions of all additional equipment and materials such as coolers, pipe lines, and fluid necessary to obtain performance within the requirements of this specification.

6.2 Ordering Data.- Requisitions, contracts, and orders should include the applicable Bureau of Aeronautics Drawing number.

6.3 Provisions for Qualification Tests.- The right is reserved to reject any bids on transmissions which have not been subjected to the required tests and found satisfactory. The attention of manufacturers is called to this provision, and they are urged to request authorization for tests of the transmissions which they propose to offer to the Navy under this specification. Requests for authorization of tests and for information as to test fees involved should be addressed to the Bureau of Aeronautics, Department of the Navy, Washington 25, D. C.

6.3.1 It is to be understood that upon receipt of the letter of authorization, samples shall be furnished at no cost to the Government and that the manufacturer shall pay the transportation charges to and from the designated point where tests are to be made. In the case of failure of the sample or samples submitted, consideration will be given to the request of the manufacturer for additional tests only after it has been clearly shown that changes have been made in the product which the qualifying agency considers sufficient to warrant additional tests.

6.3.2 It is to be understood that transmissions supplied under contract shall be identical in every respect to the sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample shall constitute cause for rejection.

6.3.3 BuAer Designations.- BuAer designations shall not be used on a product, or applied to a product in correspondence or sales matter, (except qualification test samples), until notification has been received from the Bureau of Aeronautics that the product has been approved.

Patent 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 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.

TABLE I - CONTINUOUS OPERATION TEST SCHEDULE

							Temperature Degrees C						
	Time	RPM			Tors.Vib.		Oil		Air			Leakage	Effic.
Part	Hrs.	In	Out	Load	In	Out	In	Out	In	Out	Ambient	cc/hr.(a)	%
A	(b)	(f)		100%	40°	40°							
B	(c)	(c)		(d)									
	4	(e)		(h)									
	4	(f)		(i)									
	4	(g)		(i)									
C	Repeat Part B for four additional times												

NOTES:

(a) Leakage shall be checked after each indicated speed change and after each load change except cycling loads. Measurements shall be made when total leakage exceeds 2cc per hour.

(b) Operate until temperature rise of operating parts or coolant above ambient does not increase more than 1°C or 2°F in five minutes of continuous operation.

(c) Operate for 1 hour at minimum rated input speed and at each 500 RPM increment above minimum rated input speed to the maximum rated input speed inclusive.

(d) Application of Loads:

(1) No loads to be applied for the first half hour of operation at each 500 RPM increment.

(2) 100% rated load to be applied for the remaining half hour of operation at each 500 RPM increment.

(3) Full load as specified on the applicable drawing shall be applied at input speeds below the minimum input speed for 100% continuous rating.

(e) Minimum rated input speed.

(f) Average rated input speed.

(g) Maximum rated input speed.

(h) Load to be cycled as follows: 1 minute at full load as specified on the applicable drawing for input speeds below minimum input speed for 100% continuous rating, 1 minute at 50% of above load, 1 minute at no load and repeat.

(i) Load to be cycled as follows: 1 minute at 100% continuous rating, 1 minute at 50% continuous rating, 1 minute at no load and repeat.

(j) Testing may be interrupted provided that a warm-up period as indicated in note (b) precedes continuation of testing.