SPECIFICATION NUMBER 115

MARCH 25, 1962

X376 PITCH FAN FLIGHTWORTHINESS RATING TEST SPECIFICATION

VZ-11

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM

CONTRACT NUMBER DA44-177-TC-715

GENERAL ELECTRIC

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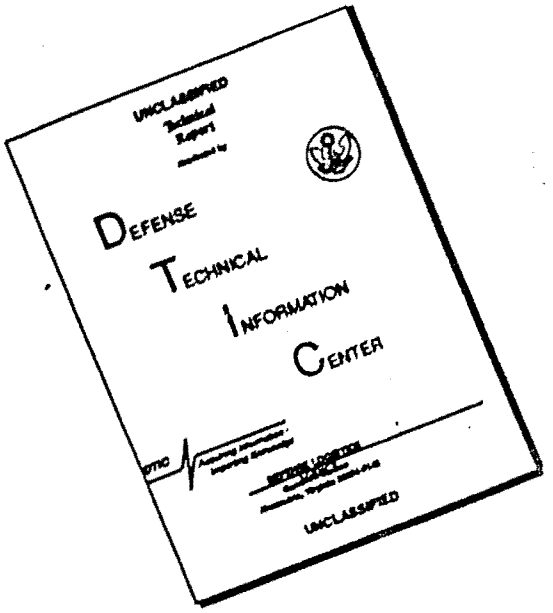

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LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM

CONTRACT DA44-177-TC-715

X376 PITCH FAN

FLIGHTWORTHINESS RATING TEST

Specification No. 115

March 25, 1962

April 19, 1962 (Revision)

APPROVAL STATUS: This specification was approved by U.S. Army TRECOM for use on this program with modifications incorporated on pages marked (1) as of April 19, 1962.

GENERAL ELECTRIC COMPANY

FLIGHT PROPULSION LABORATORY DEPARTMENT

CINCINNATI, OHIO

(1)

Modification ⟨1⟩ applies to the following pages:

i, 1, 2, 3, 4, 6, 7, 9, 11, 12, 13, 14, 18, 20, 22, and 27.

Spec. No. 115

Date March 25, 1962

Revised April 19, 1962

X376 PITCH FAN

FLIGHTWORTHINESS RATING TEST

1. SCOPE

1.1 General. - This specification defines the flightworthiness rating test requirements for the X376, ducted, pitch trim control fan.

1.2 Classification. - The General Electric X376 pitch fan is designed for supplying augmented control and trim force in V/STOL systems. It is comprised of a single stage, tip-turbine driven fan supplied with turbojet exhaust gas bleed through two separate nozzle scrolls. The double scroll arrangement provides single-engine operating capability in a two-engine, cross-ducted lift propulsion system.

2. APPLICABLE DOCUMENTS

2.1 The X376 Pitch fan Specification No. 113, and applicable publications from ANA Bulletin 343n form part of this specification in so far as specifically referenced in other paragraphs of this specification.

3. REQUIREMENTS

3.1 Test Approval. - The test shall be considered complete when the X376 pitch fan has been subjected to the specified 50 hour test. The flightworthiness rating test shall be considered satisfactory when, in the judgement of the contracting agency, the calibration is adequate, the pitch fan is operating satisfactorily at the end of the test, re-

3.2 Reports.

3.2.1 Test Reports. - Following completion of the specified 50 hour test on any test system or component, a report may be submitted to the contracting agency at the option of the contractor. This report, certified by a contracting agency representative as to proper conduct of the test, shall constitute the basis for approval of the test or any portion thereof. Penalty test required based on the test report or otherwise shall be reported as an addendum to the test report and, along with the test report, shall constitute the basis for approval of the part or parts specifically subject to the penalty test. The test report shall not include recommendations nor justifications thereof for the specific purpose of obtaining approval of any ducting or thrust reverser equipment used in the test.

3.2.1.1 Report Preparation. - The test report shall contain essentially the following information:

a. Cover: (Per the contracting agency, including title, number, source, date, author(s), and contract reference)
b. Title Page: (Same information as cover)
c. Abstract: (A brief statement of the contents of the report including the objectives)
d. Table of Contents
e. List of Illustrations
f. Summary: (A brief resume of the test conducted, including objectives, procedures, results, conclusions and recommendations)
g. Body of the report:
    1. Brief general description of the X376 pitch fan tested and a detailed description of all features which differ from the X376 Pitch Fan Specification No. 113.

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f. Summary: (A brief resume of the test conducted, including objectives, procedures, results, conclusions and recommendations)
g. Body of the report:
    1. Brief general description of the X376 pitch fan tested and a detailed description of all features which differ from the X376 Pitch Fan Specification No. 113.

2. Method of test (general description of test facility, instrumentation, equipment and methods used in conducting the test).
3. Record of test (chronological history of all events in connection with all of the testing).
4. Tabulated data of all pertinent instrument readings and all required instrument readings taken during test.
5. Calibration and recalibration data (data both in uncorrected and corrected form, if applicable, shall be shown by suitable curves).
6. Description of the condition of tested parts at disassembly inspection.
7. Analysis of results (a complete discussion of all phases of the test, including probable reasons for any failure and unusual wear, comparison of test performance with the X376 Pitch Fan Specification No. 113, and analysis of general operation).
8. Conclusions and recommendations with respect to contracting agency approval of the X376 pitch fan flightworthiness rating test, supplemented by such discussions as are necessary for their justification.

3.2.1.2 Number and distribution of copies. - Six copies of the test report and applicable addenda shall be forwarded to the contracting agency.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - All tests defined by this specification shall be conducted at the convenience of the contractor. Systems, components and test apparatus shall be subject to inspection by authorized con-

tracting agency representatives who shall be given all reasonable facilities to determine conformance with this specification. All instructions for testing of the pitch fan shall be available to the contracting agency's representative prior to the test.

4.1.1 Accuracy of Data. - For all system and component calibrations reported data shall have a steady state accuracy within the tolerances shown below. The instrumentation systems and calibration methods used by the contractor shall be subject to the approval of an authorized contract agency representative and shall be described in the test report. Calibrations shall be performed as often as necessary in the judgement of the contractor to insure the required degree of accuracy is maintained. Corrected performance data will include instrument system calibrations where appropriate in the judgement of the contractor.

ITEM OF DATA	
Fan speed	± 0.5 per cent of maximum rated speed
Fan thrust	± 5.0 per cent of maximum rated thrust
Weight	± 2.0 pounds
Other	Appropriate to the test in the judgement of the contractor

4.2 Pitch Fan Test. -

4.2.1 Test Conditions. - The test shall be conducted at the ambient conditions of the contractor's plant at Evendale, Ohio in an outdoor facility. Performance calibrations shall be obtained for wind conditions not to exceed 5 mph and with the fan mounted such that, in the judgement of the contractor, there are no appreciable effects of ground proximity influencing the ratings.

4.2.1.1 Test Apparatus. -

4.2.1.1.1 Gas Generator. - The gas generator(s) shall be either a YJ85-GE-5 or J85-GE-5 turbojet engine less afterburner and may be changed and/or maintained to the extent necessary to complete the test. Test ducting connecting the gas generator to the pitch fan shall be selected such that, in the judgement of the contractor, system conditions essentially as described in the X376 Pitch Fan Specification No. 113 shall be maintained as appropriate for test.

4.2.1.1.2 Test Arrangement. - The test arrangement may, at the contractor's option, include one gas generator providing gas for each section of the pitch fan scroll, or two gas generators. The diverter valve(s) used during the test shall be X353-5B hardware or equivalent to obtain appropriate transient test conditions.

4.2.1.1.3 Vibration Measuring Equipment. - The vibration equipment used for the measurement of component vibration shall have frequency response characteristics in accordance with the curves in Figure 1. The actual response of the vibration measuring equipment when calibrated by applying known sinusoidal motion to the pickup shall not deviate from the curves shown in Figure 1 by more than 5 per cent at frequencies up to 1000 cps.

4.2.1.1.4 Test Stand Dynamic Characteristics. - Vibratory amplitudes shall be measured with the engine operating on a test stand which has the following dynamic characteristics: the natural frequencies of the installed propulsion system shall be no higher than 50 per cent of the rated fan speed in all modes of motion which can be excited by residual rotor unbalance. In the event of simultaneous testing with the X353-5B propulsion system, the rated fan speed used for this requirement shall be the lower value.

4.2.1.2 Preliminary Data. - The major component weights and centers of gravity, photographs and other pertinent descriptive data

shall be obtained at the time the component is being prepared for test.

4.2.1.3 Operating Test Conditions. -

4.2.1.3.1 Lubrication. - The fan bearings shall each be packed with 50 grams of contractor specified grease during initial assembly. Removal of the fan hub cover (3) for bearing and instrumentation inspection shall be permitted between test cycles in accordance with the requirements of the contractor.

4.2.1.3.2 Accreditable Test Time. - Test time shall not be credited by increments shorter than 15 minutes, except when shorter periods are a test requirement.

4.2.1.3.3 Miscellaneous Data. - The date, operating schedule, test system model designation and serial number shall be recorded on each log sheet. Test configuration details shall be included in the general log.

4.2.1.3.4 Test Notes. - Notes shall be placed on the log sheets of all incidents of the run, such as leaks, vibrations, and other irregular functioning of the propulsion system components or the equipment, and corrective measures taken.

4.2.1.3.5 Gas Requirement. - The gas flow provided to each scroll shall be discharge bleed from the gas generator(s) and shall be a nominal value at rated fan speed as determined below:

$$W_{16.3} = (0.106)\ (0.992)\ (W_g + W_f) \quad \text{per scroll}$$

where: 0.106 represents 10.6% diverter valve discharge flow bleed and 0.992 represents nominal 0.8% diverter valve leakage per gas generator - diverter valve system.

4.2.1.3.6 Scroll Area Requirement. - The scroll areas of the pitch fan shall be trimmed for the flow in 4.2.1.3.5 and the total area (scroll plus excess flow bleed ducts) shall be trimmed for producing rated gas generator discharge temperature as defined in specification No. 113 at ambient conditions corresponding to 2500 feet altitude on an ANA 421 standard hot day.

4.2.1.3.7 Bleed Thrust. - The method of accounting for any extraneous thrust from the remaining gas generator(s) flow shall be subject to the approval of an authorized contracting agency representative and shall be described in the test report.

4.2.1.3.8 Ambient Conditions. - Approval of the contracting agency shall be obtained for location of the barometer pressure and ambient temperature measuring devices. A minimum stabilization time of two hours shall precede any readings for calibration or recalibration checks. Ambient conditions shall be read and recorded at intervals not exceeding one hour.

4.2.1.3.8.1 Barometer Correction. - Barometer readings shall be corrected for the difference between the mercury temperature and $32^{\circ}F$.

4.2.1.3.9 Fan Discharge Conditions. - The test equipment shall include provision for simulating fan discharge conditions corresponding to maximum, nominal, and maximum reverse thrust, steady state. Transient operation of this equipment shall not be required. The nominal thrust setting shall be established prior to test and shall be subject to the approval of the contracting agency. Equipment used to provide these test conditions may be flight or test quality at the contractor's option and its performance shall not affect the flightworthiness rating of the pitch fan.

4.2.1.3.10 Diverter Valve Adjustment. - The diverter valve doors shall be adjusted for normal closure at either terminal position. The

actuation rate shall be adjusted so that the time for full valve travel in either direction at maximum power shall not exceed one second.

4.2.1.3.11 Overspeed Signal. - The pitch fan speed signal output shall fall within the limits shown on Figure 5, "X376 Fan RPM Indicating and Limiting System for VZ-11 Flight Research Vehicle".

4.2.1.3.12 Data Correction. - Readings of thrust, rpm, airflow rate, fuel flow rate, gas pressures, and gas temperatures shall be corrected to ARDC standard sea level atmospheric conditions: Correction for humidity effect will be applied when appropriate in the judgement of the contractor. In order to determine conformance with system performance ratings, the data shall be adjusted for any difference between the test gas conditions and Specification No. 113 estimated gas conditions. Corrected values shall be obtained as follows:

$$\text{Corrected temperature, } T_c = T\left(\frac{518.688}{T_{inlet}}\right) = \frac{T}{\theta}$$

$$\text{Corrected pressure, } P_c = P\left(\frac{14.696}{P_{inlet}}\right) = \frac{P}{\delta}$$

$$\text{Corrected fan speed, } N_{fc} = N_f\sqrt{\frac{518.688}{T_{t_{2.0}}}} = \frac{N_f}{\sqrt{\theta_{2.0}}} \times C_{1h}$$

where: C_{1h} is the humidity correction, Figure 2a.

$$\text{Corrected g.g. speed, } N_{gc} = N_g\sqrt{\frac{518.688}{T_{t_{2.0}}}} \times C_{1h} = \frac{N_g}{\sqrt{\theta_{2.0}}} \times C_{1h}$$

$$\text{Corrected g.g. thrust, } F_{gc} = F_g\,\frac{14.696}{P_{t_{2.0}}} \times C_{2h} = \left(\frac{F_g}{\delta_{2.0}}\right) \times C_{2h}$$

where: C_{2h} is the humidity correction, Figure 3a.

Corrected fan thrust, $L_c = L \left(\frac{14.696}{P_{t_{2.0.0}}}\right) C_{3h} = \frac{L}{\delta_{2.0.0}} \times C_{3h}$

where: C_{3h} is the humidity correction, Figure 2b.

Corrected g.g. airflow, $W_{ac} = W_a \left(\frac{14.696}{P_{t_{2.0}}}\right) \sqrt{\frac{T_{t_{2.0}}}{518.688}} \times C_{4h} =$

$$\frac{W_a \sqrt{\theta_{2.0}}}{\delta_{2.0}} \times C_{4h}$$

where: C_{4h} is the humidity correction, Figure 3b.

Exhaust gas temperature, $T_{t_{5.1c}} = T_{t_{5.1}} \left(\frac{518.688}{T_{t_{2.0}}}\right) C_{5h} = \frac{T_{t_{5.1}}}{\theta_{2.0}} \times C_{5h}$

where: C_{5h} is the humidity correction, Figure 4a.

Corrected fuel flow, $W_{fc} = W_f \left(\frac{14.696}{P_{t_{2.0}}}\right) \sqrt{\frac{518.688}{T_{t_{2.0}}}} \times C_{6h} =$

$$\frac{W_f}{\delta_{2.0} \sqrt{\theta_{2.0}}} \times C_{6h}$$

where: C_{6h} is the correction for humidity, Figure 4b.

Corrected horsepower, $HP_{15.3c} = HP_{15.3} \left(\frac{14.696}{P_{t_{20.0}}}\right) \sqrt{\frac{518.688}{T_{t_{20.0}}}} \times C_{7h} =$

$$\frac{HP_{5.1}}{\sqrt{\theta_{20.0}}\ \delta_{20.0}} \times C_{7h}$$

where: C_{7h} is the correction for humidity: Figure 2c.

For Comparison of Pitch Fan Performance with that Based on Specification No. 113 Estimated Gas Conditions:

a. determine ideal $HP_{16\cdot3} = \frac{778}{550} T_{t8\cdot1} C_{Pg\cdot1} \left[1 - \left(\frac{P_{am}}{P_{t16\cdot3}}\right)^{\frac{\gamma-1}{\gamma}}\right] W_{g16\cdot3}$

b. correct $HP_{16\cdot3}$ to pitch fan inlet conditions

c. enter Figure 12, Specification No. 113 to obtain estimated lift for the value of horsepower calculated in (b) and compare the test result with this.

4.2.2 Endurance Tests. -

4.2.2.1 Calibrations, Checks and Adjustments. - Pitch fan performance during calibration shall be compared with rating points defined in Table I of the X376 Pitch Fan Specification No. 113. Test data shall be corrected to the rating points by application of the ideal fan laws if ambient conditions or the gas generator(s) used in the test preclude actual test demonstration.

4.2.2.1.1 Temperature Sensing System Calibration. - The engine gas temperature sensing system for the purpose of adjusting tail pipe temperature and nozzle area shall be a standard YJ85-GE-5 or J85-GE-5 engine T_5 harness, whichever is applicable, located in the diverter valve inlet in the same relative position to the gas generator and engine seal leakages recovery tubes as in the standard engine configuration. For the purpose of fan performance calculations, the indicated temperature shall be compared with a test array of thermocouples located downstream of the diverter valve. Harness calibration shall be in accordance with 4.1.1.

4.2.2.1.2 Pitch Fan Calibration. - The procedure during the calibration shall be such as to establish ARDC standard sea level static performance characteristics of the X376 pitch fan prior to the endurance run. Calibrations shall be made with the fan scroll trimmed in accordance with 4.2.1.3.5 and 4.2.1.3.6 and with the fan discharge arranged for maximum lift; deviations in fan performance which can be directly attributed to variations in actual gas generator performance shall be permitted. The following data shall be obtained:

a. Steady state data: Data required to establish compliance with applicable sea level performance characteristics displayed by Table I of the X376 Pitch Fan Specification No. 113.

b. Transient data: Data required to demonstrate thrust transients (as estimated) in paragraph 3.4.11 of Specification No. 113.

4.2.2.2 Procedure. - Following the calibration run, the control(s) shall be adjusted while in the turbojet mode to produce as closely as possible the rated steady state gas temperature and gas generator rotor speed with the power lever in the maximum thrust position and these values shall be re-established at the beginning of each cycle. With the diverter valve positioned for the lift mode a schedule of fan speed and lift versus power lever setting shall be determined which will form the basis for setting test conditions in 4.2.2.2.1 and 4.2.2.2.2.

The pitch fan shall be subjected to an endurance test consisting of ten cycles of five hours each in accordance with 4.2.2.2.1 and 4.2.2.2.2. The test runs shall be conducted in the order given unless otherwise approved by the contracting agency. Changes in order shall be considered by the contracting agency if facility utilization is thereby improved. The time for changing thrust shall be charged to the

duration at the lower setting. For all power lever movements, the power lever shall be advanced or retarded, as applicable, in not more than one second. Full diverter valve travel in either direction shall likewise be accomplished in not more than one second. The maximum and idle thrusts shall be as established by the gas generator control. During transient operations the gas generator control(s) may be adjusted, as necessary, to avoid exceeding maximum allowable conditions, provided the adjustments are within the mechanical adjustment limits furnished with the X353-5B propulsion system.

The test shall consist of two parts defined in 4.2.2.2.1 and 4.2.2.2.2.

4.2.2.2.1 Part 1. - Part 1 is a cyclic power endurance test and shall consist of six five-hour cycles to be conducted in accordance with the schedule listed below, using inlet air at ambient temperature. The fan discharge conditions shall correspond to the nominal thrust setting, T = nominal, except as noted in any specific run:

a. Maximum-idle thrust run (60 minutes):
This run shall consist of six successive periods of 10 minutes each, including 5 minutes with the power lever in the maximum thrust position and 5 minutes with the power lever in the idle position as follows:

First 3 periods	-	turbojet mode (c.o.)[a]
Period 4	-	lift mode, T = nominal
Period 5	-	lift mode, T = maximum reverse
Period 6	-	lift mode, T = maximum

[a]Runs marked (c.o.) are not a requirement but may be inserted at the contractor's option in order to permit performance of this test schedule in conjunction with Specification No. 114.

Power Lever Position	τ
Maximum	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal

e. Extended maximum thrust run (18 minutes):
This run shall consist of one period in the turbojet mode at maximum power lever setting (c.o.).

f. Normal thrust run (18 minutes):
This run shall consist of one period in the turbojet mode at the normal continuous power lever setting (c.o.).

g. Short maximum lift run (8 minutes):
This run shall consist of one period in the lift mode, at maximum lift (τ = maximum).

h. Maximum reverse thrust - maximum thrust run (40 minutes):
This run shall consist of eight periods of 5 minutes each at alternate conditions of maximum reverse thrust and maximum turbojet thrust via power transfers using the diverter valve as follows:

Power Lever Position	T
Maximum	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal
"	Maximum Reverse
"	Maximum
"	Maximum Reverse
"	Nominal

e. Extended maximum thrust run (18 minutes):
This run shall consist of one period in the turbojet mode at maximum power lever setting (c.o.).

f. Normal thrust run (18 minutes):
This run shall consist of one period in the turbojet mode at the normal continuous power lever setting (c.o.).

g. Short maximum lift run (8 minutes):
This run shall consist of one period in the lift mode, at maximum lift (T = maximum).

h. Maximum reverse thrust - maximum thrust run (40 minutes):
This run shall consist of eight periods of 5 minutes each at alternate conditions of maximum reverse thrust and maximum turbojet thrust via power transfers using the diverter valve as follows:

Mode	τ	Diverter Valve Schedule
L	Max. Rev.	
TJ	-	simultaneous
L	Max. Rev.	simultaneous
TJ	-	simultaneous
L	Max. Rev.	simultaneous
TJ	-	sequential - 10 sec. delay (optional)
L	Max. Rev.	simultaneous
TJ/L	Max. Rev.	{one valve TJ mode / one valve L mode} (optional)

i. Idle thrust - idle lift - maximum lift run (14 minutes): This run shall consist of seven periods of 2 minutes duration each at alternate conditions of idle turbojet thrust and lift via power transfer with the diverter valve, including lift mode throttle bursts, as follows:

Power Setting	Mode	τ	Diverter Valve Schedule
Idle	TJ		
"	L	Max.	simultaneous
Max.	L	Max.	
"	TJ		simultaneous
Idle	TJ		
"	L	Max.	simultaneous
Max.	L	Max.	

4.2.2.2.2 Part 2. - Part 2 is a constant power endurance test and shall consist of four five-hour cycles in accordance with the schedule listed below using inlet air and fuel at ambient conditions:

a. Take off simulation run (90 minutes):
This run shall consist of nine periods of 10 minutes

duration each, as follows:

Power Setting	Mode	τ	
Idle	TJ	-	(c.o.)
"	L	Max.	
Max.	L	Max.	
"	L	Nom.	
"	L	Nom.	
"	L	Nom.	
"	L	Max. Rev.	
Normal Continuous	L	Max. Rev.	
Max.	L	Max. Rev.	

b. Conversion simulation run (100 minutes):

This run shall consist of five periods of 20 minutes duration each, as follows:

Power Setting	Mode	τ	Diverter Valve Schedule
Max.	L	Max. Rev.	
"	TJ/L	Max. Rev.	{one valve TJ / one valve L} (optional)
"	TJ	-	both valves (c.o.)
Idle	TJ	-	(c.o.)
"	L	Max. Rev.	simultaneous

c. Landing simulation run (110 minutes):

This run shall consist of 11 periods of 10 minutes duration each, as follows:

Power Setting	Mode	T	Notes
3200 rpm	L	Max. Rev.	Power setting shall be
3400 "	L	Max. Rev.	adjusted as necessary to
3600 "	L	Max. Rev.	conform with Specification
3800 "	L	Nom.	No. 114 during tests in-
Max.	L	Nom.	volving both the X376 and
"	L	Nom.	X353-5B fans.
"	L	Nom.	
3800 rpm	L	Max.	
Max.	L	Max.	
Idle	L	Max.	
"	TJ	-	(valves, simultaneous) (c.o.)

4.2.2.2.3 Starts. - A minimum of five starts shall be made during the test each preceded by a one-hour minimum shutdown. All starts shall be performed in the turbojet mode with the standard engine air impingement system using the contractor's shop air supply system.

4.2.2.2.4 Test Options. -

4.2.2.2.4.1 Inlet Closure. - An inlet closure may be installed during portions of part 2 of the endurance test at the contractor's option.

4.2.2.2.4.2 Maximum Bleed Flow. - One cycle of part 1 and one cycle of part 2 may be run at the pitch fan high lift setting as specified in Specification No. 113 at the contractor's option.

4.2.2.2.5 Additional Runs. - Additional runs may be incorporated as part of the endurance test upon mutual agreement by the contractor and the contracting agency. This test time shall be deducted from the endurance test time at the nearest equivalent condition.

4.2.2.2.6 Data. -

4.2.2.2.6.1 Steady State Data. - During the endurance test, except for the transient runs, the following data shall be recorded at intervals not greater than 30 minutes:

Time of day
Total endurance time, hours:minutes
Ambient dry bulb temperature, ^{o}F
Ambient wet bulb temperature, ^{o}F
Wind velocity, mph
Wind direction
Power lever position, degrees
Fan discharge setting (T)
Diverter valve position, degrees
Scroll area, sq. in.
Cruise nozzle area, sq. in. } if readjusted
Data for determining trim bleed flow
Engine(s) rotor speed, rpm
Fan rotor speed, rpm
Vertical lift, lb.
Fuel consumption, lb/hr.
Data for determining engine(s) air flow
Engine inlet total temperature, ^{o}F
Fan inlet total temperature, ^{o}F
Engine turbine discharge total pressure, psig
Engine turbine discharge total temperature, EGT, ^{o}F
Engine and fan vibrations, mils peak to peak
Optional:
- Fan bearing temperatures, ^{o}F
- J85 lube oil temperature, ^{o}F
- J85 lube oil pressure, psig
- J85 compressor discharge pressure, psig
- Fuel manifold pressure, psig

4.2.2.2.6.2 Transient Data. - For each transient test performed in 4.2.2.1.2 "b" and 4.2.2.2.1 "c" the maximum values of measured engine T_5 harness temperature, fuel flow, engine speed, fan speed and power lever position or diverter valve position attained during the transient shall be read and recorded. Periodic checks of fuel boost pressure and diverter valve actuator pressure shall be read and recorded throughout the test.

4.2.2.2.6.3 Starting Data. - During the starts performed under 4.2.2.2.3 the following data shall be recorded for each start performed:

Start number

Optional:

- Time to ignition, sec.
- Time to starter cut out, sec.
- Time to stabilize idle rpm, sec.
- Speed of engine and fan, rpm, at:
  - ignition
  - starter cut out
  - idle
- Maximum measured EGT, ^{o}F
- Running time during which the measured EGT exceeds a temperature $20^{o}F$ below the maximum allowable starting temperature for the particular engine model used, sec.

Torque versus rpm calibration shall not be required, data presented in Figures 48 and 49, X353-5B Propulsion System Specification No. 112 shall be considered adequate.

4.2.2.3 Recalibrations. -

4.2.2.3.1 Pitch Fan Recalibration. - After completion of the tests specified in 4.2.2.2, a recalibration check run in accordance with the requirements of 4.2.2.1.2 "a" and "b" shall be made on the

endurance test pitch fan with γ = maximum. The recalibration check run shall be conducted with the gas generator adjusted to produce as closely as possible under standard sea level static conditions the values of measured gas temperature and engine speed obtained during the initial calibration and with pitch fan scroll areas trimmed per 4.2.1.3.5. During this run the corrected lift shall be not less than 95% of the initial calibration exclusive of changes attributable directly to the gas generator. Transient performance shall be demonstrated. The check run may be preceded by a run-in period during which a cleaning procedure recommended for field use by the contractor and approved by the contracting agency may be applied.

4.2.2.3.2 Temperature Sensing System Recalibration. - Prior to the propulsion system recalibration specified in 4.2.2.3.1 the indicated temperature shall be compared with a test array of thermocouples located downstream of the diverter valve. Harness calibration shall be in accordance with 4.1.1.

4.3 Pitch Fan Components Test. -

4.3.1 Previous Components Approval. - Fan components requiring testing as specified herein may have these tests waived at the option of the contracting agency if the component has been previously approved for Service use on another engine or by other equivalent tests. All such components must be substantially identical with the components previously approved with exception of provisions for engine mounting.

4.3.2 Electrical Components Proof Test. - No proof tests shall be required on the electrical components including electrical connectors and interconnecting cables which are provided with the pitch fan.

4.4 Teardown Inspection. - After completion of the tests, the pitch fan shall be completely disassembled for examination of all parts

and measured as necessary to disclose excessively worn, distorted, or weakened parts. These measurements shall be compared with the contractor's drawing dimensions and tolerances, or with similar measurements made prior to the test when available.

4.5 General Inspection. - All tests shall be subject to witnessing by a contracting agency representative. At convenient times prior to the tests and during the teardown inspection the pitch fan 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 pitch fan be disassembled or removed for examination or cleaning without prior approval of the contracting agency except as specified in 4.2.1.3.1. Field maintenance and minor part replacement to the extent identified in the X376 Maintenance Instructions applicable to the flight-worthiness rating test shall be permitted between five-hour test cycles without penalty to the accumulated test time.

5. PREPARATION FOR DELIVERY

5.1 Not applicable

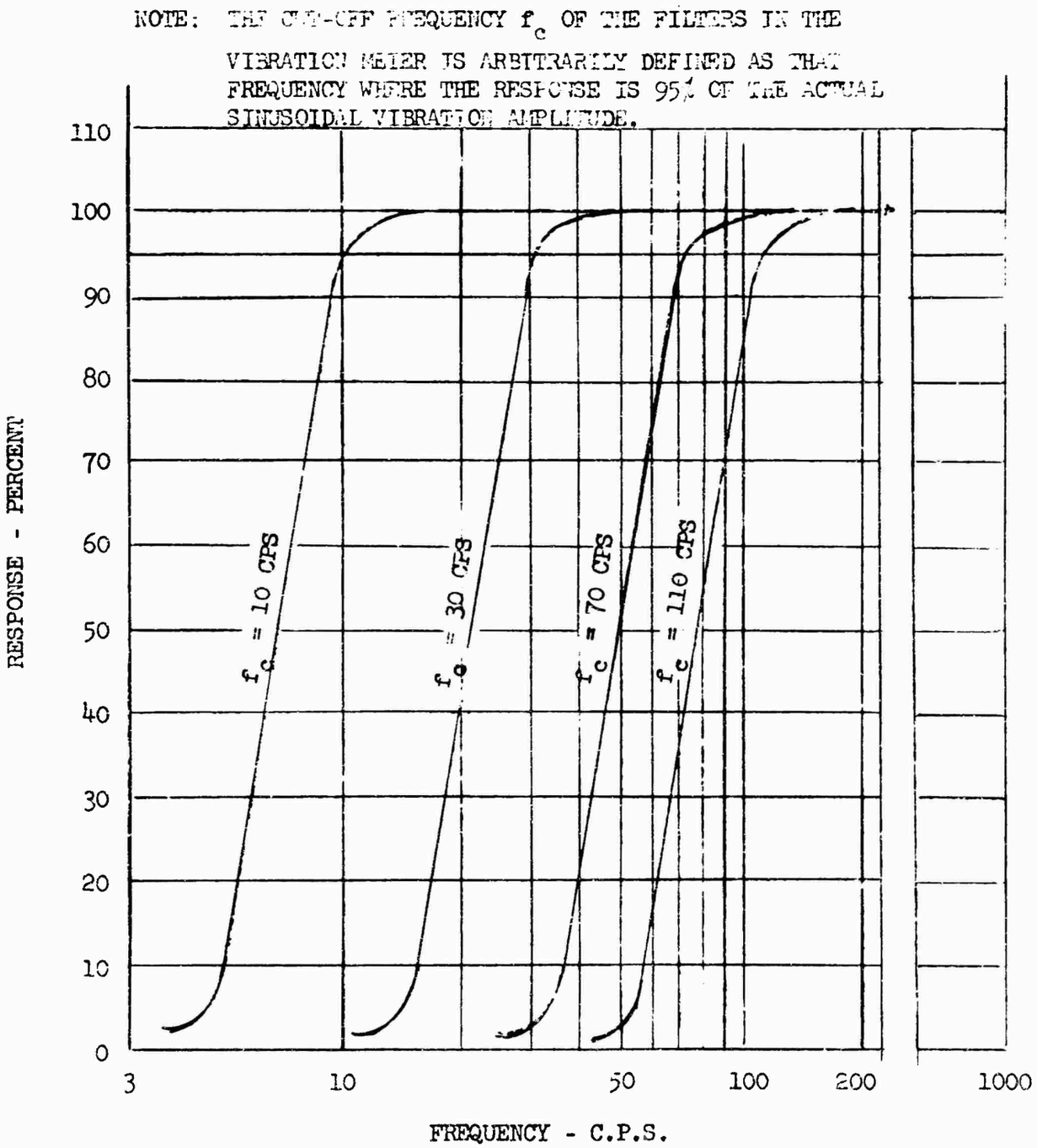
6. NOTES

6.1 Intended Use. - This specification defines the test requirements for a ducted, pitch trim control fan which will have a flight-worthiness rating established with the objective of insuring that the pitch fan has a sufficient durability and reliability to permit experimental flight test.

6.2 Definitions and Symbols. - The definitions and symbols used in this specification are as specified in the X376 Pitch Fan Specification No. 113 and, where this is not inclusive, in MIL-E-5007B.

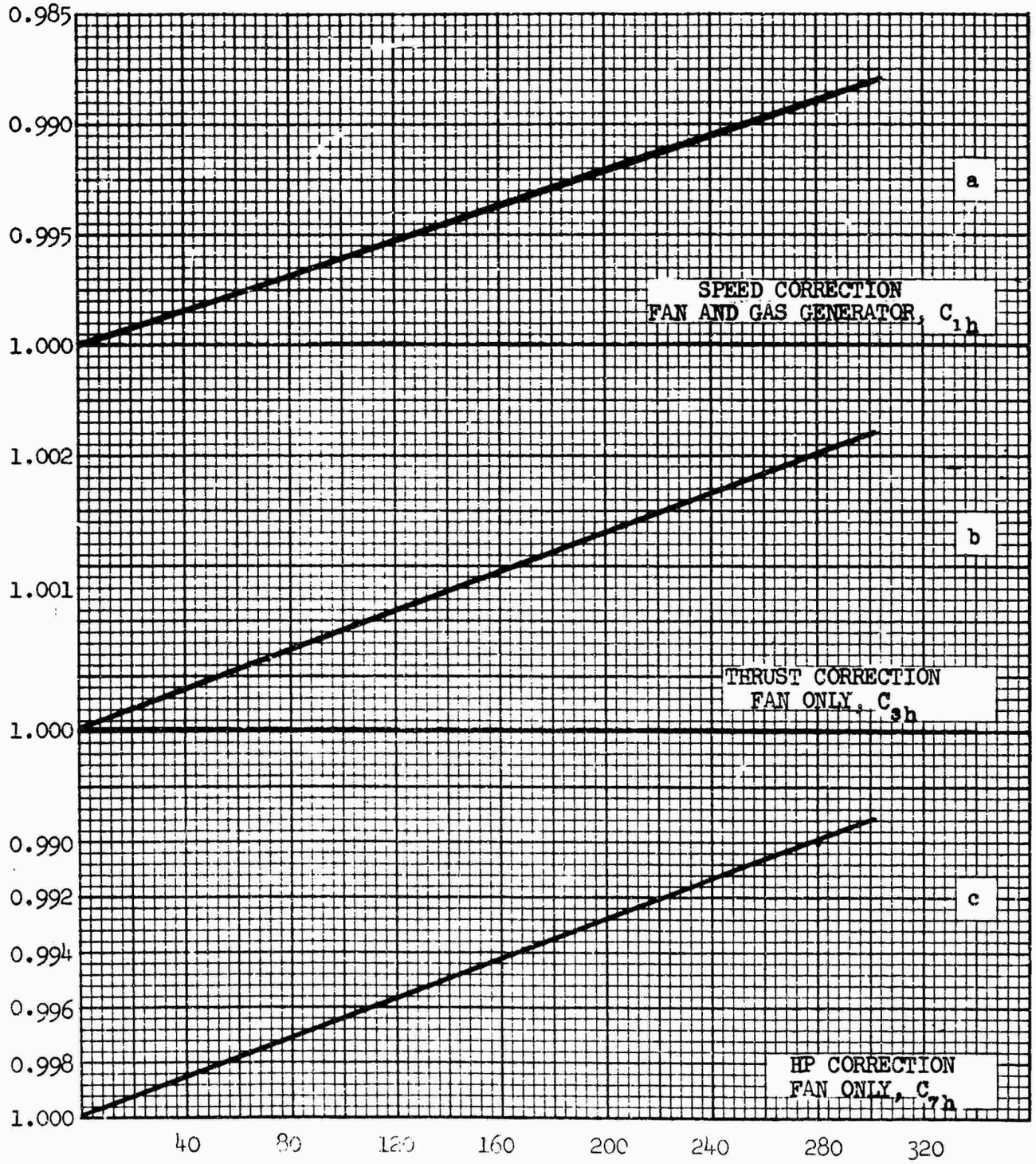
Custodian:
U.S. Army (TRECOM)

Preparing Organization:
The General Electric Company



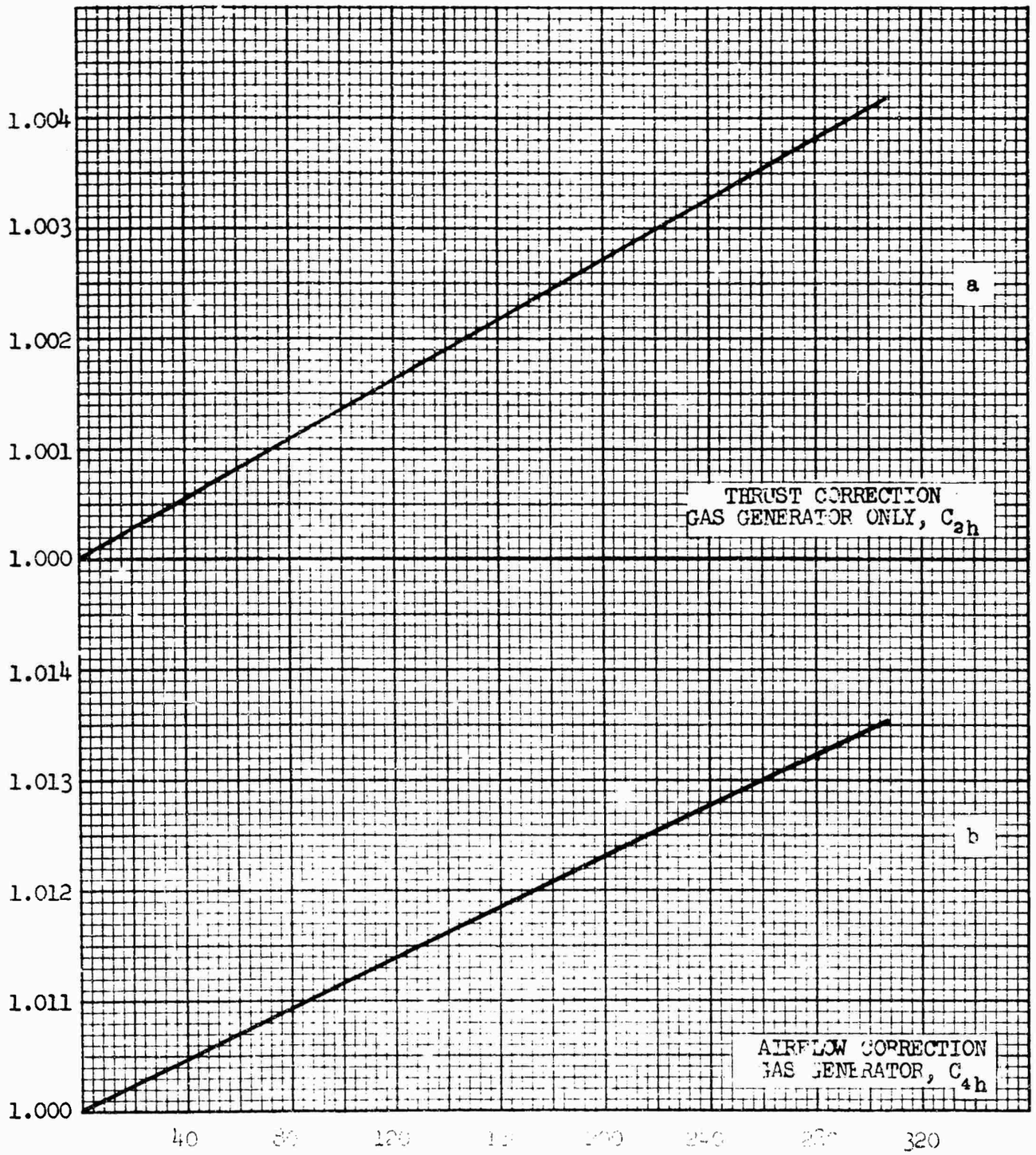
Frequency response characteristics

Figure 1



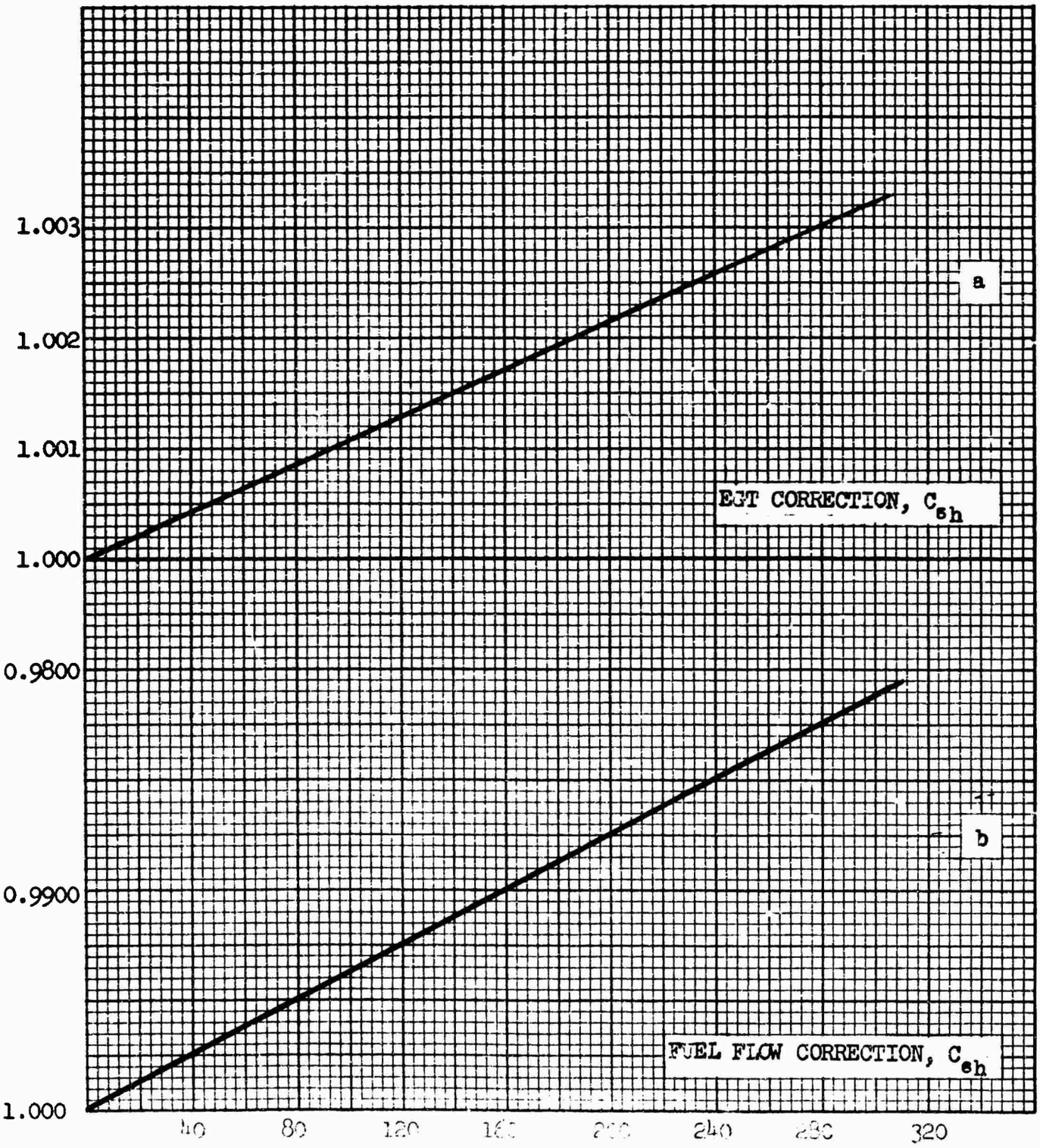
HUMIDITY CORRECTION FACTORS

Figure 2 a, b, c

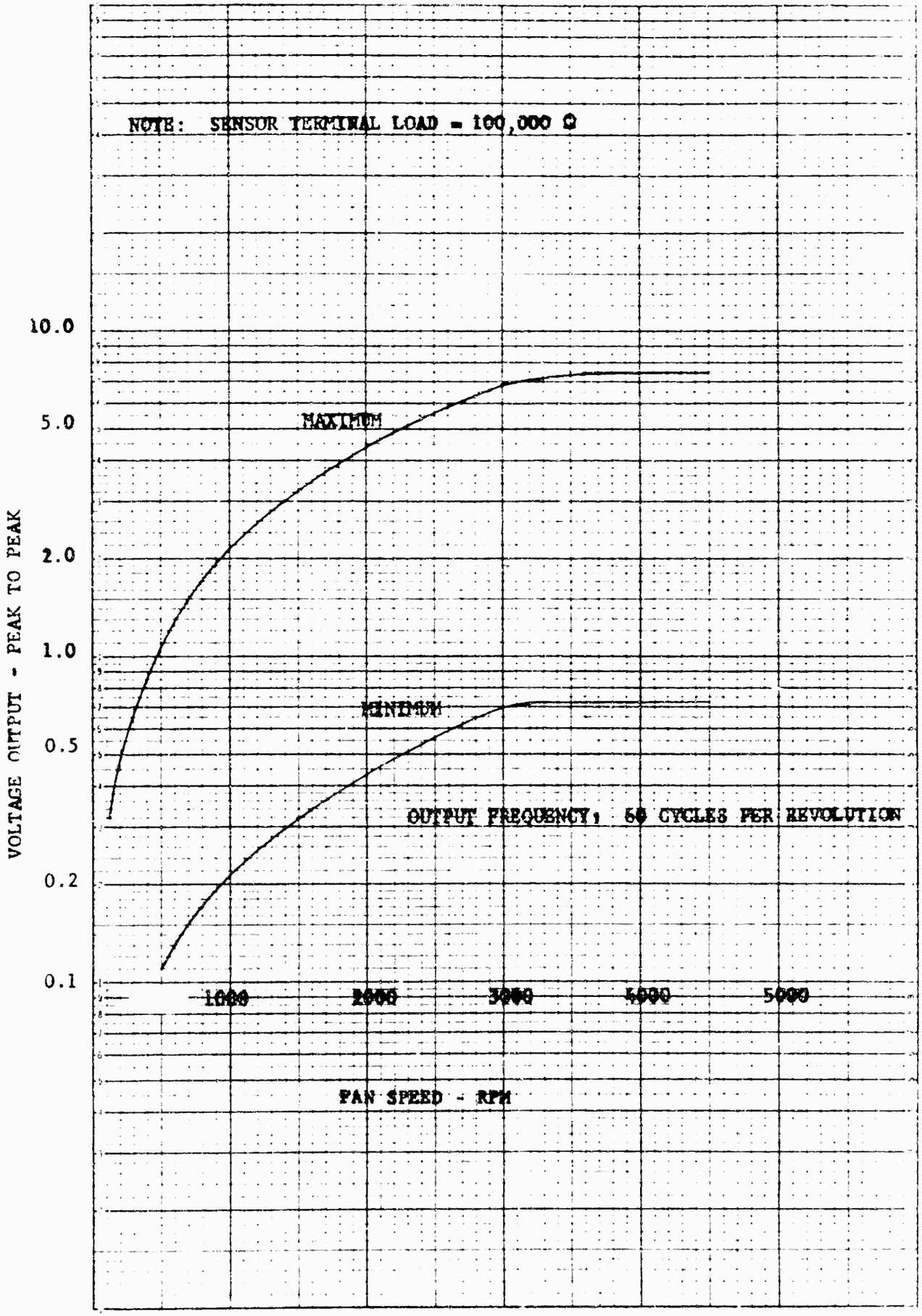


ATMOSPHERIC CORRECTION FACTORS

Fig. 3 (a)



HUMIDITY CORRECTION FACTORS



X376 RPM INDICATING AND LIMITING SYSTEM FOR VZ-11 FLIGHT RESEARCH VEHICLE

Figure 5