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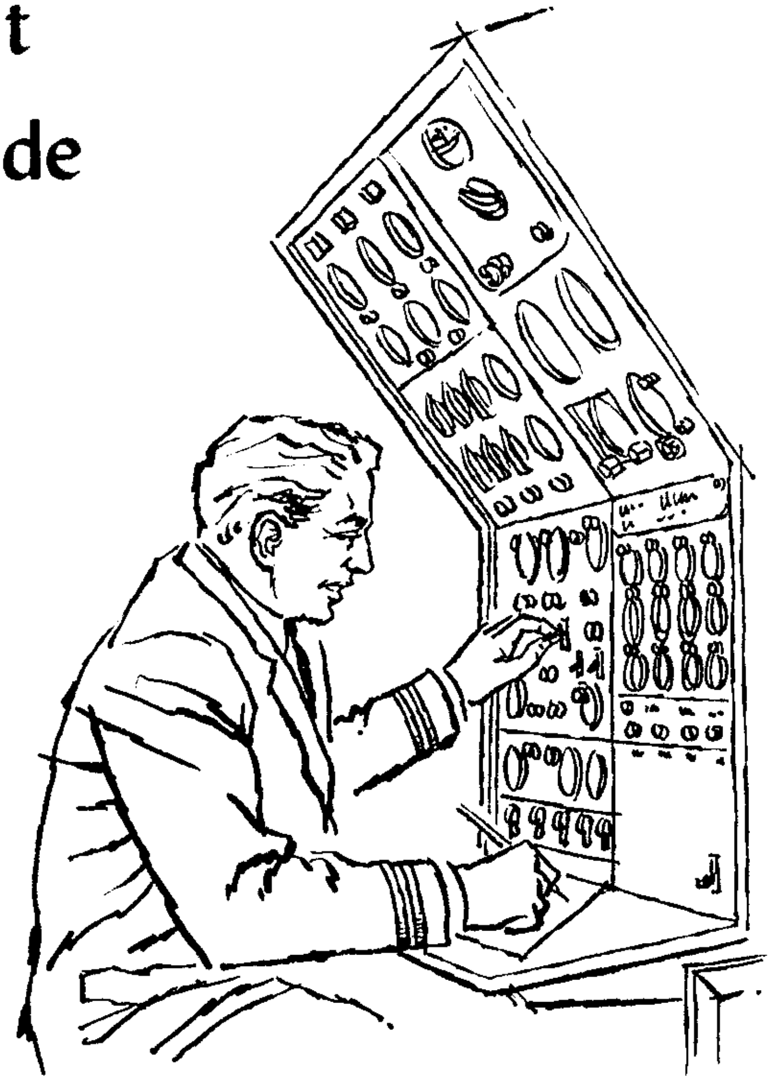
AC 63-1B

For Sale

FLIGHT ENGINEER

Written Test Guide



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

FLIGHT ENGINEER WRITTEN TEST GUIDE

1971

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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FLIGHT ENGINEER WRITTEN TEST GUIDE

INTRODUCTION

The Flight Standards Service of the Federal Aviation Administration has issued this *Flight Engineer Written Test Guide* as Advisory Circular 63–1B to provide information to prospective flight engineers and others interested in this certification area. It cancels the previous edition, AC 63–1A. The new guide contains information about certification requirements and describes the type and scope of the written test. It lists appropriate study and reference material and presents sample questions similar to those found in the official written tests.

As a further convenience to the applicant, those portions of the present Federal Aviation Regulations concerning general eligibility and aeronautical experience requirements have been included. Applicants should be aware, however, that regulations are subject to amendment. Any question regarding the currency of these quoted excerpts should be checked with the appropriate FAA office.

The written tests are designed to measure the aeronautical knowledge of the prospective flight engineer on an air carrier aircraft. The flight engineer is primarily a technical expert, who must be thoroughly familiar with the operation and function of various components of his aircraft. His specific duties vary with different aircraft and with different air carriers. The flight engineer written tests place major emphasis on the normal and emergency duties of an air carrier flight engineer and on his required understanding of systems and components related to a particular powerplant class aircraft.

ELIGIBILITY REQUIREMENTS FOR CERTIFICATION

The following excerpts from the Federal Aviation Regulations, Part 63, pertaining to eligibility, are given for the convenience of the applicant:

§ 63.31 Eligibility requirements: general.

To be eligible for a flight engineer certificate, a person must—

(a) Be at least 21 years of age;

(b) Be able to read, speak, and understand the English language, or have an appropriate limitation placed on his flight engineer certificate;

(c) Hold at least a second-class medical certificate issued under Part 67 of this chapter within the 12 months before the date he applies, or other evidence of medical qualification accepted for the issue of a flight engineer certificate under § 63.42; and

(d) Comply with the requirements of this Subpart that apply to the rating he seeks.

§ 63.37 Aeronautical experience requirements.

(a) Except as otherwise specified therein, the flight time used to satisfy the aeronautical experience requirements of paragraph (b) of this section must have been obtained on an airplane—

(1) On which a flight engineer is required by this chapter; or

(2) That has at least three engines that are rated at least 800 horsepower each or the equivalent in turbine-powered engines.

(b) An applicant for a flight engineer certificate with a class rating must present, for the class rating sought, satisfactory evidence of one of the following:

(1) At least three years of diversified practical experience in aircraft and aircraft engine maintenance (of which at least one year was in maintaining multiengine aircraft with engines rated at least 800 horsepower each, or the equivalent in turbine engine powered aircraft), and at least five hours of flight training in the duties of a flight engineer.

(2) Graduation from at least a two-year specialized aeronautical training course in maintaining aircraft and aircraft engines (of which at least six calendar months were in maintaining multiengine aircraft with engines rated at least 800 horsepower each, or the equivalent in turbine engine powered aircraft), and at least five hours of flight training in the duties of a flight engineer.

(3) A degree in aeronautical, electrical, or mechanical engineering from a recognized college, university, or engineering school; at least six calendar months of practical experience in maintaining multiengine aircraft with engines rated at least 800 horsepower each, or the equivalent in turbine engine powered aircraft; and at least five hours of flight training in the duties of a flight engineer.

(4) At least 200 hours of flight time in a transport category airplane (or in a military airplane with at least two engines and at least equivalent weight and horsepower) as pilot in command or second in command performing the functions of a pilot in command under the supervision of a pilot in command.

(5) At least 100 hours of flight time as a flight engineer.

(6) Within the 90-day period before he applies, successful completion of an approved flight engineer ground and flight course of instruction as provided in Appendix C of this part [Part 63].

TYPE OF WRITTEN TESTS

An applicant for a flight engineer certificate must pass a Basic Written Test and a Class Rating Written Test appropriate to the class of aircraft on which he desires to be rated.

The Flight Engineer Basic Written Test consists of items pertaining to:

- Federal Aviation Regulations
- Theory of Flight and Elementary Aerodynamics
- Basic Meteorology with respect to engine operations
- Center of Gravity Computations

The Flight Engineer Class Rating Written Tests are related to a particular powerplant class of airplane and are titled:

- Flight Engineer—Reciprocating Engine Written Test
- Flight Engineer—Turboprop Written Test
- Flight Engineer—Turbojet Written Test

The Class Rating Written Test consists of items pertaining to:

- Airplane Systems and Equipment
- Powerplant Systems and Equipment
- Normal Operating Procedures
- Emergency Procedures

Test items are multiple-choice, similar to those in the sample written test in this guide. Questions are designed to determine whether the applicant has an adequate knowledge of fundamental principles and whether he can apply that knowledge to problems encountered in flight operations. Many items are based upon charts, graphs, and diagrams similar to those found in this study guide.

The applicant marks his answers on a special answer sheet. He should read the instructions very carefully before beginning the test. Incomplete or erroneous personal information entered on the scoring sheet delays the scoring process.

A minimum grade of 70 percent is required to pass a Basic or Class Rating Written Test.

The applicant is notified of his grade on the Airman Written Examination Report, Form 8060–37, which he receives for each test. The report also contains coded indications of the subject matter involved in test items which the applicant missed. A Written Examination Subject Matter Outline is provided to relate the codes to specific topics. The study outlines contained in this Guide are similar to the Subject Matter Outlines the applicant receives with Form 8060–37. An applicant who receives a failing grade must present the appropriate Form 8060–37 when he appears for re-examination.

TAKING THE WRITTEN TESTS

The written tests may be taken at FAA Air Carrier and General Aviation District Offices of the Flight Standards Service, and at selected

Flight Service Stations. A test must be started in sufficient time to permit its completion during the normal working day. To save time, applicants should plan to use a computer or slide rule in solving weight and balance problems and in performing other computations. After completing the test, the applicant must surrender the answer sheet to the proctor, together with any papers used for computations or notations, before leaving the examination room.

When taking the test, the applicant should keep the following points in mind:

1. Each question or problem should be read carefully before looking at the possible answers. The applicant should clearly understand the problem before attempting to solve it.
2. After formulating his own answer, the applicant should determine which of the alternative answers most nearly corresponds with his answer. The answer chosen should completely resolve the problem.
3. From the answers given, it may appear that there is more than one possible answer; however, there is only one answer that is correct and complete. The other answers are either incomplete or derived from popular misconceptions.
4. If a particular test item proves difficult, it is best to proceed to another question. After the less difficult questions have been answered, the others should then be reconsidered.
5. There are no "trick" questions in the test.

SCOPE OF THE WRITTEN TESTS

All test items used in official Flight Engineer Written Tests are related to topics in the study outlines in this guide. An applicant who is thoroughly prepared in the subject matter and who follows the procedures recommended in this guide should have no difficulty in satisfactorily completing the written tests. The suggested topics for study are directly associated with the normal and emergency flight engineer duties.

When studying the topics listed in the outline, the prospective flight engineer should be concerned primarily with basic principles underlying the performance and operation of transport aircraft.

It is suggested that the applicant study only the topics listed for the basic test and those indicated for the particular class airplane on which he desires a class rating. Maximum utilization of hours available for study can be obtained by concentrating on applicable topics. Unnecessary study of topics related to other powerplant class airplanes may reduce the applicant's degree of readiness to pass the test on the rating he desires.

RECOMMENDED STUDY MATERIALS

The publications listed in this section will be helpful to persons studying for the flight engineer written tests. A variety of additional textual material which can be helpful in preparing for the written test is available from various publishers, manufacturers, and operators. Textbook publishers will usually furnish a listing of their available publications in a specific area of information. Most public and institutional libraries maintain technical reference sections and will assist interested persons in locating materials for study. Flight manuals, operation manuals, maintenance manuals, and technical booklets concerning transport category airplanes and equipment are also good information sources.

It is the responsibility of each applicant to obtain study materials appropriate to his needs.

Federal Aviation Regulations

Part 1. *Definitions and Abbreviations*—This part lists the official abbreviations and definitions used in the Federal Aviation Regulations. (Vol I $1.50 [+50¢ foreign mailing].)

Part 63. *Certification: Flight Crewmembers Other Than Pilots*—The applicant should be thoroughly familiar with the provisions of this part pertaining to the flight engineer. (Vol IX $6.00 [+$1.50 foreign mailing].)

Part 121. *Certification and Operations: Air Carriers and Commercial Operators of Large Aircraft*—This part provides the source material for most of the test items on Federal Aviation Regulations appearing in the tests. (Vol VII $6.50 [+$1.35 foreign mailing].)

Important Notice

The Federal Aviation Administration has issued the Federal Aviation Regulations (FAR) in a volume system to be sold on a subscription basis by the Superintendent of Documents.

The purchase of a FAR volume will establish your subscription service with the Superintendent of Documents for automatic receipt of changes to the volume as issued by FAA.

The volume structure is:

Volume	*FAR Part*
I	1.
II	11, 13, 15, 21, 37, 39, 45, 47, 49, 183, 185, 187, 189.
III	23, 25, 36.
IV	27, 29, 31, 33, 35.
V	43, 145, 149.
VI	91, 93, 99, 101, 103, 105.
VII	121, 123, 127, 129.
VIII	133, 135, 137.
IX	61, 63, 65, 67, 141, 143, 147.
X	151, 153, 155, 159, 165, 167.
XI	71, 73, 75, 77, 95, 97, 157, 169, 171.

Study Manuals

Aerodynamics for Naval Aviators, NAVAIR 00–80T–80—($3.50). 217.2: AE8/965. This textbook is a valuable source of information dealing with the aerodynamics of subsonic and supersonic flight. It also contains excellent chapters on aircraft and engine performance of reciprocating engine, turboprop, and turbojet aircraft.

Pilot's Weight and Balance Handbook, Advisory Circular 91–23—($0.70). TD 4.408:P64/3. This publication provides instruction on weight and balance terms, methods, and theory. It contains information relating to the control of loading of large aircraft. Practical examples are used throughout the text including problems similar to those used in this guide.

Aviation Weather, Advisory Circular 00–6—($4.00). FAA 5.8/2: W37. This joint FAA-National Weather Service publication provides an authoritative text on meteorology for the aircrew member. It gives the prospective engineer a practical understanding of those meteorological principles important to aviation and to aircraft operations.

HOW TO OBTAIN STUDY MATERIALS

The study materials listed previously may be obtained by remitting check or money order to:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402.

Orders for mailing or shipping to foreign countries should include an additional amount of about one-fourth of the total purchase price for postage. Remittance for orders from foreign countries should be by International Money Order or by a draft on a U.S. bank.

How to Get GPO Publications Promptly:

(1) Use an order form, not a letter, unless absolutely necessary. Order forms, *which may be duplicated by the user*, are included in the catalog "FAA Publications," sent free upon request from:

Department of Transportation
Distribution Unit, TAD 484.3
Washington, D.C. 20590

(2) Send separate orders for a subscription and a non-subscription item.

(3) Get the exact name of the publication, the agency number, and the catalog number.

(4) Send a check or money order, not cash. Send the exact amount.

(5) Enclose a self-addressed mailing label if you have no order blank.

(6) Use special delivery when needed.

(7) Use GPO bookstores—they give priority mail order service.

The retail GPO bookstores now in being are located at the following addresses:

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U.S. Government Printing Office
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GPO Bookstore
Federal Building
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450 Golden Gate Avenue
San Francisco, Calif. 94102

GPO Bookstore
Federal Office Building
Room 1463 14th Floor
219 South Dearborn Street
Chicago, Illinois 60604

GPO Bookstore
Federal Building
300 N. Los Angeles Street
Los Angeles, California 90012

GPO Bookstore
Federal Building
Room 135
601 East 12th Street
Kansas City, Mo. 64106

GPO Bookstore
Room G25
John F. Kennedy Federal Building
Sudbury St.
Boston, Massachusetts 02203

424-713 O-71—2

FLIGHT ENGINEER BASIC STUDY OUTLINE

General and flight engineer regulations

A01. General Definitions—FAR 1.1.
A02. Abbreviations and symbols—FAR 1.2.
A03. Flight Engineer Certificates—FAR 63.1 through 63.16.
A04. Written test requirements—FAR 63.17 and 63.18.
A05. Certificate, logbook, and record rules—FAR 63.19 through 63.21.
A06. Eligibility requirements—FAR 63.31.
A07. Aircraft ratings—FAR 63.33.
A08. Knowledge requirements—FAR 63.35.
A09. Aeronautical experience requirements—FAR 63.37.
A10. Skill requirements—FAR 63.39.
A11. Retesting, courses, and exchange—FAR 63.41 through 63.45.

General air carrier rules

B01. General Certification Requirements—FAR 121.1 through 121.11.
B02. Carriage of drugs—FAR 121.15.
B03. Air Carrier operating rules—FAR 121.71 through 121.81.
B04. Manual requirements—FAR 121.131 through 121.141.

Certification and operation of air carriers

C01. Airplane performance—FAR 121.171 through 121.207.
C02. Cabin interiors—FAR 121.215 through 121.219.
C03. Fire precautions, cabin and cargo compartment—FAR 121.221 and 121.223.
C04. Powerplant fire precautions—FAR 121.225 through 121.261.
C05. Fire detection, extinguishing, and failures—FAR 121.263 through 121.283.
C06. Cargo in passenger compartment—FAR 121.285 and 121.287.
C07. Landing gear warning devices—FAR 121.289.
C08. Demonstration of emergency evacuation—FAR 121.291.

Instrument and equipment requirements

D01. Instrument and equipment, flight and navigational—FAR 121.303 and 121.305.
D02. Engine instruments—FAR 121.307.
D03. Emergency equipment—FAR 121.309 and 121.310.
D04. Miscellaneous equipment—FAR 121.311 through 121.321.
D05. Equipment for night and IFR—FAR 121.323 and 121.325.
D06. Oxygen requirements—FAR 121.327 through 121.337.
D07. Overwater and icing equipment—FAR 121.339 through 121.341.
D08. Flight recorders—FAR 121.343.
D09. Radio and radar—FAR 121.345 through 121.357.
D10. Voice recorders—FAR 121.359.
D11. Maintenance requirements—FAR 121.363 through 121.379.

Airman and crewmember requirements

E01. Limitations on airman services—FAR 121.383.
E02. Composition of flight crew—FAR 121.385 and 121.387.
E03. Emergency duties—FAR 121.397.
E04. Training programs—FAR 121.400 through 121.415.
E05. Crewmember emergency training—FAR 121.417.
E06. Differences training—FAR 121.418.
E07. Ground training—FAR 121.419.
E08. Flight training—FAR 121.425.
E09. Recurrent training—FAR 121.427.
E10. Flight Engineer qualifications—FAR 121.453.
E11. Flight time limitations, Domestic—FAR 121.471.

E12. Flight time limitations, Flag—FAR 121.483, 121.489 through 121.493.

E13. Flight time limitations, Supplemental—FAR 121.511 through 121.521.

Flight operations and dispatch

F01. Flight operations responsibility—FAR 121.533 through 121.541.

F02. Crewmembers at controls—FAR 121.543 and 121.545.

F03. Admission to flight deck and locks—FAR 121.547 and 121.587.

F04. Flying equipment and rules—FAR 121.549 through 121.569.

F05. Passenger briefing—FAR 121.571 and 121.573.

F06. Alcoholic beverages—FAR 121.575.

F07. Carrying persons in all-cargo aircraft—FAR 121.583.

F08. Weapons, flight compartment door—FAR 121.585 and 121.587.

F09. Carry-on baggage—FAR 121.589.

F10. Continuing flight in unsafe conditions—FAR 121.627.

F11. Operations in icing conditions—FAR 121.629.

F12. Fuel supply—FAR 121.639, 121.641, and 121.647.

Records and reports

G01. Dispatch release—FAR 121.685 and 121.687.

G02. Load manifest—FAR 121.691 and 121.695.

G03. Maintenance records and logs—FAR 121.699 and 121.701.

G04. Mechanical reliability and interruption—FAR 121.703 and 121.705.

G05. Repair and airworthiness release—FAR 121.707 and 121.709.

G06. Crewmember Certificate—FAR 121.721 and 121.723.

Theory of flight and aerodynamics

H01. Airspeed measurement.

H02. Airfoil terminology.

H03. Lift and stall characteristics.

H04. Drag characteristics.

H05. Flight efficiency, L/D ratio.

H06. High-lift devices.

H07. Subsonic and transonic flight.

H08. Supersonic flight.

Airplane performance

I01. Required thrust and power.

I02. Takeoff performance.

I03. Climb performance.

I04. Range and endurance.

I05. Maneuvering performance.

I06. Descent and landing performance.

I07. Stability.

I08. Control and trim devices.

I09. Operating limitations.

I10. Flight loads, maneuvers, and gusts.

I11. Wake turbulence.

Basic meteorology

J01. Standard atmosphere.

J02. Troposphere, tropopause, stratosphere.

J03. Pressure altitude, density altitude, and altimeter setting.

J04. Effect of temperature and density variations.

J05. Effect of pressure variations.

J06. Effect of humidity variations.

J07. Icing conditions and effects.

J08. Visible moisture, weather.

J09. Jet stream.

J10. Speed of sound.

J11. Turbulence.

Center of gravity computations

K01. Weight and balance definitions.

K02. Calculate c.g. from given weights.

K03. Calculate basic or total index.

K04. Adding or removing payload.

K05. C.G. shift with fuel burn.

K06. Fuel dumping calculations.

K07. Effect of landing gear retraction.

K08. Shifting payload.

K09. Weight and limit check.

K10. Fore and aft limit variations.

K11. Effect of c.g. on trim setting.

K12. Effect of c.g. on flight characteristics.

K13. Use of loading charts and tables.

K14. Use of loading or c.g. calculators.

K15. Compartment loading limits.

K16. Cargo security.

FLIGHT ENGINEER CLASS RATING STUDY OUTLINES

The applicant for a Flight Engineer Class Rating needs to be familiar with construction features and component functions; normal operations; trouble analysis; and isolation and correction of faults in the airplane and powerplant systems relevant to the Class Rating which he seeks. He also needs to know the proper procedures for ground and inflight emergencies, as well as the reasons for operating in an approved manner and the possible effects if improper methods are used.

FLIGHT ENGINEER—RECIPROCATING ENGINE

Airplane systems—general

A01. Basic airframe, cabin, and flight deck.
A02. Hydraulic reservoirs, accumulators, pumps, regulators, and valves.
A03. Hydraulic systems, principles, and operation.
A04. Landing gear, nose wheel steering, wheels, and tires.
A05. Brake system.
A06. Flap system.
A07. Flight controls and trim systems.
A08. Wing and tail ice protection.
A09. Windshield ice and rain protection.
A10. Pitot-static and miscellaneous ice protection.
A11. Fuel system components.
A12. Fuel system controls and indicators.
A13. Fuel dumping, fueling, and defueling.
A14. Fuel system management.

Electrical and instrument systems

B01. Theory of DC electricity.
B02. DC generators.
B03. Generator control and regulating system.
B04. Electrical indicating systems.
B05. Battery and ground power.
B06. Miscellaneous circuits.
B07. Theory of AC electricity.
B08. Alternators and inverters.
B09. AC electrical circuits.
B10. Instrument power sources.
B11. Flight and navigation instruments.
B12. Pitot-static system.
B13. Miscellaneous instruments.
B14. Airspeed and altitude indications.

Emergency systems

C01. Warning indicators and lights.
C02. Fire and smoke detection system.
C03. Fire extinguisher system.
C04. Portable fire extinguishers.
C05. Crew and passenger oxygen systems.
C06. Miscellaneous emergency equipment.

Pressurization and air conditioning

D01. Pressurization principles.
D02. Cabin supercharger and drive.
D03. Cabin pressurization, regulation, and control.
D04. Calculations for cabin pressurization.
D05. Adjustment of cabin pressurization settings.
D06. Air conditioning and ventilation.
D07. Heating systems.
D08. Cooling systems.
D09. Adjustment of cabin temperature controls.

Reciprocating engines

E01. Twin-row radial engine components.
E02. Operating principles and characteristics.
E03. Factors affecting operation.
E04. Supercharging and power recovery systems.
E05. Lubrication system.
E06. Engine limitations.
E07. Engine computations.
E08. Torquemeter system.

Engine accessory systems

F01. Low-tension ignition.
F02. Spark plugs, harness, and switch.
F03. Carburetion principles.
F04. Pressure carburetor system.
F05. Direct injection system.
F06. Anti-detonant injection.

F07. Ice control system.
F08. Starter system.
F09. Engine instrument power sources.
F10. Power and temperature instruments.
F11. Engine analyzer.

Propeller systems

G01. Principles of constant speed propellers.
G02. Feather and reverse systems.
G03. Synchronization system.
G04. Auto-feather system.
G05. Propeller ice control.
G06. Overspeed protection.

Powerplant systems operation

H01. Preflight inspection.
H02. Starting procedure.
H03. Abnormal starting indications and actions.
H04. Ground operation check procedures.
H05. Analysis of ground check indications.
H06. Power and temperature control for takeoff.
H07. Climb power and blower shift procedures.
H08. Setting cruise power.
H09. RPM, manifold pressure, and BMEP control.
H10. Effects of density altitude, temperature, and humidity.
H11. Ram, icing, and carburetor heat effects.
H12. Control adjustments for descent and landing.
H13. Shutdown procedures.
H14. Effects of exceeding powerplant limitations.

Cruise and power computations

I01. Cruise control principles.
I02. Fuel consumption in climb.
I03. Use of constant power schedules.
I04. Use of long-range cruise procedures.
I05. Calculation of fuel burnout and fuel remaining.
I06. Prediction of fuel required.
I07. Prediction of landing weight.
I08. Fuel consumption with an engine shutdown.
I09. RPM, BMEP, and power relationships.
I10. Specific range.
I11. Power, fuel, and performance charts.

Emergency operation of systems

J01. Hydraulic system trouble shooting.
J02. Emergency landing gear extension.
J03. Emergency brake operation.
J04. Emergency flap extension.
J05. Asymmetric flaps.
J06. Pressurization and air conditioning troubles.
J07. Shutdown of cabin compressors.
J08. Manual control of cabin pressure.
J09. Manual control of cabin temperature.
J10. Emergency depressurization.
J11. Fuel dumping procedure and calculations.
J12. Fuselage fire procedure.
J13. Smoke evacuation.
J14. Landing gear and brake fires.
J15. Electrical system trouble analysis.
J16. Electrical load reduction procedure.
J17. Electrical fire procedure.
J18. Generator overheat procedure.

Emergency operation of powerplants

K01. Engine fire indications.
K02. Engine fire procedure.
K03. Engine failure procedure.
K04. Engine trouble analysis.
K05. Procedures for propeller malfunction.
K06. Unfeathering and airstart procedures.

FLIGHT ENGINEER—TURBOPROP

Airplane systems—general

A01. Basic airframe, cabin, and flight deck.
A02. Autopilot.
A03. Hydraulic reservoirs, accumulators, pumps, regulators, and valves.
A04. Landing gear, trucks, wheels, and tires.
A05. Brakes and anti-skid system.
A06. Nose wheel steering.
A07. Trailing edge flaps.
A08. Flap asymmetry system.
A09. Flight controls, spoilers, speed brakes, and trim system.
A10. Cockpit windshield, ice and rain protection.
A11. Pitot-static, wing, and tail ice protection.
A12. Fuel system components.
A13. Fuel system controls and indicators.
A14. Aircraft fueling, defueling, and dumping.

Electrical and instrument systems

B01. Theory of DC electricity.
B02. Transformer-rectifiers.
B03. Electrical indicating systems.
B04. Batteries and circuits.
B05. DC electrical circuits.
B06. Theory of AC electricity.

B07. AC generators.
B08. AC generator control and regulating systems.
B09. AC bus and distribution systems.
B10. Constant speed drive.
B11. Ground power system.
B12. AC electrical circuits.
B13. Operation of electrical systems.
B14. Instrument power sources.
B15. Flight and navigation instruments.
B16. Altimeter settings and indications.
B17. Pitot-static systems.
B18. Air temperature indications.
B19. Airspeed and altitude indications.

Emergency systems

C01. Warning indicators and lights.
C02. Fire and smoke detector systems.
C03. Fire extinguisher systems.
C04. Portable fire extinguishers.
C05. Crew and passenger oxygen systems.
C06. Miscellaneous emergency equipment.

Pressurization, air conditioning, and pneumatic systems

D01. Cabin compressor and drive.
D02. Pressurization principles.
D03. Pressurization regulation and control.
D04. Calculations for cabin pressurization.
D05. Adjustment of cabin pressurization settings.
D06. Air conditioning and ventilation.
D07. Heating systems.
D08. Cooling systems.
D09. Adjustment of cabin temperature controls.
D10. Pneumatic power sources.
D11. Pneumatic system regulation and control.
D12. Overheat and malfunction protection.
D13. Operation of the pneumatic system.

Turboprop engines

E01. Basic engine components.
E02. Operating principles and characteristics.
E03. Accessories and drives.
E04. Lubrication system.
E05. Temperature control and regulation.
E06. Engine limitations.
E07. Engine computations.
E08. Reduction gear box.
E09. Torque-sensing devices.
E10. Sensing elements and purposes.

Engine accessory systems

F01. Fuel control.
F02. Fuel and propeller coordinator.
F03. Bleed air system.
F04. Anti-icing systems.
F05. Starter system.
F06. Ignition system.
F07. Engine instrument power sources.
F08. Power and temperature instruments.

Propeller system

G01. Principles of turboprop propellers.
G02. BETA range principles.
G03. Constant speed principles.
G04. Manual feather and unfeather.
G05. Auto-feather.
G06. Speed and phase synchronization.
G07. Negative thrust sensing.
G08. Propeller ice control.

Powerplant systems operation

H01. Preflight inspection.
H02. Starting procedures.
H03. Abnormal starting indications and actions.
H04. Effects of exceeding powerplant limitations.
H05. BETA range operation.
H06. Ground checks and analysis.
H07. Setting takeoff power and thrust.
H08. Effects of air temperature and density.
H09. Effects of using engine bleed air.
H10. Control adjustments during climb.
H11. Setting cruise power or thrust.
H12. Control adjustments for descent and landing.
H13. Monitoring the powerplant during ground operation and shutdown.

Cruise and power computations

I01. Cruise control principles and definitions.
I02. Fuel consumption in climb.
I03. Use of constant power or temperature cruise procedures.
I04. Use of long-range cruise procedures.
I05. Calculation of fuel burnout and fuel remaining.
I06. Computing fuel required.
I07. Fuel consumption with an engine shutdown.
I08. Performance charts.
I09. Specific range.

Emergency operation of systems

J01. Hydraulic system trouble shooting.
J02. Emergency landing gear extension.
J03. Emergency brake operation.
J04. Emergency flap extension.
J05. Asymmetric flaps.
J06. Pressurization and air conditioning troubles.
J07. Shutdown of cabin compressors.
J08. Manual control of cabin pressure.
J09. Manual control of cabin temperature.
J10. Emergency depressurization.
J11. Fuel dumping procedure and calculations.
J12. Fuselage fire procedure.
J13. Smoke evacuation.
J14. Landing gear and brake fires.
J15. Electrical system trouble analysis.
J16. Electrical load reduction procedure.
J17. Electrical fire procedure.
J18. Generator and CSD malfunction procedure.
J19. Emergency operation of flight controls.

Emergency operation of powerplants

K01. Engine fire indications.
K02. Engine fire procedure.
K03. Engine failure procedure.
K04. Engine trouble analysis.
K05. Procedures for propeller malfunction.
K06. Unfeathering and airstart procedures.
K07. Control adjustments for partial failure.

FLIGHT ENGINEER—TURBOJET

Airplane systems—general

A01. Basic airframe, cabin, and flight deck.
A02. Autopilot and yaw damper.
A03. Adjustable stabilizer.
A04. Hydraulic reservoirs, accumulators, pumps, regulators, and valves.
A05. Landing gear, trucks, wheels, and tires.
A06. Brakes and anti-skid system.
A07. Nose wheel steering.
A08. Trailing edge flaps, leading edge flaps, slats, and slots.
A09. Flap asymmetry system.
A10. Flight controls, spoilers, speed brakes, and trim system.
A11. Cockpit windshield, ice and rain protection.
A12. Pitot-static, wing, and tail ice protection.
A13. Fuel system components.
A14. Fuel system controls and indicators.
A15. Aircraft fueling, defueling, and dumping.

Electrical and instrument systems

B01. Theory of DC electricity.
B02. Transformer–rectifiers.
B03. Electrical indicating systems.
B04. Batteries and circuits.
B05. DC electrical circuits.
B06. Theory of AC electricity.
B07. AC generators.
B08. AC generator control and regulating systems.
B09. AC bus and distribution systems.
B10. Constant speed drive.
B11. Ground power system.
B12. AC electrical circuits.
B13. AC electrical computations.
B14. Operation of electrical systems.
B15. Instrument power sources.
B16. Flight and navigation instruments.
B17. Altimeter settings and indications.
B18. Pitot-static systems.
B19. Air temperature indications.
B20. Airspeed and altitude indications.

Emergency systems

C01. Warning indicators and lights.
C02. Fire and smoke detector systems.
C03. Fire extinguisher systems.
C04. Portable fire extinguishers.
C05. Crew and passenger oxygen systems.
C06. Miscellaneous emergency equipment.

Pressurization, air conditioning, and pneumatic systems

D01. Turbocompressor systems.
D02. Bleed air pressurization.
D03. Pressurization principles.
D04. Pressurization regulation and control.
D05. Calculations for cabin pressurization.
D06. Adjustment of cabin pressurization settings.
D07. Air conditioning and ventilation.
D08. Heating systems.
D09. Cooling systems.
D10. Adjustment of cabin temperature controls.
D11. Pneumatic power sources.
D12. Pneumatic system regulation and control.
D13. Overheat and malfunction protection.
D14. Operation of the pneumatic system.

Turbojet engines

E01. Basic engine components.
E02. Operating principles and characteristics.

E03. Accessories and drives.
E04. Cooling systems.
E05. Fans and bypass.
E06. Lubrication system.
E07. Temperature control and regulation.
E08. Engine limitations.
E09. Sensing elements and purposes.

Engine accessory systems

F01. Fuel control.
F02. Fuel system accessories.
F03. Bleed air system.
F04. Anti-icing system.
F05. Starter system.
F06. Ignition system.
F07. Thrust reverser.
F08. Engine instrument power sources.
F09. Power and temperature instruments.
F10. Vibration monitoring.

Powerplant systems operation

H01. Preflight inspection.
H02. Starting procedures.
H03. Abnormal starting indications and actions.
H04. Effects of exceeding powerplant limitations.
H05. Ground checks and analysis.
H06. Setting takeoff power and thrust.
H07. Effects of air temperature and density.
H08. Effects of using engine bleed air.
H09. Control adjustments during climb.
H10. Setting cruise power or thrust.
H11. Control adjustments for descent and landing.
H12. Monitoring the powerplant during ground operation and shutdown.

Cruise and power computations

I01. Cruise control principles and definitions.
I02. Fuel consumption in climb.
I03. Use of constant Mach cruise procedures.
I04. Use of long-range cruise procedures.
I05. Calculation of fuel burnout and fuel remaining.
I06. Computing fuel required.
I07. Fuel consumption with an engine shutdown.
I08. Power computations.
I09. Performance charts.
I10. Specific range.

Emergency operation of systems

J01. Hydraulic system trouble shooting.
J02. Emergency landing gear extension.
J03. Emergency brake operation.
J04. Emergency flap extension.
J05. Asymmetric flaps.
J06. Pressurization and air conditioning troubles.
J07. Shutdown of cabin compressors.
J08. Manual control of cabin pressure.
J09. Manual control of cabin temperature.
J10. Emergency depressurization.
J11. Fuel dumping procedure and calculations.
J12. Fuselage fire procedure.
J13. Smoke evacuation.
J14. Landing gear and brake fires.
J15. Electrical system trouble analysis.
J16. Electrical load reduction procedure.
J17. Electrical fire procedure.
J18. Generator and CSD malfunction procedure.
J19. Emergency operation of flight controls and horizontal stabilizer.

Emergency operation of powerplants

K01. Engine fire indications.
K02. Engine fire procedure.
K03. Engine failure procedure.
K04. Engine trouble analysis.
K05. Airstart procedure.
K06. Control adjustments for partial failure.

High-speed aerodynamics

L01. Aerodynamic definitions.
L02. Mach number versus true airspeed.
L03. Effect of wing "sweepback," advantages and disadvantages.

SAMPLE WRITTEN TESTS

The following sample written tests are provided to familiarize the applicant with the types of questions contained in the official FAA tests. The sample questions do not cover all topics included in the official tests; therefore, the applicant should not necessarily consider himself prepared if he successfully completes the appropriate sample written tests. To be adequately prepared, the applicant should study all the topics for the Basic Test and for the appropriate Class Rating Test included in the sections entitled "Flight Engineer Basic Study Outline" and "Flight Engineer Class Rating Study Outlines." Answers to the sample tests and explanations of questions are given in a separate section at the end of the sample written test.

NOTE.—The reader should be aware that the sample questions are based on regulations and procedures in effect at the time of preparation of this guide. Questions in the official FAA written tests should always be answered in terms of current regulations and procedures.

424-713 O-71—3

FLIGHT ENGINEER BASIC TEST

1. Which of the following speed symbol definitions are correct for transport category airplanes?

A. V_{MC} is the minimum control speed with all engines operative.

B. V_{SO} is the stalling speed with gear and flaps in landing configuration.

C. V_{LE} is the maximum speed at which the landing gear can be raised or lowered.

D. V_{MO}/M_{MO} is the maximum operating limit speed.

1—B and D.

2—A and B.

3—C and D.

4—A and C.

2. A temporary flight engineer certificate remains in effect—

1—indefinitely unless surrendered or revoked.

2—a maximum of 60 days.

3—for 30 days or until a permanent certificate is issued.

4—for no longer than 90 days.

3. Which of the following is an aircraft class rating appropriate for a Flight Engineer Certificate?

1—Multi-engine land.

2—Propeller driven.

3—Three or four engine, fanjet.

4—Turbojet powered.

4. Which class of cargo and baggage compartments require the installation of FAA approved smoke or fire detectors designed to provide a warning at the pilot or flight engineer station?

1—Class B, C, and D compartments.

2—Class C and D compartments.

3—Class B, C, and E compartments.

4—Class A, B, C, and E compartments.

5. The carriage of cargo aft of the rearmost seated passengers in the passenger compartment is—

1—permissible only if the cargo is carried in an approved cargo bin.

2—permissible if carried either in a cargo bin or tied securely to the floor and properly wrapped.

3—not permissible if the aircraft is used on a domestic or flag carrier route.

4—not permissible.

6. In accordance with FAR 121, above which cabin-pressure altitude must each air carrier crewmember on flight deck duty start using oxygen?

1—8,000 ft.

2—14,000 ft.

3—12,000 ft.

4—10,000 ft.

7. An approved flight recorder is required equipment for FAR Part 121 operations on—

1—only those turbine-powered aircraft certificated for operations above 35,000 ft.

2—all transport category aircraft certificated for operations above 10,000 ft.

3—all turbine-powered aircraft of more than 12,500 pounds maximum certificated takeoff weight.

4—all piston-engine-powered aircraft certificated for operations above 20,000 ft.

8. What action must be taken if a required flight engineer becomes incapacitated during flight?

1—Another qualified flight crewmember must be assigned the emergency Flight Engineer duties.

2—The flight must be diverted to the nearest suitable airport.

3—A pilot who holds a valid flight engineer certificate must occupy the flight engineer station.

4—The pilot-in-command must assign the flight engineer duties to the pilot who is second-in-command.

9. Which of the following examples of "recent experience" qualifies the flight engineer to be assigned to flight engineer duties on a domestic air carrier operating under FAR Part 121?

1—50 hours of experience in the preceding 6 months as flight engineer on any aircraft which incorporates a flight engineer station.

2—50 hours of experience in the preceding 6 months as flight engineer on the type of aircraft on which he is to serve.

3—50 hours of experience in the preceding 12 months as flight engineer on the type of aircraft on which he is to serve.

4—50 hours of experience in the preceding 12 months as flight engineer on any aircraft which incorporates a flight engineer station.

10. A flight engineer is scheduled for 12 hours of flight duty on a domestic air carrier within 24 consecutive hours. If his aircraft arrives at the first layover point after a 5-hour flight, how many hours of rest must he have before the next departure?

1—12 hours.

2— 8 hours.

3—24 hours.

4—10 hours.

11. Calibrated airspeed is determined by correcting—

1—indicated airspeed for instrument and position error.

2—equivalent airspeed for density altitude.

3—indicated airspeed for compressibility effects.

4—equivalent airspeed for pressure altitude and aircraft gross weight.

12. The stall angle of attack of an airplane—

1—varies with the gross weight and the center of gravity location.

2—remains constant regardless of gross weight and density altitude.

3—decreases as density altitude increases.

4—increases as gross weight increases.

13. Which device allows the use of a high angle of attack because it delays air flow separation over the wing?

1—Slotted flap.

2—Fowler flap.

3—Spoiler.

4—Slot.

14. Abnormally high headwinds or tailwinds have an effect upon the airplane performance with regard to the airspeed necessary to obtain—

1—the maximum rate of climb.

2—maximum range.

3—the maximum angle of climb.

4—maximum endurance.

15. Wake turbulence produced by large aircraft in flight is—

1—greatest at high weights and low airspeeds.

2—primarily caused by jet engine exhaust.

3—greatest at high airspeeds.

4—produced by downwash over the tail surfaces.

16. A decrease of one inch of mercury (barometric pressure) in the lower troposphere, would result in a change (or error) in the altimeter reading of approximately—

1—plus 1,000 ft.

2—minus 1,000 ft.

3—plus 100 ft.

4—minus 100 ft.

17. The speed of sound in the atmosphere increases when—

1—temperature decreases.

2—pressure decreases.

3—temperature increases.

4—pressure increases.

18. Zero fuel weight is defined as—

1—empty weight plus passengers and cargo.

2—basic operating weight plus passengers and cargo.

3—empty weight plus crew, passengers, and cargo.

4—basic operating weight plus crew, passengers, and cargo.

19. An airplane with an empty weight of 80,000 lbs. has an empty c.g. located 405.0 inches aft of the datum. The airplane is then loaded as follows:

Item		*Index Unit*
Fuel	—18,000 lbs.	572.0
Oil	— 900 lbs.	17.6
Crew	— 800 lbs.	12.3
Passengers	— 4,800 lbs.	241.9

Reduction Factor=10,000
(Moments÷Reduction Factor=Index Unit

What is the location of the c.g. in inches aft of the datum when the airplane is loaded?

1—318.1″ aft of the datum.
2—409.9″ aft of the datum.
3—390.8″ aft of the datum.
4—378.5″ aft of the datum.

20. An airplane has a mean aerodynamic chord of 175 inches and has the center of gravity limits illustrated in Figure 1. What is the center of gravity range when this airplane is loaded to a weight of 112,500 lbs?

1—21.5″.
2—38.8″.
3—22.9″.
4—40.1″.

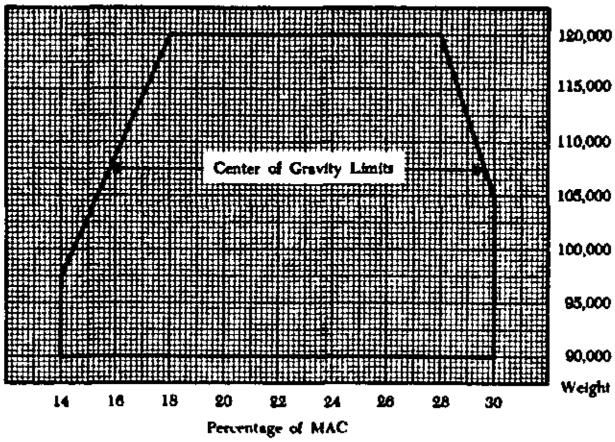


FIGURE 1. Center of gravity limit chart.

FLIGHT ENGINEER RECIPROCATING ENGINE TEST

1. What is the function of the lockout cylinder located in the landing gear and brake system?

   1—To reduce the hydraulic system pressure to a value which will minimize nose wheel shimmy.
   2—To ensure that the landing gear will lock in the down position when it has been lowered by gravity in the event of a hydraulic system failure.
   3—To allow the use of a nitrogen cylinder to actuate the brakes in the event of a hydraulic system failure.
   4—To prevent the loss of hydraulic system pressure in the event of a brake line failure.

2. When checking the electrical system, a satisfactory indication of engine instrument power would be—

   1— 26v AC.
   2—115v AC.
   3—110v AC.
   4— 30v AC.

3. A thermocouple of a typical fire-warning system causes the system to actuate because—

   1—heat increases its electrical resistance.
   2—it expands when heated and forms an electrical ground for the warning light and bell circuit.
   3—heat decreases its electrical resistance.
   4—it generates a small current when it becomes hot.

4. In what position should the mixture control normally be set for starting a reciprocating engine equipped with a *pressure-injection carburetor?*

   1—Manual lean.
   2—Auto-rich.
   3—Idle-cutoff.
   4—Auto-lean or manual lean.

5. The expansion turbine in a cooling system is driven by—

   1—the engine through a drive shaft.
   2—outside ram air.
   3—discharge air from the superchargers.
   4—a direct current electric motor.

6. The hopper in the oil tank is installed for the purpose of—

   1—maintaining an oil reserve in the event of tank failure.
   2—providing sufficient oil for feathering the propeller.
   3—quick warming of the oil after starting.
   4—providing an expansion space for hot oil.

7. When making a power check on number 1 and 2 engines, you set the manifold pressure at local

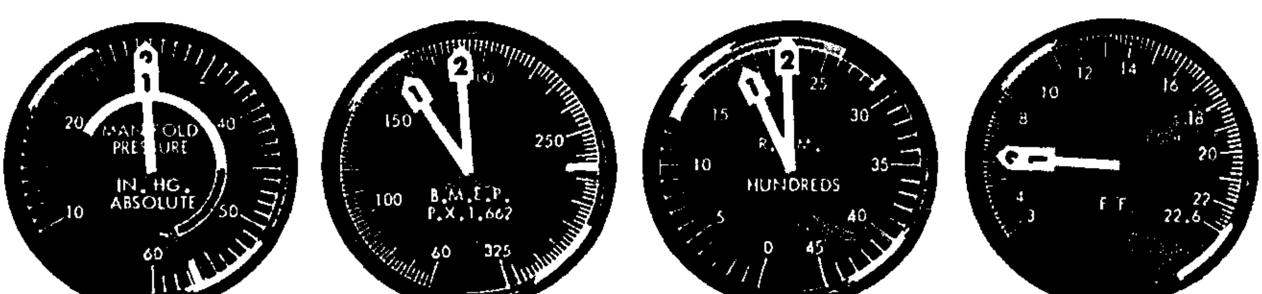


FIGURE 2. Reciprocating engine power check diagram.

barometric pressure. Number 2 engine responds normally but number 1 engine does not. If number 1 engine responds as shown on the engine power check diagram, it is possible that—

1—the carburetor is excessively lean.

2—the propeller is set at too low a blade angle.

3—several cylinders are not firing.

4—the propeller is set at too high a blade angle.

To answer test item 7, refer to the Engine Power Check Diagram, Figure 2.

8. You are making a feathering check on a hydromatic reversing propeller. If the RPM increases when the feathering button is depressed, it is an indication that the—

1—auxiliary pump is inoperative.

2—propeller master lever is *not* full forward.

3—propeller is in reverse pitch.

4—engine selector switch is in manual position.

9. What is the probable trouble if there is a 7 BMEP drop when the ignition switch is moved from "Both" to "Left" and there is no change of BMEP when the switch is moved from "Both" to "Right"?

1—Right magneto ignition switch wire is grounded.

2—Right magneto ignition switch wire is open.

3—Left magneto ignition switch wire is grounded.

4—Left magneto ignition switch wire is open.

10. High supercharger ratio shall not be used during takeoff from relatively low altitude airports because—

1—detonation will occur at all power settings above maximum cruise power.

2—engine overspeeding will result if takeoff MAP is obtained.

3—excessive MAP will be needed to obtain takeoff BMEP.

4—excessive BMEP will be developed at takeoff RPM and MAP.

11. A four-engine aircraft is to be dispatched under the following conditions:

Takeoff weight ----------	100,000 lbs.
Climb time -------------	45 minutes.
Climb fuel flow --------	1,400 lbs./hr./eng.
Fuel load --------------	4,000 gals. (6 lbs./gal.)

How much time would be required to reduce weight to 85,000 lbs. at the beginning of cruising flight, using a dumping rate of 600 gals./min.?

1—1.8 minutes.

2—3.0 minutes.

3—2.5 minutes.

4—4.2 minutes.

12. Assume that there is an unusual drop of BMEP on one engine during takeoff. What action should the flight engineer take if this occurs when the airplane has accelerated beyond V_1 speed but has not yet reached V_2 speed?

1—Advise the pilot-in-command.

2—Increase power on the other three engines.

3—Arm the auto-feathering system.

4—Reduce all throttles to idle in preparation for stopping with reverse thrust.

13. The cabin pressurization system is adjusted as shown on the controller illustrated in Figure 3. If the system is performing according to the chart, also illustrated in Figure 3, what will be the differential pressure at a flight altitude of 5,000 feet?

1—3.2 psi.

2—4.2 psi.

3—2.5 psi.

4—0.5 psi.

Refer to the Cabin Pressure Control Diagram, Figure 3, for information relating to test item 13.

14. Which of the following are indications of a proper shift from the "Takeoff and Climb" to the "Cruise" spark advance setting?

A. Shift of analyzer pattern to right.

B. Shift of analyzer pattern to left.

C. Decrease in BMEP.

D. Increase in BMEP.

1—A and C.

2—B and C.

3—B and D.

4—A and D.

15. What would be the effect if the static pressure line became disconnected inside a pressurized cabin during cruising flight?

1—The altimeter would read high and the airspeed indicator would read low.

2—Both the altimeter and the airspeed indicator would read high.

3—The altimeter would read low and the airspeed indicator would read high.

4—Both the altimeter and the airspeed indicator would read low.

16. How much fuel remains after cruising flight of a four-engine aircraft under these conditions?

Beginning total weight (top of climb)	87,350 lbs.
Zero fuel weight	64,750 lbs.
Pressure altitude	16,000 feet
Standard cruise, 1,200b.hp. high blower	0915–1251Z
Standard cruise, 1,100 b.hp. high blower	1251–1432Z

1—11,713 lbs.

2— 9,830 lbs.

3—12,592 lbs.

4—10,886 lbs.

Use standard cruise power tables, Figure 4.

17. If a serious leak developed in the oil pressure line which supplies the constant-speed governor, the propeller pitch-lock mechanism will prevent a—

1—change to full low pitch.

2—surge into full feather pitch.

3—change to full high pitch.

4—surge into reverse pitch.

18. What is a probable source of trouble if a DC generator is producing zero amperage and residual voltage?

1—The main feeder line is disconnected at the bus bar.

2—The voltmeter is faulty.

3—The field circuit breaker is open.

4—The reverse current relay main contactor points are stuck open.

19. The log of a four-engine airplane in cruising flight indicates the following:

Time	1:15 p.m.
Pressure altitude	15,000 feet
Weight	96,000 lbs.
Operation	Four-engine, long-range cruise.

Assuming the airplane continues to operate according to the four-engine, long-range cruise performance table, what will be the airplane weight at 4:45 p.m.?

1—88,230 pounds.

2—90,450 pounds.

3—89,540 pounds.

4—88,870 pounds.

Refer to the Cruise Performance Table, Figure 5, for information relating to test item 19.

20. Which is the correct position for a powerplant control immediately prior to unfeathering?

1—Mixture in auto-lean position.

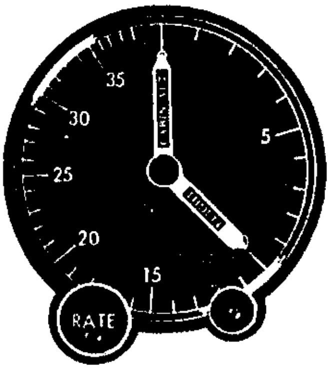
2—Propeller toggle switch to increase RPM position.

3—Spark control to retard (takeoff) position.

4—Throttle at cruising BMEP position.

Applicants who desire to prepare for the Reciprocating Engine Written Test should also attempt to answer the following:

Turboprop Sample Test Items—1, 2, 3, 12, 16, 18, and 20.
Turbojet Sample Test Item—19.



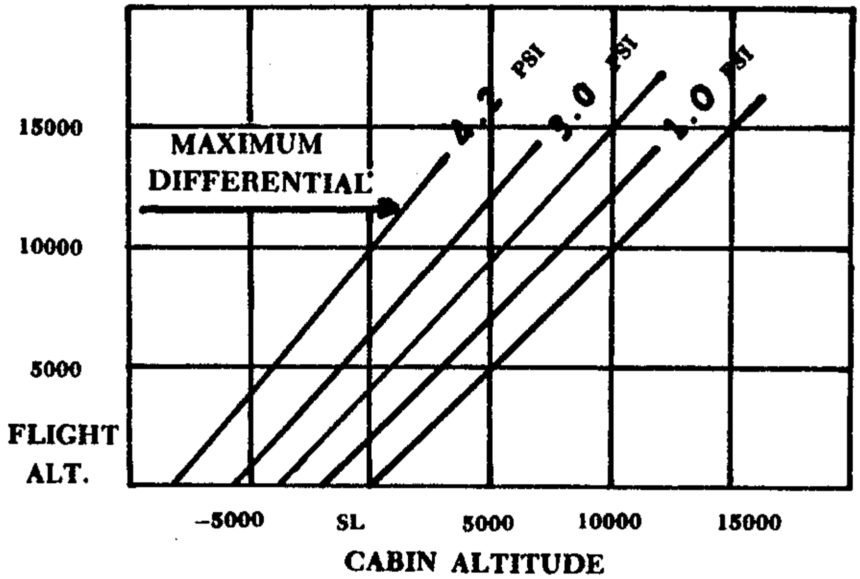


FIGURE 3. Cabin pressure control diagram.

STANDARD CRUISE POWER TABLE

1200 Brake Horsepower

PRESSURE ALTITUDE FEET	BLOWER	RPM	BMEP	BMEP DROP	SPARK	FUEL FLOW lbs/hr/engine
0 - 3,000	LOW	2200	154	12	Cruise	545
3,001 - 6,000	LOW	2200	154	12	Cruise	545
6,001 - 9,000	LOW	2200	154	12	Cruise	545
9,001 - 12,000	LOW	2200	154	12	Cruise	545
12,001 - 14,000	LOW	2200	154	12	Cruise	545
14,001 - 16,000	LOW	2300	148	12	Cruise	555
15,001 - 21,000	HIGH	2300	148	12	TO&CL	575

1100 Brake Horsepower

PRESSURE ALTITUDE FEET	BLOWER	RPM	BMEP	BMEP DROP	SPARK	FUEL FLOW lbs/hr/engine
0 - 3,000	LOW	2100	148	12	Cruise	495
3,001 - 6,000	LOW	2100	148	12	Cruise	495
6,001 - 9,000	LOW	2100	148	12	Cruise	495
9,001 - 12,000	LOW	2100	148	12	Cruise	495
12,000 - 14,000	LOW	2100	148	12	Cruise	495
14,001 - 16,000	LOW	2200	142	12	Cruise	505
15,001 - 17,000	HIGH	2100	149	12	*Cruise	510
17,001 - 20,000	HIGH	2200	142	12	*Cruise	520
20,001 - 24,000	HIGH	2300	135	12	TO&CL	535

FIGURE 4. Standard cruise power table.

FOUR-ENGINE, LONG-RANGE CRUISE PERFORMANCE

Pressure Altitude	*Gross Weight*	*100,000 to 95,001*	*95,000 to 90,001*	*90,000 to 85,001*	*85,000 to 80,001*
14,000	TAS (IAS) Knots	237 (185)	231 (180)	224 (175)	218 (170)
	BHP	1,186	1,096	1,008	922
	BLOWER	LOW	LOW	LOW	LOW
	RPM	2,250	2,150	2,100	2,000
	SPARK	CRUISE	CRUISE	CRUISE	CRUISE
	B.P. BMEP	161	156	148	142
	BMEP DROP	12	12	12	12
	MAP (approx.)	32.5	31.5	29.5	28.5
	FF lb./hr./eng.	545	495	460	420
15,000	TAS (IAS) Knots	240 (185)	235 (181)	228 (176)	221 (171)
	BHP	1,200	1,114	1,025	937
	BLOWER	LOW	LOW	LOW	LOW
	RPM	2,300	2,200	2,150	2,000
	SPARK	CRUISE	CRUISE	CRUISE	CRUISE
	B.P. BMEP	160	155	147	145
	BMEP DROP	12	12	12	12
	MAP (approx.)	33.0	31.0	29.5	28.5
	FF lb./hr./eng.	555	510	470	425
16,000	TAS (IAS) Knots		238 (181)	232 (176)	225 (171)
	BHP		1,131	1,041	952
	BLOWER		LOW	LOW	LOW
	RPM		2,300	2,200	2,100
	SPARK		CRUISE	CRUISE	CRUISE
	B.P. BMEP		151	146	137
	BMEP DROP		12	12	12
	MAP (approx.)		31.0	29.5	28.0
	FF lb./hr./eng.		525	480	440
17,000	TAS (IAS) Knots		243 (181)	236 (176)	229 (171)
	BHP		1,152	1,060	970
	BLOWER		HIGH	HIGH	LOW
	RPM		2,200	2,100	2,150
	SPARK		TO&CL	CRUISE	CRUISE
	B.P. BMEP		160	155	140
	BMEP DROP		12	12	12
	MAP (approx.)		34.0	32.5	28.0
	FF lb./hr./eng.		540	495	450
18,000	TAS (IAS) Knots		247 (180)	240 (175)	233 (170)
	BHP		1,173	1,079	987
	BLOWER		HIGH	HIGH	HIGH
	RPM		2,250	2,150	2,100
	SPARK		TO&CL	CRUISE	CRUISE
	B.P. BMEP		160	154	145
	BMEP DROP		12	12	12
	MAP (approx.)		34.5	32.5	30.5
	FF lb./hr./eng.		555	510	465

FIGURE 5. Reciprocating engine cruise performance table.

FLIGHT ENGINEER TURBOPROP TEST

1. While inspecting the control surfaces, you notice that the trailing edges of the trim tabs on the right aileron and on both elevators are turned down. What position would you expect to find on the flight deck trim tab indicators?

1—Nose up and right wing up.
2—Nose up and left wing up.
3—Nose down and left wing up.
4—Nose down and right wing up.

2. When the test switch for the fuel tank gauge is operated, the gauge should—

1—change toward the zero position.
2—stop at the full tank position.
3—shut off the underwing fueling operation.
4—indicate the fuel used instead of fuel remaining.

3. Which of the following receives power from the three-phase, 115v AC system and provides power to the essential DC bus?

1—Static exciter.
2—Rotary inverter.
3—Magnetic amplifier.
4—Transformer-rectifier.

4. The air cycle machine produces cold air by—

1—extracting heat energy across the expansion turbine.
2—utilizing the heat of compression.
3—forcing the air through a sonic venturi.
4—circulating the air over cooling coils containing Freon 12.

5. At which position should the power lever be placed to properly adjust the propeller for engine starting?

1—Zero blade angle position.
2—Low flight idle position.
3—Maximum reverse position.
4—Minimum drag position.

6. When the starter switch in the flight compartment is activated, the starter is operated because an electric solenoid—

1—permits the starter air shutoff valve to open.
2—opens the valve which allows pneumatic system pressure crossover from an operating engine.
3—engages the ratchet type starter dog to the engine.
4—closes the starter relay permitting a high amperage flow in the starter field winding.

7. The turboprop engine utilizes air bleeds in the middle of the compressor section for the purpose of—

1—directing cooling air to the combustion liners.
2—preventing stall and surge at low RPM.
3—extracting hot air for inlet scoop anti-icing.
4—pressurizing the oil tank.

8. When the propeller is in the BETA range, blade angle is controlled by the—

1—negative torque-sensing (automatic drag limiting) system.
2—power lever through mechanical linkage.
3—propeller governor spring setting.
4—blade pitch-lock mechanism.

9. During climbing flight you observe the indications shown on the engine instrument diagram, Figure 6. If number 2 engine is performing normally for the particular power lever setting, what is the most likely source of trouble in number 1 engine if it has the same power lever setting?

1—Turbine damage.
2—Misrigged power lever.
3—Torquemeter malfunction.
4—Bleed valve stuck open.

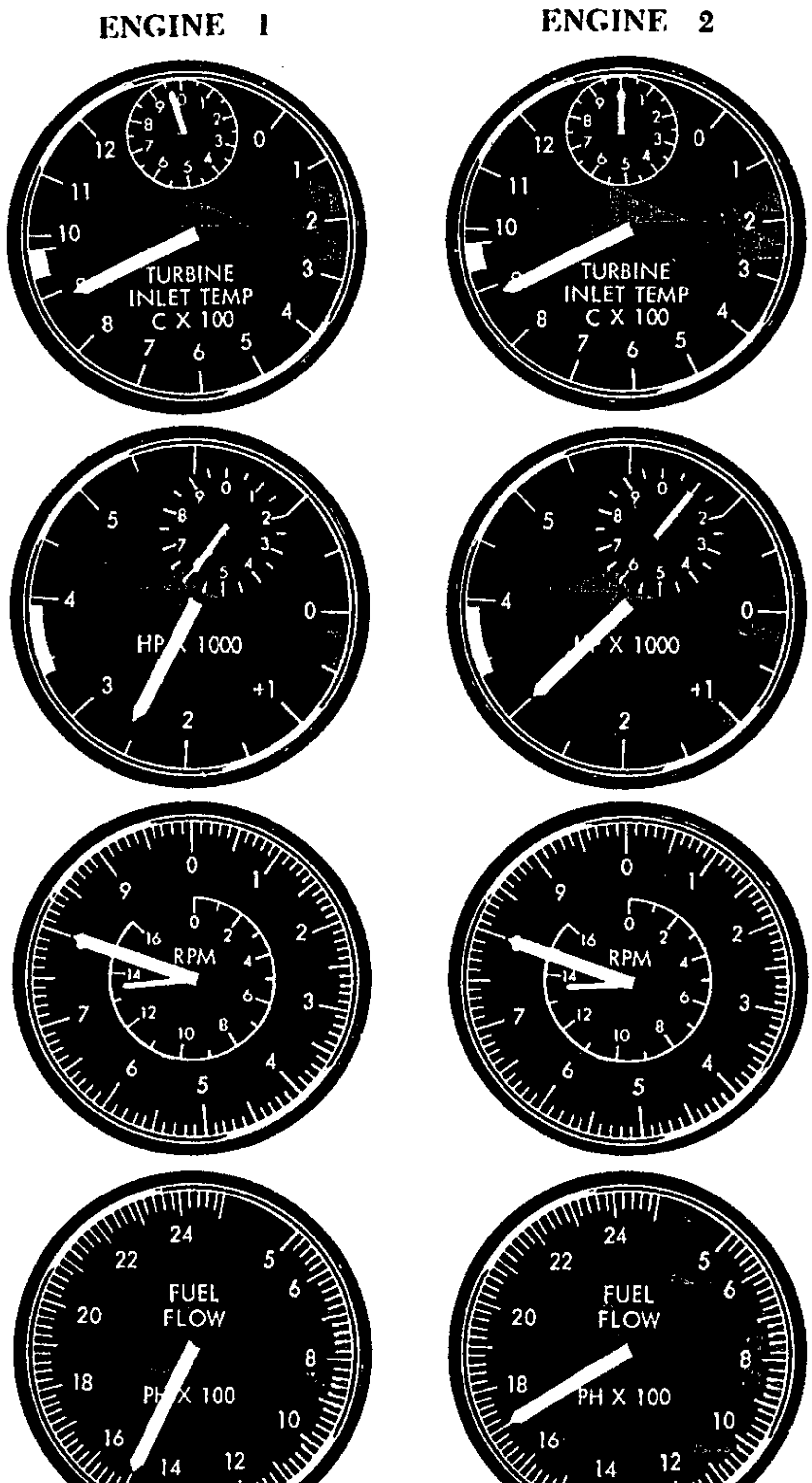


FIGURE 6. Turboprop engine instrument diagram.

10. When turning on the engine anti-icing system, the best instrument to watch for positive indications of system operation is the—

1—shaft horsepower indicator.
2—turbine temperature gauge.
3—tachometer.
4—pneumatic duct pressure gauge.

11. What is the primary purpose of the propeller phase synchronization system?

1—Synchronize all propellers to the same blade angle during flight operations.
2—Synchronize all engine speeds within 3% of the master engine speed.
3—Maintain a given propeller blade angle relative to power lever position for ground operation.
4—Maintain a preset angular relationship between propeller blades of master and slave engines.

12. When the four-position (AUTO, OFF, INCR, DECR) manual temperature control switch is used to decrease the temperature in the flight station, the switch should be—

1—held in DECR until the flight station air reaches the desired temperature.
2—placed momentarily in DECR and then back to AUTO.
3—placed momentarily in DECR and then back to OFF.
4—held in DECR until the flight station air temperature decreases at least 5° F. and then placed in AUTO.

13. How will the negative torque (automatic drag limiting) system make a correction if an engine fails and the propeller attempts to windmill the engine?

1—By disconnecting the propeller reduction gearing from the engine compressor.
2—By increasing fuel flow.
3—By applying the propeller brake mechanism.
4—By increasing propeller blade angle.

14. An airplane is flying at a true airspeed of 350 kts. The speed of sound (Mach 1.0) is 1,000 ft./sec. What is the airspeed of the airplane expressed in Mach number?

1—Mach .43.
2—Mach .59.
3—Mach .35.
4—Mach .51.

15. If the asymmetry system actuates in flight after the flaps have been lowered to the approach position, the flight crew should—

1—raise the flaps by the emergency system.
2—raise the flaps by the normal system.
3—trim the aircraft laterally.
4—lower the flaps to landing position by the electric emergency system.

16. The hydraulic system contains a piston-type accumulator which has a 1,000 p.s.i. air charge when the system is off. What is the air charge when the system is pressurized to 3,000 p.s.i.?

1—1,000 p.s.i.
2—2,000 p.s.i.
3—3,000 p.s.i.
4—4,000 p.s.i.

17. An airplane is in cruising flight and performing according to the standard cruise tables, Figure 7. What is the predicted landing weight under these conditions?

Weight at start of cruise	110,000 lbs.
Altitude	17,000 ft.
Static air temperature	−19° C.
Cruising time	4:23.
Descent and landing fuel	1,750 lbs.

1—88,925 lbs.
2—88,110 lbs.
3—86,385 lbs.
4—87,150 lbs.

18. Which oxygen control position should be selected when full face masks are used during smoke evacuation procedures?

1—Off position unless the cabin is being depressurized.
2—Normal, or diluter demand position.
3—Smoke filter position.
4—100% oxygen position.

19. After which type failure will it be impossible to transfer a particular electrical load to an alternative generator in a non-parallel constant frequency AC electrical system?

1—Generator over or under frequency.
2—Generator over voltage.
3—Bus fault.
4—Feeder fault (generator to bus).

20. An airplane is cruising at 20,000 feet with a cabin pressue altitude of 8,000 feet. The airplane will descend to an approach altitude of 2,000 feet at a rate of descent of 750 feet per minute. What cabin rate of descent must be established to have the cabin completely depressurized when the approach altitude is reached?

1—285 feet per minute.
2—367 feet per minute.
3—250 feet per minute.
4—416 feet per minute.

Applicants who desire to prepare for the Turboprop Class Written Test should also attempt to answer the following:

Reciprocating Engine Sample Test Items—1, 5, and 15.
Turbojet Sample Test Items—1, 3, 12, and 19.

STD. + 10°C

GROSS WEIGHT - POUNDS / PRESS ALT-1000 FT	25	23	21	19	17	15	13
115,000				321 4210	323 4440	324 4690	325 4930
110,000			322 3990	324 4220	326 4460	326 4700	327 4950
105,000			325 4000	327 4230	328 4470	329 4710	328 4960
100,000		327 3780	329 4010	330 4240	331 4480	331 4720	330 4970
95,000	328 3580	330 3790	331 4020	332 4250	333 4490	332 4730	332 4970
90,000	332 3590	333 3800	334 4020	335 4250	335 4490	334 4730	333 4970
85,000	335 3600	336 3800	337 4030	337 4250	337 4500	336 4730	335 4980
80,000	338 3600	339 3800	339 4030	339 4260	338 4500	337 4740	336 4980
75,000	340 3600	341 3800	341 4030	341 4260	340 4500	338 4740	337 4980
70,000 * **	344 3600	344 3800	344 4040	343 4260	342 4510	340 4750	338 4990

*True Airspeed - Knots
**Four Engine Fuel Flow - Lbs/Hr

STD. DAY

GROSS WEIGHT - POUNDS / PRESS ALT-1000 FT	25	23	21	19	17	15	13
115,000			331 4280	333 4530	335 4800	335 5050	336 5320
110,000		331 4060	334 4290	336 4540	337 4800	337 5050	337 5320
105,000	331 3840	335 4070	337 4290	338 4540	339 4810	339 5060	339 5330
100,000	335 3850	338 4080	340 4300	340 4550	341 4810	341 5070	340 5330
95,000	339 3850	341 4080	342 4310	342 4550	343 4820	342 5070	341 5340
90,000	342 3860	343 4090	344 4320	344 4560	344 4820	343 5080	342 5340
85,000	344 3870	345 4090	346 4320	346 4570	346 4830	345 5080	343 5350
80,000	348 3880	348 4100	348 4330	348 4570	347 4830	346 5090	345 5350
75,000	349 3880	350 4100	350 4330	350 4580	348 4840	347 5090	345 5360
70,000 * **	351 3890	352 4110	352 4340	351 4580	350 4840	348 5100	347 5360

*True Airspeed - Knots
**Four Engine Fuel Flow - Lbs/Hr

Figure 7. Standard cruise tables.

FLIGHT ENGINEER TURBOJET TEST

1. Which of the following would be affected by a blockage or failure of the static pressure system?

   A. Machmeter.
   B. Cabin pressure controller.
   C. Cabin altimeter.
   D. Static air temperature indicator.

   1—A and C.
   2—C and D.
   3—A and B.
   4—B and D.

2. What does the EPR gauge measure?

   1—The ratio of compressor inlet air pressure to turbine discharge gas pressure.
   2—The ratio of combustion chamber discharge gas pressure to compressor discharge gas pressure.
   3—The ratio of combustion chamber discharge gas pressure to ambient air pressure.
   4—The ratio of ambient air pressure to compressor discharge air pressure.

3. Compressor stall is caused by—

   1—back flow of air from the combustion chambers.
   2—insufficient fuel flow during acceleration.
   3—excessive angle of attack on the compressor blades.
   4—excessive EPR for the particular RPM.

4. During an unsuccessful starting attempt you observe the indications shown on the engine instrument diagram, Figure 8. What is the most likely source of trouble in this event?

   1—Malfunction of the engine ignition.
   2—No fuel to the engine.
   3—Low starter air pressure.
   4—Electrical power failure to the EGT and EPR gauges.

5. What is the specified takeoff EPR according to the takeoff data charts, Figure 9., for the following conditions?

   Pressure altitude .... 1,000 ft.
   OAT .... −5° C.
   Turbocompressors .... OFF

   1—1.91.
   2—2.03.
   3—1.99.
   4—1.96.

6. What are the takeoff speeds according to the takeoff data charts, Figure 9, for the following conditions?

   Gross weight .... 270,000 lbs.
   Pressure altitude .... 4,000 ft.
   OAT .... 0° C.
   Tailwind component .... 4 kts.
   Runway upslope 4%

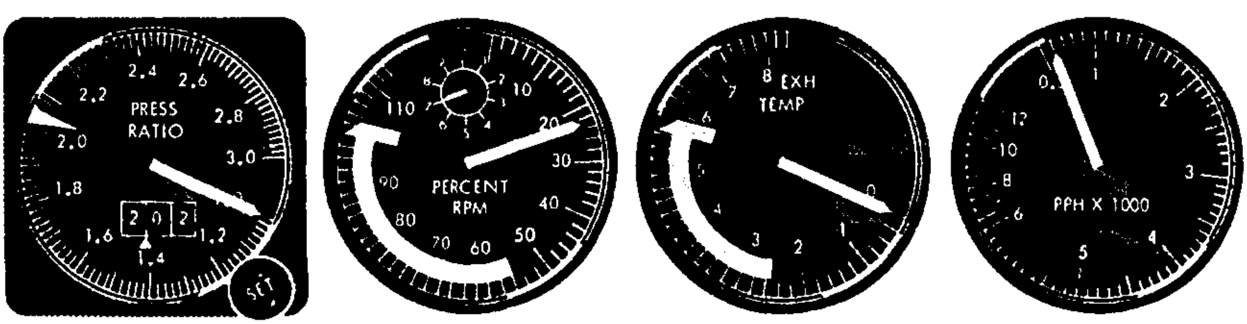


FIGURE 8. Turbojet engine instrument diagram.

TAKEOFF

EPR																					
DRY	OAT	°F	-58	-40	-31	-22	-13	-4	5	14	23	32	41	50	59	68	77	86	95	104	122
		°C	-50	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	50
	T/C	ON	2.07	2.05	2.04	2.03	2.02	2.01	1.99	1.98	1.96	1.93	1.89	1.87	1.83	1.83	1.83	1.82	1.77	1.73	1.63
		OFF	2.12	2.10	2.09	2.08	2.06	2.05	2.03	2.01	1.99	1.96	1.92	1.89	1.85	1.85	1.85	1.84	1.79	1.75	1.65

MAX EPR FOR COLDER TEMPS AT PRESS ALT (40 TO 80 KTS, ENG A/I ON OR OFF)

T/C	5000	4000	3000	2000	1000	SL	-1000
ON	2.08	2.02	1.99	1.93	1.89	1.83	1.78
OFF	2.11	2.06	2.01	1.96	1.91	1.85	1.80

V_1, V_R, V_2 - KTS IAS

14 FLAPS ANTISKID ON

PRESS ALT 1,000 FT		OAT			
9 TO 10	°F / °C			-65 TO 5 / -54 TO -15	6 TO 82 / -14 TO 28
7 TO 9	°F / °C		-65 TO -7 / -54 TO -22	-6 TO 37 / -21 TO 3	38 TO 94 / 4 TO 34
5 TO 7	°F / °C	-65 TO -22 / -54 TO -30	-21 TO 31 / -29 TO -1	32 TO 89 / 0 TO 32	90 TO 101 / 33 TO 38
3 TO 5	°F / °C	-65 TO 23 / -54 TO -5	24 TO 56 / -4 TO 13	57 TO 104 / 14 TO 40	105 TO 108 / 41 TO 42
1 TO 3	°F / °C	-65 TO 50 / -54 TO 10	51 TO 97 / 11 TO 36	98 TO 115 / 37 TO 46	
-1 TO 1	°F / °C	-65 TO 94 / -54 TO 34	95 TO 113 / 35 TO 45	114 TO 120 / 46 TO 50	

GROSS WT 1,000 LB	V_1 V_R V_2	V_1 V_R V_2	V_1 V_R V_2	V_1 V_R V_2
340	150 156 171			
330	148 153 168	150 155 168		
320	145 150 166	147 152 166		
310	142 147 163	145 149 163		
300	139 144 161	142 146 161	144 148 160	
290	136 141 158	139 143 158	141 146 158	
280	133 138 155	135 140 155	138 142 155	
270	130 135 153	132 137 153	135 139 152	138 141 152
260	128 132 150	129 134 150	131 136 150	135 137 149
250	123 128 147	125 130 147	128 132 147	131 134 146
240	120 126 145	122 127 144	124 129 144	127 131 144
230	123 142	119 123 142	121 125 141	124 128 141
220	139	115 120 139	117 122 138	120 124 138
210	136	118 136	113 118 135	116 120 135
200	133	133	112 114 132	112 116 132
190	130	130	113 129	108 112 129
180		128	126	108 108 126
170			122	122
160			119	119

SHADED AREA INDICATES PERFORMANCE AFFECTED BY MINIMUM CONTROL SPEED MINIMUM FIELD LENGTH FOR LIGHTEST WEIGHT ABOVE SHADED AREA IS REQUIRED

V_1 ADJUSTMENTS

WIND

ADD 1 KT PER 18 KTS HEADWIND

SUBTRACT 1 KT PER 3½ KTS TAILWIND

SLOPE

ADD 1KT PER .4% UP SLOPE

SUBTRACT 1 KT PER .4% DOWN SLOPE

ENGINE LIMITS	
N_1 RPM	110.8%
N_2 RPM	100.7%
EGT STARTING	460°C
TAKE-OFF	555°C
MAX CONT	490°C

AFTER TAKEOFF NORMAL MANEUVERING SPEEDS - KTS IAS

FLAPS	NORM MAN (30° BANK)	MIN MAN (15° BANK)
0°	V_2 + 50	V_2 + 30
14°	V_2 + 30	V_2

STAB TRIM SETTING

CG – % MAC	16	18	20	22	24	26	28	30	32	34	35
UNITS - A/P N U	6½	6	5½	4½	4	3½	2½	2	1½	½	0

FIGURE 9. Takeoff data charts.

1—$V_1=132$, $V_R=137$, $V_2=153$.
2—$V_1=130$, $V_R=135$, $V_2=153$.
3—$V_1=135$, $V_R=139$, $V_2=152$.
4—$V_1=131$, $V_R=136$, $V_2=152$.

7. The slats or other hydraulically operated leading edge devices are normally extended when the—

1—speed brakes are raised.
2—trailing edge flaps are lowered to takeoff position.
3—spoilers are raised.
4—landing gear is lowered for landing.

8. The cabin pressure control setting has a direct influence upon the—

1—outflow valve opening.
2—turbocompressor speed.
3—cabin pressure relief valve setting.
4—bleed air supply system pressure.

9. Asume you have just finished making the following entries in the Flight Engineers' log:

Time	1130Z
Gross weight	210,000 lbs.
Pressure altitude	35,000 ft.
TAS	485
Mach	.84
NM/1,000 lbs	34.2

After 1 hour of cruising at this rate, a descent to a landing will be started which you estimate will consume 1,200 lbs. of fuel. What will be the estimate gross weight at landing?

1—201,750 lbs.
2—195,800 lbs.
3—194,600 lbs.
4—193,350 lbs.

10. During normal crossfeed operation, when one tank runs dry, it is indicated by—

1—the booster pump operating light going out.
2—reduction of manifold fuel pressure.
3—drop of fuel flow for the engines involved.
4—illumination of the booster pump low-pressure light.

11. A four-engine aircraft is performing according to the M .82 operating table, Figure 10, with the following conditions:

Gross weight	238,000 lbs.
SAT	−50° C.
Time	8:45 a.m.

At what time should a change be made to a new power setting?

1— 9:17 a.m.
2—10:47 a.m.
3— 9:32 a.m.
4— 9:45 a.m.

12. What should be done in the event that a wing overheat warning indication occurs?

1—The fire extinguishing systems should be discharged into both nacelles on that side of the aircraft.
2—The pneumatic system in that wing should be shut off automatically or manually.
3—The bleed air system of both engines on that side of the aircraft should be opened.
4—The cooling system for that wing should be turned on.

13. Due to an inflight electrical emergency, one generator breaker has been tripped and the generator drive disconnected. The bus tie breaker for the generator has remained closed. Which generator and CSD indications assure a positive disconnect of the drive? (Refer to the flight engineer panel, Figure 11.)

1—CSD oil temperature decrease, CSD low oil pressure light on, residual volts 28 DC.
2—Bus tie volts zero, frequency zero, CSD low oil pressure light on.
3—Frequency zero, generator volts zero, CSD low oil pressure light on.
4—Generator volts zero, frequency 400 Hz, CSD low oil pressure light out.

14. How is ignition accomplished during a windmilling start?

1—By turning the magneto switch to "Both."
2—By placing the ignition switch to "Airstart" or "Override."
3—By selecting "Windmilling Start" for the induction vibrator.
4—By the heat of compression from the windmilling engine.

M .82
29000 FT.

OPERATING TABLE

WGT	ITEM	TRUE STATIC AIR TEMP. —°C							STD. TEMP —42.5°C	
1000		—60	—55	—50	—45	—40	—35	—30	—25	—20
	MACH/RAT	.816/-35	.807/-30	.783/-26	.743/-22					
280	IAS/TAS	317/466	313/466	303/458	287/439					
	EPR/N1	2.57/93.4	2.52/93.5	2.48/93.5	2.45/93.5					
	N2/EGT	88.3/440	88.7/445	89.0/445	89.3/450					
270	FF/ENG	4120	3970	3800	3600					
	NM/1000	28.6	29.2	30.0	30.4					
	MACH/RAT	.816/-35	.816/-30	.801/-25	.774/-21	.728/-18				
270	IAS/TAS	317/466	317/472	311/468	299/458	280/435				
	EPR/N1	2.53/92.7	2.51/93.5	2.46/93.5	2.43/93.5	2.40/93.6				
	N2/EGT	87.9/430	88.8/445	89.2/450	89.5/450	89.6/450				
260	FF/ENG	4010	4000	3840	3660	3450				
	NM/1000	29.4	29.4	30.4	31.2	31.4				
	MACH/RAT	.816/-35	.816/-30	.812/-24	.793/-20	.762/-16	.710/-13			
260	IAS/TAS	317/466	317/472	316/475	308/469	294/455	273/429			
	EPR/N1	2.49/92.0	2.49/93.0	2.45/93.5	2.41/93.6	2.38/93.5	2.36/93.5			
	N2/EGT	87.5/425	88.6/440	89.2/450	89.6/450	89.8/455	89.9/455			
250	FF/ENG	3910	3930	3860	3700	3510	3300			
	NM/1000	30.1	30.2	30.6	31.6	32.4	32.4			
	MACH/RAT	.816/-35	.816/-30	.816/-24	.806/-19	.782/-15	.743/-12	.687/-9		
250	IAS/TAS	317/466	317/472	317/477	313/477	303/467	286/449	263/420		
	EPR/N1	2.45/91.3	2.45/92.4	2.45/93.4	2.40/93.6	2.36/93.5	2.33/93.4	2.31/93.4		
	N2/EGT	87.2/415	88.2/430	89.2/450	89.6/450	89.9/455	90.1/455	90.2/455		
240	FF/ENG	3810	3830	3860	3720	3540	3350	3140		
	NM/1000	30.9	31.0	31.1	31.9	32.9	33.4	33.3		
	MACH/RAT	.816/-35	.816/-30	.816/-24	.816/-18	.797/-14	.766/-10	.722/-7	.648/-6	
240	IAS/TAS	317/466	317/472	317/477	317/482	309/477	296/463	278/441	247/400	
	EPR/N1	2.41/90.7	2.41/91.8	2.41/92.8	2.40/93.5	2.35/93.5	2.31/93.4	2.28/93.3	2.28/93.3	
	N2/EGT	86.8/410	87.9/425	88.9/440	89.7/450	90.0/455	90.2/455	90.3/455	90.3/455	
230	FF/ENG	3720	3740	3770	3740	3570	3380	3190	2970	
	NM/1000	31.7	31.8	31.9	32.1	33.3	34.1	34.5	33.5	
	MACH/RAT	.816/-35	.816/-30	.816/-24	.816/-18	.807/-13	.782/-9	.745/-6	.701/-3	.632/-1
230	IAS/TAS	317/466	317/472	317/477	317/482	313/482	303/473	287/455	269/432	241/393
	EPR/N1	2.38/90.2	2.38/91.3	2.38/92.3	2.38/93.3	2.34/93.5	2.30/93.3	2.26/93.2	2.23/93.1	2.22/93.1
	N2/EGT	86.6/400	87.6/420	88.6/435	89.6/450	90.0/455	90.2/455	90.4/455	90.5/455	90.5/455
220	FF/ENG	3640	3670	3690	3710	3590	3400	3210	3030	2840
	NM/1000	32.4	32.5	32.6	32.7	33.5	34.6	35.3	35.6	34.6
	MACH/RAT	.816/-35	.816/-30	.816/-24	.816/-18	.813/-13	.794/-9	.765/-5	.724/-2	.681/-1
220	IAS/TAS	317/466	317/472	317/477	317/482	316/486	308/480	296/467	279/447	261/424
	EPR/N1	2.36/89.8	2.36/90.8	2.36/91.9	2.36/92.9	2.33/93.4	2.28/93.3	2.24/93.1	2.21/93.0	2.18/92.9
	N2/EGT	86.3/395	87.4/415	88.3/430	89.3/445	90.0/455	90.3/455	90.4/455	90.6/455	90.7/455
210	FF/ENG	3580	3600	3630	3640	3600	3420	3240	3050	2880
	NM/1000	32.9	33.0	33.2	33.3	33.7	35.0	35.9	36.5	36.7
	MACH/RAT	.816/-35	.816/-30	.816/-24	.816/-18	.816/-13	.801/-8	.776/-4	.743/-1	.704/-3
210	IAS/TAS	317/466	317/472	317/477	317/482	317/488	311/484	300/474	286/458	270/439
	EPR/N1	2.34/89.4	2.34/90.5	2.34/91.5	2.34/92.5	2.33/93.4	2.28/93.3	2.23/93.1	2.20/93.0	2.16/92.8
	N2/EGT	86.2/395	87.2/410	88.2/425	89.1/440	90.1/455	90.3/455	90.5/455	90.6/455	90.8/455
200	FF/ENG	3520	3550	3570	3590	3600	3430	3250	3070	2900
	NM/1000	33.4	33.5	33.7	33.8	34.1	35.2	36.3	37.1	37.7
	EPR INC		.08	.07	.06	.05	.05	.05	.04	.04

1. If anti-icing on, reduce EPR as follows: Engine & Nacelle —.05, Wing —.05.
2. When operating to left of heavy vertical line, set all engines to chart EPR.
3. When operating to right of heavy vertical line, increase EPR on non-turbo compressor engine(s) by value indicated at bottom of Temp. column.
4. Key to abbreviations: Mach — Mach Number; RAT — RAM Air Temperature °C; IAS — Indicated Airspeed; TAS — True Airspeed; EPR — Engine Pressure Ratio; N_1 and N_2 — Compressor RPM; EGT — Exhaust Gas Temperature °C; FF/Eng — Fuel Flow in Lbs. Per Engine; NM/1000—Nautical Miles Per 1000 Lbs. of Fuel.

FIGURE 10. Turbojet Mach .82 operating table.

15. How can the rate of smoke removal be increased during pressurized flight?

1—Turn off one turbocompressor.
2—Increase cabin differential pressure.
3—Close the cabin air jet pump valves.
4—Increase cabin altitude.

16. In the event of cabin decompression, the passenger oxygen masks are automatically dropped when the cabin altitude reaches approximately—

1— 8,000 ft.
2—10,000 ft.
3—12,000 ft.
4—14,000 ft.

17. How is reverse thrust generated on the turbojet engine during the landing roll?

1—By reversing the pitch of the compressor stator blades.
2—By diverting the exhaust gases forward outside the engine.
3—By reversing the flow of gases in the combustion chambers.
4—By blocking the exhaust gases to cause a reverse reaction force against the turbine blades.

18. The anti-skid system is designed to reduce brake pressure if the wheel—

1—decelerates too rapidly.
2—skids sideways.
3—overspeeds.
4—gains heat too rapidly.

19. Which is the preferred method of combating a brake fire on the ground?

1—Completely smother the gear with a foam extinguishing agent.
2—Keep the engine running to blow out the fire.
3—Use a dry chemical fire extinguisher.
4—Allow the tire to burst to blow out the fire.

20. In comparison to a straight wing of the same wing area, a swept wing has the advantage of—

1—a higher critical Mach number.
2—less tendency to "Dutch Roll."
3—greater wing loading.
4—less wing loading.

Applicants who desire to prepare for the Turbojet Class Written Test should also attempt to answer the following:

Reciprocating Engine Sample Test Items—1, 5, and 15.
Turboprop Sample Test Items—2, 3, 4, 6, 12, 14, 15, 16, 18, and 20.

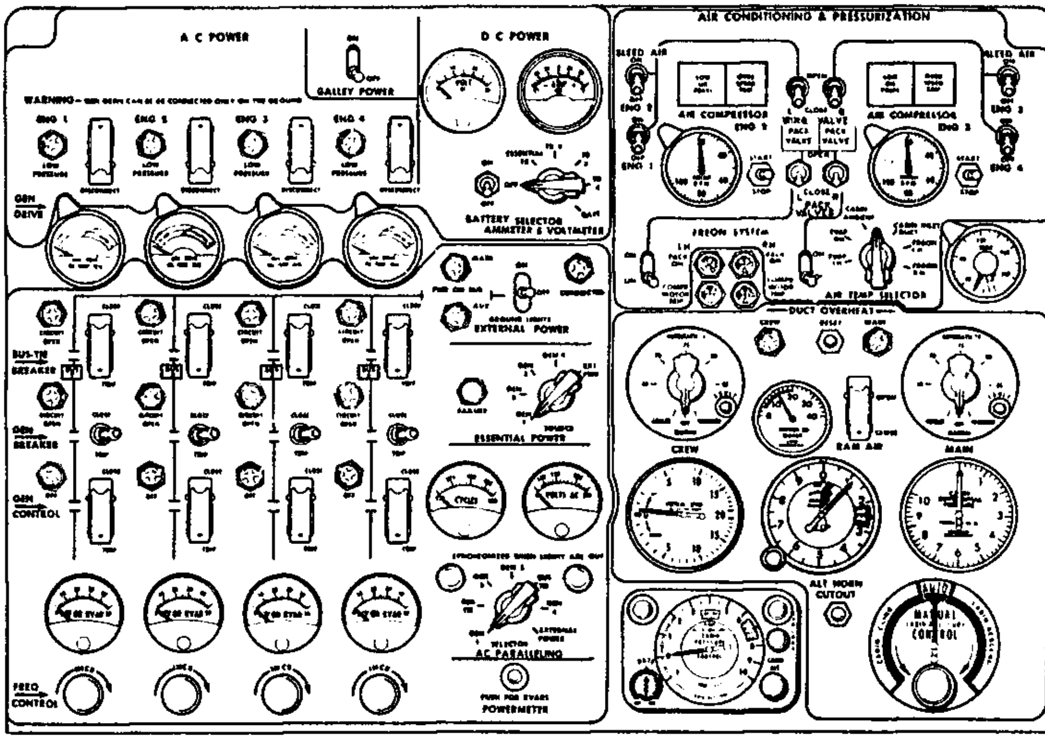


FIGURE 11. Flight engineer panel.

ANALYSIS OF ANSWERS TO SAMPLE TESTS

FLIGHT ENGINEER BASIC TEST

Area codes refer to the related study outline.

1—(1) Area A02

See Federal Aviation Regulation, Part 1, Section 1.2.

2—(4) Area A03

See Federal Aviation Regulation, Part 63, Section 63.13.

3—(4) Area A07

See Federal Aviation Regulation, Part 63, Section 63.33.

4—(3) Area C03

See Federal Aviation Regulation, Part 121, Section 121.221.

5—(1) Area C06

See Federal Aviation Regulation, Part 121, Section 121.285.

6—(4) Area D06

See Federal Aviation Regulation, Part 121, Sections 121.327 and 329.

7—(3) Area D08

See Federal Aviation Regulation, Part 121, Section 121.343.

8—(1) Area E02

See Federal Aviation Regulation, Part 121, Section 121.385.

9—(2) Area E10

See Federal Aviation Regulation, Part 121, Section 121.453.

10—(4) Area E11

See Federal Aviation Regulation, Part 121, Section 121.471.

11—(1) Area H01

Calibrated airspeed (CAS) is indicated airspeed (IAS) corrected for errors in the instrument mechanism and for errors of the pitot-static system. Static system errors vary with the location of the static vent and are affected by airspeed and angle of attack changes.

12—(2) Area H03

The airplane stalls at the same angle of attack regardless of weight or air density for a given flap setting. However, the stall speed of the airplane is affected by these and many other factors.

13—(4) Area H06

The fixed slot in a wing conducts a flow of high-energy air into the boundary layer on the upper wing surface and delays airflow separation to some higher angle of attack.

14—(2) Area I04

The speed required to obtain maximum range performance increases in a headwind and decreases in a tailwind. The speeds required to obtain maximum endurance, maximum rate of climb, or maximum angle of climb are unaffected by wind.

15—(1) Area I11

Wake turbulence, primarily the result of wing tip vortices, is directly related to the weight, wing span, and speed of the aircraft. Its intensity is directly proportional to the weight and inversely proportional to the wing span and speed of the aircraft. The heavier and slower the aircraft, the greater the intensity of the air circulation in the vortex. See Advisory Circular 90-23A.

16—(1) Area J03

One inch of mercury is equivalent to approximately 1,000 ft. in the standard atmosphere. This relationship is not true at the higher altitudes of the troposphere where 1 inch of mercury is equivalent to more than a 1,000 ft. change of altitude. Typical standard pressures are: Sea level—29.92; 5,000 ft.—24.90; 10,000 ft.—20.58; 20,000 ft.—13.75; 40,000 ft.—5.54.

17—(3) Area J10

The speed of sound in the atmosphere is solely a function of temperature and varies in the same direction as the temperature.

18—(2) Area K01

Zero fuel weight is the total weight of the aircraft with the exception of the fuel load. Basic operating weight is the weight of the aircraft, including crew, ready for flight with the exception of fuel and payload. Zero fuel weight is therefore basic operating weight plus payload (passengers and cargo). See Advisory Circulars 91-23 and 120-27.

19—(3) Area K03

$$\text{Empty Weight Index} = \frac{405 \times 80{,}000}{10{,}000} = 3240.0$$

Item	*Weight*	*Index Unit*
Empty weight	80,000	3240.0
Fuel	18,000	572.0
Oil	900	17.6
Crew	800	12.3
Passengers	4,800	241.9
	104,500	4083.8

C.G. = (4083.8 x 10,000) ÷ 104,500 = 390.8″ aft of datum.

20—(1) Area K10

The center of gravity limits for 112,500 lbs., as indicated on the chart are 16.7% and 29.0% MAC., 29.0 − 16.7 = 12.3% or .123., .123 x 175 inches = 21.5 inches.

FLIGHT ENGINEER RECIPROCATING ENGINE TEST

Area codes refer to the related study outline.

1—(4) Area A05

The lockout cylinder is located in the brake line between the brake control valve and the wheel cylinder. If the brake line fails below the lockout cylinder, fluid and pressure in the line above the lockout cylinder will not escape through the leak.

2—(1) Area B10

Most electrical engine instruments (BMEP, fuel flow, fuel pressure, etc.) are the remote indicating type. These instrument systems have a transmitter unit at the engine which measures the engine function. The measurement is transmitted to an instrument at the flight deck by means of a 26 volt, 3-phase AC circuit.

3—(4) Area C02

A thermocouple circuit consists of a hot junction (detector) of two dissimilar metals connected by dissimilar metal leads to a cold junction (warning relay). The difference in temperature between the hot and cold junctions produces a proportionate current flow because of the dissimilar atomic structure of the metals.

4—(3) Area H02

An engine equipped with a *pressure-injection carburetor* is started with fuel supplied from the primer. Any mixture position other than idle cutoff will lead to flooding of the induction system.

5—(3) Area D08

The turbine of the cooling unit is rotated by air from the cabin pressurization source. In reciprocating engine airplanes this source is the engine-driven cabin supercharger.

6—(3) Area E05

Return oil enters the hopper in the oil tank and tends to return directly to the engine without mixing with the cold oil in the tank. This action accelerates the heating of the oil which is being used in the engine.

7—(3) Area H05

When several cylinders are not firing, the engine input indications (MAP and F/F) will be normal while the output indications (BMEP and RPM) will be below normal. These dead cylinders are receiving the proper fuel and air but are not producing power.

8—(3) Area G02

When the feathering button is depressed, the blade angle will change toward a higher pitch. If the propeller is in reverse pitch, the RPM will increase as the blade angle approaches flat pitch.

9—(4) Area F02

When the ignition switch wire is grounded, the magneto is off. When the wire is open, the magneto is on. A normal drop of 7 BMEP is noted in the "Left" position where the right magneto is shut off. An indication of no BMEP drop in the "Right" position shows that the left magneto is on and therefore its switch wire is open.

10—(3) Area H06

High supercharger ratio consumes more friction horsepower than low supercharger ratio. Higher manifold pressure (MAP) is then required to produce the normal takeoff brake horsepower as measured by the BMEP gauge system. Detonation is a possibility, but its actual occurrence also depends on temperatures and the performance rating of the fuel. The propeller and governor should control overspeeding tendencies.

11—(2) Area J11

45 minutes at 1,400 lbs. fuel flow x 4 engines = 4,200 lbs. fuel used in climb.

100,000 lbs. −4,200 lbs. = 95,800 lbs.
95,800 lbs. −85,000 lbs. = 10,800 lbs. to dump.
10,800 lbs. at 3,600 lbs./min. = 3.0 min.

12—(1) Area K03

The flight engineer should advise the pilot-in-command immediately and then comply with his orders. Ordinarily the pilot-in-command will make the decision to shut down the engine.

13—(3) Area D03

The cabin pressure controller diagram indicates that the cabin pressure is set for sea level. The performance chart shows that a differential pressure of 2.5 psi will provide a sea level cabin altitude when the flight altitude is 5,000 feet.

14—(3) Area H08

As the ignition timing is changed to an advanced setting, the analyzer pattern will shift toward the beginning of the trace at the left side of the scope. Power and BMEP is improved because the early timing is more correct for the relatively slow burning lean cruise mixture.

15—(4) Area B12

When a relatively high air pressure is sensed by the altimeter, it indicates a relatively low altitude. The airspeed indicator measures the difference between pitot and static pressure. A relatively high static presure decreases the differential and causes the airspeed indicator to read low.

16—(4) Area I05

Weight	*Fuel used*	*Fuel flow*	*Time used*	*Clock time*
87,350–79,070	8,280	575	3:36	0915–1215Z
79,070–75,636	3,434	510	1:41	1251–1432Z

Final weight 75,636 lbs.
Zero fuel weight −64,750 lbs.

Final fuel remaining 10,886 lbs.

17—(1) Area K05

When the propeller tends to twist to low pitch because of a loss of governing oil pressure, the engine will start to overspeed. This sudden overspeeding causes a flyweight valve in the propeller to close and trap oil in the propeller dome. The trapped oil prevents further movement of the propeller blades toward low pitch.

18—(3) Area J15

Residual voltage is that low voltage generated by the permanent magnets of the field coils. If the electrical circuit of the field is open, the generator voltage cannot be increased above this low level. A residual voltage output is not sufficient to close the reverse current relay points and therefore there can be no current flow at the ammeter.

19—(4) Area I04

Weight	*Fuel used*	*Fuel flow*	*Time used*	*Clock time*
96,000–95,000	1,000	555	:27	1:15–1:42
95,000–90,000	5,000	510	2:27	1:42–4:09
90,000–88,870	1,130	470	:36	4:09–4:45

20—(3) Area K06

The retard (takeoff) spark advance position should be used for all operations except lean cruising. The mixture is kept in idle cutoff until the engine is rotated and then placed in rich for starting. The propeller control should be placed in decrease RPM to guard against a runaway propeller. The throttle should be set to forward idle position.

FLIGHT ENGINEER TURBOPROP TEST

Area codes refer to the related study outline.

1—(2) Area A09

The control surface moves opposite to the tab. The airplane is rotated on its axis opposite to the control surface or in the same direction as the tab.

2—(1) Area A13

When the test switch is operated, the fuel quantity gauge needle will rotate toward the zero position. When the switch is released, the needle will return to its original setting. This check is accomplished to detect sticking gauges or those which have had a power failure.

3—(4) Area B02

The transformer-rectifier reduces the 115 volt AC input to 28 volts AC by transformer action. The AC is then changed to DC by the use of rectifiers. The 28 volts DC is then routed to various DC units including the essential DC bus.

4—(1) Area D08

High-pressure air from the cabin compressor is used in the air cyclė machine to drive a high-speed turbine. The air expands during this process and therefore loses heat. In effect, heat energy of the air is converted into mechanical energy of the turbine. The turbine in turn rotates a compressor to force the air through a heat exchanger.

5—(4) Area H02

In ground operation range, blade angle is a direct function of power lever position. The power lever should be set so that the propeller is placed in the blade angle where it will offer the least resistance to the turning efforts of the starter.

6—(1) Area F05

Air pressure is used to turn the starter turbine which is connected to the engine. The air pressure may be obtained from an external ground air source or from an operating engine. The starter switch circuit opens the valve in the pneumatic line which admits air to the starter turbine.

7—(2) Area E02

The interstage bleed valves are held open by a speed-sensitive device at low speeds. These valves provide an exit for some of the air and therefore unload the compressor. Thus stall and surge are prevented—especially during engine start, acceleration, and low-speed taxi.

8—(2) Area G02

During normal flight operation the blade angle is controlled by the propeller governor to maintain a certain engine RPM. In BETA, or ground operation range, the blade angle follows power lever setting for both forward and reverse pitch.

9—(4) Area K04

Low airflow because of an open bleed valve produces low power and fuel flow. Misrigged power lever would also affect turbine inlet temperature. Torquemeter malfunction would affect only the horsepower indication. Damaged turbine normally results in high fuel flow.

10—(1) Area H09

The use of compressor hot air for engine anti-icing may cause as much as a 10% reduction of horsepower. In addition to other useful indications, this change of horsepower is an important factor to observe when shifting the anti-icing on or off.

11—(4) Area G06

A synchronizer system adjusts the blade of each propeller to obtain a speed the same as a chosen master engine speed. A phase synchronization system goes even further and causes each propeller to arrive at pre-selected points in their rotary movement at exactly the same instant. The RPM of each engine must be identical to satisfy and maintain this condition.

12—(3) Area J09

If the manual temperature control is held in the DECR position too long, the temperature programmer will move to an excessively cold position. Placing the control back to AUTO may cause the original trouble to return. Answer number 3 is correct but may need to be repeated after waiting for results.

13—(4) Area G07

The automatic drag-limiting system causes the propeller blade angle to increase. This action will take place when there is a negative torque greater than a certain value during flight. A windmilling propeller on a turboprop engine must be controlled quickly because of the excessive drag which is produced.

14—(2) Area B19

Speed in ft./sec. x .5925 = Speed in knots.
1,000 ft./sec. x .5925 = 592.5 knots.
TAS ÷ speed of sound = Mach number.
350 knots ÷ 592.5 knots = Mach .59.

15—(3) Area J05

When the flaps become split, the asymmetry system on most aircraft deactivates the flap-operating system. The aircraft can be trimmed laterally by alternate flaps on some systems and by aileron trim on others. The flaps should not be raised or lowered.

16—(3) Area A03

Hydraulic fluid will not enter the fluid side of the accumulator unless the hydraulic pressure is greater than the air charge. At all fluid pressures above the air charge, the air will be compressed to the same pressure as the fluid.

17—(4) Area I03

Weight	*Fuel used*	*Fuel flow*	*Time used*	*Clock time*
110,000–105,000	5,000	4,800	1:02	0000–0102
105,000– 95,000	10,000	4,810	2:05	0102–0307
95,000– 88,900	6,100	4,820	1:16	0307–0423

Final cruising weight	88,900 lbs.
Descent and landing fuel	− 1,750 lbs.
Predicted landing weight	87,150 lbs.

18—(4) Area C05

It is imperative that flight crewmembers not be incapacitated by the inhalation of smoke during emergencies. Emergency procedures require the use of protective breathing equipment at these times. When the 100% oxygen position of the oxygen control is selected, entrance of flight deck air (or smoke) into the oxygen mask is prevented.

19—(3) Area J15

If there is an electrical failure at a bus, it is not safe for any generator to feed that bus. If the generator or the feeder system has failed, it is safe for the electrical loads to be fed by or transferred to another generator. Automatic circuits ordinarily detect these faults and make the proper transfer or bus isolation, whichever is required.

20—(3) Area D05

18,000 ft. @ 750 ft./min.=24 min.

6,000 ft. (8,000−2,000) in 24 min.=250 ft./min.

FLIGHT ENGINEER TURBOJET TEST

Area codes refer to the related study outline.

1—(3) Area B18

The Machmeter is essentially an airspeed indicator and must sense static pressure. The cabin pressure controller must sense ambient air pressure through the static system. The cabin altimeter measures only internal cabin pressure. The Static Air Temperature Indicator has its own temperature probe.

2—(1) Area F09

The EPR gauge indicates the engine pressure ratio as a measure of the thrust being developed by the engine. This is a ratio of the turbine discharge total pressure to the equivalent of the compressor inlet total pressure.

3—(3) Area E02

Compressor blades are shaped similar to the airfoil sections of wings or propeller blades. The compressor blade will stall at a particular high angle of attack just as any other airfoil.

4—(1) Area H03

Normal fuel flow is indicated. Low air pressure would be indicated by slow acceleration but with combustion and probable high EGT. If ignition does not occur, the starter cannot accelerate the engine above approximately 23%. It is improbable that there is a multiple gauge failure.

5—(1) Area H06

The limiting takeoff EPR at a pressure altitude of 1,000 ft. is 1.91 with T/C OFF for any temperature below +5° C. The takeoff data chart indicates that an EPR of 1.99 is specified for a temperature of −5° C. with a pressure altitude of approximately 2,500 ft. or higher.

6—(1) Area H07

Proceed right in the 3,000 – 5,000 ft. pressure altitude bracket to the second temperature column. Then move down to the aircraft weight of 270,000 lbs, and read 132, 137, and 153. The corrections of V_1 speed for the tail wind and upslope cancel out.

7—(2) Area A08

Leading edge devices such as slots, slats, and flaps are extended for takeoff and landing through movement of the trailing edge flap control system.

8—(1) Area D04

Control of cabin pressurization is accomplished by metering the quantity of air which escapes from the cabin through the outflow valve. The cabin pressure control has no direct effect upon pressurization input devices or upon relief valves.

9—(3) Area 105

485 mi.÷34.2 specific range=14,200 lbs. consumed in cruise.

14,200+1,200=15,400 lbs. total consumed.
210,000−15,400=194,600 landing weight.

10—(4) Area A14

In crossfeed operation, fuel flow and pressure in the manifold and at the engine would remain normal. The light associated with the fuel pump is normally a "Low Pressure" light rather than a "Normal Operation" light.

11—(1) Area I03

Obtain fuel flow on chart at intersection of 240 - 230 (x1,000) wgt. and −50° C. SAT=3770 ff/eng.

8,000 lbs. @ 3770 ff/eng.=32 minutes
8:45 a.m.+ :32 minutes=9:17 a.m.

12—(2) Area D13

An overheat warning for a wing area is an indication of a leaking duct or other types of penumatic system failure. Alternative answers 1, 3, and 4 will not remove the source of hot air.

13—(3) Area J18

The generator must be rotating if frequency or volts are indicated. The CSD low oil pressure light will be on with a positive disconnect. CSD oil temperature indications do not confirm a disconnect because the temperature indication may rise after rotation is stopped. Bus tie volts will be normal with the other generators operating.

14—(2) Area K05

A turbojet engine does not have a magneto or an induction vibrator included in its accessory equipment. The temperature rise due to compression is not sufficient to ignite fuel for a windmilling start. The igniter system must be activated by selection of an inflight start position of the switch.

15—(4) Area J13

The rate of smoke removal can be increased by opening the outflow valve or using additional cabin air outlets. This is done when the cabin altitude is raised. It is desirable to continue operation of the turbo-compressors, unless they are the source of smoke, to promote a high degree of air flow which will carry the smoke overboard.

16—(4) Area C05

A cabin altitude-sensing device opens a valve in the passenger oxygen system at approximately 14,000 ft. cabin altitude. When the valve opens, oxygen is permitted to flow from the bottles into the passenger oxygen system. This oxygen pressure is used to actuate a mechanism which trips open the oxygen mask containers.

17—(2) Area F07

The thrust reverser normally incorporates clam shell doors which block the exhaust gases. The exhaust gases escape out the sides or top and bottom of the tail pipe and are deflected forward at an angle by vanes or doors.

18—(1) Area A06

Once the wheel has come up to speed during a landing, any unusual deceleration is an indication of an impending skid. The anti-skid system senses the deceleration and causes a corrective action by releasing brake pressure before the skid occurs.

19—(3) Area J14

The use of a dry chemical extinguisher is considered the preferred method. There is danger of the wheel shattering if other agents are used, this could cause severe damage to the airplane or injuries to nearby personnel. Engine operation or a tire burst would have no effect on the fire.

20—(1) Area L03

The sweep of a wing has the effect of increasing the speed at which supersonic airflow begins, this is the Critical Mach Number. Swept wings have a greater tendency to cause "Dutch Roll." Wings with identical wing areas would have the same wing loading assuming constant aircraft weight.

PREPARATION FOR THE PRACTICAL TEST

After you take your Flight Engineer Written Test, you will receive a report of your grade on AC Form 8060–37. The sample report illustrated in Figure 12 indicates the results of a Flight Engineer-Turbojet Written Test taken by Richard C. Roe. The report indicates that Mr. Roe passed a Flight Engineer-Turbojet Written Test which he took on October 25, 1970. The expiration date indicates that he may use the AC Form 8060–37 until the end of October 1972 to apply for the Practical Test. If he does not make use of the AC Form 8060–37 in that time period, he will have to take and pass another written test prior to applying for the Practical Test.

The lower section of the AC Form 8060–37 indicates the subject matter areas on which Mr. Roe missed particular test questions. He may have missed more than one question on any one of the areas indicated. This group of codes can be compared to the outline which Mr. Roe received with his AC Form 8060–37 or the outline of page 11 of this study guide to determine the related subjects. If Mr. Roe had failed the test it would have been advisable for him to do extra study on the subjects related to these codes before applying for re-testing. Although Mr. Roe has proven by this passing grade that he meets the minimum aeronautical knowledge requirements of FAR 63.35, he would be wise to review the subject areas where weakness is indicated before he applies for his Practical Test.

Information concerning application for your Practical Test can be obtained at any FAA Flight Standards District Office. Generally, you must have made arrangements for the use of an airplane of the class for which you are seeking a rating. The airplane must be made available, along with the required crew, for the ground and flight test portions of your Practical Test.

As indicated in FAR 63.39, you must be able to show:

(1) That you can satisfactorily perform preflight inspection, servicing, starting, pre-takeoff, and post-landing procedures;

(2) In flight, that you can satisfactorily perform the normal duties and procedures relating to the airplane, airplane engines, propellers (if appropriate), systems and appliances; and

(3) In flight, in an airplane simulator, or in an approved flight engineer training device, show that you can satisfactorily perform emergency duties and procedures and recognize and take appropriate action for malfunctions of the airplane, engines, propellers (if appropriate), systems and appliances.

DO NOT DESTROY THIS TEST REPORT This Test Report must be presented for retesting or certification.	DEPARTMENT OF TRANSPORTATION – FEDERAL AVIATION ADMINISTRATION AIRMAN WRITTEN TEST REPORT	SSN 999-90-1234

TEST		GRADES BY SECTION							FAA OFFICE NO.	TEST DATE	EXPIRATION DATE	PREVIOUS SERIES
NO	TITLE *	1	2	3	4	5	6	7				
30	FEJ	85							SW39	10-25-70	10-25-72	
EXPIRATION DATE (Last day of month)												

* See codes on reverse side:

MECHANICS ONLY – EXPIRATION DATE CODES

The first character designates the month; the second and third characters, the year. January through September as shown by numbers 1 through 9; October as "O"; November as "N"; December as "D".

EXAMPLES: 6 68 D 68
Month (June)
Year (1968)
Month (December)
Year (1968)

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NOTE: TO FIND THE SUBJECT AREA IN WHICH QUESTIONS WERE MISSED, COMPARE THE CODES SHOWN BELOW WITH THE CODED ITEMS ON THE ENCLOSED SUBJECT AREA OUTLINE.

SECTION	SUBJECT AREA CODES
1	A07, A14, B08, C05, E06, F08, I06, J15, L02

ISSUED BY: ADMINISTRATOR
FEDERAL AVIATION ADMINISTRATION

AC FORM 8060-37 (8-68) SUPERSEDES PREVIOUS EDITION

FIGURE 12. Airman written test report.

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