

AVIATION COURSES, LTD.

AIRCRAFT MAINTENANCE TECHNICIAN ORAL AND PRACTICAL STUDY GUIDE

Table of Contents

Contents

INTRODUCTION	1
FAA ELIGIBILITY REQUIREMENTS	1
THE FAA WRITTEN (COMPUTERIZED) TEST	1
ORAL AND PRACTICAL EXAMINATIONS	1
FAA TEST PREPARATION	2
THE ORAL EXAM	2
THE PRACTICAL EXAM	2
OTHER AREAS APPLICANTS SHOULD BE PROFICIENT IN	2
INDEX AND SUBJECT CODES	3
GENERAL TEST SUBJECTS	5
BASIC ELECTRICITY ORAL	5
AIRCRAFT DRAWINGS ORAL	7
WEIGHT AND BALANCE ORAL	8
FLUID LINES AND FITTINGS ORAL	10
MATERIALS AND PROCESSES ORAL	11
GROUND OPERATIONS AND SERVICING ORAL	13
CLEANING AND CORROSION CONTROL ORAL	15
MATHEMATICS ORAL	16
MAINTENANCE FORMS AND RECORDS ORAL	17
BASIC PHYSICS ORAL	19
MAINTENANCE PUBLICATIONS ORAL	20
MECHANIC PRIVILEGES AND LIMITATIONS ORAL	21
AIRFRAME TEST SUBJECTS	22
AIRFRAME STRUCTURES	22
WOOD STRUCTURES ORAL	22
AIRCRAFT COVERING ORAL	24
AIRCRAFT FINISHES ORAL	26
SHEET METAL STRUCTURES ORAL	28

WELDING ORAL	30
ASSEMBLY AND RIGGING ORAL	32
AIRFRAME INSPECTION ORAL	34
AIRFRAME SYSTEMS AND COMPONENTS	35
AIRCRAFT LANDING GEAR SYSTEMS ORAL	35
HYDRAULIC AND PNEUMATIC POWER SYSTEMS ORAL	37
CABIN ATMOSPHERE CONTROL SYSTEMS ORAL	39
AIRCRAFT INSTRUMENT SYSTEM ORAL	41
COMMUNICATION AND NAVIGATION SYSTEMS ORAL	43
AIRCRAFT FUEL SYSTEMS ORAL	45
AIRCRAFT ELECTRICAL SYSTEMS ORAL	47
POSITION AND WARNINGS SYSTEM ORAL	49
ICE AND RAIN CONTROL SYSTEMS ORAL	50
FIRE PROTECTION SYSTEMS ORAL	52
POWERPLANT TEST SUBJECTS	54
THEORY AND MAINTENANCE	54
RECIPROCATING ENGINES ORAL	54
TURBINE ENGINES ORAL	56
ENGINE INSPECTION ORAL	58
SYSTEMS AND COMPONENTS	59
ENGINE INSTRUMENT SYSTEMS ORAL	59
ENGINE FIRE PROTECTION SYSTEMS ORAL	60
ENGINE ELECTRICAL SYSTEMS ORAL	62
LUBRICATION SYSTEMS ORAL	64
IGNITION SYSTEMS ORAL	66
FUEL METERING SYSTEMS ORAL	68
ENGINE FUEL SYSTEMS ORAL	70
ENGINE INDUCTION SYSTEMS ORAL	71
ENGINE COOLING SYSTEMS ORAL	72
ENGINE EXHAUST SYSTEMS ORAL	74
PROPELLER ORAL	75
AUXILIARY POWER UNITS (APU) ORAL	77
APPENDIX 1	78
APPENDIX 2	80
APPENDIX 3	99

INTRODUCTION

FAA ELIGIBILITY REQUIREMENTS

To qualify for the Airframe and/or Powerplant rating, the FAA requires an applicant to show a certificate of completion from an aviation maintenance school, certificates under FAR 147, or written proof of past experience. For applicants applying for eligibility through past experience, the FAA requires documented proof of 18 months' experience for one rating (Airframe or Powerplant) and 30 months' experience for both ratings. This written documentation may be in the form of letters, DD-214 forms, and/or training certificates. It is always wise to contact the local Flight Standard District Office (FSDO) and speak with an Aviation Maintenance Inspector (ASI) to determine what documentation they will require to obtain the authorizations. The applicant is also required to be at least 18 years of age, be able to read, write, speak, and understand the English language, and pass all the required tests within a 24-month period.

Upon presenting the documented evidence to the FAA for authorization, an applicant will be required to complete two original FAA 8610-2 forms (Airmen Certificate and Rating Application). [Visit this link for a copy of the Form 8610-2](#). Ensure that the ASI has signed both forms. These forms must be presented to the appropriate testing designees before an applicant will be allowed to take any of the required FAA tests for certification.

THE FAA WRITTEN (COMPUTERIZED) TEST

Before you can take an oral and practical exam, you must first pass the required written exams. The written exams are given by Computerized Test Designees (CTDs). CTDs are selected by the FAA FSDOs. When ready to take the written (computerized) exams, you will need to contact a CTD to schedule your tests. Your local FSDO should be able to provide you with the available CTDs in your area. Testing fees normally range from \$90 to \$100. You will be required to present your 8610-2 forms and two forms of identification (one with a photo) to the CTD the day you arrive to take the test. You are allowed to bring a simple electronic calculator for use on the test. The CTD will provide you with any FAA-approved reference material needed for the test.

ORAL AND PRACTICAL EXAMINATIONS

After taking and passing the required FAA computerized tests, you have two years to take an oral and practical exam with a DME (Designated Mechanic Examiner). Your local FSDO can provide you with a list of the available DMEs in your area. After two years, your computerized test reports expire and will have to be retaken if you have not taken and passed the oral and practical exam. You must present the computerized test reports from the CTD, the two original 8610-2 forms, and proper identification in order to take an oral and practical exam. Testing fees for the oral and practical exam can range significantly from one DME to the next.

There are 43 subject areas that are covered on the oral and practical exams. Each subject area is coded by section and an alphabetical letter. You will find all 43 subjects listed by section and alphabetical letter in the Oral Test Index at the end of this section. Your examiner is required to cover all 43 subject areas during the examination. If an applicant fails any portion of the oral and practical exam, the DME will list the failed sections on the back of the applicant's 8610-2 form by section and alphabetical letter. If you schedule to retake the oral and practical exam with the same DME within 30 days after the failure, you will be required to have another certified mechanic to give you additional instruction and sign a letter stating that additional instruction has been given. Remember, after taking and passing the written (computerized) FAA exams, you have up to two years to pass the oral and practical exams. Upon retesting, the DME is then required to retest you only on the failed subject areas listed on the back of your 8610-2 form. If you decide to retake the oral and practical with a different DME, you may have to retake the entire exam. It is best to discuss this with your DME, prior to scheduling a retest.

Upon completing and passing your oral and practical exam, the DME will issue you a temporary certificate the same day as testing. The DME must process the appropriate paperwork through FAA channels before you will receive your permanent certificate in the mail.

FAA TEST PREPARATION

To do well on the oral and practical exams, as well as the written tests, a person needs to incorporate their past experience and skills as much as possible. Since the FAA mechanic tests cover all facets of aviation maintenance, individuals normally do better if they attend a structured course of instruction. In school, you will have instructors to guide you and answer any questions on areas that may not be familiar to you. When preparing for these exams at home, without an instructor, you should first insure that you have access to the FAA publications for research and study. The FAA publications that are used most for preparation are listed in Appendix 1 in this study guide.

THE ORAL EXAM

The DME is required to give you an oral exam and a practical exam. During your oral exam, the DME will simply ask questions. Sample oral exam questions are presented in this study guide covering the 43 subject areas. We suggest that, as you go through the oral questions in this study guide, you locate the information in the appropriate FAA publication if you do not completely understand the answer. This process will be time consuming but will prove to be a beneficial learning experience, and the knowledge gained will be very helpful during your practical exam.

THE PRACTICAL EXAM

The practical exam given by any DME can vary, depending on the equipment the DME has available and the areas in which he or she may feel is important during the testing process.

After you have studied the oral questions and researching answers to areas that you do not fully understand, then we suggest that you begin working through the projects and assignments found in Appendix 2 and 3 of this study guide. As with the oral section, if a project or assignment is not completely understood, look up the subject in your FAA publications to help guide you through the project or assignment. We have provided some instruction and formulas with most of the projects found in these two appendices, but you may need to refer to the appropriate FAA publication to give you a better understanding on completing these projects.

Knowing how to research and use the prescribed FAA publications is an important part of the practical portion of the oral and practical exams. Most DMEs will have these publications available to you during your practical exam.

OTHER AREAS APPLICANTS SHOULD BE PROFICIENT IN

- Researching Type Certificate Data Sheets and Aircraft Specifications
- Researching Airworthiness Directives and Service Letters
- Interpreting the Applicability and Requirements of Airworthiness Directives
- Locating Information in Aircraft Maintenance Manuals

AVIATION MAINTENANCE TECHNICIAN ORAL TEST GUIDE

INDEX AND SUBJECT CODES

Subject Codes	Test Subjects	Chapter
SECTION I – GENERAL		
A.	Basic Electricity	1
B.	Aircraft Drawings	2
C.	Weight and Balance	3
D.	Fluid Lines and Fittings	4
E.	Materials and Processes	5
F.	Ground Operations and Servicing	6
G.	Cleaning and Corrosion Control	7
H.	Mathematics	8
I.	Maintenance Forms and Records	9
J.	Basic Physics	10
K.	Maintenance Publications	11
L.	Mechanic Privileges and Limitations	12
SECTION II – AIRFRAME STRUCTURES		
A.	Wood Structures	13
B.	Aircraft Covering	14
C.	Aircraft Finishes	15
D.	Sheet Metal Structures	16
E.	Welding	17
F.	Assembly and Rigging	18
G.	Airframe Inspection	19
SECTION III – AIRFRAME SYSTEMS AND COMPONENTS		
A.	Aircraft Landing Gear Systems	20
B.	Hydraulic and Pneumatic Power Systems	21
C.	Cabin Atmosphere Control Systems	22
D.	Aircraft Instrument Systems	23
E.	Communication and Navigation Systems	24
F.	Aircraft Fuel Systems	25
G.	Aircraft Electrical Systems	26
H.	Position and Warning Systems	27
I.	Ice and Rain Control Systems	28
J.	Fire Protection Systems	29

SECTION IV – POWERPLANT THEORY AND MAINTENANCE

A.	Reciprocating Engines	30
B.	Turbine Engines	31
C.	Engine Inspection	32

SECTION V – POWERPLANT SYSTEMS AND COMPONENTS

A.	Engine Instrument Systems	33
B.	Engine Fire Protection System	34
C.	Engine Electrical System	35
D.	Lubrication Systems	36
E.	Ignition Systems	37
F.	Fuel Metering Systems	38
G.	Engine Fuel Systems	39
H.	Engine Induction Systems	40
I.	Engine Cooling Systems	41
J.	Engine Exhaust Systems	42
K.	Propellers	43
L.	Auxiliary Power Units (APU)	44

GENERAL TEST SUBJECTS

BASIC ELECTRICITY ORAL

1. What is the most important law applicable to the study of electricity?
Ohm's Law ($I = E \div R$)
2. What are the elements of Ohm's Law?
Voltage (E), current (I), and resistance (R)
3. What are the sources of electrical power?
Mechanical (generator), chemical (battery), photoelectric (light), and thermal heat
4. What does an electrical circuit consist of?
A source of electrical pressure or EMF, resistance in the form of an energy-consuming electrical device and conductors, usually in the form of copper or aluminum wires, to provide a path for electron flow
5. What represents capacitance in an AC circuit?
A capacitor (condenser)
6. What is the function of a capacitor?
To store electricity
7. What is inductance?
A voltage that is induced in a coil in an AC circuit. The induced voltage is opposite in direction to the applied voltage and opposes any change in the alternating current.
8. What is impedance?
It is the combined effect of resistance, inductive reactance, and capacitive reactance in an AC circuit.
9. What is the unit of measurement of power in a DC circuit?
The watt. Amperes times volts equals watts ($P = I \times E$). 746 watts equals one horsepower.
10. What is a kilowatt?
It is 1,000 watts.
11. In a DC circuit, what occurs when voltage is increased while resistance remains constant?
There will be an increase in current.
12. What are the three types of DC electrical circuits?
They are series circuits, parallel circuits, and series parallel circuits.
13. A 24-volt lead acid battery has how many cells?
It has 12 cells. Each cell is rated at 2 volts.
14. What should be the specific gravity of the electrolyte in a fully charged lead acid battery?
It should be between 1.275 and 1.300.
15. What instrument is used to determine the specific gravity of electrolyte in a lead acid battery?
A hydrometer
16. Why can't a hydrometer be used to determine the charge of a nickel cadmium battery?
The specific gravity of the electrolyte in a nickel cadmium battery does not change appreciably during charge or discharge of the battery.

17. When using a hydrometer to check the charge of a lead acid battery, at what temperatures must a correction factor be applied to the reading?
Adjustments must be made if temperature of the electrolyte is above 90° F. or below 70° F.
18. What is electromagnetic induction?
It is the transfer of electrical energy by means of a magnetic field. This is the principle of transformer operation.
19. How are battery compartments protected against corrosion?
They are coated with special corrosion resistant paint such as bituminous paint.
20. What should be the correct electrolyte level in a properly serviced battery?
It should be approximately 3/8 inches above the plates. If the battery has baffle plates above the cell plates, the electrolyte level should be up to the hole in the baffle plate in each cell.
21. What is paralleling generators?
This is when two or more generators are operated at the same time to supply power for a load that must be shared equally.
22. Describe a no-trip circuit breaker (trip free).
It is a breaker that cannot be reset while in flight.
23. Can you store ni-cad and lead acid batteries together?
No, the fumes from the lead acid battery can contaminate the electrolyte in the ni-cad battery.

AIRCRAFT DRAWINGS ORAL

1. What types of lines are used on aircraft drawings to indicate hidden views, alternate positions, and center lines?
A hidden view is a medium-width line made up of short dashes. It represents an edge that cannot be seen when looking at the part from a specific position.

Alternate position lines are medium-width lines composed of one long and two short evenly spaced dashes. They are used to show the alternate position of a part or the relative position of a missing part.

Center lines are composed of alternate long and short dashes and are used to indicate the center of an object or part of an object.
2. Define "tolerance" as used in aircraft drawings.
The difference between the plus and the minus allowance figures when a dimension shows an allowable variation
3. Define "clearance" as used in aircraft drawings.
Clearance is the dimension given for the space between moving parts.
4. What information is given in the title block of a blueprint?
The drawing number, the name of the part or assembly, the scale, the date, the name of the firm, the name of the draftsman, the checker, and the approving official.
5. Why are dimensions used, and how are they shown on the aircraft drawings?
Dimensions are solid narrow lines, broken at midpoint for the insertion of measurements. They are used to indicate the size of an object.
6. How can a change to an aircraft drawing be identified?
By its revision letter. The revision letters are usually listed in a table next to the title block or at one corner of the drawing.
7. What is a "bill of material" associated with aircraft blueprints?
It is a list of materials and parts necessary for fabrication or assembly of a component or system.
8. Why are symbols used when drawing aircraft blueprints?
Symbols are a type of shorthand used for drawing. They show the characteristics of a component with a minimum amount of drawing.
9. How many views are required to determine the shape of an object?
Three views. Two views will not always determine the shape of an object. If three views are given, all three must be reviewed.

WEIGHT AND BALANCE ORAL

1. What is the datum and its purpose when making weight and balance computations?
It is an imaginary vertical line or plane used in weight and balance calculations from which measurements are taken both forward and aft to determine the relative location of items in the aircraft. The distance from the datum, in inches, to the weight center of an item is called the "arm."
2. What is the purpose of weight and balance control?
Safety and efficiency in flight.
3. When computing weight and balance, what is the "moment" and how is it obtained?
A moment is a force which tends to rotate the aircraft about its center of gravity. It is obtained by multiplying the weight of an item (pounds) by the distance of the item from the datum (inches). It is usually expressed in "inch-pounds."
4. What is the "arm" of an item and how is it obtained?
The arm is the distance (in inches) an item is located either forward or aft of datum. It is obtained either by actual measurement or from the aircraft weight and balance records.
5. What is "tare" weight and how is it handled when making weight and balance calculations?
"Tare" is the weight of extra equipment used for weighing the aircraft such as chocks, blocks, jacks, and chains. Tare weight must be subtracted from the scale readings in order to obtain the actual weight of the aircraft.
6. What is meant by "minimum fuel" and how is it calculated for weight and balance purposes?
Minimum fuel is the amount of the fuel that should be used in weight and balance computations when the aircraft is loaded for an extreme condition check. For a reciprocating engine airplane certified under FAR Part 23, this is the fuel necessary to operate the engine(s) for one-half hour at maximum continuous power.
7. What is meant by "residual" fuel?
It is the fuel remaining in the tanks, lines, and engine after draining. Also called "undrainable" or "unusable." It is part of the aircraft's empty weight.
8. How would you determine the empty weight and empty weight CG of an aircraft which has tricycle landing gear if all weight and balance records are missing?
Use three scales and record the weight under each wheel. Then, measure the distance in inches from the nose wheel to the main gear and multiply the figure by the combined weight of each main wheel. Into this number, divide the total weight of the aircraft. The answer will be the number of inches the CG is located aft of the nose wheel. NOTE: This can be proved by using the figures on page App 2-8. Using this approach, you should find a CG 92.5 inches aft of the nose wheel. The nose wheel is 20 inches aft of datum, so the CG would be 112.5 inches aft of the datum.
9. What is ballast?
Ballast is lead bars, metal plates, shot bags, sand bags, or other items of weight placed into the aircraft to attain a desired CG location.
10. What is the difference between fixed-wing aircraft and helicopter CG ranges?
The CG location in a helicopter is much more critical than fixed-wing aircraft. The CG range in some helicopters is less than three inches.

11. When weighing an aircraft to determine the empty weight CG, which aircraft operations equipment must be included in the weight determination?
All fixed (non-portable) operations equipment, whether required, optional, or special, must be included in the aircraft's empty weight.
12. Why do some manufacturers specify an empty weight CG range even though the aircraft is not operated at its empty weight?
When the empty weight CG falls within the empty weight CG range, it is unnecessary to perform a weight-and-balance check if standard loading and seating arrangements are used.
13. Why must the aircraft category be considered when computing weight and balance?
Some airplanes are certified in both normal and utility categories. This means a different maximum allowable gross weight, depending on which category the aircraft will be operated in.

FLUID LINES AND FITTINGS ORAL

1. What are aircraft plumbing lines usually made of?
Metal tubing and fittings, or flexible hose.
2. How is metal tubing sized?
By outside diameter, which is measured fractionally in sixteenths of an inch, and by wall thickness
3. What precautions should be taken when routing fluid lines adjacent to electrical wiring?
Rotate the fluid lines below the electrical wiring and maintain a clearance of at least six inches whenever possible. In no case should fluid lines and electrical wiring be closer than one-half inch. Ensure that both the wiring and the fluid lines are fastened to the aircraft structure by clamps or other methods that will maintain the separation.
4. What is the purpose of the identification stripe running along the length of a flexible hose?
The stripe is used to determine if the hose has twisted during installation. The stripe should not spiral around the hose after installation is completed.
5. How are standard AN-type fluid line fittings identified?
AN-fluid line fittings are colored either blue or black while AC-type fittings are usually gray or yellow. AN fittings have coarser threads than AC fittings, and they also have a small shoulder between the threads and the flare cone. The AC fittings are completely threaded from the shoulder all the way to the flare cone.
6. What is the purpose of using quick disconnect couplings in fluid systems?
Quick disconnect couplings are installed at locations where frequent uncoupling of the lines is required for inspection maintenance. Each half has a valve that is open when coupled together and spring-loaded closed when disconnected. They provide a means of quickly disconnecting a line without a loss of fluid or air entering the system.
7. How is flexible hose sized?
By the inside diameter in sixteenths of an inch increments.
8. How much slack must be left in a flexible hose during installation?
Five to eight percent of the total hose length must be allowed for freedom of movement under pressure.
9. What are the three parts of a Military Standard (MS) flareless tube fitting?
The body, the sleeve, and a nut.
10. What will be the result of over tightening a flareless tube fitting?
The sleeve's cutting edge will cut too deeply into the tube and cause the tube to be weakened.
11. What are the two kinds of flares used in aircraft plumbing systems?
A single flare and a double flare.
12. What is the advantage of flexible Teflon hose over rubber hose?
It can be used in the same manner as rubber hose, but it has a better operating strength.
13. What precaution should be taken when deburring the cut end of a tube?
Care should be taken that the tubing is not cracked or that the wall thickness is not reduced by the deburring process.

MATERIALS AND PROCESSES ORAL

1. What is suitable nondestructive method for detecting surface cracks in aluminum castings and forgings?
The dye penetrant inspection method detects surface cracks with equal success on aluminum, magnesium, brass, copper, and titanium. It can also be used on ceramics, plastics, and glass.
2. List the steps in a dye-penetrant inspection.
 1. **Thoroughly clean the material surface.**
 2. **Apply the penetrant.**
 3. **Remove the penetrant with emulsifier cleaner.**
 4. **Dry the part.**
 5. **Apply developer.**
 6. **Inspect the results.**
3. Describe the procedure for performing a magnetic particle inspection.
Thoroughly clean all grease, oil, and dirt from the metal part, which must be of magnetic material such as iron or steel. Magnetize the part and then apply the ferromagnetic particles, either held in liquid suspension or in dry power form to the area to be inspected. If a discontinuity is present, the magnetized particles will form a pattern in the approximate shape of the discontinuity.
4. What is the general rule for using self-locking nuts?
Do not use self-locking nuts at joints which subject either the nut or bolt to rotation.
5. What type of cable is used in primary control systems?
Extra-flexible 7x19 cable
6. How can the correct 'grip length' of a bolt be determined?
The grip length is the unthreaded portion of the bolt shank. Generally speaking, the grip length should equal the total thickness of the material being bolted together.
7. What is the smallest cable that can be used in primary control systems?
Federal regulations state that no cable smaller than one-eighth inch in diameter may be used for this purpose.
8. What should be the depth of penetration when making a fillet weld?
Penetration should be 25 to 50 percent of the thickness of a base metal.
9. What should be the width of the weld bead and depth of penetration when making a butt weld?
The bead width should be 3 to 5 times the thickness of the base metal, and there should be 100 percent penetration.
10. What system is used to identify AN-type aircraft bolts?
Aircraft bolts have code markings on the bolt heads for identification.
11. What are the steps for solution heat treating aluminum alloys?
The alloy must be heated to a predetermined temperature, heat soaked for a specified period of time, and then rapidly quenched to a relatively low temperature.
12. In what state is aluminum alloy immediately after solution heat treating and quenching?
The alloy is in a comparatively soft state, so the material must be naturally aged or precipitation-hardened.
13. What is done to prevent certain aluminum alloy rivets from becoming hard after heat treating and quenching?

The rivets are stored in a refrigerator at a temperature lower than 32° F. The rivets will remain soft for several days.

14. What are the characteristics of a cold weld?
A cold weld has improper penetration and cold laps caused by the insufficient heat. It appears rough and irregular and its edges are not feathered into the metal base.
15. What tools are used to measure the outside dimensions of shafts, thickness of sheet metal stock, diameter of drills, and for many other similar applications?
Outside micrometer or caliper
16. What should be used to make a visual inspection of a weld?
A magnifying glass of at least ten power
17. Name some types of non-destructive testing used on non-ferrous materials.
Eddy current, dye penetrant, x-ray, and visual inspection

GROUND OPERATIONS AND SERVICING ORAL

1. What is the procedure for extinguishing an induction system fire that occurs during starting of a reciprocating aircraft engine?
A fireguard familiar with the aircraft's induction system should be standing by with a CO₂ fire extinguisher during the engine start. If an engine fire develops, continue cranking to start the engine and blow out the fire. If the engine does not start and the fire continues to burn, discontinue starting. The fireguard should extinguish the fire using available equipment.
2. What is the purpose of pulling a propeller through by hand for two or three revolutions prior to starting some reciprocating engines?
The purpose is to detect a hydraulic lock if one is present. Any liquid present in the cylinder will be indicated by an abnormal effort required to rotate the propeller, or by the propeller stopping abruptly during rotation.
3. What damage is most likely to occur if force is exerted on the crankshaft when there is liquid lock?
The force can bend or break a connecting rod.
4. What information must be located on or near fuel filler openings? Oil filler openings?
For normal category aircraft, the word "fuel" and the minimum fuel grade or designation for the engine. For transport category aircraft, the same information listed for normal category. Oil filler openings require the word "oil" to be marked at or near the filler cover.
5. Describe the system used to designate performance rating of aviation gasoline.
For fuels below grade 100, octane numbers are used, such as 91/96. The fuel is compared with mixtures of iso-octane and normal heptanes. Thus, grade 91 fuel has the same knock characteristics as a blend of 91 percent octane and 9 percent heptane. When two numbers are used, the first number is the lean mixture performance rating. The second number is the rich mixture performance rating.

For fuels above grade 100, the numbers represent the performance rating of the fuel compared to 100 percent iso-octane. That is, its knock-free power available as compared with that available with pure iso-octane. The first number is the lean mixture performance rating. The second number is the rich mixture performance rating.
6. What would be the result of operating an aircraft reciprocating engine using a lower grade of gasoline than that specified for the engine?
There would be a loss of engine power, efficiency, and possible detonation.
7. Why should an aviation mechanic know the meaning of the standard light signals that are used by control tower operations?
If radio communication is not possible, the light signals may be used for taxi control when an aircraft must be taxied to another part of the airport.
8. Which publication lists the standard FAA hand signals a taxi signalman should use?
The FAA Airman's Information Manual (AIM).
9. What is the result of mixing aviation gasoline with jet fuel in a turbine engine?
When aviation gasoline is mixed with jet fuel, the tetraethyl lead in the gasoline will form deposits on the turbine blades and vanes. Continued use of mixed fuel may cause a loss in engine efficiency. However, there will be no detrimental effect on the engine if such usage is on a limited basis.
10. What may result if gasoline that is contaminated with jet fuel is used in a reciprocating engine?
Gasoline that is contaminated with jet fuel is unsafe for use in a reciprocating engine and can result in complete engine failure.

11. When towing an aircraft with a tow tractor, what brakes should be used to stop the aircraft?
The tow tractor brakes and the aircraft brakes should both be used. Use of the brakes should be coordinated by the man in the cockpit.

CLEANING AND CORROSION CONTROL ORAL

1. What are the five common forms of corrosion?
Surface corrosion, dissimilar metal corrosion, intergranular corrosion, stress corrosion, and fretting corrosion.
2. What is the cause of fretting corrosion?
It occurs when two mating surfaces, which are normally at rest with respect to each other, are subject to slight relative motion. It is characterized by pitting of the surfaces and the generation of large quantities of fine debris between the surfaces.
3. What are the factors that affect the type (form) of corrosion?
The form of corrosion varies with atmospheric conditions, size and shape of the metal, the type of metal, and the corrosion-producing agents present.
4. What methods are used for removing rust from aircraft materials?
Except on highly stressed steel surfaces, the use of abrasive papers and compounds, small power buffers and buffing compounds, hand wire brushing and steel wool are all acceptable methods of removing rust.
5. What specific operations are part of corrosion-preventive maintenance?
Adequate cleaning, periodic lubrication, detailed inspection, prompt corrosion treatment, touch-up of damaged paint, sealing, use of protective covers, and daily wipe-down of exposed critical areas.
6. Name the steps for corrosion removal.
Clean and strip the corroded area, remove as much corrosion as possible, neutralize any residual material remaining in pits and crevices, restore protective surface films, and paint.
7. What tools are approved for cleaning corroded anodized surfaces?
Fiber bristle brushes, aluminum wool, and aluminum wire brushes.
8. What products should be used to clean an aircraft engine?
A fine spray of kerosene or solvent
9. What is the preferred cleaning agent for plastic surfaces?
Soap and water
10. What areas of an aircraft are more prone to corrosion?
Battery compartments, bilge areas, wheel well and landing gear, flap recesses, and other areas where water might be entrapped
11. What is the difference between "wet wash" and "dry wash" aircraft cleaning?
Wet wash cleaning is used to remove oil, grease, carbon deposits, and soils with the exception of corrosion and oxide films. Dry wash cleaning is used to remove film, dust, and small accumulations of dirt.
12. What are types of light-duty and heavy-duty aircraft cleaning agents?
Light-duty cleaning agents are soap and synthetic detergent; heavy-duty cleaning agents are solvents and emulsions.

MATHEMATICS ORAL

1. What is the formula for the area of a rectangle?
 $A = \text{Length} \times \text{Width}$
2. What is *Pi* (π)?
***Pi* is a constant (3.1416) and is the ratio of the circumference to the diameter of any circle.**
3. What is the formula for the circumference to the diameter of any circle?
 $C = \pi d$
4. What is the formula for the area of a circle?
 $A = \pi r^2$
5. What is the root of a number?
The root of a given number is the base number that, when multiplied by itself one or more times, will produce the given number (e.g., the root of 4 is 2; $2 \times 2 = 4$)
6. Give examples of perfect square numbers.
4, 9, 16, 64, 100, 144, etc.
7. How do you express a decimal as a percent?
Move the decimal two places to the right and add the percent sign. For example, .75 is 75%, or .375 is 37.5%.
8. Using the powers of ten, how can 1,000,000 be expressed?
Ten to the sixth power
9. What is the sum of a large negative number and a small positive number?
Subtract the smaller number from the larger number and use the sign of the larger number in the answer.
10. How is a ratio expressed?
A ratio may be expressed as a fraction or it may be written using the colon (:) as a symbol for expressing ratio. Thus, the ratio $\frac{5}{7}$ may be written 5:7.

MAINTENANCE FORMS AND RECORDS ORAL

1. What is the definition of "time in service" with respect to maintenance time records?
"Time in service" means the time from the moment an aircraft leaves the surface of the earth until it touches it at the next point of landing.
2. What are the record requirements after compliance with a 100-hour inspection?
There must be an entry made in the maintenance records indicating the type and date of the inspection, aircraft time in service, a statement to the effect that the aircraft has been inspected in accordance with 100-hour inspection requirements and was determined to be in airworthy condition, and the signature and certificate number of the person approving the aircraft for return to service.
3. What are the record requirements after compliance with an Airworthiness Directive (AD)?
No specific format for the record is required. However, the record entries must show the specific number assigned to the Airworthiness Directives (AD), the date of compliance, the method of compliance, aircraft time in service, as well as the signature and certificate number of the person who complied with the AD. In addition, the records must show the current status of all applicable ADs, and must include the method of compliance.
4. Where should the description of a major repair or major alteration be recorded?
On an FAA Form 337, which then becomes part of the maintenance records
5. What is the disposition of an FAA Form 337 after it is completed?
You must give one signed copy to the aircraft owner and one copy to the local FAA Flight Standards District Office (FSDO).
6. Who is required to make the entry in the aircraft records after a 100-hour inspection has been performed?
An appropriately rated certificated mechanic
7. How long must the record of a 100-hour inspection be retained by the owner or operator?
Until the work is repeated or superseded by other work or for one year after the 100-hour inspection was performed.
8. Where can a mechanic find an example of a 100-hour inspection maintenance record entry?
FAR 43.11
9. When an aircraft is sold, what is done with the aircraft records containing the current status of Airworthiness Directives?
FARs require the records to be transferred to the purchaser at the time of the sale.
10. What type of maintenance record entry is required when an inspection under FAR 91.417 is made to a large airplane or a turbine engine-powered multiengine airplane and defects are found?
The entry must name the kind of inspection (continuous airworthiness inspection program, approved inspection program, etc.). A signed and dated list of defects found must be given to the owner.
11. What are the required entries in a new maintenance record for an engine that has been rebuilt and granted zero time by the manufacturer or by an agency approved by the manufacturer?
The manufacturer or agency that grants zero time to a rebuilt engine must enter into the records a signed statement of the date the engine was rebuilt, each change made as required by Airworthiness Directives, and each change made in compliance with the manufacturer's service bulletins if any entry requested in a bulletin.

12. What is an AD Summary?
A regulatory notice sent by the FAA to inform an aircraft owner of a condition that will keep his aircraft unairworthy.
13. What are AD frequencies?
Updates that are issued every two weeks

BASIC PHYSICS ORAL

1. What is matter?
Anything that occupies space and has weight
2. What are the three states of matter?
Solids, liquids, and gases
3. What is the standard atmospheric pressure at sea level?
It is considered to be 14.7 psi or 29.92 inches of Hg.
4. What is the name of the atmospheric phenomenon where cool air is trapped near the earth by warm air?
A temperature inversion
5. What is the speed of sound through the air under standard sea level conditions?
It is 662 knots and 761 mph
6. What determines the density of the air (density altitude)?
The temperature and pressure acting upon it
7. What are the three basic parts of a lever?
The fulcrum, force of effort, and resistance
8. What is a first-class lever, and give an example.
A first-class lever is when the fulcrum is located between the effort and the resistance. An example of a first-class level is a seesaw.
9. In what direction is force transmitted in a confined fluid?
Force is transmitted equally in all directions.
10. What is the formula for computing force, pressure, and area?
Force equals pressure times area or $F = P \times A$
11. What is absolute zero?
It is the temperature at which all motion of the molecules will cease entirely in a given sample of gas. It is considered to be -273°C .
12. What are the two factors involved in work?
Force and movement through a measurable distance
13. How is pressure expressed in hydraulics and pneumatics?
It is expressed in pounds per square inch (psi).
14. What are three methods of heat transfer?
Conduction, convection, and radiation
15. What are the three types of friction?
Rolling, sliding, and static

MAINTENANCE PUBLICATIONS ORAL

1. What is the purpose of Airworthiness Directives?
They are used to correct unsafe conditions in aircraft, engines, propellers, and appliances.
2. What FAA publication is used to notify aircraft owners of unsafe conditions?
Airworthiness Directives
3. When must an Airworthiness Directive be complied with?
The AD will include the time or period necessary for corrective action.
4. Where can you find a list of approved engines for use in a specific model aircraft?
On the Type-Certificate Data Sheet for the Aircraft
5. Where can you find Airworthiness Standards for normal, utility, and acrobatic category airplanes?
FAR Part 23
6. Where can you find Airworthiness Standards for transport category airplanes?
FAR Part 25
7. What federal regulation defines the requirements for the issue of Type Certificates?
FAR Part 21
8. Where would you look to find out if a specific airplane can be certified in more than one category?
On the Aircraft Specifications or Type Certificate Data Sheet
9. What publication is issued by airframe, engine, and component manufacturers to notify aircraft owners of design defects?
Service bulletins
10. What publication contains complete instructions for maintenance of all systems and components installed in an aircraft?
The manufacturer's Aircraft Maintenance Manual
11. What are FAA Advisory Circulars?
They are publications containing non-regulatory material of interest to the aviation public.

MECHANIC PRIVILEGES AND LIMITATIONS ORAL

1. Which federal regulation prescribes the certificate requirements for a mechanic?
FAR Part 65
2. What are the limitations of a certified mechanic in regard to aircraft instruments?
A mechanic may not calibrate or make any repairs or alterations to aircraft instruments.
3. What are the privileges and limitations of a certified mechanic in regard to propellers?
A powerplant mechanic may make minor repairs and alterations, but may not make major repairs or major alterations to propellers.
4. When a mechanic has a permanent change of address, what must be done within 30 days after the change?
He must notify in writing the administrator of the FAA.
5. What is the duration of a certified mechanic?
It is effective until surrendered, suspended, or revoked.
6. How long is a temporary mechanic certificate in effect?
For a period of 120 days
7. What is used as a guide to determine if a repair is a major or a minor repair?
FAR Part 43, Appendix A.
8. What is the recency of experience requirements for a mechanic?
A certified mechanic may not exercise the privileges of his certificate and rating unless within the preceding 24 months he has, for at least 6 months, served as a mechanic under his certificate and rating, or supervised other mechanics; or supervised, in a technical capacity. The maintenance or alteration of aircraft; or the administrator has found that he is able to do the work.
9. What may be used as a guide for 100-hour inspections?
FAR Part 43, Appendix D
10. What are the privileges of a certified mechanic in regard to performing a 100-hour inspection and returning an aircraft to service? An annual inspection?
A certified A&P mechanic may perform a 100-hour inspection and return an aircraft to service by making the proper entries in the maintenance records. An A&P mechanic with an Inspection Authorization may perform an annual inspection and return an aircraft to service.
11. Who has final responsibility for maintaining aircraft maintenance records?
The owner or operator of the aircraft
12. May an airframe mechanic perform maintenance on engines?
Yes, under the supervision of a powerplant mechanic.

AIRFRAME TEST SUBJECTS

AIRFRAME STRUCTURES

WOOD STRUCTURES ORAL

1. What species of wood is used as a standard for strength properties of other species of wood used in aircraft structures?
Spruce is used as a standard.
2. What type of wood quality must be used in the repair of aircraft structures?
The wood must be aircraft quality.
3. What is the difference between laminated wood and plywood?
Laminated wood consists of two or more layers of wood that have been glued together, with the grain of all layers approximately parallel. The grain of plywood runs 90° with the adjacent ply.
4. What are two types of glue used for aircraft wood structure repair?
They are casein and synthetic resin glue. The resin glues that are recommended for wood aircraft applications are the resorcinol formaldehyde-type glues.
5. What method is used to prepare plywood for bending?
The wood is soaked in hot water and then placed on a form until completely dry.
6. What are the results of using insufficient gluing pressure when making a wood joint?
The results will normally be thick glue lines, which indicate a weak joint.
7. How long should a wood glue joint be kept under pressure before removing the clamps?
The pressure time will vary depending on the temperature of the curing room. The curing temperatures are from 70° F. and up. Higher temperatures will cause the glue to set faster. To be certain that a glue joint is satisfactory, it is recommended that it remain under pressure at about 85° F. for a period of at least seven hours. Full joint strength will develop only after conditioning for at least two days.
8. What are some of the various methods used to apply pressure to joints in aircraft gluing operations?
Brads, nails, screws, clamps, and hydraulic and electric power presses
9. Why does the strength of a scarf joint depend upon the accuracy of the two beveled surfaces?
Because an inaccurate bevel will reduce the amount of effective glue area
10. What type of patch is preferred for repair of stressed plywood skin and why?
A properly prepared and inserted scarf patch is the best repair for plywood and is preferred for most skin repairs. It differs from a splayed patch in that the edges are scarfed to a 12 to 1 slope instead of a 5 to 1 slope, and it uses reinforcements under the patch where the glue joints occur.
11. Are mineral streaks acceptable in aircraft wood?
Yes, providing careful inspection fails to reveal any decay.

12. How can the moisture content of wood be determined?
One way is to use a moisture meter. However, the most accurate method is to take a sample of the wood, weigh it, dry it in an oven at a temperature of 100° C. to 105° C., reweigh it, and then compute the moisture content by using the following formula.
$$\frac{W1 - W2}{W2} \times 100 = \text{Percent moisture content}$$
W1 = the weight of the wood sample before drying
W2 = the weight of the wood sample after drying
13. What area of the wood spar may not be spliced?
It may not be spliced under wing attachment fittings, landing gear fittings, engine mount fittings, or lift and interplane strut fittings.
14. What type of joint is generally used in splicing structural members in aircraft?
A scarf joint
15. What is compression wood and why is it not acceptable for aircraft structures?
Compression wood is wood that is characterized by high specific gravity and has the appearance of an excessive growth of summer wood (hard, non-porous). This defect is difficult to recognize and is very detrimental to strength. Reject all material containing compression wood.

AIRCRAFT COVERING ORAL

1. What determines the required quality and strength of fabric that is to be used for covering aircraft?
The required strength and quality of aircraft fabric is determined by the pounds per square foot of wing loading and the never-exceed airspeed of the aircraft.
2. When are anti-tear strips recommended and where are they used?
Anti-tear strips are used on aircraft with never-exceed speeds in excess of 250 mph, and they are installed over the ribs under the reinforcing tape. They are recommended for the complete upper surface of the wings, and on the bottom surface of that part of the wing that is in the slipstream.
3. What is the maximum permissible deterioration of aircraft fabric before it is considered unworthy?
Fabric covering is considered unworthy when it deteriorates more than 30 percent from its originally required tensile strength.
4. What should be the strength of the fabric used for re-covering an aircraft?
All fabric surface tape, reinforcing tape, thread and lacing cord used to re-cover or repair aircraft cover should be of high-grade aircraft textile material. The materials must be at least as good a quality and of equivalent strength as those originally used by the aircraft manufacturer.
5. What is the purpose, location, and the method of installing drain grommets in aircraft fabric?
Drain grommets are located on the underside of airfoils at the trailing edge as close to the rib as practical, and at the lowest point along the center of the underside of each fuselage bay. They allow the condensed moisture to leave the aircraft, as well as furnish ventilation. Brass grommets should be mounted on fabric patches and then doped to the covering. Plastic grommets are doped directly to the covering. Both types are installed with the second coat of dope, and the drain holes opened by cutting out the fabric with a small knife.
6. What is the purpose of reinforcing tape?
Reinforcing tape is used over ribs between the fabric covering and the rib stitching to prevent the stitching cord from cutting through the fabric.
7. What type of fabric is not affected by moisture or mildew?
Fiberglass fabric is not affected by moisture, mildew, chemicals, or most acids.
8. What methods are used to check the strength of doped fabric?
Fabric punch testers will provide a general indication of the strength of the fabric, but if a punch tester indicates that the fabric strength is marginal, a laboratory test should be performed to determine the actual strength of the fabric.
9. What type of machine-sewed seams are used in aircraft covering?
Plain overlap seams, folded-fell seams, and French-fell seams.
10. What should be done with structure that will come in contact with doped fabric?
Treat all parts of the structure that will come in contact with doped fabric with a protective coating such as aluminum foil, dope proof paint, or cellulose tape.
11. If the original rib stitch spacing cannot be determined when re-covering an aircraft, what rib stitch spacing should be used?
Use the rib stitch spacing chart in Advisory Circular 43.13.
12. What is the standard tie-off knot used during rib stitching?
A modified seine knot is used to tie off all stitches except the starting stitch.

13. What do you call the edge of cloth, tape, or webbing that has been woven to prevent raveling?
Selvedge edge.
14. The types of fabric used for covering aircraft are organic and synthetic. Name two organic and two synthetic fibers.
The organic fibers are cotton and linen. The synthetic fibers include fiber glass and heat shrinkable synthetic fibers such as nylon, orlon, and dacron.
15. When covering aircraft, where is surface tape used?
Sewed seams, lapped edges, and rib stitching or screws must be covered with pinked-edge surface tape.
16. Name the advantages of using the envelope method to cover fabric aircraft.
It saves labor because practically all sewing is done by machine.

AIRCRAFT FINISHES ORAL

1. Name the safety and health precautions to be observed in operating a dope room, including storage of material.
The dope room should be well lighted and ventilated, using spark-proof motors, lights, and switches. All flammable material should be stored in fireproof containers in protected areas. Dope and paint rooms that are not located in a separate building should be isolated from the rest of the building by metal partitions and fireproof doors.
2. What type of test can be performed to identify existing paint finishes?
Apply a coat of engine oil to a small area. Nitrocellulose will soften in a few minutes, but acrylic and epoxy will show no effects. If not identified, next wipe down a small area with MEK. MEK will pick up pigment from an acrylic finish, but will not affect an epoxy coating.
3. What causes blushing when applying dope or lacquer, and how can it be prevented?
When doping is accomplished under humid conditions, blushing is possible. Rapid evaporation of thinners and solvents lowers the temperature of the surface of the wet dope, causing condensation of moisture from the air. The moisture causes a milky white appearance known as blush. The condition may be eliminated by heating the room to decrease humidity or by using a blush-retarding thinner to increase the drying time. Blushing is also caused by moisture in the air supply, drafts, or change in temperature.
4. What is the purpose of using fungicidal dope when finishing aircraft fabric?
To prevent microbiological deterioration (rotting) of the fabric
5. What are the identification marking requirements for United States registered fixed wing aircraft?
The Roman capital letter "N," followed by the registration number, must be displayed on both sides of the fuselage or on both sides of the vertical tail surfaces. The height of the characters must be equal in size and at least 12 inches, and the characters must be 2/3 as wide as they are high. The exceptions to the width rule are the number "1," which must be 1/6 as wide as it is high, and the letters "M" and "W," which may be as wide as they are high. Characters must be formed by solid lines 1/6 as thick as they are high, and the spacing between each character may not be less than 1/4 of the character width.
6. What are three types of dope used for aircraft finishes?
They are clear dope, semi-pigmented dope, and pigmented dope.
7. What would happen if dope was ever used over paint or enamel?
It would have the tendency to lift and remove such materials.
8. What is applied to metallic surfaces as a common resistant covering before the application of enamel or lacquer?
Zinc chromate primer is normally used for this purpose.
9. What are the most common methods of applying aircraft finishes?
They are dipping, brushing, or spraying.
10. What type of paint may be used over any paint system that is in good condition?
Epoxy topcoats will adhere to all paint systems that are in good condition and may be used for general touchup, including touchup of defects in baked enamel coatings.
11. What is normally the cause of runs and sags in a spray paint finish?
Holding the gun too long in one place, causing too much paint to be applied

12. What causes an “orange peel” or “pebble” finish?
The spray gun setting, incorrect air pressure, incorrect paint viscosity, and holding the gun too far from the work.
13. What is used to thin chromate primer?
Toluene
14. Which federal regulation prescribes the size and location requirements for aircraft identification numbers?
FAR Part 45
15. What type of materials should be thoroughly protected when using paint remover?
Synthetic rubber surfaces, aircraft tires, fabric, and acrylics must be protected against possible contact with paint remover.

SHEET METAL STRUCTURES ORAL

1. What is the grip length of a rivet?
The grip length is the combined thickness of the materials to be joined by the rivet.
2. Where are special rivets, such as Huck or Cherry lock rivets, used?
They are used in places where access to both sides of the riveted structure is impossible, or where limited space will not permit the use of a bucking bar. These rivets require special tools, installation, and removal procedures. They are commonly called blind rivets.
3. What is bonded honeycomb (sandwich) construction?
It is a laminar construction consisting of a combination of alternating dissimilar materials, assembled, and fixed in relation to each other so that the properties of each can be used to attain specific structural advantages for the whole assembly.
4. What types of materials are used in honeycomb construction?
Honeycomb construction may employ stainless steel, titanium, magnesium, plywood, resin-impregnated paper, glass, nylon, or cotton cloth in various combinations.
5. Where are sandwich construction assemblies used?
They are used for such areas as bulkheads, control surfaces, fuselage panels, wing panels, radomes, empennage skins, or shear webs.
6. What procedures should be used to prevent damage to the hole when drilling through Plexiglas?
The Plexiglas should be backed with wood and the feed slowed as the drill point breaks through the underside of the sheet. A drill that is to be used for this purpose should be modified to a 60° tip angle, the cutting edge to a zero rake angle, and the back lip clearance angle increased to 12 to 15 degrees.
7. What calculation must be made when bending sheet metal?
The amount of material required for the bend must be determined to assure that the final dimensions will be correct. Bending a strip of metal compresses the material on the inside of the curve and stretches the material on the outside of the curve. However, in the approximate center between these two extremes is a space that is neither stretched nor compressed, which is called the neutral axis. When making a bend to exact dimensions, the length of the neutral line must be calculated so enough material can be allowed for the bend. Bend allowance depends on four factors: (1) the degree of bend, (2) the radius of the bend, (3) the thickness of the metal, and (4) the type of metal used. To save time in calculation of bend allowance, formulas, and charts for various angles, radii of bends, material thickness, and other factors have been established.
8. What factors are used to determine setback?
The radius of the bend and the thickness of the material; $\text{Setback} = \text{Radius} + \text{Thickness}$
9. What is a joggle?
A joggle is an offset formed on an angle strip to allow clearance for a sheet or extrusion.
10. What are several methods used in forming sheet metal?
Folding, bumping, crimping, shrinking, and stretching
11. What may cause plastic to craze?
Subjecting plastic to large stresses and exposure to harmful solvents will cause crazing.

12. What rules apply for the replacement of 2017-T3 and 2024-T4 rivets with 2117-T3 rivets?
You may replace 2017-T3 rivets of 3/16-inch diameter or less, and 2024-T4 rivets of 5/32 inch diameter or less with 2117-T3 for general repairs, provided the replacement rivets are 1/32 inch greater in diameter than the rivets they replace, and the edge distance and spacing are not less than specified minimums.
13. Briefly describe the anodizing process and what purpose it serves.
Aluminum alloys are placed in electrolytic bath which causes a thin film of hydroxide to form on the surface of the aluminum. This anodized coating not only provides excellent resistance to corrosion, but it is also an excellent bond for paint.
14. What are the proper dimensions for a proper shop head?
One and one-half times the diameter wide and one-half times the diameter thick after bucking
15. When inspecting Plexiglas, what should you look for?
Crazing and discoloration
16. What causes honeycomb structure to delaminate?
Moisture
17. What are the acceptable repair methods for bonded honeycomb structure that has been damaged?
There are two acceptable methods of repair currently being used on damaged skin and core materials of bonded honeycomb structures. One is the potted repair method. The other is the laminated glass fabric cloth overlay which is applied to honeycomb damage that exceeds the repair limitations of the potted compound method.
18. What size drill should be used for the common shank rivet diameters of 3/32 inch, 4/32 inch, and 5/32 inch?
**For a 3/32 rivet, a number 40
For a 4/32 rivet, a number 30
For a 5/32 rivet, a number 21**
19. What is used for hole filling in a bonded honeycomb repair?
Potting compound
20. What is a lightning hole?
Lightning holes are cut into rib sections, fuselage frames, and other structural parts to decrease weight. Flanges are pressed around the holes for strength.

WELDING ORAL

1. What type weld joint must be used to weld magnesium?
Only butt welds are used to weld magnesium. This is to prevent the possibility of trapping the contaminants.
2. Why must all flux be removed from the metal after welding magnesium?
Any flux left on the metal will result in severe corrosion.
3. What must be done in order to successfully weld titanium?
The weld zone must be shielded with an inert gas such as helium or argon.
4. What is gas shielded arc welding?
A gas is used as a covering shield around the arc to prevent atmosphere from contaminating the weld.
5. What are the advantages of gas-shielded arc welding?
It results in a stronger, more ductile, and more corrosion-resistant weld.
6. What is an advantage of electric arc welding over gas welding?
It causes less buckling and warping of the welded material.
7. What determines the amount of heat that will be applied to the work when welding by the oxy-acetylene method?
The torch tip's orifice size or diameter
8. What will be the result of using a torch tip that is too large or too small?
If the torch tip is too large, the heat will be too great and holes may be burned in the metal. If the torch tip is too small, the heat provided may be insufficient to produce penetration to the proper depth, causing a low-strength weld.
9. How do you determine the correct size filler rod to be used in welding?
Welding rods are made in standard 36-inch lengths and in diameters from 1/16 inch to 3/8 inch. The diameter of the rod to be used is governed by the thickness of the metals being joined. If the rod is too small, it will not conduct heat away from the puddle rapidly enough, and a burned weld will result. A filler rod that is too large will chill the puddle. As in selecting the proper size torch tip, experience enables the welder to select the proper diameter welding rod.
10. What is brazing?
Brazing is a metal joining process in which the bonding material is a non-ferrous metal with a melting point lower than that of the metals being used. It includes silver soldering, copper brazing, and aluminum brazing. It can be used to join metals that are damaged by high heat.
11. What is one method of controlling expansion when welding a joint?
By tack welding at intervals along the joint
12. Why is it especially desirable to use a soft flame when welding aluminum?
To avoid blowing holes in the metal when the puddle is formed
13. What is the purpose of using flux when welding aluminum?
Aluminum and its alloys combine with air and form oxides very rapidly, and oxides form doubly fast if the metal is hot. Aluminum welding flux is designed to remove the aluminum oxide by chemically combining with it. Aluminum fluxes dissolve below the surface of the puddle and float the oxides to the surface where they can be removed.

14. What is the maximum safe pressure for acetylene gas when welding?
When acetylene gas is compressed in a container to a pressure greater than 15 psi, it becomes dangerously unstable. At 29.4 psi, acetylene is self-explosive and only a slight shock can cause it to explode.
15. How can dents at a steel tube cluster joint be repaired?
Weld a specially formed steel patch over the dented area and surrounding tubes.
16. What type of flame should be used when silver soldering?
The flame should be neutral.
17. What are the procedures for preparing a metal fuel tank for welding?
The interior of the tank should be washed thoroughly with hot water and a detergent, and then steamed for a minimum of thirty minutes. This procedure will vaporize and remove any residual fuel in the tank. Then fill the tank with CO₂ gas from a fire extinguisher and seal the tank except for a small vent hole.
18. When splicing tubing for the inner sleeve method, what method can be used to insert a tight-fitting inner sleeve into the replacement tube?
The sleeve can be chilled with dry ice or in cold water.
19. Why is flux used on silver solder?
It cleans the base metal of oxide to insure a good bond.

ASSEMBLY AND RIGGING ORAL

1. What are three types of commonly used flight control systems?
They are the cable, the push-pull, and the torque tube systems. The cable system is the most widely used because deflections of the structure to which it is attached do not affect its operation.
2. What is used in large metal aircraft to keep control cable tension within acceptable limits?
Because there is a considerable difference in temperature expansion between the aluminum aircraft structure and the steel control cables, some large aircraft incorporate cable tension regulators in the control cable systems. These regulators are designed to maintain a given cable tension. The unit consists of a compression spring and a locking mechanism that allows the spring to make corrections in the system only when the cable system is in neutral.
3. What is fairlead?
It is a cable guide used to guide cables in a straight line through or between structural members of the aircraft. Fairleads should never deflect the alignments of a cable more than 3° from a straight line.
4. Where does breakage of control cables occur most frequently?
Breakage of wire strands occurs most frequently where cables pass over pulleys and through fairleads.
5. Which flight control surfaces are considered the primary group?
The elevators, the ailerons, and the rudder
6. Which flight controls are considered the secondary group?
The trim tabs and the spring tabs.
7. Which flight controls are included in the auxiliary group?
This group consists of the wing flaps, speed brakes, spoilers, slats, leading edge flaps, and slots.
8. How do wing flaps affect landing speed and approach angle of an aircraft?
The use of flaps increases the camber of a wing, and, therefore, the lift of the wing makes it possible for the speed of the aircraft to be decreased without stalling. This permits a steeper glider angle to be obtained for the landing approach.
9. What is a balance tab?
It is an auxiliary control with fixed linkage that is designed in such a way that, when the control surface is moved, the tab moves in the opposite direction. Aerodynamic forces acting on the tab assist the pilot in moving the control surface.
10. What is a trim tab?
It is auxiliary control attached to the trailing edge of a control surface that is positioned by movement of a cockpit control to balance the forces acting on the control surface.
11. What is the purpose of the collective pitch control in a helicopter?
It is used to change the lift (pitch) or the main rotor blades.
12. What unit on a helicopter is used to compensate for torque created by the main rotor?
The tail rotor
13. What control operates the helicopter tail rotor?
The anti-torque pedals.

14. What are the three axes of an aircraft, and which control surfaces cause the aircraft to move about each axis?
The axis of an aircraft can be considered as an imaginary axle around which the aircraft turns like a wheel. The axis that extends through the fuselage from nose to tail is the longitudinal axis. The axis that extends crosswise, from wingtip to wingtip, is the lateral axis. The axis that passes through the center from top to bottom is the vertical axis. Motion about the longitudinal axis is called "roll" and is controlled by ailerons. Motion around the lateral axis is called "pitch" and is affected by the elevators. Finally, motion about the vertical axis is called "yaw" and is produced by the rudder of an aircraft.
15. When installing an aircraft bolt, what precaution would you take regarding the position of the bolt?
Where possible, the bolt head should be positioned on top when a bolt is installed vertically, and the bolt head should be forward when it is installed horizontally. In these positions, the bolt is less likely to slide out if the locking device comes off.
16. How is the propeller torque corrected during assembly and rigging in some single engine aircraft?
Some aircraft have the leading edge of the vertical fin offset to the longitudinal center line to counteract engine torque.
17. What reference publications should be used to rig aircraft, including the control system?
You should refer to the Aircraft Specifications or Type Certificate Data Sheets issued by the FAA, and also to the maintenance manual issued by the manufacturer.
18. What are vortex generators?
Small, low-aspect-ratio airfoils mounted on the upper surface of wings. Their function is to dampen shock-induced separation.
19. What is a servo tab?
An adjustable tab attached to the trailing edge of a control surface. The tab moves opposite the direction of the control. It is used to aid the pilot in moving the control.
20. What factors are used to determine the proper cable tension?
The size of the cable and the outside temperature

AIRFRAME INSPECTION ORAL

1. What needs to be done to prepare an aircraft for an annual 100-hour inspection?
Before starting either inspection, the aircraft and the aircraft engine should be thoroughly cleaned. Then you must remove or open all necessary inspection plates, access doors, fairings, and cowlings.
2. What is the difference between an annual and a 100-hour inspection?
Except for the difference in time between inspections, there is no difference between the annual and the 100-hour inspection. They are identical in scope.
3. Who has the authority to sign off and return to service a 100-hour inspection?
A certified airframe and powerplant mechanic may return an aircraft to service after a 100-hour inspection.
4. What are the operating conditions that make the 100-hour inspection mandatory?
The 100-hour inspection is required for aircraft that carry persons for hire or is used to give flight instruction for hire.
5. Where can you find a checklist for the 100-hour inspection?
In FAR Part 43, Appendix D
6. Where would you find the recommended statement for recording the approval or disapproval for return to service of an aircraft after a 100-hour inspection?
In FAR part 43.
7. Who can approve an aircraft for return to service after an annual inspection?
An A&P mechanic who holds an Inspection Authorization (IA)
8. Who can approve an aircraft for return to service after a progressive inspection has been performed?
A certified mechanic holding an Inspection Authorization, the aircraft manufacturer, or a certified repair station.
9. Does an aircraft being operated under a progressive inspection program require a 100-hour inspection if it is used to give flight instruction for hire?
No
10. What is the maximum time that a 100-hour inspection may be extended?
Not more than 10 hours. The 10 hours may be used only to ferry the aircraft to the next inspection site.

AIRFRAME SYSTEMS AND COMPONENTS

AIRCRAFT LANDING GEAR SYSTEMS ORAL

1. What are two sources of power used to extend and retract landing gear?
They are electrical and hydraulic.
2. When should landing gear retracting checks be accomplished?
During annual and other type inspections, after replacing landing gear components, and after any hard landing
3. What is used to inflate an oleo-type landing gear shock strut?
Inflate the strut with a high-pressure source of dry air or nitrogen.
4. Where would you look to find proper tire inflation information?
When inflating aircraft tires, the amount of pressure is determined by such factors as tire size, outside air temperature, and the gross weight of the aircraft. Specific tire inflation information may be found in the operation manual and the aircraft maintenance manual in special tire inflation pressure charts based on gross weight.
5. What is the purpose of a hydraulic shimmy damper?
It is a unit designed to prevent nose wheel vibration or shimmy during taxiing, landing, or taking off.
6. What type care should be given to landing gear shock struts?
They should be inspected regularly for leakage of fluid and for proper extension. The exposed portion of the strut piston should be wiped clean daily and inspected for scoring or corrosion.
7. What is the effect of under-inflated tires?
Under-inflated tires are more likely to creep or slip on the wheel when landing or when brakes are applied. Under-inflation also causes rapid or uneven wear at or near the edges of the tread.
8. What is the purpose of the rubber packing mounted on the mating surface of the outer wheel half of a split-type wheel?
To prevent air leakage from the tubeless tire used with this wheel
9. What are three types of aircraft brake systems?
Independent, power boost, and power control.
10. What is the purpose of a shuttle valve in a power control system?
Each brake actuating line in a power brake system incorporates a shuttle valve for the purpose of isolating the emergency brake system from the normal brake system. When emergency brake actuating pressure enters the shuttle valve, the shuttle is systematically moved to the opposite end of the valve. This closes off the normal hydraulic brake system actuating line and allows the emergency fluid to actuate the brakes.
11. What component in the landing gear system keeps the landing gear in alignment?
The landing gear torque links.
12. What is used to prevent a nose gear from being retracted with the wheel out of the center position?
Center devices, such as an internal centering cam or an external track, that straighten the nose wheel before it enters the wheel well
13. What is the purpose of the fusible plug in some aircraft wheels?
It is designed to melt at specific elevated temperatures and relieve air pressure to prevent the tire from blowing out or breaking the wheel.

14. What is the purpose of the fusible plug in some aircraft wheels?
It is designed to melt at specific elevated temperatures and relieve air pressure to prevent the tire from blowing out or breaking the wheel.
15. What are two methods of bleeding brakes?
The gravity method and the pressure method
16. When inspecting brakes, what do you look for?
**1. Check for leaks while system is pressurized.
2. Check flex hoses for swelling, cracking, or soft spots.
3. Check brake pedals for spongy actuation (an indication of air in the system).**
17. What do you watch for when disassembling an oleo strut?
Pressure discharge

HYDRAULIC AND PNEUMATIC POWER SYSTEMS ORAL

1. What are three types of hydraulic fluid currently being used in civil aircraft?
Vegetable base, mineral base, and phosphate ester base fluids
2. What is the color of mineral base hydraulic fluid?
Red
3. How do you determine which type of hydraulic fluid to use in a specific system?
The type fluid is specified in the aircraft maintenance manual or on the instruction plate attached to the reservoir or unit being serviced.
4. What will happen to the seals in a vegetable base hydraulic system if it is serviced with mineral base or phosphate ester base fluids?
The seals will swell, break down, and block the system.
5. When hydraulic lines have been disconnected, what precautions should be taken to prevent contamination of the system?
All hydraulic lines and fittings should be capped or plugged immediately after disconnecting.
6. What happens to the hydraulic fluid flow if the filter element becomes clogged with foreign matter?
There is a bypass valve which routes the hydraulic fluid directly from the inlet port to the outlet port.
7. Why are some hydraulic reservoirs pressurized?
To ensure a positive flow of fluid to the engine-driven pump at high altitudes
8. What methods are used to pressurize hydraulic reservoirs?
Some systems use air pressure directly from the aircraft cabin pressurization system, or from the engine compressor in turbine-powered aircraft. Another method is an aspirator or venturitee.
9. Name three types of hydraulic accumulators?
The diaphragm type, the bladder type, and the piston type
10. What is the purpose of a pressure relief valve in a hydraulic system?
It is to limit the amount of pressure in the system. It is, in effect, a system safety valve.
11. What is the purpose of an unloading valve in a closed hydraulic system?
The unloading valve is designed to provide a low pressure path for the fluid to flow from the pump back to the reservoir when the system has no flow requirements. The unloading valve also acts as a pressure regulator.
12. What is the function of a wing flap overload valve?
The purpose of the valve is to prevent possible structural damage to the flaps or the flap system that might result from the flaps being lowered at excessive speeds.
13. What protects a direct-pressure type hydraulic pressure gauge from pressure surges?
A dampening device in the form of a very small restrictor is installed in the line leading to the gauge, or at the inlet to the gauge itself.
14. What are pneumatic systems used for in aircraft?
Pneumatic systems are sometimes used in operating brakes, opening and closing doors, starting, pump driving, and operating emergency devices.

15. What happens to the air when a unit in a pneumatic system is operated?
The air is dumped overboard.
16. Why should a pneumatic system be purged periodically?
To remove contamination, moisture, or oil from the components and lines
17. What is the purpose of the relief valve in a pneumatic system?
The relief valve protects the system against over-pressurization (thermal expansion) by bleeding excess pressure to the atmosphere.

CABIN ATMOSPHERE CONTROL SYSTEMS ORAL

1. What is the principal control element in a cabin pressurization system?
The cabin outflow valve
2. What is the purpose of the negative pressure relief valve in the pressurization system?
The negative pressure relief valve prevents accidentally obtaining a cabin altitude which is higher than the altitude of the aircraft.
3. What control changes the position of the outflow valve?
The pressurization controller is the source of control signals for the pressurization system.
4. What are the two groups of independent compressors and centrifugal compressors?
They are positive displacement compressors and centrifugal compressors.
5. What method is used by turbine-powered aircraft of pressurization?
Bleed air from the engine compressor is used for pressurization.
6. What limits the degree of cabin pressurization?
The structural design features of the fuselage and by the capacity of the superchargers to maintain a constant volume of airflow to the fuselage.
7. What are three methods of supplying heat to the conditioned air when the "heat of compression" is not sufficient for this purpose?
Gasoline combustion heaters, electric heaters, and exhaust gas air-to-air heat exchangers.
8. What is the function of ventilating air in a combustion heater?
Ventilating air is used to carry the heat to the places where it is needed.
9. What are the sources for ventilating air?
A blower for air circulation and heater operation on the ground, and a ram-air inlet, or the cabin compressors on pressurized aircraft
10. What are the components of an air cycle cooling system?
An expansion turbine (cooling system), an air-to-air heat exchanger, and various valves which control airflow through the system
11. What causes a temperature drop in an air cycle cooling system?
As the compressed air passes through the expansion turbine, it performs the work of turning the turbine and undergoes a pressure and temperature drop.
12. What are the components in a vapor cycle (Freon) cooling system?
The compressor, condenser, receiver/dryer, expansion valve, and the evaporator
13. How do you determine the liquid level in a vapor cycle cooling system?
Operate the system for approximately 5 minutes to reach a stable condition and then observe the flow of Freon through the sight glass. A steady flow indicates that a sufficient charge is present. If the Freon charge is low, bubbles will appear in the sight glass.
14. What is a continuous flow oxygen system?
When the line valve is turned on, oxygen will flow continuously from the charged cylinder through a high-pressure line to the pressure-reducing valve, which reduces the pressure to that required at the mask outlets. A calibrated orifice in the outlets will control the amount of oxygen delivered to the mask.

15. What must be done if an oxygen system has been depleted and not recharged within two hours?
It must be purged with dry nitrogen or dry air and oxygen.
16. How are high- and low-pressure oxygen cylinders identified?
High-pressure (1800-1850 psi) oxygen cylinders are green in color and have the words “Aviators Breathing Oxygen” stenciled lengthwise in white, one-inch letters. All low-pressure (400-425 psi) oxygen cylinders are painted light yellow.

AIRCRAFT INSTRUMENT SYSTEM ORAL

1. What three flight instruments are normally operated from the pitot-static system?
The airspeed indicator, which is connected to the pitot and static pressure sources, plus the altimeter and the vertical speed indicator, which are connected to the static pressure source only.
2. What instrument indications will result if the static pressure line becomes disconnected inside the cabin of a pressurized aircraft?
The altimeter and airspeed indications will both be lower than normal, and the vertical speed indicator will indicate a momentary descent and then return to zero.
3. What is required after replacement of components connected to the pitot-static system?
A leak test is required.
4. What are the sources of power to gyroscopic instrument operation?
Gyroscopic instruments can be operated either by vacuum, by electricity, or by air pressure.
5. What causes an electric-driven gyro rotor to tilt when the aircraft is turned?
Gyroscopic precession
6. What is used as a guide for range marking of aircraft instruments?
The aircraft specifications or type certificate data sheets and the specific aircraft maintenance or flight manual
7. Where are instrument range markings placed?
They are applied to the outer edge of the cover glass or over the calibrations on the dial face of the instrument.
8. What other type mark is required when range markings are applied to the glass instrument cover?
An index mark, which is a white line extending from the glass cover onto the instrument case to indicate slippage of the glass. Glass slippage would cause the range markings to be in error.
9. What is a synchro-type remote indicating system?
A synchro system is an electrical system used for transmitting information from one point to another. The three most common synchro systems are the Autoxyn, the Selsyn, and the Magnesyn. These systems can be used to show movement and position of landing gear, wing flaps, oil cooler doors, or other movable parts of the aircraft.
10. What type fuel quantity system is an electric fuel measuring device that accurately determines the weight of the fuel in the tanks of an aircraft?
The capacitor-type fuel quantity system
11. What is meant by "swinging a compass"?
It is the adjustment of the NORTH-SOUTH and EAST-WEST MAGNETS in order to reduce deviation, which is magnetic influences of the aircraft structure and electrical systems.
12. When inspecting a magnetic compass, the bowl should be filled with liquid and should not contain any bubbles or discoloration. What is the purpose of the liquid in the bowl?
It is to dampen the oscillations of the float.
13. Which instrument is used to indicate the speed of the crankshaft of a reciprocating engine and the speed of the main rotor assembly in a turbine engine?
A tachometer

14. What type indicating system is used to indicate turbine engine exhaust gas temperature (EGT)?
A thermocouple system
15. What does the manifold pressure gage indicate when the engine is not operating?
It indicates atmospheric pressure.
16. What is used to check a manifold pressure gauge for correct indication when the engine is not operating?
Either a barometer or an altimeter after it has been set to zero.
17. What is the meaning of the yellow range on the airspeed indicator?
The yellow arc designates the cautionary range.
18. What does a mach meter indicate?
The ratio of aircraft speed to the speed of sound at the particular altitude and temperature existing at any time during flight

COMMUNICATION AND NAVIGATION SYSTEMS ORAL

1. Name the basic components of a communication system.
They are microphone, transmitter, transmitting antenna, receiving antenna, receiver, and headset or loud speaker.
2. What is the most common communication system in use today?
It is the VHF (very high frequency) system.
3. Which radio system is used for long-range communication?
The HG (high frequency) system
4. What is a transceiver?
It is a self-contained transmitter and receiver that share the same power supply, antenna, and tuning.
5. What are the components of a typical VOR system?
A receiver, a visual indicator, antennas, and the power supply.
6. What are the basic components of an autopilot system?
The gyros, the servos, and the amplifier
7. What are the sensing elements of an autopilot system?
The directional gyro, turn-and-bank gyro, attitude gyro, and altitude control are the sensing elements. These units sense the movements of the aircraft and automatically generate signals to keep these movements under control.
8. What are the output elements of an autopilot system?
The output elements of an autopilot system are the servos which actuate the control surfaces.
9. What is the purpose of a bonding jumper on a radio shock mount?
To provide a low-impedance ground return and minimize radio interference from static electricity
10. What is the frequency of an emergency locator transmitter (ELT)?
It is 121.5 MHz.
11. How can you determine when the batteries of an ELT should be replaced, even though the set operates?
The useful life of the batteries is determined by the battery manufacturer, and the battery replacement date must be marked on the outside of the transmitter. Time is computed from the date of manufacture of the battery.
12. Describe the proper method of routing coaxial cable from the antenna to the receiver.
When installing coaxial cable, secure the cables firmly along their entire length at intervals of approximately two feet. To assure optimum operation, coaxial cables should not be routed or tied to other wire bundles. When bending coaxial cable, be sure that the bend is at least 10 times the size of the cable diameter.
13. Where is the preferred location for mounting a VOR antenna on a small aircraft?
The VOR antenna is vee-shaped, and the preferred location is on top of the forward part of the cabin with the apex of the vee toward the front. An acceptable alternate location is on top of the vertical stabilizer.
14. Where should DME antennas be located?
They should be mounted on the lower surface of the aircraft in a position that will not be blanketed by the wings when the aircraft is banked.

15. What are marker beacons?
Part of the ILS system and are used to indicate the aircraft position on the approach to the runway.
16. What is the indication of the middle marker beacon?
It is an amber light and an audible tone.
17. What is an ADF?
An automatic direction finder.

AIRCRAFT FUEL SYSTEMS ORAL

1. What is the purpose of a fuel dump system?
It is an emergency system provided so that the flight crew can quickly bring the weight of the airplane down to the maximum landing weight if an emergency occurs during or shortly after takeoff.
2. Other than reducing weight what other function can be accomplished with a fuel jettisoning system?
Fuel can be dumped from the heavy wing in order to maintain lateral stability. A fuel dump system is required for all transport airplanes if the maximum takeoff weight is more than 105% of the maximum landing weight. The airplane must be free of fire hazards during dumping, and fuel must dump free and clear of the airplane.
3. What are two types of fuel cells?
Bladder-type fuel cells and integral fuel cells
4. How is the weight of a bladder-type cell supported?
The bladder-type cell depends on the structure of the cavity in which it sits to support the weight of the fuel within it. They are made of either rubber or nylon.
5. What is "wet wing" construction?
Wet wing construction is when the fuel cells are built into the wings of the aircraft structure. They are integral part of the structure and are not removable.
6. What are the advantages of a single-point pressure fueling system?
Pressure fueling, sometimes referred to as single-point or underwing fueling, greatly reduces the time required to service large aircraft. It eliminates aircraft skin damage from hoses and hose nozzles, and reduces the chance of fuel contamination.
7. What is the purpose of a fuel temperature indicator on a turbine engine?
It is a means for checking the temperature of the fuel in the tanks and at the engine to determine when there may be danger of ice crystals forming in the fuel.
8. What is the purpose of warning lights in connection with fuel systems?
Warning lights may be used to indicate when the fuel pressure is too low or to indicate when the fuel quantity in a tank is below a certain amount.
9. Where are electrical operated valve-in-transit indicator lights used?
On large multiengine aircraft, each of the fuel crossfeed and line valves may be provided with valve-in-transit indicator lights. The light is on only during the time the valve is in motion and is off when movement is complete.
10. What are four general types of fuel quantity gauges?
The four types are sight glass, mechanical, electrical, and electronic.
11. Which type fuel quantity gauge is considered to be more accurate than the other types?
The electronic capacitance-type, because it measures by weight instead of gallons
12. What is a drip gauge?
An under-wing bayonet-type fuel gauge that consists of a hollow drip tube that is drawn out from the lower wing surface. Fuel enters the top of the tube when it reaches the level of the fuel.
13. What is a crossfeed system?
An interconnected fuel system designed so that fuel can be fed from various tanks to any engine.

14. What is the purpose of the baffles in a fuel tank?
To prevent the fuel from surging as a result of changes in the attitude of the aircraft
15. How can a fuel tank be checked for leaks after a repair?
By a pressure check using air pressure not over one-half psi and liquid soap or bubble solution to identify the leak.

AIRCRAFT ELECTRICAL SYSTEMS ORAL

1. What is the purpose of a circuit breaker?
The purpose of a circuit breaker is to open the circuit when an overload exists.
2. What tool is used to measure the size of unmarked electrical wire?
A wire gauge can be used to measure wires ranging in size from number zero to number 36.
3. What are the colors of aircraft position lights and where are they mounted?
A green light is mounted on the right wingtip, a red light on the left wingtip, and a white light is mounted in a position where it is visible for the rear of the aircraft.
4. What are the factors to be considered when selecting wire size for electrical power?
One factor is the allowable power loss in the line. A second factor is the permissible voltage drop in the line, and a third factor is the current-carrying ability of the conductor.
5. When is a circuit breaker or fuse designed to open the circuit?
A circuit breaker or fuse should open the circuit before the conductor emits smoke. To accomplish this, the time current characteristics of the protective device must fall below that of the associated conductor.
6. What are the three most common faults that occur in an electrical circuit?
They are open circuits, in which leads or wires are broken; shorted circuits, in which ground leads cause current to be returned by shortcuts to the source of power; and low power in circuits causing lights to burn dimly and relays to chatter.
7. What size electrical conduit should be used for a specific cable bundle?
To allow for ease of maintenance and possible future circuit expansion, the conduit should have an inside diameter that is 25% larger than the maximum diameter of the conductor bundle.
8. When should electrical switches be derated from their normal current rating?
For high rush-in circuits such as circuits containing incandescent lamps, for inductive circuits that have magnetic energy stored in solenoid coils, or relays, and for DC motor circuits, which draw several times in their rated current during starting.
9. When do DC electric motors draw several times their rated current?
During starting
10. What would cause an AC electric motor to run too fast?
An excessive supply voltage or the motor field windings shorted
11. What would cause an AC electric motor to run too slow?
Low applied voltage, defective wiring, or no lubrication.
12. How is the output voltage of an alternator controlled?
By using a voltage regulator to control the exciter field current and thus regulate the exciter output voltage applied to the alternator field.
13. What should be checked before any aircraft electrical load is increased?
The associated wires, cables, and circuit protection devices should be checked to determine that the new load will not exceed the rated limits of these units.
14. What is the main advantage of using AC for aircraft electric power systems?
The principal advantage is that the voltage of AC power systems is easily changed by the use of transformers. Therefore, you can transmit power at a high voltage and a low current, thus reducing the size and weight of the wiring in the circuit.

15. In AC power systems, how is DC obtained for battery charging?
The alternating current is changed to direct current by the use of rectifiers.
16. How long should bonding jumper wires be made?
As short as possible

POSITION AND WARNINGS SYSTEM ORAL

1. What is the purpose of an antiskid system?
Anti-skid systems are designed to permit effective braking throughout the landing roll, regardless of runway conditions.
2. What does an antiskid warning light indicate?
The antiskid warning light indicates that the system is turned off or there is a system failure.
3. What type of warning devices are usually provided for retractable landing gear?
A red light and an aural device
4. When does the aural device operate in a landing gear warning system?
When the throttle is retarded and the landing gear is in any position other than down and locked.
5. What type of position indicators are normally used to indicate that the landing gear is down and locked?
Normally there is a green light for each gear.
6. Which positions of retractable landing gear normally have a position indicator?
The up and locked position and the down and locked position
7. When should you check landing gear switches, lights, warning horn, or buzzer for proper operation?
During a landing gear retraction check
8. How does a takeoff warning horn differ from a landing gear warning horn?
The takeoff horn is intermittent, whereas the landing gear warning is continuous.
9. What items may cause a takeoff warning horn to operate in a typical transport jet aircraft?
If the throttles are advanced and any of the following conditions exist, the takeoff warning horn will sound.
 1. Speed brakes not down
 2. Flaps not in takeoff range
 3. Auxiliary power exhaust door open
 4. Stabilizer not in the takeoff setting
10. What is the master caution light?
It is a light that alerts the pilot that there is trouble with one of the systems.

ICE AND RAIN CONTROL SYSTEMS ORAL

1. Describe the operating principle of inflatable deicer boots.
Pneumatic deicing systems use rubber inflatable boots attached to the leading edge of the wings and stabilizers. During operation, the tubes are inflated with pressurized air and deflated in an alternating cycle. This inflation and deflation causes the ice to break off and it is carried away by the air stream.
2. What are two methods of inflating pneumatic deicer boots?
Pressurized air is provided by an engine-driven air pump (vacuum pump) or by bleed air from a turbine engine compressor.
3. What methods are used to attach deicer boots to the leading edges of wing and tail surfaces?
They are attached by bonding to the surface with cement, with fairing strips and screws, or a combination of both methods.
4. What is the purpose of an air-oil separator in a pneumatic deicing system?
The purpose of removing the oil from the air of the deicing system is to prevent deterioration of the rubber deicing boots caused by contact with the oil.
5. What is used to clean deicer boots?
A mild soap and water solution
6. What must be done before you can make a cold patch repair to a deicer boot?
The deicer boot must be relieved from its installed tension before applying the patch.
7. What component of a pneumatic deicer system normally allows suction to be supplied to the boots to hold them down in flight?
The solenoid distributor valve
8. Describe the operating principle of thermal anti-icing systems?
Thermal anti-icing systems are used primarily for the purpose of preventing ice from forming on the leading edges. However, they are designed to also deice the leading edges by supplying much hotter than normal air for short periods on a cyclic system. The airfoils that are to be protected are usually provided with closely spaced double skin. The hot air is passed through the space between skins, and the heat is sufficient to prevent formation of ice or to melt any ice next to the skin. The heated air is supplied continuously as long as the anti-icing system is turned on.
9. What methods are used to supply heated air for thermal anti-icing systems?
Bleed air from the turbine engine compressor, engine exhaust heat exchangers and ram air heated by a combustion heater.
10. How is overheating prevented in a thermal anti-icing system using bleed air?
A thermal switch will cause a shutoff valve to close and stop the flow of bleed air when the temperature of the leading edge reaches approximately 185° F. When the temperature drops, the valve opens, and hot bleed air enters the wing once again.
11. In a thermal anti-icing system, what happens to the air after it has heated the leading edge of the wing?
The air is then exhausted to the atmosphere at the wingtip or at points where ice formation could be critical.
12. What problems are associated with electricity heated windshields?
Delamination, arcing, scratches, and discoloration

13. What is windshield delamination?
Delamination is the separation of the plies.
14. What does arcing usually indicate in an electrical heated windshield?
Arcing usually indicates that there is a breakdown in the conductive coating.
15. What type of power is used to operate windshield wiper systems?
Electrical or hydraulic power
16. What are common problems encountered with windshield wipers?
One problem is the tendency of the slipstream aerodynamic forces to reduce the wiper blade loading pressure on the windshield, causing ineffective wiping or streaking. Another problem is in achieving fast enough wiper oscillation.
17. How does a pneumatic rain removal system work?
This method uses high pressure, high temperature engine compressor bleed air which is blown across the windshields. The air blast forms a barrier that prevents raindrops from striking the windshield surface.

FIRE PROTECTION SYSTEMS ORAL

1. In what area of an aircraft would you find carbon monoxide detectors?
CO detectors are commonly used to check for the presence of carbon monoxide gas in aircraft cabins and cockpits.
2. What color does a CO detector change to when carbon monoxide fumes are present?
A reliable CO detector is an indicator tube which contains yellow silica that is impregnated with a selico-olybdate compound. When air, containing carbon monoxide, is drawn through the tube, the silica gel turns a shade of green. Other types change from a tan color to gray or black.
3. What are two types of smoke detectors?
Photoelectric and visual
4. Where are smoke detectors used in the aircraft?
They are commonly used in cargo and baggage compartments.
5. How are thermal switches wired in a thermal switch fire detection system?
The switches are wired in parallel with each other, but in series with the indicator lights.
6. Describe the operating principle of a thermal switch fire detection system.
The thermal switch system consists of one or more lights that are energized by aircraft power when connected to the circuit by a thermal switch. The thermal switches are heat-sensitive units that complete the circuit at a certain temperature.
7. Describe the operating principle of a continuous loop fire detection system.
The continuous loop detector consists of one or more wires embedded in a special ceramic core within an inconel tube. In case of fire or an overheat condition, the core resistance drops, and current flows between the signal wire and ground, energizing the alarm system.
8. How does a thermocouple fire detection system differ from the thermal switch system?
A thermocouple depends upon the rate of temperature rise and will not give a warning when an engine overheats slowly or a short circuit develops.
9. What are two types of fire extinguishing systems?
The high rate of discharge (HRD) system, which is a highly effective system most currently used, and the conventional systems, which are those systems first used in aircraft and are still in use.
10. What type extinguishing agent is usually found in an HRD system?
The extinguishing agent is usually one of the halogenated hydrocarbons (Halon) sometimes boosted by high pressure dry nitrogen.
11. What type extinguishing agent is usually associated with a conventional type extinguishing system?
This system usually contains CO₂ but may use any other adequate agent.
12. What is the purpose of the yellow disk in a CO₂ fire extinguishing system?
It is the system discharge indicator disk, and it indicates which bank of bottles has been emptied.
13. In a turbine engine Freon fire extinguishing system, how are the bottles discharged?
By an explosive discharge cartridge which is detonated electrically.
14. How is a Freon fire extinguishing system protected from temperature rises in excess of set limits?
A high temperature valve will sense the overheat condition and rupture a safety disk.

15. How can you determine the service life of a fire extinguisher discharge cartridge?
The service life of the cartridge is usually recommended in terms of hours below a predetermined temperature calculated from the manufacturer's date stamp, which usually placed on the face of the cartridge.
16. What types of handheld fire extinguishers are available for extinguishing interior aircraft fires.
The three most common hand fire extinguishers use water, carbon dioxide (CO₂), and dry chemical extinguishing agents.
17. What type of fire detection system gives a more complete coverage of a fire hazard?
A continuous-loop detector system

POWERPLANT TEST SUBJECTS

THEORY AND MAINTENANCE

RECIPROCATING ENGINES ORAL

1. How are conventional reciprocating engines classified?
They are classified according to cylinder arrangement with respect to the crankshaft (in-line, V-type, radial, and opposed), or according to method of cooling (liquid cooled or air cooled).
2. What are the different types of piston rings?
Compression rings, oil control rings, and scraper rings.
3. What is the purpose of the oil control rings?
They are used to control the thickness of the oil film on the cylinder walls.
4. What may be the result of installing piston rings incorrectly?
Excessive oil consumption
5. What types of piston rods are commonly found in radial engines?
A master and articulating rod assembly
6. What types of bearings are in general use in reciprocating engines?
Plain bearings, which are generally used for crankshaft cam ring, camshaft, connecting rods, and accessory drive shaft bearings. Roller bearings, which are used primarily as crankshaft main bearings but have other applications, as well. Ball bearings, which are used for supercharger impeller shaft bearings, rocker arm bearings in some engines, and as propeller thrust bearings.
7. What is the indication of valve blow-by?
Valve blow-by is indicated by a hissing or whistle when pulling the propeller through, prior to starting the engine. A cylinder compression check should be made to identify the faulty cylinder.
8. What is the purpose of using more than one spring for valve closing?
A valve spring will resonate (or surge) at certain engine speeds. When the spring resonates, it loses its ability to keep the valve closed and the valve begins to float. By using two springs (different sizes, one inside the other) this problem is eliminated. The springs will resonate at separate engine speeds so the valve is always held closed by at least one spring.
9. What is the purpose of valve overlap?
Valve overlap permits better volumetric efficiency and lowers the cylinder operating temperatures.
10. Describe the inspection you would give the valve springs during engine overhaul.
They should be cleaned thoroughly and then visually inspected for evidence of overheating, cracks, broken ends, and for compression strength.
11. What is the purpose of using valves with sodium-filled stems?
Some intake and exhaust valve stems are hollow and partially filled with metallic sodium. Sodium is used because it is an excellent heat conductor. The sodium melts at about 208° F. and the movement of the valves circulates the liquid sodium which enables it to carry the heat from the valve head to the stem, where it is dissipated through the valve guide to the cylinder head and cooling fins.

12. What causes engine sudden stoppage?
Striking an object or engine seizure due to internal damage
13. What type inspection must be made after sudden stoppage of an engine due to striking an object?
The propeller drive shaft must be checked for misalignment and the propeller checked for track.
14. What is the purpose of crankshaft dynamic dampers used in aircraft engines?
Dampers are used to overcome forces that cause deflection of the crankshaft and torsional vibration. These forces are generated by the power impulses of the pistons. Crankshaft vibrations are reduced by placing floating dampers (weights) in the counterweight assembly, particularly in a single throw-type crankshaft.
15. How would you make a "runout" check on a crankshaft that is still installed in the engine?
Remove the propeller from the shaft and attach a dial indicator gauge to the front of the crankcase. Adjust the position of the gauge needle so that it is touching the shaft. Turn the engine through with the starter and note any changes in the gauge reading.
16. What is detonation?
Normal combustion is when the fuel-air mixture burns at a uniform rate across the combustion chamber. The temperature and pressure within the cylinder rises at a normal rate as the mixture burns. All fuels have critical limits of temperature and compression, and beyond this limit, they will ignite spontaneously and burn with explosive violence. This instantaneous explosive burning of the last portion of the charge is called the detonation.
17. During valve clearance adjustment on an R-2800 engine, why must you depress certain valves other than the ones being adjusted?
The valves must be depressed (unloaded) in order to remove the pressure from the side positions on the cam and thus permit the cam to slide away from the valves to be adjusted. This prevents the cam from introducing errors in the valve clearance settings.
18. What can be learned about the condition of an engine by studying the results of a compression check?
From the cylinder compression check you can determine if the valves, piston rings, and pistons are adequately sealing the combustion chamber.
19. How can a cold cylinder be located on a double-row radial engine?
A cold cylinder check can be made with a cold cylinder indicator, sometimes called a "magic wand," to locate any cylinder that has a temperature lower than the normal operating temperature of the other cylinders.
20. What instrument can be used to check a cylinder bore for out-of-roundness?
A cylinder bore can be checked with a dial indicator, a telescopic gauge and outside micrometer, or an inside micrometer.

TURBINE ENGINES ORAL

1. What are the major components of a typical gas turbine engine?
A typical gas turbine engine consists of an air inlet, a compression section, a combustion section, a turbine section, an exhaust section, and the accessory section, a turbine section, an exhaust section, and the accessory section.
2. What are the two principle types of compressors used in turbojet aircraft?
The two most common compressors in use today are the centrifugal flow and the axial flow types.
3. What are three types of combustion chamber systems.
They are the can type, the can-annular type, and the annular type.
4. What is the purpose of the interconnector tubes between can-type combustion chambers?
To spread the flame to the combustion chambers that are not equipped with igniter plugs during engine starting
5. What prevents burning of the liner walls in can-type combustion chambers?
Louvers are provided along the axial length of the liners to direct a cooling layer of air along the inside wall of the liner.
6. What types of damage may be found when inspecting compressor blades?
Dents, scratches, gouges, galling, burns, burrs, pitting, and cracks
7. What is the location and function of the diffuser section in a turbine engine?
The diffuser is the divergent section of the engine located between the compressor section and the burner cans. Its function is to change the high-velocity compressor discharge air to static pressure.
8. Where are stress rupture cracks most likely to occur on turbine blades?
They usually appear as small hairline cracks on or across the leading or trailing edge of the blades. The cracks appear at right angles to the edge length.
9. How are compressor blades attached to a disk-type rotor?
The compressor blades are fitted into the disks by either bulb-type or fir tree-type roots. The blades are then locked by means of screws, peening, locking wires, pins, or keys.
10. What is the purpose of the nozzle diaphragm or turbine nozzle?
The turbine nozzle prepares the combustion mass airflow to drive the turbine rotor. First, they change a portion of the heat and pressure energy to velocity energy. The fixed vanes are shaped and set at such an angle that they form a number of small nozzles that discharge the gases at extremely high speeds. The second purpose of the turbine nozzle is to deflect the gases so they strike the turbine at the most efficient angle for maximum turbine rotation.
11. What is the major difference between a turboprop and a turbojet engine?
A turboprop engine usually has more turbine stages than the turbojet engine. In addition to operating the compressor and accessories, the turboprop turbine must also drive a propeller.
12. What is a turbofan engine?
A turbofan engine is, in principle, the same as a turboprop except that the propeller is replaced by a duct-enclosed axial flow fan.

13. What is the effect of air density on the thrust of a turbine engine?
Air density determines the mass of air that is used by a jet engine? The factors that affect density are the temperature and pressure of the air. If density increases, thrust increases, and vice versa. An increase in air temperature entering an engine will cause a decrease in density and thrust. An increase in air pressure entering the engine will cause an increase in density and thrust. With a given throttle setting, engine thrust will vary if the temperature or pressure of the air entering the engine changes.
14. What are the two most common types of thrust reverse?
The mechanical blockage type and the aerodynamic blockage type
15. What is a split compressor system in a turbine engine?
The split compressor system requires two concentric shafts joining the turbine stages to their respective compressors.
16. What is one method of relieving thermal stress on a turbine disk?
One means is to bleed cooling air back onto the face of the disk.
17. What may be the indications if a turbojet engine is out of trim?
The engine has high exhaust gas temperature (EGT) at target engine pressure ratio (EPR) for takeoff.
18. What is a free turbine?
A turbine wheel that, rather than driving the compressor rotor, drives a propeller or helicopter transmission

ENGINE INSPECTION ORAL

1. What steps must be taken in order to prepare an aircraft for a 100-hour or annual inspection?
Remove or open all necessary inspection plates, access doors, fairing and cowling. Then thoroughly clean the aircraft and the engine.
2. What may be used as a guide for a 100-hour inspection on an aircraft engine?
FAR part 43, Appendix D
3. What additional inspection must be performed if the cylinder compression is weak?
You must make an internal cylinder inspection for improper internal tolerances.
4. Where are the engine operating limitations found?
In the Aircraft Specifications or Type Certificate Data Sheet
5. Where can a mechanic look to identify an aircraft engine?
On the engine identification plate that is affixed to the engine at an accessible location.
6. What publication is needed to inspect an engine for conformity with specifications?
The Engine Specifications or Engine Type Certificate Data Sheet
7. What type of FAA approval is required when a change to an engine type design is not enough to require a new Type Certificate?
A Supplemental Type Certificate is required.
8. What type of FAA approval is required when a change is made to the engine principle of operation?
A new Type Certificate must be obtained.

SYSTEMS AND COMPONENTS

ENGINE INSTRUMENT SYSTEMS ORAL

1. What are the units in an engine fuel flow system?
The system consists of a transmitter and an indicator for each engine.
2. Where is the fuel flow transmitter located?
It is mounted in the fuel line between the engine-driven pump and the carburetor.
3. What type of readout is indicated on a fuel flow system?
The indicator is calibrated to record the fuel flow in pounds of fuel per hour.
4. What is the reason for monitoring the fuel flow?
In addition to fuel consumption, the operator can determine from the fuel flow indication whether the engine is operating at the correct fuel-air mixture for a given power setting.
5. What does a manifold pressure gauge indicate?
It measures absolute pressure in the intake manifold.
6. What would be the effect of a broken manifold pressure gauge line?
A broken line will cause the gauge to indicate atmospheric pressure.
7. What does the engine tachometer indicate?
It indicates crankshaft speed (rpm).
8. What are turbine engine tachometers designed to indicate?
They are designed to indicate percent of rotor rpm.
9. What is turbojet EPR?
It is a ratio between total turbine discharge pressure to total inlet pressure and is an indication of thrust being developed by the engine.
10. What is the electric source for a cylinder head temperature gauge?
The gauge is connected to a thermocouple attached to the cylinder which tests show to be the hottest on the engine.
11. Where is a carburetor air temperature bulb located?
It is located in the air intake passage to the engine.
12. How can a turbine engine EGT be checked without operating the engine?
By checking resistance to thermocouples and circuits

ENGINE FIRE PROTECTION SYSTEMS ORAL

1. What types of fire detectors are used for engine fire protection systems?
They are overheat detectors, rate-of-temperature-rise detectors, and flame detectors.
2. When using a thermocouple type fire detector system, what happens if the engine overheats slowly?
A thermocouple depends on the rate of temperature rise and will not give a warning if the engine slowly overheats or a short circuit develops.
3. Describe the operation of a Kidde continuous loop fire detector system.
The Kidde continuous loop system has two wires embedded in a special ceramic core within an inconel tube. One wire acts as an internal ground and the other wire is a hot lead that provides a current when the ceramic core material changes its resistance with a rise in temperature.
4. Where does a thermocouple fire detector system get its electrical power to operate?
The thermocouple produces power to close a relay, and power from the aircraft electrical system flows through the relay to the warning light.
5. Describe a thermal switch fire detector system?
Thermal switch systems have one or more lights that are energized by the aircraft's electrical system when a heat-sensitive thermal switch closes the circuit at a specific temperature.
6. How are thermal switches electrically connected in the circuit?
Thermal switches are connected in parallel with each other but in series with the warning light. A temperature rise in any one section of the circuit will cause a thermal switch to close and complete the circuit to indicate a fire or overheat condition.
7. What is the most common cause of a false fire warning in a continuous loop detector system?
The most common cause of false warnings is dents, kinks, or crushed sensing element causing an internal wire to shore to the ground wire or outer tubing.
8. What two methods are used to discharge fire extinguishing agents?
Mechanical and electrical.
9. What method is used to release the fire extinguishing agent in a typical turbine engine fire protection system?
One common method is to equip the fire extinguishing containers with discharge valves that are operated by electrically discharged cartridges. The discharge plug is seated with a breakable disk that is ruptured by the explosive cartridge, and the contents of the bottle are discharged into the engine area.
10. What method is used to determine proper fire extinguisher container pressure?
Check the container gauge to determine if the pressure is between the prescribed minimum and maximum limits.
11. What method other than the pressure gauge is used to indicate low agent pressure in a container?
Some aircraft are equipped with a low-pressure warning light in the cockpit.
12. What is the purpose of the yellow and the red discharge plugs in a turbine engine fire extinguishing system?
The yellow plug indicates pilot initiated discharge, and the red plug indicates thermal discharge.
13. What are two methods commonly used to distribute the fire extinguishing agent to the engine?
Many systems use perforated tubing or discharge nozzles to distribute the agent.
14. How does the fire extinguishing agent put out the fire?
It dilutes the atmosphere so that it will not support combustion.

15. What does the “HRD” stand for in an HRD fire extinguishing system?
High rate of discharge
16. How is the fire extinguishing agent distributed from an HRD system?
It is delivered from open-end tubes.
17. How long does it take to discharge the extinguishing agent in an HRD system?
It only takes one to two seconds.
18. Which type of fire detection system gives a more complete coverage of a fire hazard?
A continuous-loop detector system.

ENGINE ELECTRICAL SYSTEMS ORAL

1. How would you seat newly installed generator brushes to the commutator?
When new brushes are installed in a generator, the face of the brushes must be shaped to provide an area of maximum contact with the commutator. To seat the brushes, use fine grain sandpaper placed around the commutator with the sanding surface facing outward. Turn the armature in a normal direction of rotation until the face of the brushes is properly contoured. Remove the sandpaper and blow out any residue with compressed air.
2. Where is the generator rating and performance data located?
It is stamped on the data plate attached to the generator.
3. What units make up a DC generator three-unit regulator?
The voltage regulator, the current limiter, and the reverse current cutout.
4. What method is used to control the voltage of an aircraft alternator?
The voltage regulator
5. What determines the frequency of the voltage of an alternator?
The frequency depends upon the speed of rotation of the rotor and the number of poles.
6. How is alternator frequency maintained?
By installing a constant speed drive (CSD) unit between the engine and the alternator.
7. What are the three basic types of DC motors?
Series motors, shunt motors, and compound motors
8. Name the parts of a DC motor?
The armature, the field, the brushes, and the frame.
9. What is a starter-generator system, used on many turbine engines?
The system uses a starter-generator which operates as a starter motor to drive the engine during starting, and after the engine has reached a self-sustaining speed, it operates as a generator to supply the electrical system power.
10. What is the American Wire Gauge (AWG) system of designating electrical wire size?
A gauge number is assigned the wire according to its cross-sectional area. The smaller the gauge number, the larger the wire.
11. What is open wiring?
Open wiring is any wire, wire group, or wire bundle not enclosed in conduit.
12. What method is used to control the voltage of DC aircraft generators?
The only practical means of regulating generator voltage is to control the strength of the magnetic field. Field strength is determined by the amount of current flowing through the field coils, and the current is controlled by placing some form of variable or intermittent resistance in the external field circuit of the generator.
13. What are the causes of excessive arcing at the generator brushes?
Arcing can be caused by a commutator that is dirty, rough, or out of round. A more common cause of arcing is worn or binding brushes or the brush spring tension too low.
14. When installing single wires or wire bundles, how much slack is normally allowed between supports?
Slack between supports should normally not exceed one-half inch.

15. What precaution should be taken when running wires close to heating ducts or exhaust stacks?
The wires should be insulated with a high-temperature material.

LUBRICATION SYSTEMS ORAL

1. What is the primary purpose of lubricant in an aircraft engine?
To reduce friction between moving parts
2. What is the most important property that aircraft reciprocating engine oil must possess?
Viscosity
3. What factors must be considered in determining the proper grade of oil to use in a specific engine?
The operating load, rotational speeds, and operating temperatures are the most important factors to be considered.
4. What is the purpose of the oil flow control valve?
The oil flow control valve, located on the oil cooler, regulates the flow of oil either into or around the oil cooler.
5. What are the main oil contaminants?
They are gasoline, moisture, acid, dirt, carbon, and metallic particles.
6. From what location on a reciprocating engine is the oil temperature usually taken?
In a dry sump lubrication system, the oil temperature bulb is located anywhere in the oil inlet line between the oil tank and the engine. Wet sump systems have the temperature bulb located where it senses the temperature after the oil passes through the oil cooler. In either system, the bulb is located where it measures oil temperature before it enters the hot sections of the engine.
7. What do metallic particles on an oil screen indicate?
Metallic particles may be an indication of internal failure of the engine.
8. What could cause oil foaming?
Foaming can be caused by diluted oil, contaminated oil, or the oil level too high.
9. What would be an indication of blocked oil cooler passages?
High oil temperature
10. What would be an indication of an inadequate oil supply?
Low oil pressure and high oil temperature
11. What type of oil is used in turbine engine lubrication systems?
Specially developed synthetic oils
12. What are two types of oil coolers used in turbine engine lubrication systems?
The air-cooled oil cooler and the fuel-cooled oil cooler are the two basic types in general use.
13. What is the meaning of oil flash point? Fire point?
Oil flash point is that temperature at which the oil will begin to give off ignitable vapors. The fire point is that temperature at which there are sufficient vapors to support a continuous flame.
14. What are the functions of engine oil in a reciprocating engine?
In addition to lubrication, oil cools various parts of the engine, helps to seal the combustion chamber by providing a film between the cylinder walls and the rings, and aids in cleaning the engine by carrying engine residues to the oil filter.
15. What is the weight of aircraft engine oil?
Approximately 7.5 pounds per US gallon

16. What is the purpose of an oil dilution system?

The oil dilution system thins the oil by introducing fuel into the lubrication system which makes cold-weather starting easier.

IGNITION SYSTEMS ORAL

1. What is a magneto?
A magneto is a special type of engine-driven AC generator that uses a permanent magnet as a source of energy. The magneto develops a high voltage that is used to fire the spark plugs.
2. What is the purpose of the condenser in a high-tension magneto electrical system?
To prevent arcing at the points and to hasten the collapse of the magnetic field around the primary coil.
3. Where is the E-gap position in a magneto?
The E-gap position is when the poles of the rotating magnet are a few degrees past the neutral position.
4. What are the three major circuits of a high-tension magneto system?
The magnetic circuit, the primary electrical circuit, and the secondary electrical circuit.
5. What are the components of a high tension magnetic circuit?
The magnetic circuit consists of a permanent multipole rotating magnet, a soft iron core, and pole shoes.
6. What happens when the primary breaker points open in a magneto?
Opening the breaker points, stops the flow of current in the primary coil. The magnetic field that was emitted by the primary coil collapses. As this magnetic field collapses, its flux lines cut across the windings of the secondary coil, inducing the pulse of high voltage current in the secondary coil needed to fire the spark plugs.
7. What is the piston position when the spark occurs in a cylinder?
The piston is a specified number of crankshaft degrees before top dead center of the compression stroke.
8. What is a dual magneto ignition system?
The dual magneto system incorporates two magnetos in one housing, and one rotating magnet, and a cam are common to two sets of breaker points and coils. On radial engines, the right magneto fires all the front plugs and the left magneto fires all the rear plugs.
9. What is the difference between a low-tension and a high-tension ignition system?
In the high-tension system, high voltage is generated in the magneto and flows to the plugs through high-tension leads. In a low-tension system, low voltage is generated in the magneto and flows through low-tension leads to the primary winding of a transformer coil located near each spark plug. There the voltage is increased to high voltage by transformer action and is conducted to the plugs by very short high-tension leads.
10. When the ignition switch is in the OFF position, what is the condition of the primary circuit?
It is completed through the ignition switch to ground.
11. What three conditions are required to fire plugs in a cylinder when the piston is in the prescribed position?
The magneto's magnet poles must be in the E-gap position, the breaker points must open, and the distributor rotor must be aligned with the distributor electrode for that cylinder.
12. In a dual magneto ignition system, what part of the system is grounded when the ignition switch is placed in the RIGHT position?
The left magneto circuit will be grounded.

13. What is internal timing of a magneto?
It is adjusting the breaker points to open when the poles of the rotating magnet are at the E-gap position.
14. What is the purpose of an impulse coupling used with a magneto?
The purpose of an impulse coupling is to retard the timing of the spark for starting the engine, and then spin the magneto rapidly to produce a hotter spark.
15. What is staggered ignition timing?
It is the firing of one spark plug before the other one instead of firing them simultaneously.
16. What is the proper spark plug reach?
The proper spark plug reach is when the electrode end of the plug inside the cylinder is in the best position to achieve ignition.
17. What type ignition system is used in most turbine engines?
A typical engine is equipped with an electronic capacitor-type ignition system.
18. What is the function of the igniter plugs in a turbine engine?
The function of the igniter plugs is to provide a discharge gap for the current which is stored in the capacitor. The discharge results in a high intensity spark which ignites the fuel-air mixture.
19. When are turbine engine ignition systems normally in use?
The ignition system is normally required only for starting or restarting an engine.
20. What are two types of igniter plugs?
Annular gap – a long-reach plug that extends into the combustion chamber

Constrained gap – a short-reach plug that does extend into the chamber because the spark does not remain close to the plug.

FUEL METERING SYSTEMS ORAL

1. Where are the fuel spray nozzles located in a turbine engine?
They are located either externally or internally on the combustion chamber in such a way that the fuel can be sprayed into the combustion area.
2. Name the heat sources for the operation of fuel heaters used in turbine engines.
Turbine engine fuel heaters operate as heat exchangers. Fuel lines are routed through the fuel heater, which uses as a heat source either bleed air engine lubricating oil. If bleed air is used as a heat source, it is called an air-to-liquid heat exchanger, and when oil is used, it is called a liquid-to-liquid heat exchanger.
3. What engine variables are sensed by a hydromechanical fuel control?
The fuel control senses power lever position, rpm, compressor inlet pressure or temperature, burner pressure or compressor discharge pressure, and EGT or TIT.
4. What are the two most commonly used carburetors in small reciprocating engines?
They are the float-type carburetor and the pressure-type carburetor.
5. What type fuel control unit is used in a turbine engine?
Both hydromechanical and electronic fuel control units are in use today. However, the most commonly used fuel control unit is completely hydromechanical type.
6. What is the purpose of a mixture control in a float-type carburetor?
It is to control the fuel-air mixture as air density changes with changes in altitude.
7. What is the purpose of an accelerating system on a float-type carburetor?
When the throttle is opened rapidly, the fuel-air mixture will lean out momentarily. To overcome this tendency, a charge of fuel from the accelerating pump will temporarily enrich the mixture in the venturi.
8. Describe the purpose and operation of a venturi.
The venturi performs three functions. It proportions the fuel-air mixture, lowers the pressure at the discharge nozzle, and limits airflow at full throttle.
9. What is the function of a metering jet?
The main metering jet is placed in the fuel passage between the float chamber and the discharge nozzle. Its purpose is to limit the fuel flow when the throttle valve is wide open.
10. What is the fuel metering force in a float-type carburetor?
It is the differential pressure between the pressure in the float chamber and that at the nozzle.
11. What will be the result of using excessively rich idle mixtures?
Excessively rich idle mixtures will cause carbon fouling of your spark plug.
12. What is the purpose of the economizer system in a float carburetor?
The economizer is essentially a valve which is closed at throttle settings below 60% to 70% of rated power, but provide additional fuel for cooling the engine to prevent detonation at higher throttle settings.
13. Where does a pressure injection carburetor obtain fuel pressure?
It obtains fuel pressure from the boost pump for starting and from the engine-driven fuel pump for normal operation of the engine.

14. What operates an automatic mixture control (AMC) on a pressure carburetor?
The AMC contains a sealed bellows that expands or contracts with changes in atmospheric pressure. The movement of the bellow operates a tapered needle that controls the impact air pressure into the "A" chamber of the carburetor.
15. In what position do you place the mixture control of a pressure injection carburetor to stop the engine?
In the idle cutoff position
16. What rpm indication should result when the mixture control is placed in the idle cutoff position when the idle mixture is set correctly?
There should be a slight increase in rpm, followed by a rapid drop of rpm to zero.
17. What is the purpose of filling a pressure injection carburetor full of fuel and allowing it to soak for a period of about eight hours prior to installation?
This is done in order to soften the diaphragms and make them as pliable as they were when the carburetor was originally calibrated.
18. What are three types of carburetor icing?
Throttle icing, impact icing, and fuel evaporator icing
19. What is the typical fuel pressure in a float-type carburetor?
3 – 5 psi

ENGINE FUEL SYSTEMS ORAL

1. What is the purpose of strainers in a fuel system?
They are used to prevent foreign matter from entering the carburetor.
2. What is the purpose of fuel selector valves?
They provide a means of shutting off fuel flow, for tank and engine selection, for crossfeed, and for fuel transfer.
3. What should be looked for when inspecting an engine-driven fuel pump?
Look for fuel leaks and security of mounting.
4. What is the purpose of an engine-driven fuel pump?
The engine-driven fuel pump must deliver a continuous supply of fuel at the proper pressure at all times during engine operation.
5. What type of fuel pump is generally used with large reciprocating engines?
A positive-displacement rotary vane-type pump
6. What happens to the excess fuel not required by the engine in a constant displacement pump?
The pressure relief valve opens and the fuel is routed back to the inlet side of the pump.
7. What is the most common type of fuel boost pump?
The electrically driven centrifugal-type pump
8. What is the purpose of the bypass valve in the engine-driven fuel pump?
The bypass valve provides a path around the pump vanes for starting the engine and to allow fuel to bypass the pump in case of pump failure.
9. What is the purpose of using boost pumps in a fuel system?
Electric boost pumps are used to supply fuel to a pressure carburetor during engine starting and in case of engine-driven pump failure. However, a main function of a boost pump is to keep the pressure on the suction side of the engine-driven pump from becoming low enough to permit the fuel to boil when operating at high altitudes.
10. What are the three general causes of vapor lock?
They are low fuel pressure, high fuel temperatures, and excessive fuel turbulence.
11. Turbine engine fuel pumps may be divided into what two distinct systems categories?
Constant displacement and variable displacement
12. What category is a turbine engine-driven gear-type pump?
Constant displacement
13. What type fuel pump can be made to vary the fuel flow at any speed?
A variable displacement pump
14. What part of a gas turbine engine fuel system is very susceptible to the formation of ice?
The fuel filter
15. How is the engine fuel system protected from ice formation?
By the use of fuel heaters
16. Why is a micron fuel filter provided with a bypass valve as a necessary safety factor?
Because the small openings in this type filter make it very susceptible to clogging.

ENGINE INDUCTION SYSTEMS ORAL

1. What are the three major parts of a reciprocating engine induction system?
The airscoop and ducting, the carburetor, and the intake manifold
2. What effect does induction system icing have on engine performance?
Induction system icing can cause an engine to act erratically and lose power.
3. What method is used to prevent or remove induction system ice in a reciprocating engine?
The most common method of preventing or removing ice formation in the induction system is by the use of heated air.
4. How is ice cleared in some aircraft induction systems if the carburetor heat is too low to clear the ice?
A fluid such as alcohol, anilol, or mersol is sprayed into the induction system ahead of the carburetor. The fluid will dislodge the ice which is ingested by the engine.
5. What engine indication can be the result of a dirty air filter?
Low power
6. What is the danger of using carburetor heat when operating at high power settings?
The higher air temperatures could cause detonation and possible engine failure.
7. Carburetor throttle ice is most likely to form when the throttle is in which position?
During part throttle operation when the throttle is near the closed position
8. What are two general classifications of superchargers used in reciprocating engine induction systems?
They are classified as internally driven or externally driven (turbocharger) supercharger systems.
9. What is the purpose of a distribution impeller in a supercharger?
It is designed to break up the fuel globules into finer particles for better distribution to the cylinders.
10. How does an internally driven supercharger boost air pressure?
A high-speed impeller is driven through a gear train from the crankshaft at a gear ratio that varies from 6:1 to 12:1.
11. Where does an externally driven supercharger get its power?
The exhaust gases are directed against a turbine. For this reason, they are commonly called turbochargers.
12. What unit regulates the amount of exhaust gases to the turbine of a turbocharger?
The waste gate
13. What type of power is used to control the position of the turbocharger waste gate on some engines?
Oil pressure to an actuating piston.

ENGINE COOLING SYSTEMS ORAL

1. What is the most common means of regulating the cooling air flow through a radial engine?
By the use of cowl flaps.
2. What is the purpose of the fins on engine cylinders?
To increase the effective size of the cylinder for cooling.
3. What other engine characteristics are designed to aid in engine cooling besides cooling fins?
The engine cowling and baffles are designed to force air over the cylinder cooling fins.
4. Why is the "open and close" adjustment during installation of cowl flaps important?
For each engine installation, the cowl flaps are set for tolerance that will permit them to open and close the correct amount to keep the cylinder head temperature within allowable limits.
5. What should be done to cylinders when too much of the cooling fin area is broken off?
The cylinder should be replaced because it cannot cool properly and a hotspot will develop.
6. When should cowl flaps be kept in the fully open position?
Normally during all ground operations
7. What publication should be referred to before reprofiling cylinder cooling fins?
The manufacturer's service or overhaul manual should be used to obtain the allowable limits.
8. What power sources are used to operate the cowl flaps?
Cowl flaps may be operated by electrical power, hydraulic power, or manually.
9. What is the purpose of blast tubes that are built into the baffles on a reciprocating engine?
To direct jets of cooling air onto the rear spark plug elbows of each cylinder to prevent overheating of the ignition leads.
10. What are the main reasons that excessive heat in a reciprocating engine is undesirable?
Excessive heat shortens the life of the engine parts, impairs lubrication, and affects combustion.
11. Describe the augmentor system.
Augmentors consist of two pairs of tubes running from the engine compartment to the rear of the nacelle. The exhaust gas collector feeds exhaust gases into the inner augmentor tubes. Air that has passed over the engine is fed into the outer tubes where it is heated by the exhaust tubes and then expelled to mix with the exhaust gases. The heating of the air causes it to form a high temperature, low pressure, jet-like exhaust which draws additional cooling air over the engine. The heated air is sometimes used for cabin heating, defrosting, and anti-icing.
12. What is the source of air that is directed to engine bearings for cooling?
It is to bleed air from the compressor section of the engine.
13. What is the purpose of installation on the exhaust duct of a turbine engine?
To reduce the temperature of the structure in the vicinity of the exhaust duct or afterburner and to eliminate the possibility of fuel or oil coming into contact with the hot parts of the engine.
14. What types of materials are used to make insulation blankets for turbine engines?
They are made of stainless steel, with layers of aluminum foil, fiberglass, and silver foil.
15. What areas of a turbine engine are cooled by the secondary air passing through the engine?
The combustion chambers and the turbines

16. What is the purpose of an engine cowling?
It streamlines the engine to reduce drag and it forms an envelope around the engine, which forces air around and between the cylinders to cool them.
17. What is the purpose of an oil cooler bypass valve?
It allows the thick oil to bypass the cooler when the oil is cold.

ENGINE EXHAUST SYSTEMS ORAL

1. What are two types of reciprocating engine exhaust systems?
The short stack system and the collector system
2. What are the possible hazards of exhaust system failure?
Depending on the location and type of exhaust system failure, it can result in carbon monoxide poisoning of the crew and passengers, partial or complete loss of engine power, and an aircraft fire.
3. What type exhaust system is generally used on low powered non-supercharged engines?
The short (open) stack system.
4. What type of exhaust system is used on turbocharged engines?
The exhaust collector system
5. What type of exhaust system creates a higher exhaust back pressure?
The collector system
6. What is the purpose of a reciprocating engine exhaust system?
To dispose of high temperature, noxious gases that are discharged by the engine
7. What happens when lead, zinc, or galvanized marks are made on an exhaust system?
The mark is absorbed by the metal when it is heated and causes a change in the molecular structure of the metal.
8. What type of visual indication can usually be seen in the area of an exhaust leak?
Exhaust leaks usually leave flat gray or sooty black streaks on the pipes in the area of the leak.
9. How are ceramic-coated exhaust stacks cleaned?
By degreasing only
10. What is the usual cause of muffler and heat exchanger failures?
They are usually caused by thermal and vibration cracking or ruptures in areas of stress concentration.
11. Where are exhaust manifold and stack failures most likely to occur?
These failures usually occur at welded or clamped points in the system.
12. What is a common cause of the waste gate unit malfunctioning in a turbocharger system?
The most common cause of waste gate malfunctioning is carbon buildup, causing the waste gate valve to stick in the CLOSED position.
13. What factors are affected if the area of the exhaust nozzle of a turbine engine is changed?
The size of the exhaust nozzle affects both the engine performance and the exhaust gas temperature.
14. What are the probes in a turbine exhaust tailpipe used for?
They are used to measure exhaust gas temperature (EGT).
15. Why do you disassemble and inspect the collector type?
Exhaust system failure can result in carbon monoxide poisoning of crew and passengers.
16. What is the purpose of the waste gate on a turbocharger exhaust?
This valve controls the amount of exhaust gases forced through the turbocharger turbine. When the gate is fully closed, all gases must pass through the turbine.

PROPELLER ORAL

1. What is the purpose of a propeller?
To create thrust and either pull or push the airplane through the air.
2. What are the two types of propeller configurations?
The tractor type and the pusher type
3. What type of propeller has the blade angle built into the propeller and cannot be changed?
A fixed-pitch propeller
4. What is the purpose of the metal tipping on a leading edge of a wooden propeller?
It is to protect the propeller from damage caused by flying particles in the air during landing, taxiing, and takeoff.
5. What tool is used to determine propeller blade angle?
A universal propeller protractor
6. What are the aerodynamic forces and loads acting on a rotating propeller blade?
A rotating propeller is acted upon by centrifugal, twisting, and bending forces.
7. What is the meaning of propeller blade "back" and "face"?
The cambered or curved side of the propeller blade is called the blade back. This is the side of the blade that faces away from the engine. The flat side of the propeller blade is known as the blade face. This side of the blade faces the engine.
8. What should be used to clean aluminum and steel propeller blades and hubs?
They should be washed with a suitable cleaning solvent using a brush or cloth.
9. What positions are used on a balance stand to check a two-bladed propeller for static balance?
First, the vertical position and then a horizontal position
10. When centrifugal force acts on the counterweights of a hydraulic counterweight propeller, it tends to rotate the blades in which direction?
Centrifugal force tends to increase the blade pitch.
11. Why do you put the blades of a counterweight propeller into high pitch before stopping the engine?
This type propeller has a movable cylinder that slides over a fixed piston. In the low pitch position, the cylinder is outboard and the piston is exposed to the open air, but in the high pitch position, the cylinder moves inboard and covers the piston. In this position, the piston is protected from dirt and moisture in the air. This is particularly important if the airplane engine will not be operated for several days.
12. Why are cones installed on splined shafts with a propeller?
The cones center the propeller on the shaft as they are forced toward each other by the tightening of the retaining nut.
13. How is feathering accomplished on a constant speed counterweight propeller?
Releasing governor oil pressure allows the counterweights and feathering spring to move the blades to the feathered position.
14. What types of systems are used for deicing propellers?
Fluid or electrical deicing systems

15. What is the purpose of a slinger ring on some propeller installations?
Propeller deicing fluid is ejected from a stationary nozzle on the engine into a scoop attached to the rear of the propeller assembly. The U-shaped channel is called the slinger ring. The fluid under pressure of centrifugal force is transferred through a tube to the propeller blades.
16. What is "blade tracking"?
It is the process of determining the position of the tips of the propeller blades relative to each other.
17. Do the counterweights on a constant-speed propeller increase or decrease the blade angle?
The centrifugal force of the counterweights is used to increase the pitch of the blades.
18. What should be adjusted if a pilot requests 50 more rpm on a constant-speed propeller-equipped aircraft engine?
Adjust the governor's prop-lever set screw.

AUXILIARY POWER UNITS (APU) ORAL

1. What is the typical relationship between an aircraft's auxiliary power unit (APU) generator and the engine-driven generator?
They are identical.
2. Where does the APU fuel supply normally come from?
The airplane's main fuel supply
3. How is the APU rotated during start up?
With an electric starter
4. What is the function of an APU air inlet plenum?
It is to stabilize the pressure of the air before it enters the compressor.
5. When operating at high loads, what is the speed of an APU?
The APU remains at or near rated speed regardless of the load condition.
6. What is the effect of the pneumatic power when being used in conjunction with maximum APU shaft power output?
The pneumatic loading will be automatically modulated to maintain a safe EGT.
7. Before shutdown, how would APU cooling be accomplished?
By closing the bleed air valve
8. When is most of the load placed on an APU?
When the bleed air is opened
9. What regulates fuel scheduling during APU start and under varying pneumatic bleed and electrical loads?
Fuel scheduling is maintained automatically by the APU fuel control system.
10. What is the primary function of the load compressor on APUs equipped with a free turbine and load compressor?
To provide bleed air for aircraft pneumatic systems.

APPENDIX 1

FAA PUBLICATIONS AND REFERENCE GUIDE

Below is a list of the main publications used by the FAA to write the A&P written and oral and practical examinations. These publications are available through most government bookstores or through the US Government Printing Office in Washington, D.C. These publications are also available in book, microfiche, and CD ROM through individual publishing companies or on the Internet at http://www.faa.gov/regulations_policies/. The publications most often used for general purpose study are as follows:

FEDERAL AVIATION REGULATIONS (TITLE 14 OF THE CODE OF REGULATIONS)

Part	
1	Definitions and Abbreviations
21	Certification Procedures for Products and Parts
23	Airworthiness Standards: Normal, Utility and Acrobatic Category Airplanes
25	airworthiness Standards: Transport Category Airplanes
27	Airworthiness Standards: Normal Category Rotorcraft
29	Airworthiness Standards: Transport Category Rotorcraft
33	Airworthiness Standards: Aircraft Engines
35	Airworthiness Standards: Propellers
37	Technical Standard Order Authorizations
39	Airworthiness Directives
43	Maintenance, Preventive Maintenance, Rebuilding and Alteration
45	Identification and Registration Markings
65	Certification: Airmen Other than Flight Crewmembers
91	General Operating and Flight Rules
121	Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft

ADVISORY CIRCULARS

AC 00-2	Advisory Circular Checklist: Provides a list of current FAA Advisory Circulars
AC 23-21	Used to substantiate major alterations of small aircraft – Advisory Circular AC 23-21 Airworthiness Compliance Checklists
AC 23-21 Change 1	Revises Paragraphs 7a, 7d, 8a(2)(b), and 8e(4) of AC 23-21 – Advisory Circular AC 23-21 Change 1
AC 39.7C	Airworthiness Directives: Provides guidance and information to owners and operators of aircraft concerning their responsibility for complying with airworthiness directives (AD) and recording AD compliance in the appropriate maintenance records – Advisory Circular AC 39-7C
AC 43.9	Maintenance Records: Discusses maintenance record requirements under FARs 43.9, 43.11, and 91.411
AC 43.9-1F	Instructions for Completion of FAA Form 337, Major Repair and Alteration: Provides instructions for completing FAA Form 337 for major repairs and major alterations on airframes, powerplants, propellers, or appliances – Advisory Circular AC 43.9-1F
AC 43.13-1B	Acceptable Methods, Techniques and Practices – Aircraft Inspection and Repair: Contains methods, techniques and practices acceptable to the administrator for inspection and repair to civil aircraft
AC 43.13-2B	Acceptable Methods, Techniques and Practices – Aircraft Alterations: Contains methods, techniques, and practices acceptable to the administrator in altering civil aircraft
AC 65.12A	Airframe & Powerplant Mechanics – Powerplant Handbook: May be used for training mechanics or for on-the-job training in the construction, theory of operation, and maintenance of aircraft powerplants
AC 65.15A	Airframe & Powerplant Mechanics – Airframe Handbook: May be used for training mechanics or for on-the-job training in airframe construction, repair, and the operating theory of airframe systems.

Miscellaneous FAA Publications

Information contained in the following publications is needed by a certificated mechanic during the exercise of certain privileges. Mechanic applicants should know what type of information they contain and be able to perform thorough researches in these publications in order to properly understand the maintenance history and future maintenance requirements for specific aircraft. It may not be feasible to purchase these publications for study purposes only.

Aircraft Type Certificate Data Sheets and Specifications: These data sheets are compiled by the FAA from information supplied by the manufacturer. The data sheets describe the type design and set forth the limitations prescribed by the applicable Federal Aviation Regulations. They also include any other limitations and information found necessary for type certificate of a particular product. They are arranged in six different volumes.

The Summary of Airworthiness Directives: Presented in three volumes, they contain all the airworthiness directives for large and small aircraft issued after 1970. ADs for engines, propellers, and equipment are included in each volume. Each volume is arranged alphabetically by product manufacturer.

The following links are compiled for your convenience all in one location so you don't have to search for them:

[Advisory Circular AC 39-7C:](#)

Information concerning the responsibility to comply with airworthiness directives (AD) and recording AD compliance in the appropriate maintenance records.

[Advisory Circular AC 43.9-1F](#)

Mandatory: Instructions on completing FAA Form 337, a necessity when documenting major repairs or modifications.

[Advisory Circular AC 23-21 Airworthiness Compliance Checklists](#)

Used to substantiate major alterations of small aircraft.

[Advisory Circular AC 23-21 Change 1](#)

Revises Paragraphs 7a, 7d, 8a(2)(b), and 8e(4) of AC 23-21.

[Aircraft Weight and Balance Handbook](#)

(Please wait for large file to load)

[Mechanic AIRFRAME, GENERAL & POWERPLANT Practical Test Standards](#)

[GENERAL, AIRFRAME & POWERPLANT Test Guide](#)

Information to prepare you to take the knowledge tests.

APPENDIX 2

This appendix contains various working assignments and projects that we feel should be reviewed and understood prior to taking an oral and practice exam. These pages contain some of the basic assignments that we give our students in the classroom. We have tried to provide formulas and explanations to help those who are attempting this at home without an instructor's help or guidance. You may find it necessary to refer to the appropriate FAA publications to aid you in completing these projects.

Contents

1. FAR Reading Assignment
2. Basic Oral Questions to Review
3. Logbook Entries
4. FAA Form 337
5. Logbook Entry Assignment
6. Weight and Balance Review
7. Weight and Balance Assignments
8. Electric Wire Chart
9. Basic Electricity
10. Basic Electricity Projects
11. Rivet Review
12. Rivet Projects
13. Temperature Conversions
14. Micrometers

FAR READING ASSIGNMENT

Read the following sections in the FARs:

FAR 1.1 – DEFINITIONS

(1) Major Alteration:

(2) Major Repair:

(3) Minor Alteration:

(4) Minor Repair:

(5) Preventative Maintenance:

FAR 43 – MAINTENANCE

(1) **FAR 43.1 – 43.17**

Please note that 43.9 and 43.11 pertain to LOGBOOK ENTRIES.

(2) **Appendix A** (Major Repairs and Major Alterations)

You do not have to read this appendix, but you **MUST** know what it consists of.

(3) **Appendix B** (Recording of Majors – FAA Form 337)

Read paragraphs (a)(1)(2)(3)

(4) **Appendix D** (Scope and Detail of Annual & 100-Hour Inspection)

Read only paragraph (a), but you **MUST** know what this appendix consists of.

FAR 65 – PRIVILEGES AND LIMITATIONS

(1) **FAR 65.71 – 65.95 (subpart D only)**

You must know your “Privileges and Limitations.”

BASIC ORAL QUESTIONS TO REVIEW

- (1) What must be done to prepare an aircraft for an annual or 100-hour inspection?
Before the inspection, remove or open all necessary inspection plates, access doors, fairing and cowling. Thoroughly clean the aircraft and aircraft engine.
- (2) What is the difference between an annual and a 100-hour inspection?
The only difference is the time between the two inspections and who can perform them. They are identical in scope and detail.
- (3) Who has the authority to sign off and return to service a 100-hour inspection?
A certificated mechanic
- (4) What are the operating conditions that make a 100-hour inspection mandatory?
If the aircraft is used to give flight instruction for hire or carry persons for hire
- (5) Where can you find the checklist for the 100-hour inspection?
FAR 43, Appendix D
- (6) Where would you find the recommended statement for recording the approval or disapproval for return to service of an aircraft after a 100-hour inspection?
FAR 43.11
- (7) Where can a mechanic find an example of a 100-hour inspection record entry?
FAR 43.11
- (8) Where are three places you find the airframe and powerplant mechanic's Privileges and Limitations?
FAR 65.81, 65.85, and 65.87

LOGBOOK ENTRIES

Listed below are three types of logbook entries. Your examiner will have you write at least one of these types as part of your practical test. **YOU MUST PASS THIS PORTION OF YOUR PRACTICAL IN ORDER TO GET YOUR LICENSE.** Study each type and know where to find them in the FARs.

Standard Maintenance Entry FAR 43.9 (a)(1)(2)(3)(4)

Date_____ Total Time_____

Removed Ni-cad battery from station 20 and installed a lead-acid battery at the same location in accordance with STC #1A9TC. Reference 337 dated 3-20-2004. Weight and balance computed and entered in the aircraft records. Equipment list revised. Operational check performed and found satisfactory.

Signature
Certificate # and Kind of Certificate

100-Hour Inspection Entry FAR 43.11 (a)(1)(2)(3)(4)

Date_____ Total Time_____

I certify that this aircraft has been inspected in accordance with a 100-hour inspection and was determined to be in airworthy condition.

Signature
Certificate # and Kind of Certificate

Combination Logbook Entry FAR 43.9 and FAR 43.11

Date_____ Total Time_____

Removed Ni-cad battery from station 20 and installed a lead-acid battery at the same location in accordance with STC #1A9TC. Reference 337 dated 3-20-2004. Weight and balance computed and entered in the aircraft records. Equipment list revised. Operational check performed and found satisfactory. I certify that this aircraft has been inspected in accordance with a 100-hour inspection and was determined to be in airworthy condition.

Signature
Certificate # and Kind of Certificate

MAJOR REPAIR AND ALTERATION (Airframe, Powerplant, Propeller, or Appliance)		Form Approved OMB No. 2120-0020 2/28/2011	Electronic Tracking Number
		For FAA Use Only	
INSTRUCTIONS: Print or type all entries. See Title 14 CFR §43.9, Part 43 Appendix B, and AC 43.9-1 (or subsequent revision thereof) for instructions and disposition of this form. This report is required by law (49 U.S.C. §44701). Failure to report can result in a civil penalty for each such violation. (49 U.S.C. §46301(a))			
1. Aircraft	Nationality and Registration Mark		Serial No.
	Make	Model	Series
2. Owner	Name (As shown on registration certificate)		Address (As shown on registration certificate)
	Address		City
	State		Country
	Zip		
3. For FAA Use Only			
4. Type		5. Unit Identification	
Repair	Alteration	Unit	Make
☐	☐	AIRFRAME	(As described in item 1 above)
☐	☐	POWERPLANT	
☐	☐	PROPELLER	
☐	☐	APPLIANCE	Type
			Manufacturer
6. Conformity Statement			
A. Agency's Name and Address		B. Kind of Agency	
Name		U. S. Certified Mechanic	
Address		Manufacturer	
City		Foreign Certified Mechanic	
State		C. Certificate No.	
Zip		Certified Repair Station	
Country		Certified Maintenance Organization	
D. I certify that the repair and/or alteration made to the unit(s) identified in item 5 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 43 of the U.S. Federal Aviation Regulations and that the information furnished herein is true and correct to the best of my knowledge.			
Extended range fuel per 14 CFR Part 43 App. B ☐		Signature/Date of Authorized Individual	
7. Approval for Return to Service			
Pursuant to the authority given persons specified below, the unit identified in item 5 was inspected in the manner proscribed by the Administrator of the Federal Aviation Administration and is ☐ Approved ☐ Rejected			
BY	FAA Fit. Standards Inspector	Manufacturer	Maintenance Organization
	FAA Designee	Repair Station	Inspection Authorization
Persons Approved by Canadian Department of Transport		Other (Specify)	
Certificate or Designation No.		Signature/Date of Authorized Individual	

NOTICE

Weight and balance or operating limitation changes shall be entered in the appropriate aircraft record. An alteration must be compatible with all previous alterations to assure continued conformity with the applicable airworthiness requirements.

8. Description of Work Accomplished

(if more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)

Nationality and Registration Mark

Date

☐ Additional Sheets Are Attached

PROBLEM

You have just completed a 100-hour inspection on a Cessna 150. At the same time you removed the generator and rewound the field coils in accordance with Service Instruction #524. Then you reinstalled the generator.

Determine if the repair is major or minor (FAR 43, App. A), and fill out the appropriate paperwork. Use the space below for the logbook entry.

Aircraft: Cessna 150-B
Serial Number: 1503153

Nationality & Reg. #: N5210
Total Time: 1780

Aircraft Owner: John Q. Public
100 Main Street
Anywhere, FL 33333

Generator: Bendix
Model #: 1285
Serial #: 2733

LOGBOOK ENTRY

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

WEIGHT AND BALANCE REVIEW

Item	Weight	Arm	Moment
Empty Weight	2550	50	127500
Removed Ni-Cad Battery	-80	20	-1600
Installed Lead-Acid Battery	50	20	1000
TOTAL	2520		126900

$$CG = \frac{\text{Total Moment}}{\text{Total Weight}} = \frac{126900}{2520} = 50.35$$

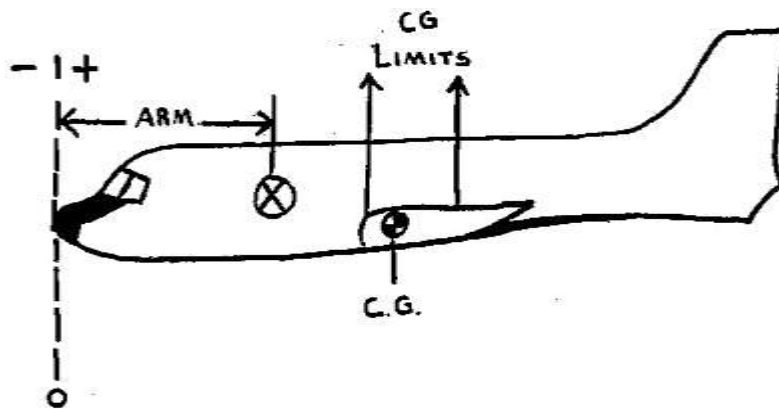
W = Weight

A = Arm/CG

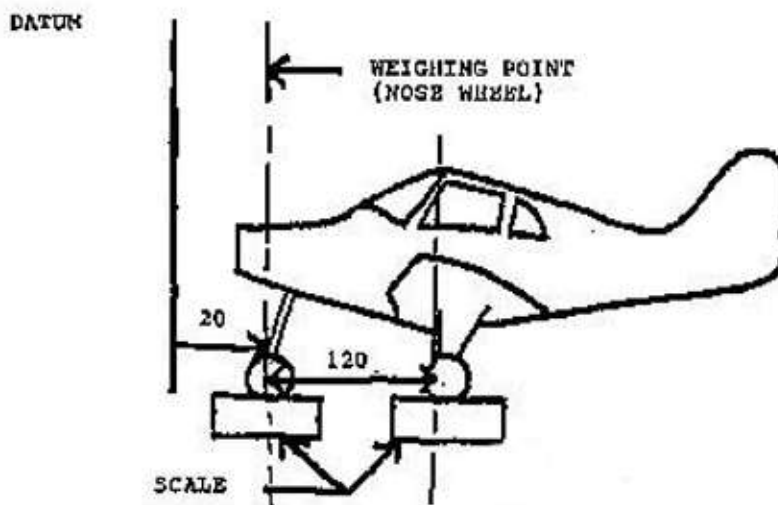
M = Moment

$W \times A = \text{Moment}$

$M \div W = \text{Arm}$



WEIGHT AND BALANCE



Weight: Nose weight 720
 Right main 1200
 Left main 1222

Location: Nose wheel 20 inches aft of the datum line
 Main gear 120 inches aft of the nose wheel

Find the empty weight and center of gravity

Item	Weight	Arm	Moment
TOTAL			

Empty Weight: _____

Center of Gravity: _____

WEIGHT AND BALANCE

An aircraft with an empty weight of 1800 pounds and an empty weight CG of 31.5 was altered as follows:

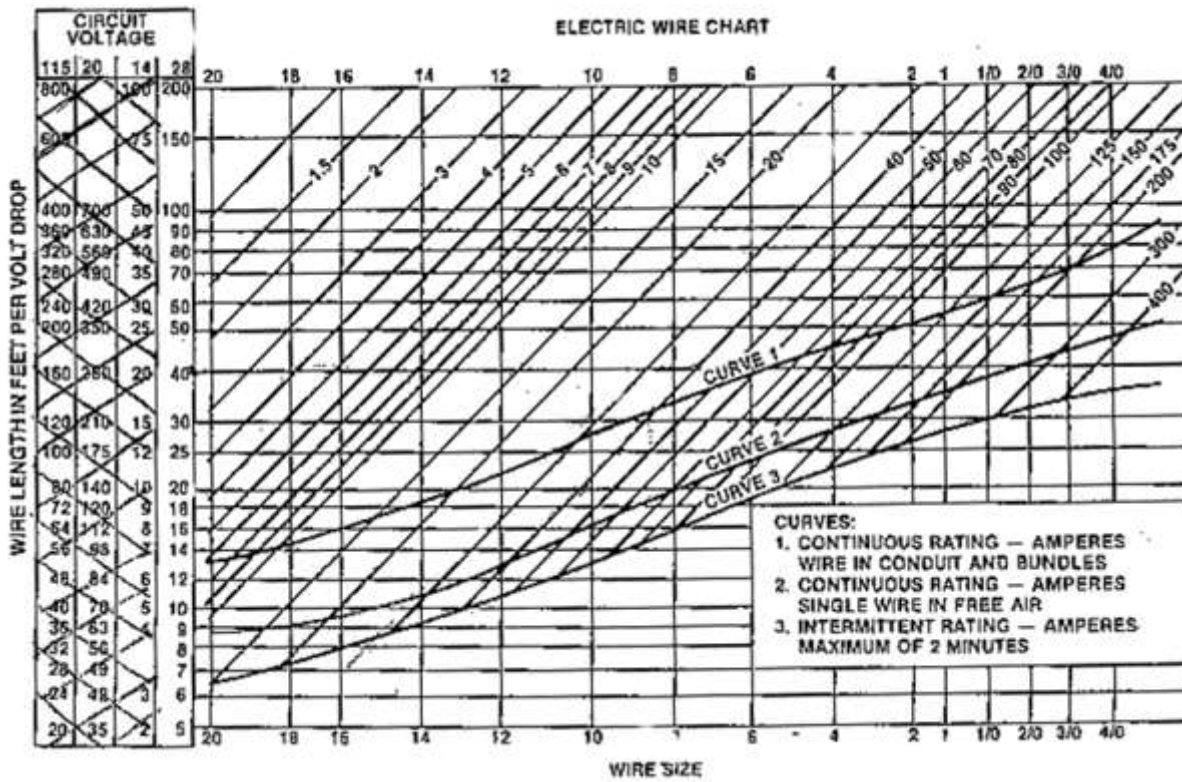
- (1) Two 15-pound passenger seats located at +72 were removed.
- (2) Structural modifications increasing the weight 14 pounds were made at +76.
- (3) A seat and safety belt weighing 20 pounds were installed at +73.5.
- (4) Radio equipment weighing 30 pounds was installed at +30.

What is the new empty weight CG? (Show work below)

Item	Weight	Arm	Moment
TOTAL			

Empty Weight: _____

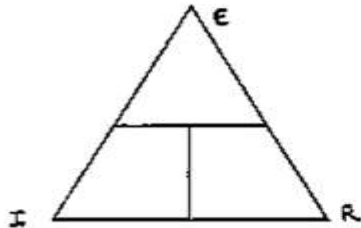
Center of Gravity: _____



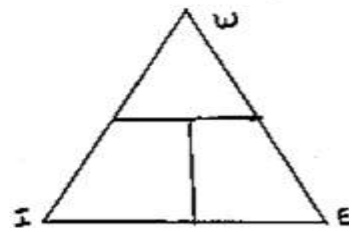
BASIC ELECTRICITY

EMF	Volts	E
Current	Amps	I
Resistance	Ohms	R
Power	Watts	W
ED	Voltage Drop	

OHMS LAW

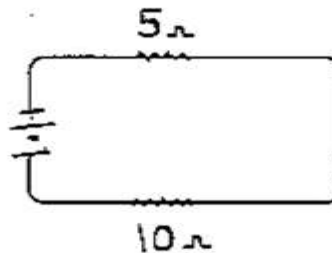


WATTS LAW



SERIES CIRCUIT

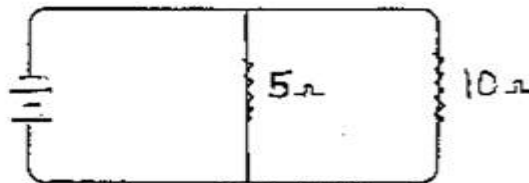
- (1) Current remains constant.....Voltage changes (voltage drop)
- (2) $R_t = \text{Sum of the resistors}$
- (3) $ED = I \times R$



PARALLEL CIRCUIT

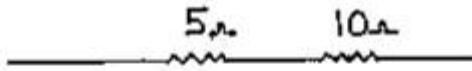
- (1) Current changes.....Voltage remains the same.
- (2) Current follows the path of least resistance.
- (3) R_t is always less than the smallest resistor.

(4) $R_t = \frac{R_1 \times R_2}{R_1 + R_2}$

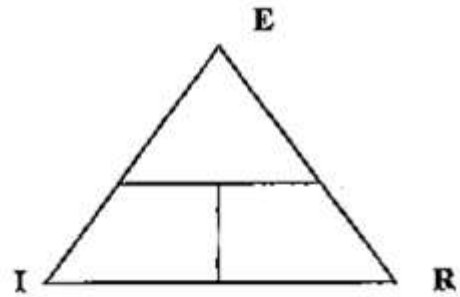


BASIC ELECTRICITY

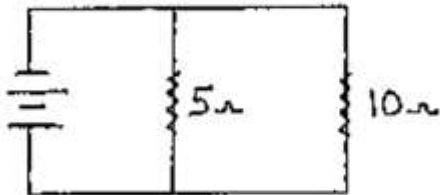
SERIES CIRCUIT



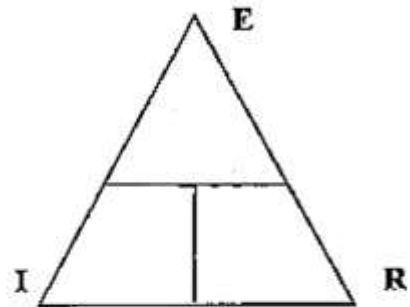
Known information: .8 amps
Find the voltage: _____



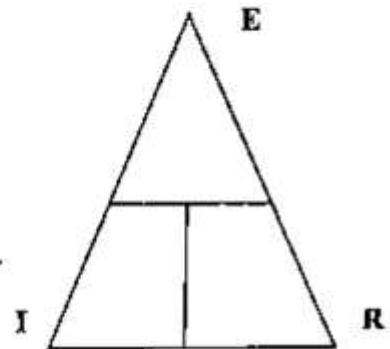
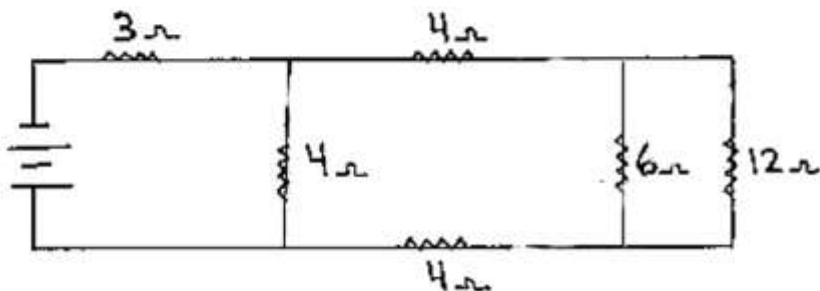
PARALLEL CIRCUIT



Known information: 7.2 amps
Find the voltage: _____



SERIES PARALLEL CIRCUIT



Known Information: 12 volts
Find Total Resistance: _____
Find Total Current: _____

RIVET REVIEW

RIVET PART NUMBER: AN470AD4-4

AN.....Identifies the "standard" of rivet. ("Airforce-Navy")

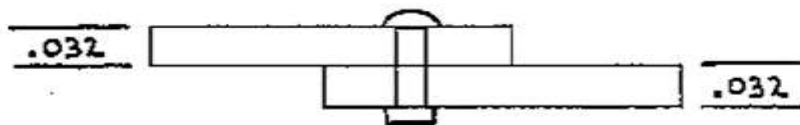
470.....Identifies the "Type Head"

AD.....Identifies the "Alloy" of the rivet

4.....Identifies the "Diameter" of the rivet. (Measured in 32nds.....4/32)

4.....Identifies the "Length" of the rivet. (Measured in 16ths.....4/16)

REFERENCE: AC65-9A (General Handbook)



FORMULAS

$$\begin{aligned}\text{DIAMETER (D)} &= 3 \text{ times the thickness of the thickest sheet} \\ &= 3 \times .032 \\ &= .096 \text{ (multiply by 32 to convert to 32nds)} \\ &= .096 \times 32 = \frac{3.07}{32} \text{ or } \frac{4}{32} \text{ (always round up on diameter)}\end{aligned}$$

$$\begin{aligned}\text{LENGTH} &= \text{Grip} + (1.5 \times D) \\ &= .064 + (1.5 \times 4/32) \text{ (Convert 4/32 to a decimal.....} 4 \div 32) \\ &= .064 + (1.5 \times .125) \\ &= .064 + .1875 \\ &= .2515 \text{ (Convert to 16ths.....} 2515 \times 16 = 4.02/16) \\ &= 4/16 \text{ (For length use the ".5 Rule".....only round up if it is .5 or above)}\end{aligned}$$

NOTES:

Length is measured from the bottom of the head to the end of the shank except for countersunk rivets.

Dimensions for shop head: (.5 × D) Thick
(1.5 × D) Wide

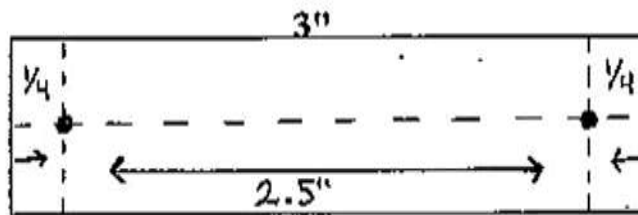
RIVET REVIEW

EDGE DISTANCE AND SPACING

Minimum Edge Distance	= 2D
Minimum Rivet Spacing	= 3D (single row)
Minimum Rivet Spacing	= 4D (double row)
Maximum Edge Distance	= 4D

PROBLEM:

Using AN470AD4-4 rivets, minimum edge distance and minimum spacing, how many rivets would it take to rivet together two 3-inch pieces of metal, using a single row of rivets?



Diameter of rivet	= $\frac{4}{32}$ or $\frac{1}{8}$
Edge distance	= $2D = 2 \times \frac{1}{8} = \frac{2}{8}$ or $\frac{1}{4}$ inch
Rivet spacing	= $3D = .375$ spacing

SOLUTION:

- (1) Plot edge rivets first (2 edge rivets; see drawing)
- (2) This leaves a 2.5-inch space to work with.
- (3) Find how many .375 spaces will fit into the 2.5-inch space.
- (4) $2.5\text{-inch space} \div .375 \text{ spacing} = 6.666$ or 6 spaces (Remember space $\div$ space = space, not rivets)
- (5) In a straight-line pattern, you will always have 1 more space than you have rivets; therefore, only 5 rivets will fit in the 2.5 inches.

Total number of rivets: 7 (5 rivets + 2 edge rivets = 7 rivets)

REVIEW PROBLEM

You are going to rivet two 3-inch sheets of metal together using 7 rivets evenly spaced. Calculate the spacing of the rivets and give your answer in 32nds.

SOLUTION: Since you are using 7 rivets, you will have 8 spaces.

$$3 \text{ inches} \div 8 = .375$$

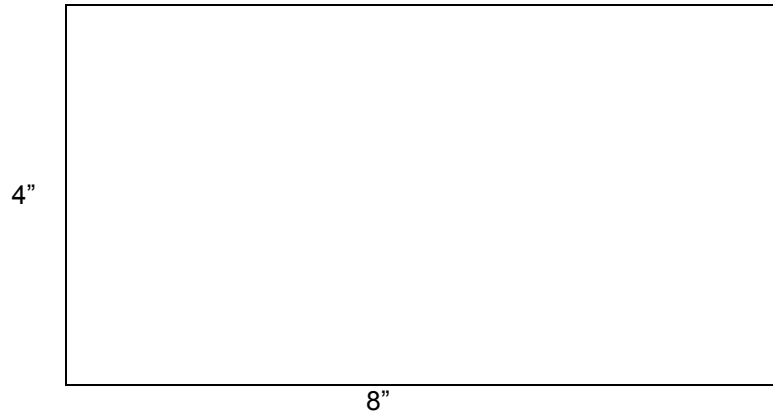
$$.375 \times 32 = 12 \text{ or } \frac{12}{32}$$

SHEET METAL PROJECT

You are going to rivet two 3-inch sheets of metal together using 6 AN470AD4-4 rivets. Use minimum edge distance, and space the others evenly. Give your answer in 32nds. (Show your work below)

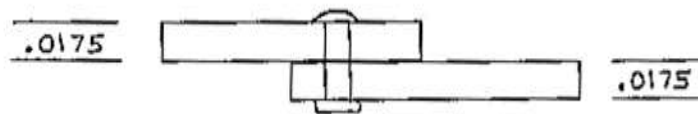
RIVET LAYOUT PROBLEM

How many AN470AD2-? Rivets will be required to attach a 4-inch x 8-inch plate using a single row of rivets (all four sides), minimum edge distance and 4D spacing?



SHOW WORK:

What length of rivet is required? _____ $L = \text{grip} + (1.5 \times D)$

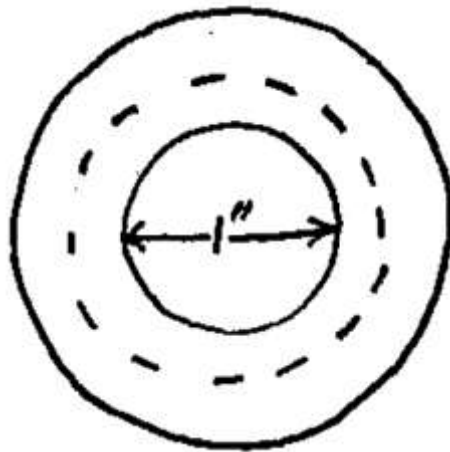


SHOW WORK:

SHEET METAL PROJECT

You are going to patch a 1-inch hole using AN470AD4-4 rivets. Use minimum edge distance and allow for a 1/2-inch overlap on each side of the hole. Place the rivets 45° apart.

- (1) How many rivets will it take? _____
- (2) Calculate the circumference of the rivet pattern:
 $C = \pi \times \text{diameter (of rivet pattern)}$
- (3) Give the distance between the rivets in inches: _____
- (4) Give the diameter of the patch: _____
- (5) Calculate the dimension of the shop head after bucking: (Give answers in 32nds)
Wide: _____ (1.5 x D)
Thick: _____ (.5 x D)



TEMPERATURE CONVERSIONS

Fahrenheit to Celsius
Degrees Fahrenheit – 32 then $\div 1.8$

Celsius to Fahrenheit
Degrees Celsius $\times 1.8$ then + 32

Convert the following:

(1) 22° C. to F.

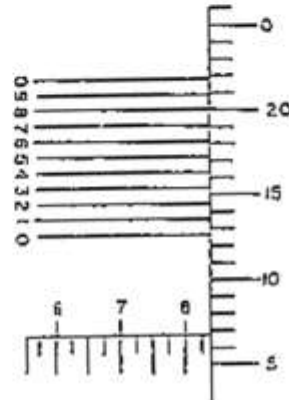
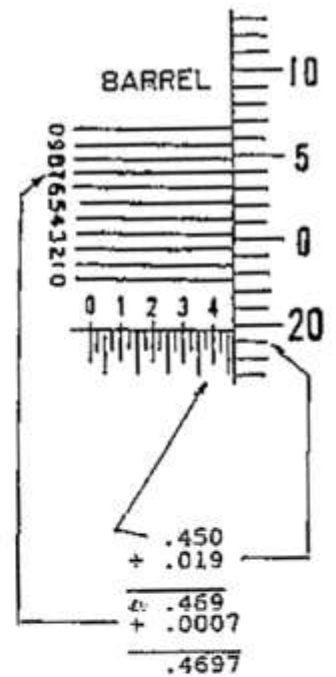
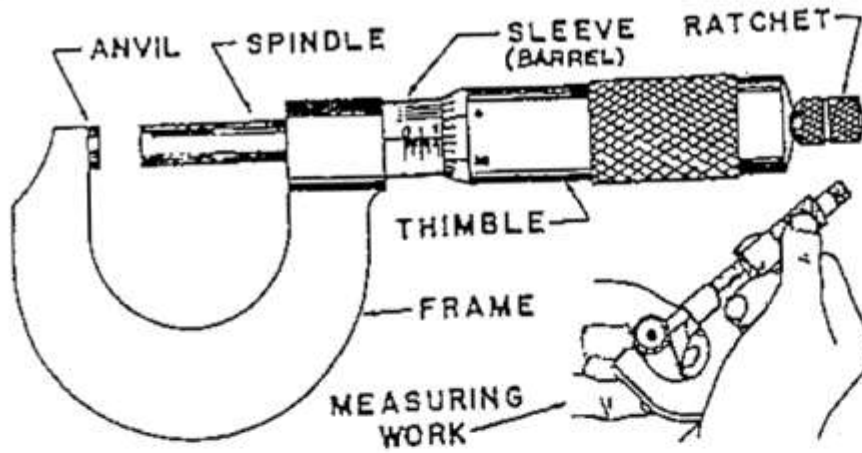
(2) 40° F. to C.

(3) 49° C. to F.

(4) 92° F. to C.

(5) -12° F. to C.

MICROMETER READING



READING _____

READING _____

APPENDIX 3

This appendix contains various working assignments and projects that we feel should be reviewed and understood prior to taking an oral and practical exam. These pages contain some of the basic assignments that we give our students in our classroom. Since an important part of passing the practical exam is having the knowledge and skills to look up information in the FAA publications, we have our students locate the answers to many of the projects found in this appendix from the appropriate FAA publication. You should also learn how to look up the answers to the projects found in this appendix.

Contents

1. Locating Information in FAA Publications
2. Identifying Pressure and Velocity in a Venturi
3. Logbook Entry Project
4. FAA Form 337 Project
5. Research Assignments
6. Identifying Control Surfaces
7. Identifying Antennas
8. Tube Fittings Reading Assignment
9. Reciprocating Engine Reading Assignment
10. Engine Fire Protection Systems Reading Assignment
11. Emergency Locator Transmitter (ELT) Reading Assignment

Locating Information in FAA Publications

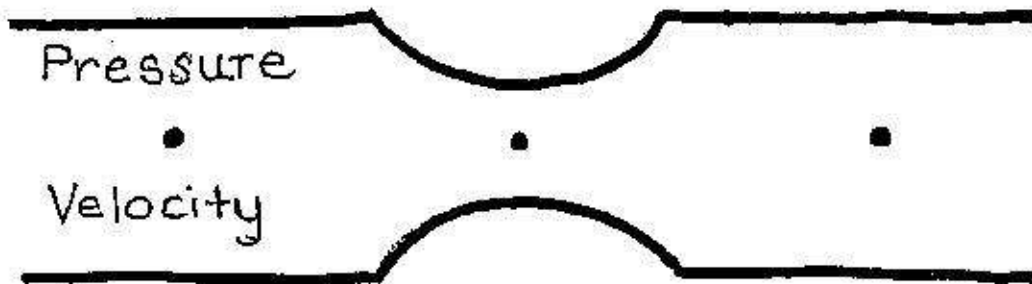
Locate the following in the AC 65-15A (Airframe Handbook)

Fabric terms page _____
Gluing terms page _____

Locate the following in the AC 43.13-1B and 2B

Wood chart page _____
Fabric chart page _____
Welding Tip chart page _____
Double Wrap Safety _____
Wire Method for a _____
Turnbuckle page _____

Label the Venturi



Problem:

Write a logbook entry and fill out a 337 form on the following alteration:

Remove King radio (Model KX-170B, S/N 3446) from Station +14 and install Bendix radio (Model KX-125, S/N 5667) at the same location. In addition to this you will also remove a King antenna (Model 355, S/N 7809) from Station +76.8 and replace with a Comant Industries (Model CI-121, S/N 2336) at the same location. All work is performed in accordance with STC #109AC.

Aircraft: Cessna 172N

S/N: 123445

CG: +37.0

Aircraft Total Time: 9806

Registration: N2345

Empty Weight: 1765.00

Radio Weights: King 5.5 lbs.; Bendix 3.5 lbs.

Antenna Weights: King 2.5 lbs.; Comant 1.5 lbs.

You are also performing a 100-hour inspection on this aircraft.

You are the aircraft owner and the mechanic performing the work.

LOGBOOK ENTRY

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



US Department
of Transportation
Federal Aviation
Administration

MAJOR REPAIR AND ALTERATION (Airframe, Powerplant, Propeller, or Appliance)

Form Approved
OMB No. 2120-0020
2/28/2011

Electronic Tracking Number

For FAA Use Only

INSTRUCTIONS: Print or type all entries. See Title 14 CFR §43.9, Part 43 Appendix B, and AC 43.9-1 (or subsequent revision thereof) for instructions and disposition of this form. This report is required by law (49 U.S.C. §44701). Failure to report can result in a civil penalty for each such violation. (49 U.S.C. §46301(a))

1. Aircraft	Nationality and Registration Mark		Serial No.	
	Make		Model	Series
2. Owner	Name (As shown on registration certificate)		Address (As shown on registration certificate)	
			Address	
			City	State
			Zip	Country

3. For FAA Use Only

4. Type		5. Unit Identification			
Repair	Alteration	Unit	Make	Model	Serial No.
☐	☐	AIRFRAME	_____	(As described in item 1 above)	_____
☐	☐	POWERPLANT	_____	_____	_____
☐	☐	PROPELLER	_____	_____	_____
☐	☐	APPLIANCE	Type	_____	_____
			Manufacturer		

6. Conformity Statement

A. Agency's Name and Address Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Country: _____		B. Kind of Agency <table style="width: 100%;"> <tr> <td style="width: 50%;">☐ U. S. Certified Mechanic</td> <td style="width: 50%;">☐ Manufacturer</td> </tr> <tr> <td>☐ Foreign Certified Mechanic</td> <td rowspan="2">C. Certificate No. _____</td> </tr> <tr> <td>☐ Certified Repair Station</td> </tr> <tr> <td colspan="2">☐ Certified Maintenance Organization</td> </tr> </table>		☐ U. S. Certified Mechanic	☐ Manufacturer	☐ Foreign Certified Mechanic	C. Certificate No. _____	☐ Certified Repair Station	☐ Certified Maintenance Organization	
☐ U. S. Certified Mechanic	☐ Manufacturer									
☐ Foreign Certified Mechanic	C. Certificate No. _____									
☐ Certified Repair Station										
☐ Certified Maintenance Organization										

D. I certify that the repair and/or alteration made to the unit(s) identified in item 5 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 43 of the U.S. Federal Aviation Regulations and that the information furnished herein is true and correct to the best of my knowledge.

Extended range fuel per 14 CFR Part 43 App. B ☐	Signature/Date of Authorized Individual _____
--	---

7. Approval for Return to Service

Pursuant to the authority given persons specified below, the unit identified in item 5 was inspected in the manner prescribed by the Administrator of the Federal Aviation Administration and is ☐ Approved ☐ Rejected

BY	FAA FR. Standards Inspector	Manufacturer	Maintenance Organization	Persons Approved by Canadian Department of Transport
	FAA Designee	Repair Station	Inspection Authorization	

Certificate or Designation No.	Signature/Date of Authorized Individual _____
--------------------------------	---

NOTICE

Weight and balance or operating limitation changes shall be entered in the appropriate aircraft record. An alteration must be compatible with all previous alterations to assure continued conformity with the applicable airworthiness requirements.

8. Description of Work Accomplished

(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)

Nationality and Registration Mark

Date

☐ Additional Sheets Are Attached

Do the following temperature conversions:

-30° F. to C.

70° F. to C.

45° C. to F.

15° C. to F.

What is the proper size welding tip for .050 steel?

Identify the following rivet part number AN470AD-3-4

AN =

470 =

AD =

3 =

4 =

Write definitions to the following terms:

(AC 43.13-1B and 2B)

Checks

Shakes

Splits

(AC 65.15A)

Glue Line

Hardener

Single Spread

Warp

Ply

Bias

Sizing

Label the components of a valve train

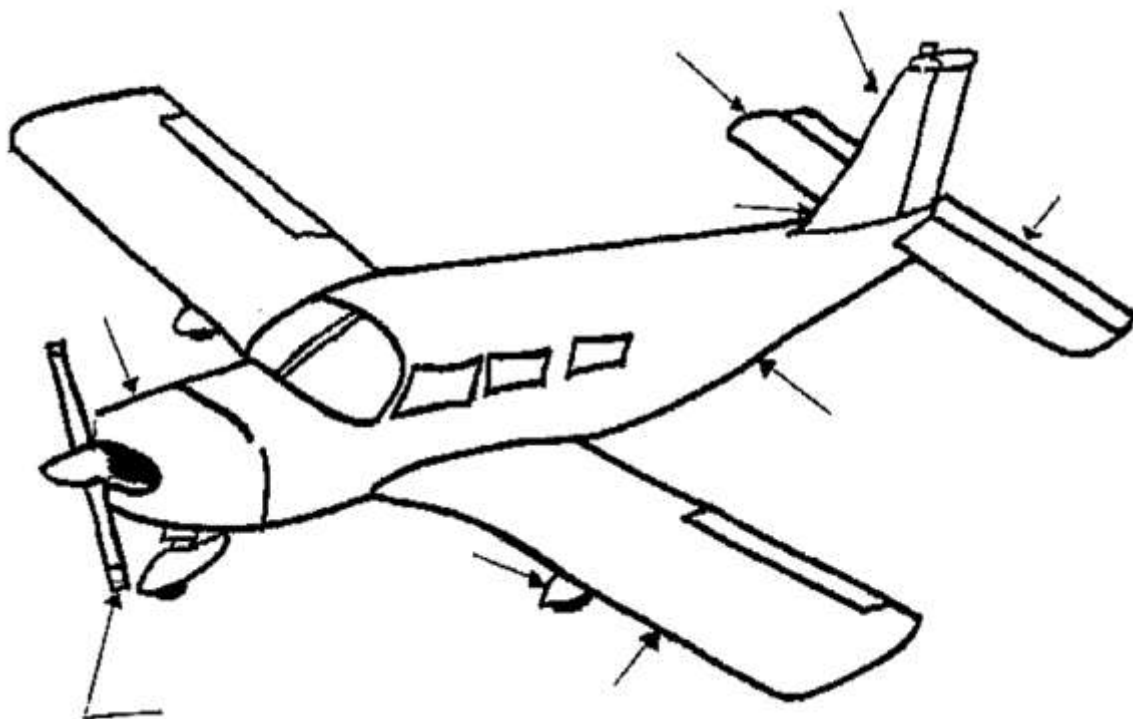
List the components of a typical gas turbine engine

(1) (4) (6)

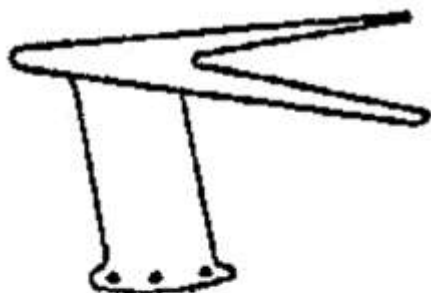
(2) (5) (7)

(3)

Identify the following aircraft control surfaces from the AC 65.15A, Page ____.



Identify the following antennas:



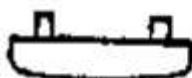
1) _____



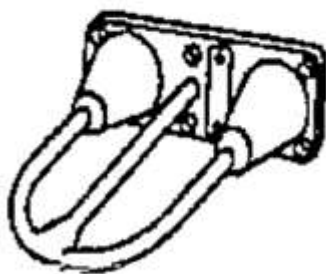
2) _____



3) _____



4) _____



5) _____



6) _____



7) _____

This Figure 13.3 is from AC 65.15A (Airframe Handbook)

TUBE FITTINGS

Tube fittings are assemblies for joining sections of tubing in a system and to hydraulic accessories. The most commonly used fittings are the standard AN-type fittings, examples of which are shown in Fig. 13-46 and flareless fittings, illustrated in Figure 13-47. The AN fitting is used for flared tubing and must include a body, a sleeve, and a nut for the complete assembly. The fitting itself is designed in a number of different shapes to provide for a variety of installations. For example, we may find straight fittings, T fittings, elbow fittings, and cross fittings, all in the same system. The hydraulic seal for a flared-tube fitting is formed between the flare cone on or with the fitting and the flare at the end of the tubing. The tube flare is pressed tightly against the flare cone by means of the sleeve and the nut. When flare fittings are to be used, the tubing should be flared with a tool designed for the purpose. The standard angle for the flare is 37° as shown in Figure 13-48. To make a double flare, which is required for some installations, a special double-flaring tool is required. Flareless fittings are installed as shown in Figure 13-49. The installation of this type of fitting is very critical because too much torque will cut the tubing and cause it to fail, and too little torque will permit the fitting to slip or leak.

If specific instructions for the installation of a particular flareless fitting are not available, a general rule for the installation may be used. The fitting is installed with the sleeve, and the end of the tubing is seated firmly against the counterbored shoulder in the body of the fitting. The nut is turned to pull the sleeve into the body until strong resistance to turning is encountered.

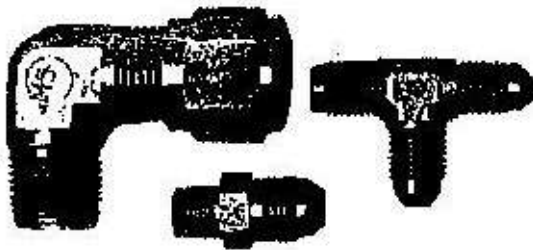


Figure 13-46 Flare-type fittings.

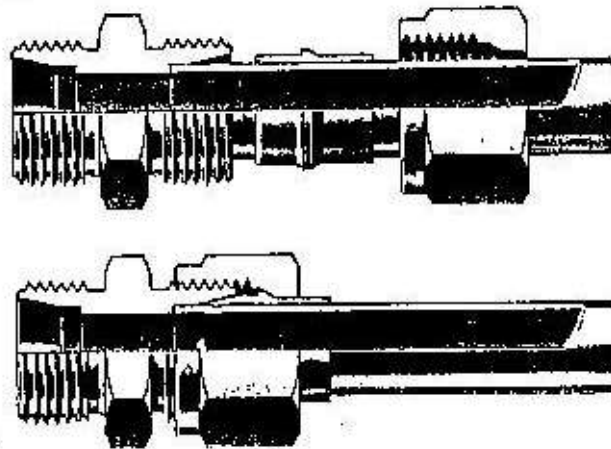


Figure 13-47 Flareless fittings.

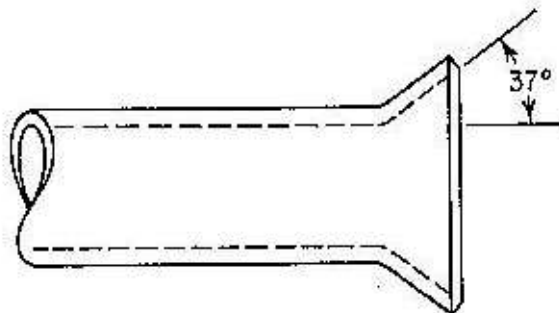


Figure 13-48 Tubing properly flared.

These figures are from the AC 65.9A (General Handbook)

RECIPROCATING ENGINE READING ASSIGNMENT

(1) Cylinders

Power in an engine is developed in the cylinder, in the combustion chamber where the burning and expansion of the gases take place. The cylinder houses the piston and contains the valves through which the combustible mixture enters the cylinder and through which the exhaust gases leave. A cylinder must be strong enough to withstand all of the internal pressures developed during engine operation while at an elevated temperature. It must be lightweight in construction so that it will not pose a weight penalty on the engine, and while it must be designed and built so it will conduct the maximum amount of heat away from the engine, it must be relatively simple to build, inspect, and maintain. Liquid-cooled cylinders are usually arranged in banks, or blocks, to facilitate the flow of the coolant; but for ease of maintenance and the ability to replace a damaged cylinder, individual cylinders are almost universally used for air-cooled engines.

a. Cylinder Barrels

A high-strength chrome molybdenum steel barrel is machined with a skirt that projects into the crankcase, a mounting flange to attach the cylinder to the case, thin cooling fins, and, on most cylinders, threads to screw into the cylinder head. Rather than having the cylinder bore ground perfectly straight, most cylinders have a certain degree of **choke**. This means that, at the point where the heat is more concentrated in the area of the head, the bore diameter is slightly less than that in the main portion of the cylinder. By the time the cylinder reaches operating temperature, the choked area has expanded more than the lower part of the barrel, and the bore has become straight. If the cylinder were not ground with this choke at the operating temperatures, the top would be larger than the bottom, and there would be danger of the combustion gases leaking past the piston rings and damaging the piston. The piston and its rings spend their useful life rubbing up and down on the cylinder wall, wearing it away. To minimize this wear, some cylinder walls are hardened. There are two commonly used procedures for providing a hard surface. One is chrome plating, and the other is a form of case hardening known as nitriding.

Chromium is a hard, natural element that has a high melting point, high heat conductivity, and a very low coefficient of friction, about half that of steel. The cylinder barrel is prepared for chrome plating by grinding to the required size and submerging it in a plating solution where a coating of chromium is deposited electrolytically on the inside of the barrel. This chromium has a natural tendency to form surface cracks, and by a carefully controlled process, these almost microscopic cracks are opened up until they form a network of visible and interconnected cracks or channels that hold lubricating oil on the cylinder wall. There are many advantages of chrome cylinders over either plain or nitride steel. They are less susceptible to rusting or corrosion, both because of the natural corrosion resistance of chromium and because of the tendency of the oil to adhere to the chromed cylinder walls better than to plain steel. The hardness of chromium causes less wear of the wall than would occur on a softer cylinder, and when the wall does wear, the cylinder may be ground enough to straighten it and then may be rechromed back to standard size. Cylinders v/with chrome-plated walls are identified by an orange band around their base or by a stripe of orange paint on certain of their fins.

(2) Nitrided Barrels

Case hardening is a process in which the surface of steel is changed by the infusion of some hardening agent. It differs from plating in that there is no material on the surface but actually a change in the surface material itself. Nitriding does not require quenching, and it does not warp the cylinder as other forms of case hardening might do. After the cylinder barrel has been ground to the required size and smoothness, it is placed in a furnace, or retort, in an atmosphere of ammonia gas. The length of treatment and the temperature are both carefully controlled, and in the process, the ammonia gas (NH_3) breaks down, or disassociates, into nitrogen and hydrogen. The steel used in the cylinder barrel has a small percentage of aluminum as an alloying agent, and the nitrogen combines with this aluminum to form aluminum nitrides, the hard, wear-resistant surface we want. Since nitriding is not a plating or a coating, it causes a dimensional growth of only about 0.0002 to 0.0004 inch, but the hardened layer varies in depth to about 0.002 inch, and gradually decreases in hardness from the surface inward until it corresponds with that of the metal itself. After the nitriding process is completed, the cylinder walls are honed to a microsmooth finish. One of the problems with a nitride surface is its susceptibility to corrosion or rust. Nitrided cylinder walls must be kept covered with oil, and if an engine is left out of service for any period of time, the walls should be coated with a sticky preservative oil. Nitrided cylinder walls are identified by a band of blue paint around their base, or by certain fins being painted blue.

b. Cylinder Heads

Most air-cooled aircraft cylinder heads are sandcast of an aluminum alloy containing copper, nickel, and magnesium. This alloy has the desirable characteristics of relatively high strength and the ability to maintain this strength to temperatures of up to about 600° F. Cooling fins are cast into the surface of the head to increase its cooling area, and because of the difference in temperatures at the various sections of the cylinder head, it is necessary to provide more cooling area in some sections than others. The exhaust valve region is the hottest part of the head, and there are more fins there than anywhere else on the head. The holes for the spark plugs are bushed with either bronze or steel bushings screwed, shrunk, and pinned in place, or by stainless steel Heli-coil inserts. Bronze, cast iron, or steel valve guides are shrunk in place, and hardened, ring-type valve seats are shrunk in the head to provide a wearing surface for the intake or exhaust valves and to protect the aluminum alloy of the head from the hot exhaust gases. Most cylinder heads are heated to expand them and then screwed onto the steel cylinder barrels which have been chilled to contract them. When the two reach the same temperature, they fit so tightly that there is no leakage of the hot gases. The Teledyne-Continental Tiara engine, rather than screwing the cylinder heads onto the barrels, uses long through-bolts to hold the head in place, as well as to hold the cylinder to the engine.

C. Valve Mechanism

(1) Valves

The valves in the cylinders of an aircraft engine are subject to high temperature, corrosion, and operating stresses; and the metal used in their manufacture must be able to resist all of these attritional factors. Because intake valves operate at lower temperatures than exhaust valves, they may be made of chrome nickel or tungsten steel, while the exhaust valves are usually made of some of the more exotic alloys such as inconel, silicon-chromium, or cobalt-chromium alloys. The ground face of the valve forms a seal against the valve seat in the cylinder head when the valve is closed. The face is usually ground to an angle of 30, 45, or 60 degrees with the choice made that will give the best airflow efficiency and seating. Valve faces are often made more durable by the application of a material called Stellite. About 1/16 inch of this alloy is welded to the valve face and ground to the correct angle. Stellite is resistant to high temperature and corrosion and withstands the shock and wear associated with valve operation. The surface-hardened valve stem acts as a pilot for the valve head and rides in the valve guide installed in the cylinder head for this purpose. The tip of the stem is hardened to withstand the hammering of the valve rocker arm as it opens the valve, and a groove machined around the stem near the tip holds the split-ring stem keys which hold the valve spring retaining washer in place. Some exhaust valve stems are hollow and partially filled with metallic sodium. The sodium melts at approximately 208° F., and the up-and-down motion of the valve circulates the liquid sodium so it can carry heat from the valve head into the stem where it can be dissipated through the valve guide to the cylinder head and then into the cooling fins. In this way, the operating temperature of the valve can be reduced by as much as 300° to 400° F. Most intake valves have either flat or tulip-shaped solid heads, and in some engines, the intake and exhaust valves are similar in appearance; they are not interchangeable, however, as they are constructed of different materials.

(2) Valve Seats

The valve operates in the hot environment of the inside of the cylinder head and is exposed to continual pounding; and for this reason, an extremely durable valve seat must be installed in the soft aluminum cylinder head. Rings of aluminum-bronze or steel are machined with an outside diameter about 0.010 to 0.015 inch larger than the hole into which they are to fit, and the head is heated in an oven to around 575° to 600° F. and the seat put in place. The interference fit will then hold it in place when the head and seat are at the same temperature. The seats are ground with a high-speed stone guided by a pilot through the valve guide so the seat will be absolutely concentric with the valve stem.

(3) Valve Guides

The hardened valve stem rides in the cylinder head in bronze or cast-iron guides that are chilled and pressed into the heated cylinder head. The stem receives the heat from the valve head and transfers it into the guide, where it is taken into the cylinder head and then dissipated into the air. Because of this heat transfer, it is important that the tolerance allowed by the manufacturer for the stem-to-guide clearance is not exceeded. This fit is provided by reaming the guide after it has been pressed into place. After the valve seat and guide have been properly installed in the cylinder head, a pilot is slipped through the guide and the seat ground so it is concentric with the valve guide hole.

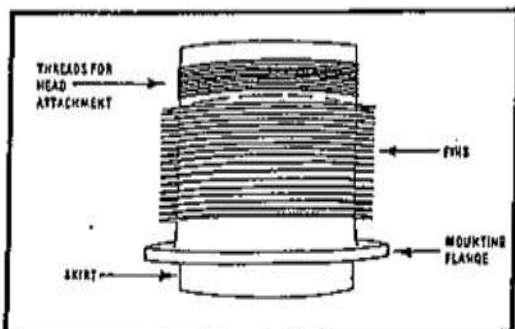


Fig. 2-24 The cylinder barrels of an air cooled aircraft engine are machined from high-strength chrome molybdenum steel.

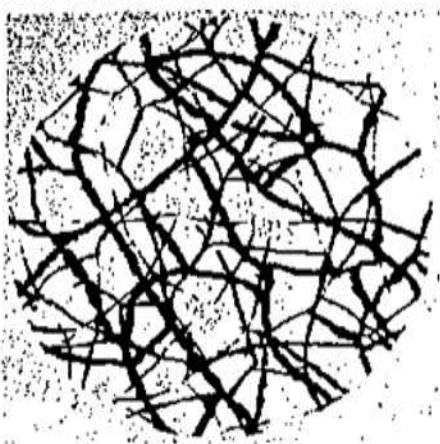


Fig. 2-26 The walls of a chrome plated cylinder are covered with thousands of tiny cracks that hold the lubricating oil.

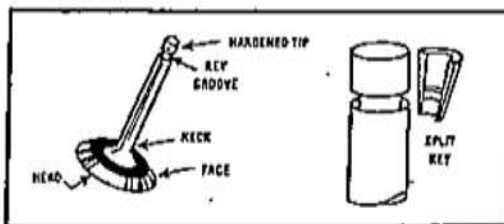


Fig. 2-27 Valve springs are locked to the valves with tapered split keys.

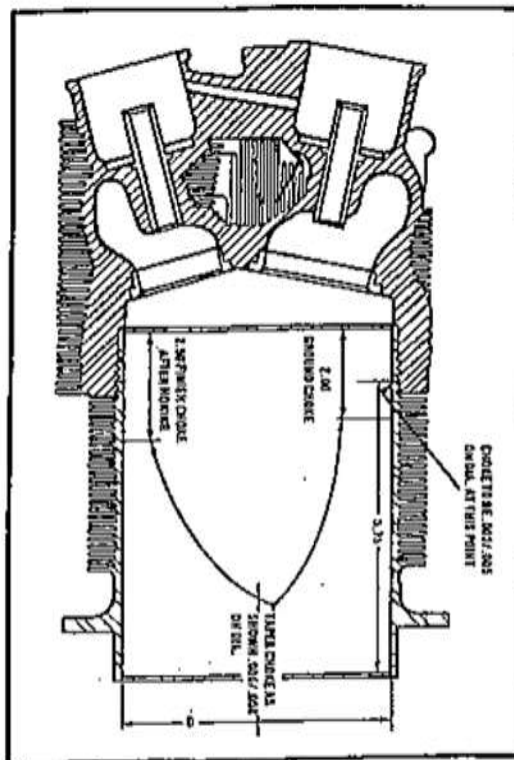


Fig. 2-25 A choke-ground cylinder has a smaller diameter at the head end than at the skirt to allow for the uneven expansion caused by the mass of the cylinder head. The bore becomes straight at operating temperature.

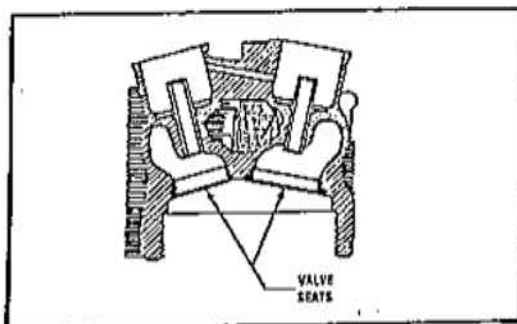


Fig. 2-28 Valve seats made of aluminum bronze or steel are shrunk into place in the soft aluminum head.

ENGINE FIRE PROTECTION SYSTEMS

Fire Detection Systems

- (1) Thermal Switch (overheat)
- (2) Thermocouple (rate of rise)
- (3) Continuous Loop (overheat)
 - (a) Kidde
 - (b) Fenwal

- (1) **Thermal Switch** Heat sensitive units that complete electrical circuits at a certain temperature. If the temperature rises above a set value in any section of the circuit, the thermal switch will close, completing a light circuit to indicate a fire or overheat condition.
- (2) **Thermocouple** Depends on the rate of temperature rise. It will not give a warning when an engine overheats slowly.
- (3) **Continuous Loop** Overheat system that completes electrical circuits at a certain temperature.
 - (a) Kidde – uses TWO wires embedded in a special ceramic core within a tube.
 - (b) Fenwal – uses a SINGLE wire surrounded by ceramic beads in a tube

In both systems, the resistance of the ceramic core material prevents electrical current from flowing at normal temperatures. If there is a fire or overheat condition, the core resistance drops and current flows between the signal wire and ground, energizing the alarm system.

EMERGENCY LOCATOR TRANSMITTER

An emergency locator transmitter (ELT), also referred to as a locator beacon, is required on aircraft to provide a signal or signals that will enable search of aircraft on ground stations to find aircraft that have made crash landings in remote or mountain areas. Even though the ELT is not strictly a communications or navigation device, it has elements of both, and so it is described in this section.

A typical ELT consists of a self-contained dual-frequency radio transmitter and battery power supply with a suitable whip antenna. When armed, it will be activated by an impact force of 5G or more, as may be experienced in a crash landing. The ELT emits an omnidirectional signal on the international distress frequencies of 121.5 and 243 MHz. General aviation aircraft, commercial aircraft, the FAA, and the Civil Air Patrol monitor 121.5; 243 MHz is monitored by the military services. After a crash landing, the ELT will provide line-of-sight transmission up to 100 miles at a receiver altitude of 10,000 feet. The ELT transmits on both distress frequencies simultaneously at 75 MBA rated power output for 50 continuous hours in the temperature range of -4° F. to 131° F. (-20° C. to 55° C.). The fixed ELT must be installed securely in the aircraft at a location where damage will be minimal. The location selected is usually in the area of the tail cone; however, in some cabin-type aircraft, the unit is installed in the aft part of the cabin. Access is provided in either case so the unit can be controlled manually.

TESTING THE ELT

The ELT control panel on the unit contains a switch with three positions: **AUTO, OFF, and ON. The unit may be tested by tuning the VHF com. receiver to 121.5 MHz and then placing the VLF switch in the ON position.** The emergency tone will be heard if the ELT is operating. Immediately after the test, the switch should be returned to the AUTO position. If the ELT is inadvertently turned on due to a lightning strike or an exceptionally hard landing, the control switch should be placed in the off position to stop the transmission, and then the switch should be returned to the AUTO position to arm the unit. Testing of ELTs should be coordinated with the nearest FAA tower or Flight Service Station and establish coordination for the test. Test should be conducted only during the first five minutes of any hour and should be restricted to three audio sweeps.

SERVICE FOR THE ELT

The ELT requires a minimum of service; however, certain procedures are necessary to assure operation. **The battery pack must be changed in accordance with the date stamped on the unit.** The new battery pack installed must be of the type specified by the manufacturer. If the unit contains a rechargeable battery pack, charging must be accomplished in accordance with the established schedule. The ELT should be tested regularly to assure satisfactory operation. An inspection of the ELT mounting and antenna should be made periodically to ensure firm attachment to the aircraft. Regulation regarding the use of operation of ELT equipment is set forth in FAR 91.207. Technicians involved with the installation service of ELTs should be familiar with these regulations and manufacturer's data.

INSPECTION OF THE ELT (Excerpt from FAR 91.207)

FAR 91.207 – Emergency Locator Transmitters

(d) Each emergency locator transmitter required by paragraph (a) of this section **must be inspected within 12 calendar months** after the last inspection for—

- (1) Proper installation;
- (2) Battery corrosion;
- (3) Operation of the controls and crash sensor; and
- (4) The presence of a sufficient signal radiated from its antenna.