AIRFRAME & POWERPLANT MECHANICS

POWERPLANT TEST GUIDE

Written, Oral, and Practical

ALIGNS WITH

FAA-H-8083-32B & FAA-H-8083-32B-ATB

Airframe & Powerplant Mechanics Powerplant Handbook

2027 EDITION

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This book is designed to help you pass your FAA knowledge exams. But even more important, it is designed to help reinforce your understanding of the subjects which you have been studying in the classroom and shop. However, rather than this being the first book you pick up, it should be the last. When you take that route, you will find the questions in this book both easy and an excellent reinforcement to your studies.

The chapters in this test guide are organized to follow those of the FAA 8083-32B Powerplant Handbook, which can be found here: www.actechbooks.com/ap-textbooks.html. The process we suggest is this: Beginning with Chapter 1, first learn from the handbooks and in the classroom. Only when you feel comfortable with each subject, is it time to prepare for your exam. This is the best time to open this Test Guide to confirm what you have learned or to reopen the Handbook to review those topics for which you need reinforcement. You will see that every question in this Test Guide includes its reference pages to that subject in the Handbook to make that process easy. Following this, is then the best time to use SkyPrep and take simulated practice exams for further confirmation that you are ready for the FAA Exam. See page ii for further information about SkyPrep.

ABOUT THE QUESTIONS

In 2011 FAA made the decision to no longer publish the actual test questions. Previous test guides where one could memorize the same questions as would be on your test are no more. Instead, questions in this and other available Test Guides are only examples of the type of question you will receive on your actual test.

AIRMAN CERTIFICATION STANDARDS (ACS)

As of August 2023 FAA has adopted the Airman's Certification Standards, replacing the older Practical Test Standards. The ACS identifies each topic which you are required to learn subdivided by knowledge, risk management, and practical skills. Each subject is given a learning code found in the ACS. The codes for each question are referenced in this book next to the question number. The complete list of codes is provided in the ACS, which can be downloaded for free below.

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Or, if you prefer a printed copy of the ACS, please visit the following link.

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FAA-S-ACS-1

U.S. Department of Transportation

Federal Aviation Administration

Aviation Mechanic
General, Airframe, and Powerplant
Airman Certification Standards

November 1, 2021

The Administrator of the Federal Aviation Administration signed the interim final rule "Part 147, Aviation Maintenance Technician Schools" on March 9, 2022. The interim final rule incorporates this version of the Aviation Mechanic General, Airframe, and Powerplant Airman Certification Standards (FAA-S-ACS-1) by reference. For identification and document-control purposes, this ACS is dated November 1, 2021. However, this ACS is not enforceable until the effective date of the interim final rule. Upon publication, the interim final rule can be found on the Federal Register's website, www.federalregister.gov, and will direct the effective date of compliance with this ACS.

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VERSION 1

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AIRCRAFT ENGINES

CHAPTER 1

Types of Engines, Connecting Rods, Piston Rings, Firing Order, Valves and Valve Operating Mechanisms, Bearings, Propellers, and Efficiencies

QUESTIONS

1-1 AM.III.B.K4
Based on the criteria of efficiency of an engine's weight to the power it produces, which type of engine is the best choice for an aircraft operating at speeds of 300 mph at altitudes between 20,000-25,000 feet?

A. Reciprocating Engines
B. Turbofan Engines
C. Turboprop Engines

1-2 AM.III.A.K5
An aircraft engine has 9 cylinders. From this information alone we can deduce that _____

A. it contains both master and articulating rods.
B. its firing order is 1-3-5-7-9-2-4-6-8.
C. it is water cooled.

1-3 AM.III.A.K4
The crankcase of an aircraft engine _____

A. houses the valve operating mechanism and the engine cylinders.
B. is lightweight and primarily used as a reservoir for the engine oil.
C. is the foundation of the engine containing crankshaft bearings and cylinder pads.

1-4 AM.III.A.K4
The cylinders of an aircraft engine are mounted on cylinder pads that are machined onto the crankcase. The common method of attachment of the cylinders to the crankcase is _____

A. by studs mounted in threaded holes in the crankcase.
B. by bolts into locking helicoils mounted in the crankcase.
C. by heating the crankcase and cooling the cylinder for an interference fit.

1-5 AM.III.A.K4
The crankpin is _____

A. used to ensure the crankshaft does not shift in the crankcase.
B. a solid, heavy journal to withstand crankshaft shock loads.
C. hardened by nitriding and is hollow to reduce weight.

1-6 AM.III.A.K5
Which statement is correct about radial engine crankshafts?

A. Movable counterweights serve to reduce the torsional vibrations in an aircraft reciprocating engine.
B. Movable counterweights serve to reduce the dynamic vibrations in an aircraft reciprocating engine.
C. Movable counterweights are designed to resonate at the natural frequency of the crankshaft.

ANSWERS

1-1 Answer C
In the cruising speed range of 180-300 mph, the turboprop engine delivers more power per weight than the reciprocating engine. Below this speed and altitude reciprocating engines provide the greatest efficiency based on cost. At higher speeds and altitudes, the turbofan engine provides the greatest efficiency. Turbo jet engines and low bypass turbofans are the only type capable of speeds higher than Mach 1.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 3, 4

1-2 Answer B
All radial engines contain an odd number of cylinders with firing orders starting with consecutive odd number cylinders followed by consecutive even cylinders. Articulated rods exist only on multiple row radial engines. This would not be possible with a 9 cylinder engine. Generally, radial engines are air cooled.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 5, 16

1-3 Answer C
The cast or forged crankcase is the foundation of the aircraft engine. It contains the bearings which support the crankshaft. Cylinders are bolted to the crankcase and the crankcase provides the attach points for the engine to be secured to the airframe. As such it must be very strong to receive the many variations of mechanical loads and forces from these components while keeping the crankshaft stable. The crankcase does act as a reservoir for the engine oil, but with all of its other functions and relatively heavyweight construction, this is not the crankcase's primary function.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 5

1-4 Answer A
Several studs are installed into the crankcase around the circumference of each machined cylinder pad. These are used to mount the cylinders securely to the crankcase with nuts. The inner portion of a cylinder pad may be chamfered or tapered to permit the installation of a large rubber o-ring around the cylinder skirt. This seals the joint between the cylinder and the crankcase pad against oil leakage.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 6

1-5 Answer C
Crankpins are the machined journals on the crankshaft to which the piston connecting rods are attached. They are off center from the main journal. The two crank cheeks and the crankpin together make a "throw". When the force of combustion is applied to the crankpin, it causes the crankshaft to rotate. Crankpins are hardened by nitriding to resist wear and are hollow to keep the total weight of the crankshaft as light as possible. The hollow crankpin also permits the passage of oil as it turns in the crankcase.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 8

1-6 Answer B
Vibration occurs as the crankshaft rotates due to the forces of combustion acting on the pistons, connecting rods, and crankpins. These power impulses cause even a statically balanced crankshaft to vibrate. Movable counterweights are dynamic dampeners are located in the counterweight lobes of the crankshaft. Using pendulum motion, the dampeners oscillate out of time with the crankshaft vibration thus reducing overall vibration.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 8, 9

QUESTIONS

1-7 AM.III.A.K5
Master rod bearings are generally what type of bearing?
A. Plain
B. Roller
C. Ball

1-8 AM.III.A.K4
Cam ground pistons are installed in some aircraft engines to _____
A. provide a better fit at operating temperatures.
B. act as a compensating feature so that a compensated magneto is not required.
C. equalize the wear on all pistons.

1-9 AM.III.A.K4
Full-floating piston pins are those which allow motion between the pin and _____
A. the piston.
B. the piston and the large end of the connecting rod.
C. the piston and the small end of the connecting rod.

1-10 AM.III.A.K4
How is oil collected by the piston oil ring returned to the crankcase?
A. Down vertical slots cut in the piston wall between the piston oil ring groove and the piston skirt.
B. Through holes drilled in the piston oil ring groove.
C. Through holes drilled in the piston pin recess.

1-11 AM.III.A.K4
In comparison to others, the cooling fins located near the exhaust valve of an air cooled piston engine will be shaped _____
A. longer and thinner.
B. shorter and thicker.
C. longer and thicker.

1-12 AM.III.A.K4
What is the determining factor in establishing the firing order on a piston engine?
A. Even pulses on the crankshaft.
B. Greatest power production.
C. Most efficient cooling.

ANSWERS

1-7 Answer A
The master rod bearings refer to the bearing located on the crankpin end and the piston end of the master connecting rod commonly found in radial engines. Whether of solid or split design, plain bearings are used to mate with the crankpin journal of the crankshaft. The piston pin end of the master rod uses a plain bearing usually called a bushing to mate with the piston pin.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 22

1-8 Answer A
Modern engines use cam ground pistons that have a larger diameter perpendicular to the piston pin. This larger diameter keeps the piston straight in the cylinder as the engine warms up from initial start. As the piston heats up during warm up, the part of the piston in line with the piston pin has more mass. It expands more than the piston area perpendicular to the piston pin making the piston completely round at operating temperature.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 12

1-9 Answer C
The piston pins used in modern aircraft engines are the full-floating type, so called because the pin is free to rotate in both the piston and in the connecting rod piston pin bearing which is the small end of the connecting rod. As such, full floating piston pins must be held in place to prevent the pin ends from scoring the cylinder walls. This is accomplished with soft aluminum plugs on each end of the piston pin.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 13

1-10 Answer B
Oil control rings are located just below the compression rings but above the piston pin on the typical aircraft piston. They regulate the thickness of the oil film on the cylinder wall. This keeps excessive oil from entering the combustion chamber past the compression rings. To allow the surplus oil to return to the crankcase, holes are drilled in the bottom of the oil control piston ring grooves or in the lands next to these grooves.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 13

1-11 Answer A
During normal operation, the warmest section of the cylinder head on a piston engine it that in close proximity to the exhaust valve, and so the section with the greatest need for cooling. Cooling fins work by dissipating this heat into the atmosphere. The larger the surface area of the fin, the more heat it can dissipate. Secondly, a thicker fin will hold on to absorbed heat to a greater extent than a thinner one. Thus the greatest release of heat will occur with a fin shape which is longer (larger) and thinner.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 15

1-12 Answer A
The firing order is designed to provide for balance and to eliminate vibration to the greatest extent possible. This is done by arranging the order so that the power pulses are most evenly distributed along the crankshaft.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1 Page 16

ANSWERS

ORAL EXAM

1-1(O). A reciprocating engine is an internal combustion device that converts the energy in fuel into mechanical energy. A compressed fuel/air charge is burned in each cylinder of the engine. The energy released pushes the piston down in successive cylinders so that the crankshaft, which is attached to the pistons via connecting rods, develops a rotational motion (force). This force is transferred to a propeller geared off of the end of the crankshaft to produce thrust. A camshaft is geared to the crankshaft to enable valves to open and close at precise times. The valves let the fuel/air mixture into each cylinder and, after the charge is burned, the valves let the exhaust gases out. Magnetos develop a high-tension current that is distributed to successive cylinders at the precise time it is advantageous to ignite the fuel air mixture. Most reciprocating aircraft engines are 4 stroke cycle engines. A stroke is the movement of the piston in the cylinder from top to bottom or from bottom to top. The 4 strokes are labeled to indicate their function in the cycle. They are in order of occurrence: the intake, compression, power, and exhaust strokes. Ignition of the fuel/air mixture via spark plugs in each cylinder occurs just before the piston reaches the top of the compression stroke. The force created by burning the fuel is then transmitted by the piston to the crankshaft on the power stroke.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-2(O). Radial engines are simply reciprocating engines with the cylinders arranged radially around a central crankcase and crankshaft. It operates like any other 4-stroke cycle reciprocating engine.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-3(O). The firing order of an engine is the sequence in which the power event occurs in the different cylinders. Firing order is designed to provide for balance and to eliminate vibration. It is set by the engineers of the engine. Cylinder firing order in opposed reciprocating aircraft engines is usually listed in pairs of cylinders as each pair fires across the center main bearing. On single row radial engines, the firing order is the sequential odd numbered cylinders followed by the sequential even numbered cylinders (from low number to high number each). Double row radials can be calculated by using a pair of firing order numbers that are either added or subtracted to the number of the cylinder previously fired as is possible.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-4(O). Reciprocating engines with solid lifters or cam followers generally require the valve clearance to be adjusted manually by adjusting a screw and locknut. Valve clearance is needed to assure that the valve has enough clearance in the valve train to close completely. This adjustment (or inspection thereof) is a continuous maintenance item except on engines with hydraulic lifters. Hydraulic lifters automatically keep the valve clearance at zero.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-5(O). The master rod serves as the connecting link between the piston pin and the crankpin. The crankpin end contains the master rod bearing. Flanges around the large end of the master rod provide for the attachment of articulating rods. They are attached to the master rod with knuckle pins which are pressed into the holes in the master rod flanges. The master and articulating rod assembly is commonly used on radial engines. In radial engines, the piston in one cylinder in each row is connected to the crankshaft by the master rod. All other pistons in the row are connected to the crankshaft through the master rod via the articulating rods.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-6(O). The function of the valve springs is to close the valve and to hold the valve securely on the valve seat. The purpose of having two or more valve springs on each valve is to prevent vibration and valve surging at certain speeds. The springs are arranged one inside the other and vibrate at different engine speeds. The result is rapid damping of all spring-surge vibrations. Two or more springs also reduce the danger of weakness and possible failure by breakage due to heat and metal fatigue.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

ANSWERS

ORAL EXAM

1-7(O). For an engine to develop high power, an increase in crankshaft rotational speed is required. However as propeller tip speed approaches the speed of sound, efficiency is greatly reduced. Propeller reduction gearing is used to allow the engine to turn at a high RPM while keeping the propeller speed lower and efficient. The propeller is geared to the engine crankshaft in such a way as to make the propeller not turn as fast as the engine. There are three common types of reduction gearing: spur planetary, bevel planetary, and spur and pinion.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-8(O). A gas turbine engine is an internal combustion engine. Like a reciprocating engine, the functions of intake, compression, combustion, and exhaust are all required. The difference is that, in a turbine engine, these functions happen in dedicated sections of the engine and they happen continuously. Air is taken in at the front of the engine and is compressed in the compressor section, either axially or centrifugally. From there it is sent through a diffuser to the combustion section where fuel is discharged and combustion takes place. The energy in the fuel is released and is directed into the turbine section. Turbine wheel(s) extract the energy in the burning fuel. Depending on the engine type, the energy is converted into rotational mechanical energy to operate the engine and create thrust by turning a fan, propeller, or rotor. In turbojet engines, just enough energy is extracted to operate the engine and the remainder is directed out of the exhaust of the engine to be used as thrust.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-9(O). The thermal efficiency of a gas turbine engine is a prime factor in performance. This is the ratio of the net work produced by the engine to the chemical energy supplied in the fuel. The turbine inlet temperature, compression ratio, and component efficiencies are the three most important factors affecting thermal efficiency. Other factors are compressor inlet temperature and combustion efficiency. A high turbine inlet temperature will result in higher efficiency and more power. However, temperature limits must be adhered to or the turbine section can be overheated and destroyed. If the efficiency of the engine components is reduced, then engine performance will reduce. So, damaged or worn components will produce performance losses. Also, if the stagnation density (a combination of airspeed, altitude, and ambient temperature) is reduced, the performance is reduced. This results from the reduced mass of air flowing through the engine.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-10(O). The diffuser is the divergent section of the engine after the compressor and before the combustion section. It functions to reduce the velocity of the compressor discharge air and increase its pressure so that it can be combined with fuel and burned in the combustion section. The lower velocity of the gases aids in the continuous burning process. If the gases pass through the combustion section at too high of a velocity, the flame could extinguish.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 1

1-11(O). A typical APU is a turboshaft gas turbine engine that is made to transfer horsepower to a shaft. The shaft turns the engine compressor from which bleed air for the aircraft is obtained. It also drives an accessory gearbox that rotates a generator. The generator supplies the aircraft with electrical power on the ground and in the air. The APU is often operated with no personnel on the flight deck.
Ref: Powerplant Handbook H-8083-32B-ATB Chapter 10 Page 58, Chapter 9 Page 19, Chapter 1

QUESTIONS

PRACTICAL EXAM

1-1(P). Given an actual aircraft reciprocating engine or mockup, measure the valve clearance with the lifters deflated and record your findings. [Level 2]

1-2(P). Given an actual aircraft reciprocating engine or mockup, accomplish a compression test, and record all findings. [Level 3]

1-3(P). Given an actual aircraft reciprocating engine or mockup, inspect engine control cables for proper rigging and record your findings. [Level 3]

1-4(P). Given an actual aircraft reciprocating engine or mockup, inspect engine push-pull tubes for proper rigging and record your findings. [Level 3]

1-5(P). Given an actual aircraft reciprocating engine or mockup, inspect ring gap and record your findings. [Level 3]

1-6(P). Given an actual aircraft reciprocating engine or mockup, install piston rings on a piston and record maintenance. [Level 3]

1-7(P). Given an actual aircraft reciprocating engine or mockup, install an aircraft engine cylinder and record maintenance. [Level 3]

1-8(P). Given an aircraft engine component and appropriate publications, inspect dimensionally and record your findings. [Level 3]

1-9(P). Given an actual aircraft reciprocating engine or mockup, component, and appropriate publications, install the component and record the maintenance. [Level 3]

1-10(P). Given a turbine engine compressor blade and appropriate publications, complete a repair by blending and record maintenance. [Level 3]

1-11(P). Given an actual aircraft turbine engine or mockup, component, and appropriate publications, install the component and record the maintenance. [Level 3]

1-12(P). Given the required information, calculate the cycle life remaining between overhaul of a turbine engine life limited component. [Level 2]

1-13(P). Given an actual aircraft turbine engine or mockup and appropriate publications, check the rigging of a turbine engine inlet guide vane system and record your findings. [Level 3]

1-14(P). Given an actual aircraft turbine engine or mockup and appropriate publications, measure a compressor or turbine blade clearance and record your findings. [Level 3]

1-15(P). Given an actual aircraft turbine engine or mockup, appropriate publications, and an unknown discrepancy, troubleshoot a turbine engine and record your findings. [Level 3]

PRACTICAL EXAM

1-16(P). Given an actual aircraft turbine engine or mockup, locate and identify various turbine engine components. [Level 2]

1-17(P). Given an aircraft turbine component and appropriate publications, inspect turbine engine component and record your findings. [Level 3]

NOTE: AUXILIARY POWER UNITS may be tested at the same time as TURBINE ENGINES. No further testing of auxiliary power units is required.