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Outline Powerplant – Part 1, Powerplant Theory and Maintenance, Curriculum

Instructional Units, Segments and Estimated Instructional Time

Reciprocating Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-A)

1. Inspect and repair a radial engine
   Ref: 147-C-A1 – 43.5 hrs — Level 1

   A. Inspect a cylinder — Level 1

   B. Detect defects in crankcase assemblies — Level 1

   C. Remove and replace stud — Level 1

   D. Select serviceable bearings — Level 1

   E. Dimensionally inspect a crankshaft — Level 1

   F. Identify, remove and install piston and knuckle pin retainers — Level 1

   G. Identify, dimensionally inspect various cams — Level 1

   H. Inspect, reface and reseat valves in cylinder — Level 1

   I. Inspect and repair 14 cylinder or larger radial engine — Level 1

2. Overhaul reciprocating engine
   Ref: 147-C-A2 – 104.0 hrs — Level 2

   A. Explain the principles of the Otto cycle — Level 2

   B. Use correct cylinder nomenclature — Level 2

   C. Identify crankshaft and rod assemblies — Level 2

   D. Recognize and classify types of reciprocating engines — Level 2

   E. Recognize and describe propeller reduction systems — Level 2

   F. Identify nose and power cases and describe loads — Level 1

G. Recognize, identify and describe function of valve springs — Level 1

H. Identify factors affecting volumetric efficiency — Level 1

I. Timing valves and explaining valve overlap — Level 2

J. Identify, clean and inspect various types of bearings — Level 2

K. Determine firing order of reciprocating aircraft engines — Level 2

L. Determine direction of rotation and speed of engine accessory drives — Level 2

M. Identify and describe problems associated with high power operation — Level 1

N. Preparation of workstation for overhaul of an engine — Level 2

O. Overhaul reciprocating engine — Level 2

3. Inspect, check, service, and repair reciprocating engines and engine installations
Ref: 147-C-A3 – 51.0 hrs — Level 3

A. Check and rig cable operated and push-pull engine controls — Level 3

B. Recognize and identify dynamic engine mounts — Level 1

C. Recognize unbalance and “critical vibration range” of propellers — Level 2

D. Operate an engine at various power settings — Level 3

E. Adjust oil pressure — Level 3

F. Check operation of an oil dilution system — Level 3

G. Performa an ignition check on an operating engine — Level 3

H. Install and time a magneto to an engine — Level 3

I. Adjust idle speed and mixture on a carburetor — Level 3

J. Perform a compression check of an engine — Level 2

K. Adjust valve clearance and make valve timing checks — Level 3

L. Identify the probable source of metal particles found in oil screens — Level 2

4. Install, troubleshoot, and remove reciprocating engines
Ref: 147-C-A4 – 40.0 hrs — Level 3

A. Lift or hoist an engine into an engine mount — Level 3

B. Install and remove a propeller from the propeller shaft — Level 3

C. Pre-oiling of overhauled engine — Level 2

D. Remove and reinstall baffles — Level 2

E. Demonstrate correct engine staring procedures — Level 3

F. Recognize symptoms that indicate operation distress — Level 2

G. Operate an engine equipped with a constant speed propeller and/or supercharger — Level 2

Estimated Instructional Time: 238.5 hrs

Turbine Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-B)

5. Overhaul turbine engine
Ref: 147-C-B5 – 34.0 hrs — Level 2

A. Illustrate Newton’s laws and the Brayton cycle — Level 2

B. Explain relationship of RPM and thrust in a turbine engine — Level 2

C. Identify and explain the characteristics of different turbine compressors — Level 2

D. Identify major components and explain airflow in fan or by-pass turbine engines — Level 2

E. Identify pressure change in a turbine engine — Level 2

F. Identify airflow in diffusers — Level 2

G. Identify types and characteristics of combustion chambers — Level 2

H. Identify impulse and reactive blades and thrust reversers — Level 2

I. Compare characteristics of turboprop and reciprocating engines — Level 1

J. Overhaul turbine engine — Level 2

K. Describe modular overhaul — Level 1

6. Inspect, check, service and repair turbine engines and engine installations
   Ref: 147-C-B6 – 10.0 hrs — Level 3

   A. Remove and install a combustion case and liner — Level 3

   B. Disassemble and reassemble compressor section of a turbine engine — Level 2

   C. Remove and reinstall a fuel nozzle in a turbine engine — Level 3

7. Install, troubleshoot, and remove turbine engines
   Ref: 147-C-B7 – 10.5 hrs — Level 3

   A. Identify damaged turbine blades — Level 3

   B. Recognize and identify combustion chamber hot spots — Level 2

   C. Adjust fuel control of a turbine engine — Level 3

   D. Recognize the effects of exhaust nozzle area — Level 1

   E. Identify compressor surge — Level 1

   F. Identify cause of performance lost — Level 1

   G. Remove and installation of turbine engine — Level 2

Estimated Instructional Time: 54.5 hrs

Turbine Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-C)

8. Perform powerplant conformity and airworthiness inspections
   Ref: 147-C-C8 – 10.0 hrs — Level 3

   A. Inspect an engine for compliance with airworthiness directives — Level 3

   B. Inspect an engine for conformity with specifications — Level 3

Estimated Instructional Time: 10.0 hrs

Additional Practice and/or Examinations 5.0 hrs

Grand Total Powerplant – Part 1, Powerplant Theory and Maintenance, Curriculum 308.0 hrs

Outline Powerplant – Part 1, Powerplant Theory and Maintenance, Curriculum Detail

Reciprocating Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-A)

1. Inspect and repair a radial engine
   (EIT = 43.5 hrs, T – 15.5 hrs, L/S = 28 hrs) Level 1

   A. Inspect a cylinder Level 1

      Student Performance Goal

      Given:
      A cylinder from an aircraft engine, appropriate inspection tools and reference manuals.

      Performance:
      The student will inspect and determine the serviceability of a cylinder.

      Standard:
      The student will correctly judge whether the cylinders should be rejected or returned to service.

   B. Detect defects in crankcase assemblies Level 1

      Student Performance Goal

      Given:
      A written list of probable defects, crankcases that exhibit one or more of the defects, and the necessary inspection equipment.

      Performance:
      Provided with a list of the probable defects, the student will clean, visually inspect and detect the defects present in the specimen crankcase assemblies.

      Standard:
      The student will detect all of the defects in the crankcase assemblies.

C. Remove and replace stud Level 1

Student Performance Goal

Given:
An aircraft engine component that has a damaged or broken stud and the necessary tools.

Performance:
The student will remove a damaged stud and install a replacement stud.

Standard:
Removal of the damaged stud will not cause further damage to the component. The replacement stud will maintain a class-3 thread fit.

D. Select serviceable bearings Level 1

Student Performance Goal

Given:
A random display of bearings which may display evidence of impending failure, an applicable table of limits and tolerances and the necessary inspection tools.

Performance:
The student will identify serviceable bearings by means of visual and dimensional inspection. He will also identify failed or failing bearings within the displayed group of bearings and when given a written list indicating where these bearings are located within an engine, will describe how these bearings could be detected in an operating engine.

Standard:
The student will identify faulty bearings without error. He will use correct nomenclature as a part of the description and explanations of symptoms which would indicate impending bearing failures.

E. Dimensionally inspect a crankshaft Level 1

Student Performance Goal

Given:
A crankshaft from an aircraft engine, the necessary inspection tools and reference manuals.

Performance:
The student will check crankshaft "run-out", measure rod and main bearing journals and judge whether the crankshaft meets dimensional tolerance.

Standard:
Inspection procedure and measurements will meet return-to-service quality.

F. Identify, remove and install piston and knuckle pin retainers Level 1

Student Performance Goal

Given:
Pistons, piston pins, master rods and knuckle pins with various types of pin retainers and the applicable manufacturer's manuals.

Performance:
Provided with examples of the various types of pistons and knuckle pin retainers, the student will correctly name and identify each type. He will remove and reinstall at least one type of retainer.

Standard:
Removal and reinstallation of the retainer will be in accord with the procedure specified in the manual and will be accomplished without damaging the retainer of the engine component.

G. Identify, dimensionally inspect various cams Level 1

Student Performance Goal

Given:
A typical camshaft, cam ring, cam-followers, the precision measuring tools and appropriate reference information.

Performance:

The student will identify the components, dimensionally inspect and describe the operation of the valve mechanisms. He will disassemble, assemble and test zero lash lifters.

Standard:

Correct nomenclature will be used to identify the components and describe the operation of valve mechanisms. Measurements will be accurate but components need not be of return-to-service quality.

H. Inspect, reface and reseat valves in cylinder Level 1

Student Performance Goal

Given:

An aircraft engine cylinder containing valves, valve spring assemblies, appropriate reference information and the required, tools.

Performance:

The student will inspect the valve assemblies, then reface and reseat the valves. He will interpret the manufacturer's over haul instructions and describe the replacement of valve guides and valve seats.

Standard:

The refaced and reseated valves will not leak when checked in accordance with the manufacturer's overhaul instructions.

I. Inspect and repair 14 cylinder or larger radial engine Level 1

Student Performance Goal

Given:

A numbered schematic diagram of an 18 cylinder radial engine and appropriate overhaul manual.

Performance:

Using the manual the student will list the specifications and inspection procedures for the engine in accordance with the numbers.

Standard:

The student will list the specifications and procedures with 70 percent accuracy.

2. Overhaul reciprocating engine
(EIT = 104 hrs, T = 24 hrs, L/S = 80 hrs) Level 2

A. Explain the principles of the Otto cycle Level 2

Student Performance Goal

Given:
Unlabeled sketches or diagrams illustrating the five events and four strokes of an Otto cycle.

Performance:
The student will label the illustrations and describe the five events which occur in an Otto cycle.

Standard:
The labeled sketches or diagrams will correctly identify piston, valve, and crankshaft positions in each of the four strokes. Correct nomenclature will be used in labeling the diagrams and while describing the events.

B. Use correct cylinder nomenclature Level 2

Student Performance Goal

Given:
A typical air-cooled cylinder, an unlabeled diagram or sketch of that cylinder, and appropriate reference manuals.

Performance:
The student will interpret Information from the manual, identifying the construction features of the cylinder and label the diagram or sketch.

Standard:
The student will identify as a minimum requirement, the following parts of the cylinder: barrel, head, skirt, fins, base flange, rocker cover, valve guide and seats, valve ports, spark plug bushings. Correct nomenclature will be used when labeling the diagram or sketch.

C. Identify crankshaft and rod assemblies Level 2

Student Performance Goal

Given:
A display of various crankshaft and rod assemblies and associated reference manuals.

Performance:
The student will examine the crankshaft and rod assemblies and identify an assembly from an engine that incorporates a dynamic dampener. He will explain the purpose of a dynamic dampener. The student will identify, disassemble and reassemble an articulating rod in a master rod assembly, naming and describing the function of the principle parts of the crankshaft assembly.

Standard:
The student will correctly distinguish between the various types of crankshafts and rod assemblies. He will follow the correct procedure while disassembling and reassembling the articulating rod and will accomplish the assignment without damage to the tools or part of the engine. Correct nomenclature will be used during all explaining.

D. Recognize and classify types of reciprocating engines Level 2

Student Performance Goal

Given:
A random display of air or liquid cooled engines of the radial, opposed and in-line cylinder arrangement.

Performance:
The student will physically examine the engines and classify them by both cylinder arrangement and method of cooling.

Standard:
Identification will be without error.

E. Recognize and describe propeller reduction systems Level 2

Student Performance Goal

Given:
A drawing or sketch of both a spur and a planetary propeller reduction gearing including BMEP systems, and a display or cutaway of one of the two systems.

Performance:
The student will label the components illustrated in the drawing. He will indicate by means of arrows the direction of rotation of each of the gears in the reduction system and describe three reasons for reducing propeller speeds. He/She will trace and explain the operation of the BMEP system.

Standard:
Correct nomenclature will be used in labeling the drawings and describing the systems.

F. Identify nose and power cases and describe loads Level 1

Student Performance Goal

Given:
Mock-ups, cutaways or actual nose and power cases of reciprocating engines.

Performance:
The student will recognize the construction feature and describe how the working loads are imposed on the nose and power cases.

Standard:
The student will use correct nomenclature to identify the features and describe the loads and forces.

G. Recognize, identify and describe function of valve springs Level 1

Student Performance Goal

Given:
A random display of poppet valve spring assemblies from typical aircraft piston engines.

Performance:

The student will recognize and identify a multi-spring assembly from the valve spring display and describe the reasons for the use of multi-springs in aircraft engines.

Standard:

Recognition and identification of the assembly will be without error. The student will cite at least two reasons for the use of multi-spring assemblies.

H. Identify factors affecting volumetric efficiency Level 1

Student Performance Goal

Given:

Information sheets, reference manuals and a listing of at least seven factors that affect the volumetric efficiency of an engine.

Performance:

The student will explain how five of the factors are related to volumetric efficiency.

Standard:

Correct nomenclature will be used with at least five factors of the explanation.

I. Timing valves and explaining valve overlap Level 2

Student Performance Goal

Given:

A valve-timing diagram and a blank table of limits-chart with manufacturer's instructions for an engine that incorporates external valve timing adjustments.

Performance:

The student will describe the purpose of valve overlap and explain how valve overlap affects engine performance. Provided with the manufacturer's manuals, the student will interpret the instructions, complete the diagram, and table of limits chart for timing the valves of the engine.

Standard:

The student will use correct nomenclature as part of the descriptions and explanations. Valve timing diagram and completed table of limits will be within the tolerance prescribed in the manufacturer's manual.

J. Identify, clean and inspect various types of bearings Level 2

Student Performance Goal

Given:

A random display of plain, roller, ball and needle bearings of the types found in aircraft engines and the manufacturer's manuals specifying the inspection procedures and limits applicable to these bearings.

Performance:

From this display of bearings, the student will name and identify each type of bearing and describe one probable location where such bearing would be used within the engine. He will clean, inspect each type of bearing and judge whether the bearing is of return-to-service quality.

Standard:

Identification of each type of bearing will be without error- Interpretation of the tolerance and procedures specified in the manuals and the acceptance or rejection of the bearings will be accurate.

K. Determine firing order of reciprocating aircraft engines Level 2

Student Performance Goal

Given:

Aircraft engines of the radial, opposed and inline types and the associated maintenance manuals.

Performance:

The student will explain the principles that determine the firing order for each engine. Using the information available in the manuals or on the engine data plate, the student will rotate the crankshaft, observe the valve rocker arm action and point to each cylinder in the order in which it will fire.

Standard:

The explanations and determination of firing order will be without error.

L. Determine direction of rotation and speed of engine accessory drives — Level 2

Student Performance Goal

Given:

Any aircraft engine incorporating at least five accessory drives, a line drawing of the accessory case of the engine and the associated manufacturer's manual.

Performance:

The student will interpret information from the manual, rotate the crankshaft of the engine, and then draw arrows on the diagram illustrating the direction and the speed of accessory drive gears.

Standard:

Interpretation of information will be without error.

M. Identify and describe problems associated with high power operation — Level 1

Student Performance Goal

Given:

A written list describing twenty problems that are common to the operation of aircraft engines and the operation/limitations for a specific engine.

Performance:

Provided with a list describing problems common to the operation of aircraft engines, the student will identify five problems which could have resulted from high power operation before the oil temperature and pressures reached operating limits.

Standard:

At least four or the five problems identified by the student will be correct.

N. Preparation of workstation for overhaul of an engine Level 2

Student Performance Goal

Given:

A written list that identifies twenty save and unsafe practices (normally associated with handling of engines and the preparation of a work station prior to engine overhaul), an engine and a workstation.

Performance:

The student will recognize all hazardous conditions and arrange the engine in the workstation for an engine overhaul.

Standard:

All hazardous practices will be identified. The sequence of operations to prepare the workstation will be in general agreement with common industry practice.

O. Overhaul reciprocating engine Level 2

Student Performance Goal

Given:

A small opposed or radial engine, a work station having an engine overhaul stand and necessary tables and parts racks, necessary hand and specialized tools and fixtures, an overhaul manual and overhaul inspection sheets.

Performance:

With the use of the overhaul manual the student will disassemble the engine, label and store the parts, clean the parts, inspect the parts physically, visually, and with nondestructive testing; measure the parts for wear and identify those parts that are reusable from the table of limits; reassemble the engine; and record all findings and recommendations on the overhaul inspection sheets.

Standard:

All procedures followed, recorded data on the overhaul inspection sheets, and recommendations for parts rejection will be correct for the particular engine and the engine will be assembled mechanically correct.

3. Inspect, check, service, and repair reciprocating engines and engine installations
(EIT = 51 hrs, T = 20.5 hrs, L/S = 30.5 hrs) Level 3

A. Check and rig cable operated and push-pull engine controls Level 3

Student Performance Goal

Given:
An engine control system incorporating cable and push-pull operated controls and the manual applicable to the system.

Performance:
The student will inspect and operationally check the engine control system on a mock-up or in the aircraft. He will correct minor defects and/or rig the system.

Standard:
The correction of defects and/or rigging of the system will result in a control system which functions within the tolerances specified in the manual.

B. Recognize and identify dynamic engine mounts Level 1

Student Performance Goal

Given:
A display featuring the different types of engine mounting systems.

Performance:
The student will recognize the components of an engine dynamic suspension system and explain the purpose and operating principles of the system.

Standard:
The student will point to the components and use the correct name when identifying the parts of the system.

C. Recognize unbalance and “critical vibration range” of propellers Level 2

Student Performance Goal

Given:

Aircraft Specification Sheets, manufacturer's publications and a list of ten conditions which might result in propeller vibration.

Performance:

The student will explain the effects of propeller unbalance on engine operation, and when provided with appropriate reference materials, will recognize the conditions of critical vibration range in a given engine propeller combination.

Standard:

The student will use correct nomenclature and phraseology when describing propeller unbalance. He will recognize critical vibration ranges as identified in the specifications without error.

D. Operate an engine at various power settings Level 3

Student Performance Goal

Given:

An operable aircraft engine on an aircraft or in a test cell and the manufacturer's operation manual for that engine.

Performance:

The student will operate the engine and demonstrate how to establish take-off climb and cruise power settings. He will describe the factors to be considered during prolonged high power operation.

Standard:

Operation of the engines will be exactly in accord with the manufacturer's recommended procedure. When provided with a list of operating conditions, i.e., various powers, etc., he will correctly identify 80 percent of the indications that would be considered critical.

E. Adjust oil pressure Level 3

Student Performance Goal

Given:

An operable engine (mounted in a stand or on an airplane) and the manufacturer's specifications.

Performance:

The student will operate the engine and record the operating oil temperature and oil pressure. He will then interpret the manufacturer's instructions and adjust the oil pressure to conform to the specifications.

Standard:

The operating procedures described in the manual will be followed, he adjustment-of pressure will result in a final adjustment within the specified tolerance.

F. Check operation of an oil dilution system Level 3

Student Performance Goal

Given:

An operable engine equipped with an oil dilution system written instructions and a list describing five engine malfunctions or indications that would be associated with malfunctions of an oil dilution system or low oil supply.

Performance:

At the conclusion of an engine operational check, the student will dilute an engine oil system. He will observe the indication of normal operation and when provided with a list of conditions describing various engine malfunctions, will recognize and describe the effects of a leaking oil dilution valve, or a low oil supply in the operation of an engine. He will detect the source of oil leaks.

Standard:

Operation of the oil dilution system will be fully in accord with the operating procedures prescribed by the manufacturer. Correct nomenclature and terminology will be used as part of the explanation of malfunctions of the oil system.

G. Performa an ignition check on an operating engine Level 3

Student Performance Goal

Given:

An operable reciprocating engine equipped with a dual ignition system and the associated operations, instructions or procedures.

Performance:

The student will perform an ignition check on an operating engine and interpret the results of this check. The instructor will-then introduce a fault into the ignition system which will result in a "cold" cylinder. The student will detect this cylinder condition and describe three probable causes for this condition.

Standard:

The operational check of the ignition system will be fully in accord with the prescribed procedures. Detection of the cold cylinder will be prompt and the explanation of three probable causes will involve use of correct terminology and nomenclature.

H. Install and time a magneto to an engine Level 3

Student Performance Goal

Given:

An operable engine, a magneto and the manufacturer's manual or instructions and equipment for the installation and timing of a magneto to the engine.

Performance:

The student will interpret information from, the manual or information sheet and install and time the magneto to the engine.

Standard:

The procedure will be followed without exception. The magneto installation and timing will be of return-to-service quality.

I. Adjust idle speed and mixture on a carburetor Level 3

Student Performance Goal

Given:
An operable, carbureted engine and the manufacturer's operating instructions, manuals and procedures.

Performance:
The student will make an operational check of the engine, then adjust both idle speed and mixture to the limits and tolerances prescribed by the manufacturer.

Standard:
The procedure specified will be followed without exception. The adjustments will result in a condition that would permit return-to-service.

J. Perform a compression check of an engine Level 2

Student Performance Goal

Given:
An operable aircraft engine, a compression-testing device and the operating instruction provided with the type of tester being used.

Performance:
The student will perform a compression check on the engine. Provided with a written list of five symptoms associated with low compression, he will describe the probable cause and a sequence that he would follow to isolate the problem.

Standard:
The procedure followed will be in accordance with the instructions provided by the manufacturer. The record of compression will reflect the cylinder conditions within the accuracy of the tester used.

K. Adjust valve clearance and make valve timing checks — Level 3

Student Performance Goal

Given:

Both radial and opposed type aircraft engines, incorporating either solid or hydraulic valve lifters, the associated manufacturer's manuals and equipment.

Performance:

Provided with appropriate information, the student will adjust the valve clearances and make valve-timing checks on engines equipped with solid and/or hydraulic lifters. Using a chart or diagram, he will explain the relationship between hot and cold clearance and when given the number of cam lobes he will be able to compute the speed of the cam in relation to crankshaft speed. He will time the valves on a radial engine in accordance with. The manufacturer's instructions and be able to explain the effects of excessive and insufficient valve clearance.

Standard:

The procedures and tolerances specified in the instructions will be maintained. Explanations will involve use of correct nomenclature and terminology.

L. Identify the probable source of metal particles found in oil screens — Level 2

Student Performance Goal

Given:

A list naming at least five metals that may be found in the oil screens of an engine.

Performance:

From a list of metals that may be found in an oil screen during an engine inspection, the student will identify the probable part of the engine, which has failed and describe the probable causes for this type of failure.

Standard:

The student will identify the names of the engine parts that contain at least three of the metals listed. He will use correct nomenclature when describing the probable causes of failure.

4. Install, troubleshoot, and remove reciprocating engines (EIT = 40 hrs, T = 15.5 hrs, L/S = 24.5 hrs) Level 3

   A. Lift or hoist an engine into an engine mount Level 3

      Student Performance Goal

      Given:
      Necessary lifting or hoisting equipment, an aircraft engine, test stand or airplane and written instructions or procedures.

      Performance:
      The student will demonstrate a correct method of hoisting or lifting an engine into the shock mounts of an airplane or test stand.

      Standard:
      The procedure will be accomplished in strict accordance with the instructions supplied. Every safety precaution will be observed and the installation will be accomplished without damage to the engine or equipment beyond minor damage to the finish.

   B. Install and remove a propeller from the propeller shaft Level 3

      Student Performance Goal

      Given:
      A propeller on the shaft of a given engine and the appropriate reference information and installation tools.

      Performance:
      The student will remove, inspect, set blade angles if necessary, and install a propeller on the propeller shaft of the engine.

      Standard:
      The procedure specified in the manual will be followed without exception. The resulting installation will be of return to service quality.

C. Pre-oiling of overhauled engine Level 2

Student Performance Goal

Given:

An aircraft engine, pre-oiling equipment and an information sheet detailing the pre-oiling procedure.

Performance:

The student will describe the pre-oiling of an overhauled engine and explain the purpose of this operation. He will interpret information from the procedure sheet and accomplish the pre-oiling of an engine as a prelude to engine operation.

Standard:

The pre-oiling procedure will be interpreted and executed without error. The explanations will use correct nomenclature and terminology.

D. Remove and reinstall baffles Level 2

Student Performance Goal

Given:

An engine that is equipped with baffles and a listing of ten engine operating problems which may or may not be related to improperly fitted baffles, and the manufacturer's manual.

Performance:

The student will remove and reinstall two or more engine baffles in accordance with the manufacturer's manual, when provided with a list of operational problems that could be associated with improperly fitted baffles, he will explain the corrective action that should be taken.

Standard:

The student will identify all operational problems appearing in the list that are related to baffling. He will use correct nomenclature while describing corrective actions and will remove and reinstall the baffles without damaging or deforming the baffles and in accordance with manufacturer's specifications.

E. Demonstrate correct engine staring procedures Level 3

Student Performance Goal

Given:
An operable aircraft engine and a written starting "check list".

Performance:
The student will demonstrate correct procedures while starting an engine. He will describe the effects and recognize symptoms associated with backfire, after-fire, and kickback and the importance of various throttle/mixture positions while starting.

Standard:
The procedure and performance will be without error and/or hazard.

F. Recognize symptoms that indicate operation distress Level 2

Student Performance Goal

Given:
A list of twenty symptoms that indicate operational distress due to detonation, exhaust back pressure, leaking primers, and/or carburetor icing.

Performance:
The student will correctly associate each symptom with problems related to detonation, exhaust back pressure, leaking primers or carburetor icing.

Standard:
The student will recognize the symptom and explain the cause of each of the operational problems. He will describe at least one method of procedure that will minimize the operational distress,

G. Operate an engine equipped with a constant speed propeller and/or supercharger Level 2

Student Performance Goal

Given:
An operable engine equipped with a constant speed propeller and/or supercharger and an operating "check" sheet or manual.

Performance:
The student will demonstrate correct operational sequence for increasing and reducing the power output, and controlling RPM. He will explain how master rod bearing loads are affected by increased manifold pressures.

Standard:
Operation of the engine will be fully in accord with the operating "check" sheet or manual. Explanations will involve use of correct nomenclature.

Turbine Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-B)

5. Overhaul turbine engine
(EIT = 34 hrs, T = 24 hrs5, L/S = 10 hrs) Level 2

A. Illustrate Newton’s laws and the Brayton cycle Level 2

Student Performance Goal

Given:
A line drawing or sketch of a turbine engine and appropriate reference information.

Performance:
Provided with a line drawing or sketch, the student will label the sections of a turbine engine and draw arrows to illustrate the application of Newton's second and third laws of motion and explain the Brayton cycle and principles of turbine engine operation.

Standard:
Correct terminology and nomenclature will be used to label the diagram and explain the theory of turbine engine operation.

B. Explain relationship of RPM and thrust in a turbine engine Level 2

Student Performance Goal

Given:

A chart and reference information comparing turbine inlet temperatures to thrust and the relationship of RPM to thrust in a turbine engine.

Performance:

Provided with appropriate reference information, the student – will interpret the manufacturer's manuals and charts and explain the relationship of RPM to thrust and the relationship of turbine inlet temperature vs. thrust. He will explain how estimates can be made. He will illustrate and explain why an engine produces less thrust as altitude increases.

Standard:

Correct nomenclature will be used during all explanations. Appropriate reference will be cited and correctly interpreted,

C. Identify and explain the characteristics of different turbine compressors Level 2

Student Performance Goal

Given:

Unlabeled sketches illustrating the various types of compressors and ten statements describing the characteristics, advantages and limitations of turbine compressors.

Performance:

Provided with unlabeled sketches illustrating the various types of compressors, the student will identify the type of compressor, label the sketch, and explain the airflow characteristics of each type. From a list of ten statements which describe the characteristics, advantages and limitations applicable to the various turbine compressors, he will associate three characteristics with each type of compressor.

Standard:

The sketches will be correctly labeled. Correct terminology will be used as a part of the explanation.

D. Identify major components and explain airflow in fan or by-pass turbine engines Level 2

Student Performance Goal

Given:

A sketch or line diagram of a fan or by-pass engine and appropriate reference information.

Performance:

The student will label the diagrams, identify the major components and indicate by means of arrows, the direction of airflows thorough the turbine. He will interpret the reference information and explain the operating theory underlying each engine design.

Standard:

The sketches will be correctly labeled. Correct terminology will be used as a part of the explanation of engine theory.

E. Identify pressure change in a turbine engine Level 2

Student Performance Goal

Given:

A sketch of a turbine engine and appropriate reference information.

Performance:

Provided with appropriate reference information and a sketch of a turbine engine, the student will interpret the information and identify on the sketch the areas of the engine where significant pressure changes occur.

Standard:

The sketch will illustrate at least the pressure changes occurring between the air inlet, the compressors the combustion chamber' and exhaust nozzle. Explanations and labeling of sketches will reflect correct nomenclature and terminology.

F. Identify airflow in diffusers Level 2

Student Performance Goal

Given:

Mock-ups, visual aids or line drawings of subsonic and supersonic diffusers and appropriate reference information.

Performance:

The student will point to the diffuser section of a turbine engine and explain the relationship of the diffuser to the compressor and combustion chamber. Provided with appropriate references, he will interpret the information necessary to distinguish between subsonic and supersonic diffusers and describe the airflow characteristics of each type.

Standard:

Identification of diffusers will be without error. Correct nomenclature will be used throughout all descriptions and explanations.

G. Identify types and characteristics of combustion chambers Level 2

Student Performance Goal

Given:

Various types of combustion chambers and line drawings illustrating the different types and appropriate reference information.

Performance:

From the displayed combustion chambers, the student will identify the various types and explain the operating characteristics of each type. He will draw arrows on the line sketches to illustrate the airflow and flame paths through each type of combustion chamber.

Standard:

The types of combustion chambers will be identified without error. Correct nomenclature will be used as a part of all descriptions and explanations.

H. Identify impulse and reactive blades and thrust reversers — Level 2

Student Performance Goal

Given:

Examples of impulse, reaction, and impulse-reaction type turbine blades, sketches or line drawings of the types of turbine engine blades and thrust reversing systems and appropriate reference information.

Performance:

The student will identify each type of turbine blade. Using the line drawings or sketches, he will illustrate the characteristics of each type of blade and label the reverser drawing and describe the gas flow around the exhaust cone of a turbine engine.

Standard:

The types of turbine blades will be identified without error. The descriptions and explanations will display correct nomenclature and terminology.

I. Compare characteristics of turboprop and reciprocating engines — Level 1

Student Performance Goal

Given:

Twenty statements which identify the fuel consumption, specific weight, maintenance and operational characteristics of turboprop and reciprocating engines.

Performance:

The student will arrange the statements in two columns. One column will list all statements applicable to a turboprop engine; the second column will record statements applicable to reciprocating engines.

Standard:

The student will correctly associate 70 percent of the statements with the type of powerplant.

J. Overhaul turbine engine Level 2

Student Performance Goal

Given:

Written information, turbine engine diagrams, a turbine engine, selected parts from a turbine engine, appropriate measuring devices, and an overhaul manual.

Performance:

The student will identify the major parts of the turbine engine by writing the names of the parts on a diagram. He will inspect and make recommendations for repair according to the overhaul manual table of limits, as well as write recommendations for reuse or suggested types of repair.

Standard:

The listing of parts on the diagram and determination for serviceability of engine parts will be 100 percent accurate and recommendations for reuse or repair will be within the limits established by the overhaul manual in use.

K. Describe modular overhaul Level 1

Student Performance Goal

Given:

Controlled notes, written information, and matching test.

Performance:

The student will complete the matching test and will cite cases when modular overhaul is appropriate.

Standard:

The matching test and cited statements will be 80 percent accurate.

6. Inspect, check, service and repair turbine engines and engine installations
(EIT = 10 hrs, T = 5 hrs, L/S = 5 hrs) Level 3

A. Remove and install a combustion case and liner Level 3

Student Performance Goal

Given:
A turbine engine incorporating a combustion case and liner, an appropriate manual or instruction sheet and the required special tools and equipment.

Performance:
The student will remove and install a combustion case and liner in the engine.

Standard:
The student will correctly interpret the instructions and follow all procedures regarding uses of special tools, torque values and safety practices.

B. Disassemble and reassemble compressor section of a turbine engine Level 2

Student Performance Goal

Given:
A typical turbine engine (or turbine engine compressor section), the manufacturer's overhaul manual and the specified tools and special equipment.

Performance:
The student will locate and interpret information contained in the manual as a prelude to developing a written outline listing the procedure, tools and safety precautions to be observed when disassembling the compressor section off a turbine engine. He will remove and reinstall some portions of a compressor section without damage to the engine or component.

Standard:
Interpretation of procedures appearing in the manuals will be without error. Removal and reinstallation of a portion of compressor section will be fully in accord with the specified procedures.

C. Remove and reinstall a fuel nozzle in a turbine engine — Level 3

Student Performance Goal

Given:

A turbine engine or mock-up, the manufacturer's instructions and the necessary special tools.

Performance:

The student will make a sketch or line drawing illustrating the fuel nozzle arrangement in various types of engines. He will remove and reinstall a fuel nozzle in an engine without damaging the nozzle or components and will explain the fuel flow through the nozzle.

Standard:

Correct nomenclature will be used as a part of all descriptions and explanations. Removal and reinstallation of the fuel nozzle will be at return-to-service quality.

7. Install, troubleshoot, and remove turbine engines (EIT = 10.5, T = 5 hrs, L/S = 5.5 hrs) — Level 3

A. Identify damaged turbine blades — Level 3

Student Performance Goal

Given:

Random display of 20 blades from a turbine engine, some of which display damage as a result of excessive operating temperatures.

Performance:

The student will recognize and select those blades that show evidence of being overheated, blade creep, scraping, and other deformations.

Standard:

The student will correctly identify 70 percent of the overheated blades.

B. Recognize and identify combustion chamber hot spots — Level 2

Student Performance Goal

Given:

Typical combustion chambers from turbine engines and the manufacturer's maintenance publications.

Performance:

When handed a combustion chamber, the student will identify a combustion chamber hot spot. He will explain the two causes of hot spots in the outer combustion casing. He will interpret information contained in the manual as a part of a demonstration showing how the alignment and spray pattern of a fuel nozzle is checked.

Standard:

The student will promptly and correctly recognize hot spots. He will use the correct nomenclature and terminology as part of the explanations and interpretation of information contained in the manual.

C. Adjust fuel control of a turbine engine — Level 3

Student Performance Goal

Given:

A turbine engine (simulator or mock-up) including the fuel control unit and the manufacturer's service/operations manual.

Performance:

The student will describe the operation of the fuel control unit of a turbine engine from idle speed range through to full power. On the mock-up or simulated engine, he will demonstrate the procedure for adjusting the fuel control unit.

Standard:

Correct nomenclature will be used throughout the demonstration and description of operation. The student will correctly interpret information from the manual and make adjustments as specified.

D. Recognize the effects of exhaust nozzle area Level 1

Student Performance Goal

Given:
Twenty statements describing operating conditions which may result in changes in fuel consumptions exhaust gas velocities and tail pipe temperatures of turbine engines.

Performance:
The student will recognize the conditions that are related to changes in exhaust nozzle area, and explain the reasons for selecting each answer.

Standard:
The student will recognize 70 percent of the conditions.

E. Identify compressor surge Level 1

Student Performance Goal

Given:
A written information sheet identifying the causes and methods of controlling compressor surges in turbine engines.

Performance:
The student will distinguish between the causes and methods of control.

Standard:
When given a matching type questionnaire, the student will associate the causes and methods of control with 70 percent accuracy.

F. Identify cause of performance lost Level 1

Student Performance Goal

Given:
Written information identifying the causes and methods for determining performance loss in turbine engines.

Performance:
The student will identify four basic causes of engine performance deterioration and methods of detecting these causes.

Standard:

When given a matching type questionnaire, the student will associate the causes for power loss with their related symptoms.

G. Remove and installation of turbine engine Level 2

Student Performance Goal

Given:

Controlled notes containing procedural steps, and written information.

Performance:

The student will list necessary steps for turbine engine removal and installation.

Standard:

All steps will be correct and in an acceptable sequence.

Turbine Engines

(Meets the requirements of Part 147, Appendix D-Powerplant Theory and Maintenance-C)

8. Perform powerplant conformity and airworthiness inspections (EIT = 10 hrs, T = 3 hrs, L/S = 7 hrs) Level 3

A. Inspect an engine for compliance with airworthiness directives Level 3

Student Performance Goal

Given:

An aircraft engine, complete with all accessories, a file or airworthiness directives, the logbook and other maintenance records for the specific engine and the engine manufacturer's manuals and service bulletins.

Performance:

The student will inspect the engine and accessories and determine whether the airworthiness directives have been compiled with.

Standard:

The student will locate and interpret the directives without error. He will research the engine maintenance records and correctly determine whether the required maintenance has been accomplished.

B. Inspect an engine for conformity with specifications Level 3

Student Performance Goal

Given:

An aircraft engine complete with all accessories, (turbine or reciprocating) the FAA specifications and manufacturer's publications.

Performance:

The student will inspect the engine and judge whether the engine and its accessories comply with the FAA and manufacturer's specifications.

Standard:

The engine and accessories need not be operable, but must have all required identification and data plates. The student will interpret the specifications and identify required equipment without error.