

1. **OBJECTIVE.** At the end of this session the student will be able to:
 - a. Define energy, potential energy, and kinetic energy.
 - b. Explain the application of Boyle's and Charles' laws to the operation of a reciprocating engine
 - c. Identify the major parts of a reciprocating engine.
 - d. Name the five events in the OTTO cycle

2. **INTRODUCTION**

3. **TERMS AND DEFINITIONS.**

- a. Handout

4. **LESSON OUTLINE**

- a. Reciprocating engine fundamentals.

- (1) Energy

- (2) Gas laws

- (3) Components

- (4) OTTO Cycle

- b. Engine classification

- (1) Cylinder arrangement

- (2) Displacement

5. **EXERCISE**

- a. Do the exercise in text.

RECIPROCATING ENGINE TERMS

ENERGY - The capacity for doing work and overcoming resistance. Cannot be created or destroyed, can only be transformed from one kind to another.

KINETIC ENERGY - Energy due to motion.

POTENTIAL ENERGY - Stored energy, or energy due to position.

GAS LAWS - Statements of the relationship between Pressure, Volume and Temperature of a confined gas.

CYCLE - A complete sequence of events returning to the original state.

INTAKE STROKE - The piston begins this stroke at Top Dead Center and moves downward, the fuel air mixture is drawn in through the open intake valve.

COMPRESSION STROKE - Following the Intake stroke the piston moves upward and the fuel air mixture is compressed due to the valves being closed.

IGNITION - An electric spark produced by the sparkplug in the area between the piston and the cylinder head, used to ignite the compressed fuel air mixture.

POWER STROKE - The burning fuel air mixture expands greatly due to the increased temperature and this expansion pushes the piston downward causing the crankshaft to rotate.

CRANKCASE - Housing that encloses the various mechanisms surrounding the crankshaft, hence it is the foundation of the engine.

CRANKSHAFT - Transforms the reciprocating motion of the pistons and connecting rods into rotary motion for turning the propeller.

CYLINDER - An assembly enclosing the valves, pistons and connecting rods that are used to convert the energy in the fuel into reciprocating motion.

PISTON - The plunger that moves within the cylinder. It transmits the force of the burning and expanding gases to the connecting rod.

CONNECTING ROD - The link that transmits the force between the piston and the crankshaft.

VALVES - Devices that control the movement of the fuel air mixture and exhaust gases to and from the cylinders.

SPARKPLUG - A device in the ignition system that produces the spark that ignites the compressed fuel air mixture inside the cylinder.

RPM - Revolutions per minute. The rotational speed of the power producing parts of the engine.

MANIFOLD PRESSURE - The pressure of the fuel air mixture as it enters the cylinder assembly on the intake stroke.

POWER - Is FORCE multiplied by DISTANCE and then divided by TIME.

FORMULA FOR HORSEPOWER -
$$\text{HORSEPOWER} = \frac{\text{PLANCK}}{33000}$$

P = Average Effective pressure during power stroke.

L = Length of the stroke of the piston

A = Area of the top of the piston

N = Number of power strokes per minute (RPM/2)

K = Number of cylinders on the engine.

1. **OBJECTIVE.** At the end of this session the student will be able to:
 - a. Identify the major components of turbine engines
 - b. Identify the different applications of turbine engines.
 - c. Describe the BRAYTON cycle of operation.

2. **INTRODUCTION**

3. **TERMS AND DEFINITIONS**

- a. Handout

4. **LESSON OUTLINE.**

- a. Turbine engine fundamentals.

- (1) Brayton cycle

- b. Major components

- c. Turbine engine types

- (1) Thrust producing

- (2) Torque producing

5. **EXERCISE**

- a. Do the exercise in text.

6. **SUMMARY**

TURBINE ENGINE TERMS

Axial flow compressor Compression with airflow parallel to the axis of the engine. The numerous compression stages raise pressure of air but essentially make no change in direction of airflow.

Brayton cycle A thermodynamic cycle of operation that may be used to explain the operating principles of the gas turbine engine. It is sometimes referred to as the continuous combustion, or constant pressure cycle.

Centrifugal flow compressor An impeller shaped device which receives air at its center and slings air outward at high velocity into a defused to increase pressure.

Combustor The section of the engine into which fuel is injected and burned to create expansion of the gases.

Compressor An impeller or multi-bladed rotor assembly. A component which is driven by a turbine rotor for the purpose of compressing the incoming air.

Exhaust nozzle Also referred to as the jet nozzle, this is the rear-most part of the engine.

Gas generator turbine High pressure turbine wheels which drive the compressor of a turboshaft or turboprop engine.

Gas turbine Engine consisting of a compressor, combustor and turbine, using a gaseous fluid as a working medium and producing either shaft horsepower, jet thrust, or both.

Inlet duct The ambient air entrance duct which directs air into the engine.

Jet engine A reaction engine which derives its thrust from the acceleration of an air mass through an orifice. There are four common types: rocket, ramjet, pulsejet, and turbojet.

Power turbine A turbine rotor connected to an output reduction gearbox. Also referred to as free power turbine.

Thrust A pushing force exerted by one mass against another, which tends to produce motion in the masses. In jet propulsion, thrust is the forward force in the direction of motion caused by the pressure forces acting on the inner surfaces of the engine. Or, in other words, it is the reaction to the exhaust gases exiting the nozzle. Thrust force is generally measured in pounds.

Torque A force multiplied by its lever arm, acting at right angles to an axis.

Turbine wheel A rotating device actuated by either reaction, impulse or a combination of both, and used to transform some kinetic energy of the exhaust gases into shaft horsepower to drive the compressor and accessories

1. **OBJECTIVE.** At the end of this session the student will be able to:

- a. Define a system.
- b. List major systems found in modern aircraft.
- c. Identify components that make up a system.

2. **INTRODUCTION.**

3. **lesson outline.**

- a. What is a SYSTEM??
- b. What is the PURPOSE of a system??
- c. Major components make use of systems.
- d. Systems in turn become major components.
- e. Systems interact and support each other.
- f. Major systems found in modern aircraft.

4. **SUMMARY**

1. **OBJECTIVE.** At the end of this session the student will be able to:
 - a. Identify the parts of a propeller
 - b. Explain how a propeller creates thrust.

2. **INTRODUCTION**

3. **TERMS AND DEFINITIONS**

- a. Handout

4. **LESSON OUTLINE.**

- a. Parts of the propeller

- b. Producing thrust

- c. Types of propellers

- d. Changing blade angles

5. **SUMMARY**

PROPELLER TERMS

PROPELLER - A rotating airfoil that consists of two or more blades attached to a central hub which is mounted on an engine crankshaft. The function of a propeller is to convert engine horsepower to useful thrust.

BLADE TIP - The part of the blade farthest from the hub.

HUB - The portion of a propeller that attaches to the propeller shaft of the engine.

BLADE SHANK - The thick, rounded portion of the blade near the hub.

BLADE FACE - The flat portion of the blade. This compares with the flat bottom part of a wing airfoil section.

BLADE BACK - The curved portion of the blade. This compares with the curved upper part of a wing airfoil section.

BLADE CHORD - A straight line through the center of a propeller blade, perpendicular to its span, between its leading edge and its trailing edge.

BLADE LEADING EDGE - The edge of a moving object that reaches a point in space or in time ahead of the rest of the object. In an airplane wing or propeller blade, the leading edge is the part that the moving air first touches.

BLADE TRAILING EDGE - The back edge of an airfoil. It is the edge that passes through the air last.

BLADE ANGLE - The angle that is formed between the chord of the blade section and the plane of rotation of the propeller.

BLADE PITCH - The distance, in inches, that a blade section will move forward in one revolution.

BLADE STATION - A reference position on a blade that is a specified distance from the center of the hub, measured in inches.

RELATIVE WIND - The apparent motion between an airfoil and the air. Either of which can be moving, or both may be moving but at different rates.