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DOCUMENT TITLE

GAS TURBINE ENGINES (HK CAD)

CHAPTER 1 – ENGINEERING TERMS AND DEFINITIONS

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INTRODUCTION

This chapter has been written to introduce the student to some of the more common engineering terms and definitions that they may encounter during their aviation career.

These terms and definitions are not comprehensive and are Not Examinable. They are meant to help the student understand some of the jargon used in aviation and are listed in no particular order. References may also be found in Chapter 16, Basic Gas Turbine Terms and Definitions.

Bearings

Bearings are used to support the engine spools and to absorb radial and axial loads. The most common configuration is for four main bearings to be fitted. The compressor will have a front and rear bearing, as will the turbine. Large engines will have two bearings in each location. The accessory case will have bearings for the gearing and drives.

There are two types of bearings used in modern engines. They are;

- Ball Bearings, and
- Roller Bearings.

Ball Bearings are the only bearings designed to take axial as well as radial loads. This is possible because spherical balls are used to transmit the axial forces. These are usually located in the rear compressor and front turbine locations, and are usually installed in pairs. Refer to Figure 1-1.

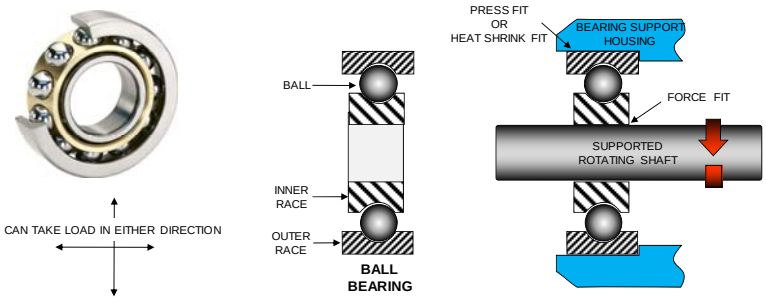

Figure 1-1 Ball Bearing

Roller Bearings can only take radial loads as they use a cylindrical cross section to transmit the load. These bearings are used for the engine spools and all the drives, and accessory case bearings. Refer to Figure 1-2.

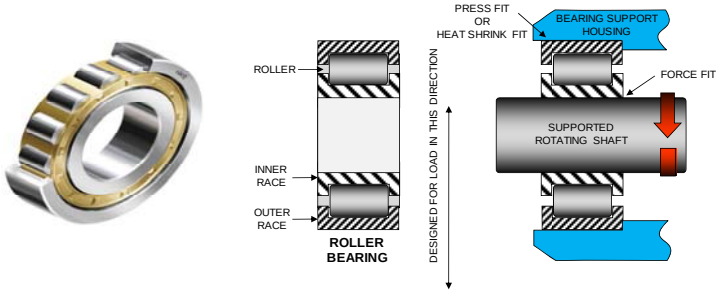

Figure 1-2 Roller Bearing

Other bearings in use, mainly in piston engines (at a much lower RPM), are plain slipper bearings. Refer to Figure 1-3. There is also a tapered roller bearing which can absorb axial loads, but these are not generally used in gas turbine engines. Refer to figure 1-4.

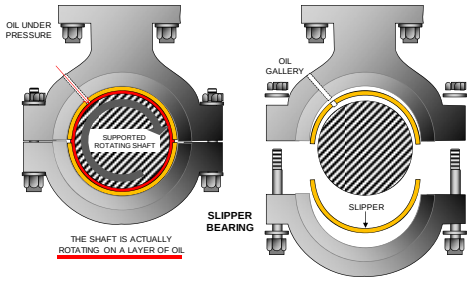

Figure 1-3 Slipper Bearing

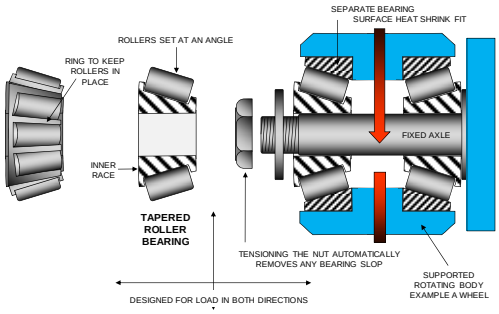

Figure 1-4 Tapered Roller Bearing

Turbofan Engine Life

One important measure of an aircraft engine's overall economics is how often it has to be overhauled, the so-called time between overhaul, typically seen as **TBO**.

The time between overhaul is generally a function of the complexity of the engine. Piston-based engines are much more complex than their turbine-powered cousins, and generally have TBO's on the order of 1,200 to 2,000 hours of running time. In comparison, jet engines and turboprops often have **TBO's** on the order of 3,000 to 5,000 hours.

As with airframes, cycles also determine the life of an engine. Engines in a B737, flying up to eight sectors a day with eight high power take offs will obviously incur more wear than engines in a B777 flying fifteen hour sectors.

Modern turbofan engines use a modular construction technique. This allows certain sections of the engine to be replaced without overhauling the whole engine.

Since the overhaul process requires the engine to be taken apart, it is typically an expensive process. The value of a used engine decreases if it is close to requiring an overhaul, so used engines (and aircraft) typically list their time since overhaul or **TSOH**.

Shear Shaft

A shear shaft (quill shaft), is fitted to any component which drives, or is driven by an accessory case. If the component fails, and seizes the drive shaft will break, preventing any damage to the accessory case. Refer to Figure 1-5.

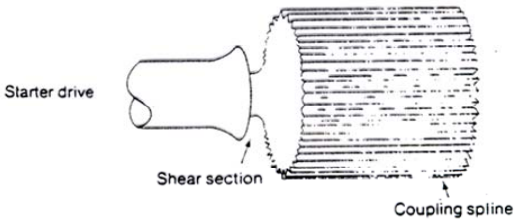

Figure 1-5 Shear Shaft

Fail Safe

A fail safe device is one that, in the event of a failure, responds in a way that will cause no harm, or at least a minimum of harm, to other devices or personnel.

Fail safe is a term usually used in fuel, hydraulic and pneumatic systems. Valves that are fail safe, usually default to the open position when electrical power is lost. These valves are solenoid operated.

Valves that are driven to both open and close, obviously, remain in the selected position when power is lost.

Cannon Plug

A cannon plug is an electrical connector, used in countless areas of the engine and airframe. It consists of a male and female connector, joined by a screw thread. Refer to Figure 1-6.

Figure 1-6 Cannon Plugs

Circuit Breaker

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset. Refer to Figure 1-7.

Figure 1-7 Circuit Breakers

Helical Spline

A Helical Spline is used to transmit a force in one direction. If the force is transmitted from the other direction the spline will disengage. Refer to Figure 1-8.

Figure 1-8 Helical Spline Assembly

Turnbuckle

A turnbuckle is a device for adjusting the tension or length of ropes, cables, tie rods, and other tensioning systems. It normally consists of two threaded eyelets, one screwed into each end of a small metal frame, one with a left-hand thread and the other with a right-hand thread. The tension can be adjusted by rotating the frame, which causes both eyelets to be screwed in or out simultaneously, without twisting the eyelets or attached cables. Refer to Figure 1-9.

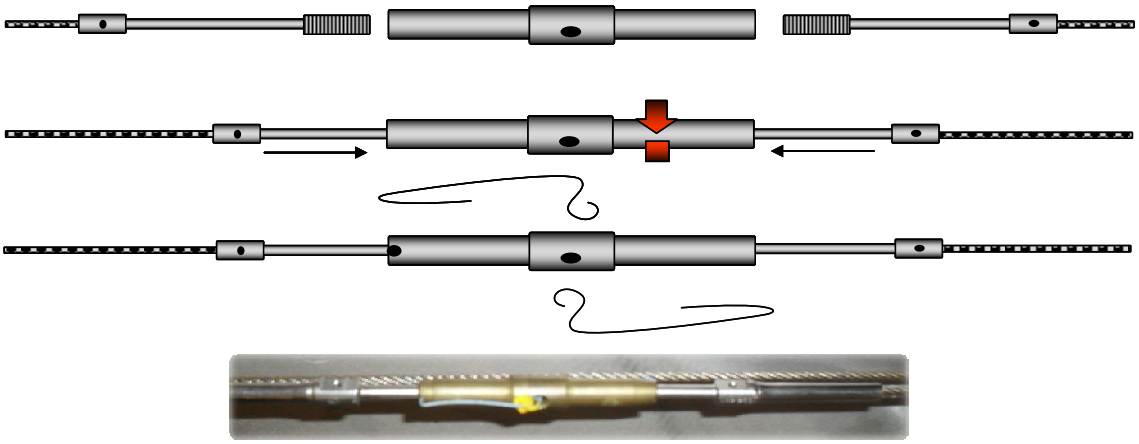

Figure 1-9 Turnbuckle

Nacelle

The nacelle is a cover or housing (separate from the fuselage), that holds engines, fuel, or equipment on an aircraft. Refer to Figure 1-10.

Figure 1-10 Nacelle

Monocoque

Monocoque is a construction technique that supports structural loads by using an object's external skin, as opposed to using an internal frame or truss that is then covered with a non-load-bearing skin.

An Egg is a true monocoque construction. An aircraft fuselage has an internal framing construction and an outer skin. This is called Semi-Monocoque construction.

Forging

This is a manufacturing process involving the shaping of metal using localized compressive forces. Forged parts can range in weight from less than a kilogram to 580 metric tons. Forged parts usually require further processing to achieve a finished part.

Forgings are used when tensile strength is required. Centrifugal compressor impellers and axial flow compressor blades are good examples of forgings. Refer to Figure 1-11.

Figure 1-11 Forging

Casting

This is a manufacturing process by which a liquid material is usually poured into a mould, which contains a hollow cavity of the desired shape, and then allowed to solidify.

Casting as used for items that do not require high torsion strength such as compressor casings and accessory gear boxes. Refer to Figure 1-12.

Figure 1-12 Casting

Trunnion Bearing

A trunnion is a cylindrical protrusion used as a mounting and/or pivoting point. Refer to Figure 1-13. A Trunnion bearing is used to support this assembly, and is typically used to attach a landing gear strut to the aircraft structure

Figure 1-13 Trunnion

Clutch

A clutch is a mechanical device that provides for the transmission of power (and therefore usually motion) from one component (the driving member) to another (the driven member) when engaged, but can then be disengaged.

A centrifugal clutch is used in where the speed of the engine defines the state of the clutch, for example, a pneumatic starter motor. This clutch system employs centrifugal force to automatically engage the clutch when the engine rpm rises above a threshold and to automatically disengage the clutch when the engine rpm falls low enough.

Bayonet Fitting

A bayonet mount (mainly as a method of mechanical attachment, as for fitting a lens to a camera) or bayonet connector (for electrical use) is a fastening mechanism consisting of a cylindrical male side with one or more radial pins, and a female receptor with matching L-shaped slot(s) and with spring(s) to keep the two parts locked together. The slots are shaped like a capital letter *L* with serif (a short upward segment at the end of the horizontal arm); the pin slides into the vertical arm of the L, rotates across the horizontal arm, then is pushed slightly upwards into the short vertical "serif" by the spring; the connector is no longer free to rotate unless pushed down against the spring until the pin is out of the "serif". Refer to Figure 1-14.

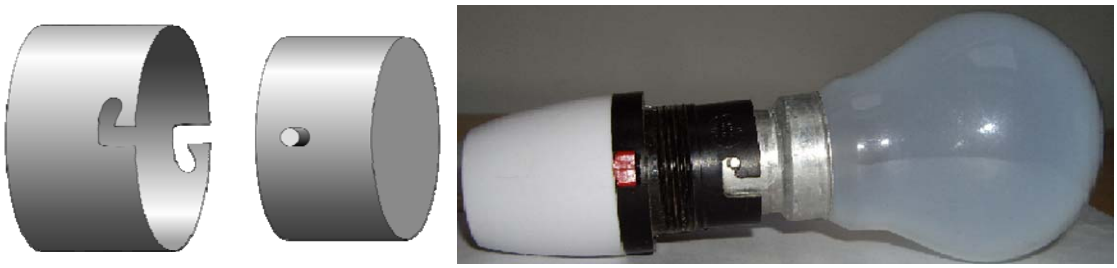

Figure 1-14 Bayonet Fitting

Aneroid

Aneroid gauges are based on a metallic pressure sensing element that flexes elastically under the effect of a pressure difference across the element. "Aneroid" means "without fluid. Aneroid gauges can be used to measure the pressure of a liquid as well as a gas. Aneroid gauges are not dependent on the type of gas being measured The pressure sensing element may be a tube, a diaphragm, a capsule, or a set of bellows, which will change shape in response to the pressure of the region in question. The deflection of the pressure sensing element may be read by a linkage connected to a needle, or it may be read by a secondary transducer. Refer to Figure 1-15.

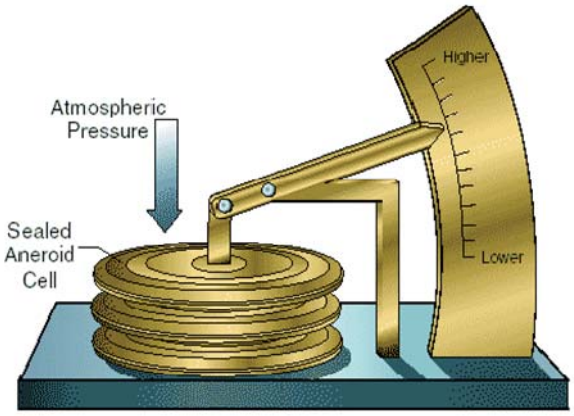

Figure 1-15 Aneroid Barometer