FUNCTION OF THE LUBRICATION SYSTEM

The components that make up a piston engine are subjected to high loads, high temperatures, and high speeds. The component parts are generally made of metals, and as the moving parts of the engine slide against each other, there is a resistance to their movement. This is called **'Friction'.**

The friction will increase as the load, temperature and speed increases, the movement of the components also produces **'Wear'** which is the loss or destruction of the metal components. Both friction and wear can be reduced by preventing the moving surfaces coming into contact by separating them with a material/substance which has lower frictional properties than the component parts. This is referred to as a **'Lubricant'.**

A lubricant can come in many forms. Greases, Powders and some solid materials. However it is in the form of **'Oils'** with which this chapter will concentrate on. The oil can be forced between the moving parts, called **'Pressure Lubrication'** or the components can be **'Splash Lubricated'**.

The **'Primary'** task of the lubrication system of the engine is to **'Reduce Friction'** and component **'Wear'**, it also has a number of secondary functions. Of these perhaps the most important is the task of **'Cooling'.** The flow of oil through the engine helps to dissipate the heat away from the internal components of the engine.

As the oil flows through the engine it also carries away the by-products of the combustion process and **'Cleans'** the engine. The internal metal components are protecte against **'Corrosion'** by the oil, which also acts a **'Hydraulic Medium'** reducing the shock loads between crankshaft and bearing and so reducing vibration. The oil can provide the power source for the operation of a hydraulic variable pitch propeller.

The oil system can be used to give an indication of the power being developed by the engine, and its condition. The oil system's use as an **'Indicating Medium'** is of great importance to the pilot as it can give an early warning of mechanical failure or loss of power.

It should be remembered that an increase in friction will cause an increase in Friction Horse Power, and therefore a reduction in the Brake Horse Power developed by the engine.

The **'Reduction in Friction and Wear'** by the lubricant is of prime importance, but the secondary functions of **'Cooling, Cleaning, Protection, Hydraulic** and **Indicating Mediums'** should not be ignored.

THE WET AND DRY SUMP LUBRICATING SYSTEMS

There are two lubrication systems in common use, these are the **'Wet Sump'** and **'Dry Sump'** systems. The system used is normally dependant on the power output of the engine, and role of the aircraft. The principle of lubrication of the engine is the same whichever system is used, the principle difference between the two systems being the method used to store the supply of oil.

Most light, non-aerobatic aircraft engines use the **'Wet Sump'** system. In this system the oil is stored in the bottom or sump of the engine. This simplifies construction but has number of disadvantages:

a) Lubrication difficulties arise during manoeuvres. The oil enters the crankcase, is flung around by the revolving shafts with possible over-oiling of the engine, inverted flight being particularly hazardous.

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Piston Engines Chapter Lubrication Aircraft Spruce

Jiyuan Zhang

Piston Engines Chapter Lubrication Aircraft Spruce:

Sport Aviation ,1960 *The Engineer* ,1952 The Continuing Study of Newspaper Reading Advertising Research Foundation,1944 *Aircraft Engine Lubrication* Sinclair Refining Company. Aviation Sales Department,1944

Lubrication Systems for Aircraft Gas Turbine Engines Ion Stiharu,Patrick Hendrick,2012-12-01 Lubrication Systems for Aircraft Gas Turbine Engines presents a systematic approach to the lubrication systems of generic aircraft gas turbine engines This topic requires a dedicated approach due to the constraints and requirements imposed by the propulsion system that include high sustained operating temperatures and speeds mass constraints for the lubrication system and its ancillary components required for heat management filtering and sealing of the lubricant These requirements are not discussed in tribology texts and the solution to such problems is often non tribology related but heat transfer or two phase flow related The editors have collated vital research and methodology and present the problems as well as current and potential future solutions to these problems in a systematic and consistent manner The book is organized into eleven chapters covering the subject of lubrication in GTEs from systems to components Advanced methods and tools used to evaluate the performance of lubrication systems are also introduced Lubrication Systems for Aircraft Gas Turbine Engines is addressed to researchers and graduate students who are interested in lubrication aspects related to aircraft GTEs as well as lubrication problems and solutions in general It also represents an excellent reference for practicing engineers who work in lubrication systems and components from design to test and maintenance *Lubricating Oils, Aircraft Piston Engine (Non-Dispersant Mineral Oil)* E-38 Aviation Piston Engine Fuels and Lubricants,2005 This SAE Standard establishes the requirements for nondispersant mineral lubricating oils to be used in four stroke cycle piston aircraft engines This document covers the same lubricating oil requirements as the former military specification MIL L 6082 Users should consult their airframe or engine manufacturers manuals for the latest listing of acceptable lubricants *Aviation Maintenance Technician Certification Series* ,2015

Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant) E-38 Aviation Piston Engine Fuels and Lubricants,2011 This SAE Standard establishes the requirements for lubricating oils containing ashless dispersant additives to be used in four stroke cycle reciprocating piston aircraft engines This document covers the same lubricating oil requirements as the former military specification MIL L 22851 Users should consult their airframe or engine manufacturers manuals for the latest listing of acceptable lubricants This Standard was revised based on the recommendations made at the 22 April 2010 SAE E 38 Aviation Piston Engine Fuels and Lubricants Committee meeting The revision is part of the standard SAE five year review process and it includes both technical and editorial changes The name of the preparing SAE committee has changed to E 38 and is now under the SAE Aerospace Council **Low Temperature Lubrication of Aircraft Engines** Saul Barron,Society of Automotive Engineers,1951 **Chapter 5 : Combustion Engine Lubricants** ,2009 DISCUSSION IN THIS CHAPTER PERTAINS TO combustion engine lubricants The chemistry and technology of these lubricants are presented along with

United States and European performance specifications and the process of establishing them In order to facilitate understanding various types of internal combustion engines and their operation are described The chapter also addresses the current topics of fuel economy emissions control and extended service intervals The chapter is concluded by citing examples of several engine oil formulations Engine lubricants or engine oils are designed for use in internal combustion engines Modern engines operate on a wide variety of fuels and in environments that involve temperature extremes hence their lubrication is quite complex A combustion engine lubricant must possess attributes to help it perform the following functions effectively 1 Permit Easy Starting It must have low viscosity at low temperatures and be pumpable so as to instantaneously reach the engine parts that need lubrication This is an important attribute since most of the engine wear occurs during the start up primarily due to lubricant starvation 2 Maintain Adequate Viscosity at High Temperatures This is important because most oils experience a decrease in viscosity at high temperatures such as those in and around the combustion engine If the viscosity of the oil drops too far the lubricant loses its ability to form the lubricating film of the appropriate thickness which will permit metal to metal contact and wear will ensue 3 Lubricate and Prevent Wear This translates into the oil forming a lubricating film of appropriate thickness to prevent metal surfaces from contacting each other and experiencing wear For most engine parts the surfaces are well separated which makes lubrication easier However there are parts such as the piston rings and cam lobes which are designed to have metal to metal contact and the function of the lubricant is to minimize wear by making chemical surface films 4 Reduce Friction The formation of the lubricant film of proper thickness on surfaces and its maintenance will reduce friction and the accompanied wear This is especially true during the start up and idle when the lubrication is inadequate and the frictional losses occur Therefore controlling friction will improve the fuel economy 5 Protect Against Rust and Corrosion Water resulting from the fuel combustion while meant to escape through the exhaust can condense on the cylinder walls or travel past piston rings as part of the blow by and enter the crankcase This typically occurs in cold weather or short distance driving because the engine and the lubricant are not hot enough for water to be removed via evaporation Water can initiate rust and in the presence of the acidic materials resulting from the lubricant oxidation and additive decomposition can cause corrosion 6 Keep Engine Parts Clean Partial fuel combustion products such as free radicals soot sulfur and nitrogen oxides enter the crankcase as the blow by and react interact with the lubricant to form highly polar deposit precursors and corrosive materials These species have the tendency to separate on the hot surfaces to form deposits and to lead to corrosion Engine lubricants are designed to prevent the formation of these species or keep them from separating on the surfaces by suspending them in the bulk lubricant or both 7 Cool Engine Parts Cooling of the engine parts is crucial to its trouble free operation Parts that must be cooled include cylinder heads cylinder walls valves crankshaft main and connecting rod bearings timing gears pistons and others Certain parts of the engine can be cooled by the use of a coolant which is typically a mixture of water and ethylene glycol Other parts cannot be effectively cooled by the coolant either because of their vicinity or the part temperature is extremely high which leads to the rapid evaporation of water In such situations the lubricant acts as a coolant 8 Seal Combustion Pressures Surfaces of piston rings ring grooves and cylinder walls do not have an ideal fit primarily because of the machining limitations It is important that these parts act as a good seal to prevent the loss of the high combustion and compression pressures which are needed for the efficient engine operation A loss into the low pressure area of the crankcase would result in a reduction of the engine power and efficiency Engine oils therefore improve the seal by filling spaces in the above listed parts Typically the oil film that acts as a seal is only 0 025 mm thick hence it is ineffective in filling spaces that are larger because of the intensive wear Incidentally the oil consumption in a new engine is high until the surfaces in these parts become smoother due to wear for the oil to form a better seal 9 Control Foam Foaming of the engine oil due to air entrainment occurs because of the rapidly moving engine parts which create turbulence The result is the formation of the air bubbles which normally rise to the surface of the oil and break However the presence of water and additives many of which have surfactant properties slows down this process Foam in the engine oil is undesired because of its poor cooling ability and noncontinuous film formation which will result in excessive engine wear While a good quality engine oil can perform these functions adequately the continuing efforts of the OEMs to improve emissions quality by recycling partial combustion products from the exhaust and venting the volatiles from the fuel system and the bulk lubricant positive crankcase ventilation into the combustion chamber place additional demands on the lubricant This strategy is effective in lowering the partial combustion products such as the unburned or partially burned hydrocarbons and carbon monoxide but at the expense of enriching the combustion mixture in NOx nitrogen oxides a potent oxidant This will be discussed further in Chapter 6 dealing with Emissions in an Internal Combustion Engine

Lubrication and Fuel Requirements of Aircraft Engines Tide Water Oil Company,Wright Aeronautical Corporation,1930 Visual Studies of Cylinder Lubrication Milton C. Shaw,Theodore Nusssdorfer,United States. National Advisory Committee for Aeronautics,Aircraft Engine Research Laboratory,1945 A V type engine provided with a glass cylinder was used to study visually the lubrication characteristics of an aircraft type piston Photographs and data were obtained with the engine motored at engine speeds up to 1000 rpm and constant cylinder head pressure from 0 to 50 pounds per square inch *Motor Oils and Engine Lubrication* Carl W. Georgi,1950 **Aviation Engines** Ray Forest Kuns,1930

Aircraft Piston Engines Herschel H. Smith,1986 Fundamentals of Aircraft Piston Engines Norman E. Borden,Walter J. Cake,1970 **Chapter 4-Aviation Fuels** KH. Strauss,2003 EARLY AIRCRAFT ENGINES WERE OPERATED on ordinary straight run motor gasoline well into the 1920s Research then isolated uncontrolled combustion as a major source of engine overheating and failures prompting a search for ways to cure the problem The big step came in 1921 with the invention of tetraethyl lead TEL an unequaled knock resistance enhancer The same period saw the development of the heptane isooctane scale still in use today for rating antiknock properties in terms iof ocatne numbers For aviation gasoline the concept of rating knock resistance in special single cylinder engines resulted in the Aviation Octane Test Method D 614 which tested fuels under lean fuel mixture conditions simulating cruise operation In 1970 this method was replaced in the specification by the Motor Octane Method D 2700 An aviation gasoline specification issued by the U S Air Corps in 1938 listed a 68 octane grade containing no lead and a 92 octane grade with a maximum of 6 ml TEL gallon As engine power output was increased by supercharging the fuel air mixture a second rating method D 909 came into use to evaluate performance under rich take off conditions so that by World War II both rating methods were required Engine designers soon discovered the performance benefits of high octane which permitted a higher octane fuel so develop more power in a given engine or allowed a reduction in engine size with the same power output Research on high octane fuel thus received a high priority and resulted in a 100 octane fuel by the beginning of World War II while the heroic performance of the RAF is widely recognized it would have been impossible without the 100 octane fuel **Lubricants for Inerted Lubrication Systems in Engines for Advanced Aircraft** William R. Loomis,Dennis P. Townsend,Robert L. Johnson,Society of Automotive Engineers,1968 *Lubrication and Care of Wright Aircraft Engines Cyclone, Whirlwind, Conqueror* Wright Aeronautical Corporation,193? **Trial of a Twin Lubrication System on an Aircraft Engine** George A. Roth,T. R. Salter,1950

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