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OIL DILUTION AND COLD STARTING
OF
AIRCRAFT ENGINES



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Committee S-4, Cold Starting Requirements

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
485 Lexington Avenue
New York 17, N. Y.

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INTRODUCTION

Oil dilution has within the past year become a very much discussed subject, especially since the operation of large numbers of aircraft in Northern regions. Many tests have been run both in laboratory cold rooms and in the field, and considerable data have been accumulated. Unfortunately, there has been no yardstick by which to run these tests or interpret the data. It has often been found necessary before entering into any discussion to first define the terms which were being used, and then discuss methods and procedures so that a common ground for an intelligent discussion could be obtained. Diluted oil samples have been taken from many locations, namely: the engine's sump, the oil cooler drain plug, bottom of the oil tank, "Y" drain valve, etc. Dilution has also been determined by viscosimeter, distillation, specific gravity, bubble tube, and other methods. Therefore the committee wishes to submit the following definitions and methods for determination of oil dilution in aircraft engines, with the ultimate desire of having these definitions and method accepted as a standard procedure.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

Committee S-4, Cold Starting Requirements

G. A. Bleyie, Chairman
Wright Aeronautical Corp.

H. J. Buttner	Packard Motor Car Company
Floyd Dougherty	Allison Division, GMC
B. W. Geddes	Standard Oil Development Co.
A. Pomeroy	Ranger Aircraft Engines
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Tom Spalding	Jack & Heintz, Inc.
W. H. Sprenkle	Pratt & Whitney Aircraft

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I DEFINITIONS

- A. Oil Dilution System - The mechanism by which dilution is added to the lubrication system in order to reduce the viscosity and pour point of the lubrication oil.
- B. Diluent - A substance which reduces the viscosity and pour point of an engine's lubrication oil.
- C. Pour Point Depressant - A substance which when added to an engine lubricating oil in relatively low concentrations will reduce its pour point by retarding the formation of a rigid wax structure.
- D. Mixture - The mixture of the engine lubricating oil and diluent.
- E. Per Cent of Dilution (or amount) - The amount of diluent in the mixture expressed in whole numbers, i.e. a mixture consisting of thirty parts of diluent and seventy parts of oil by volume is a thirty per cent mixture and its dilution shall be known as thirty per cent. Percentage of dilution shall not be measured as the amount of diluent with respect to the original amount of oil.

II METHOD OF DETERMINATION

Engines are diluted, primarily, to reduce the viscosity and pour point of the lubricating oil so as (1) to enable the engine to be cranked at a reasonable speed using a reasonable amount of power to accomplish this, and (2) to insure that the lubricating oil will circulate continuously when the engine starts to run under its own power. The diluent in the case of aircraft engines is usually aviation fuel. The fuel is introduced to some part of the oil system and its mixing with the lubricating oil is accomplished by the oil and fuel entering the engine's oil pump, and then being splashed about in the engine. Obviously, due to the operating temperature of the bearings and the crankcase structure in general, the lighter ends of the fuel will tend to be driven off during the dilution process. As a result, the fuel which remains in the oil as diluent may be of a different character than that fuel which enters. Hence, lubricating mixtures containing in one case fresh fuel and in the second case an equal amount of fuel that has passed through the engine's lubricating system will not have the same viscosity although their component mixture percentages are the same.

As originally stated, the engine knows only the viscosity of the oil and viscosities are normally determined at 100°F and 210°F. The viscosity of the oil at any temperature is usually obtained by plotting on ASTM temperature viscosity paper the viscosity obtained at these temperatures and drawing thru the points a straight line. This may be done for any oil and the slopes of the resulting lines may vary considerably between oils. Fortunately, however, for Army-Navy approved aviation engine oils the viscosity limits at 100°F and 210°F are quite close and hence the extrapolated viscosity between different brand oils of the same grade at low temperatures do not vary too much and can be neglected for all practical purposes.