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Effect of Operating Temperature on The Kinematic Viscosity of Ms-20 Oil in The M-14p Aircraft Engine

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Abstract- Kinematic viscosity is a critical parameter governing lubrication performance in aircraft piston engines. For the M-14P radial engine, MS-20 oil has been widely used under varying operating temperature conditions. This study investigates the influence of operating temperature on the kinematic viscosity of MS-20 oil. The viscosity–temperature relationship of MS-20 oil is analyzed using reference temperature data and the ASTM D341 Walther equation, specifically within the typical operating range of the M-14P engine. The results indicate a continuous and stable decrease in viscosity with increasing temperature, thereby providing a quantitative basis for evaluating lubrication behavior under varying engine operating conditions.

Keywords: MS-20 oil, kinematic viscosity, temperature effect, M-14P engine, ASTM D341.

I. INTRODUCTION

Lubricating oil plays a critical role in ensuring reliable operation and durability of aircraft piston engines. In radial piston engines such as the M-14P, lubrication conditions are strongly influenced by oil viscosity, which directly affects hydrodynamic film formation, friction losses, and oil pressure stability. Among the factors influencing oil viscosity, operating temperature is recognized as one of the most significant.

MS-20 oil, a monograde SAE 50 aviation lubricant, has been traditionally specified for the M-14P engine. During engine operation, oil temperature varies depending on engine load, ambient conditions, and cooling efficiency, leading to changes in oil viscosity. Understanding the relationship between temperature and kinematic viscosity of MS-20 oil is therefore essential for assessing lubrication performance and operational reliability of the M-14P engine.

The objective of this study is to analyze the effect of operating temperature on the kinematic viscosity of MS-20 oil using a standard viscosity–temperature interpolation method, thereby providing quantitative insight into viscosity variation within the typical operating temperature range of the M-14P engine.

II. PROBLEM STATEMENT

The lubricant investigated in this study is MS-20 aviation oil, a monograde SAE 50 oil traditionally used in the M-14P radial piston engine. The manufacturer's kinematic viscosity data at the reference temperatures were used as input parameters: ν_{40} = 125.73 cSt and ν_{100} = 20.5 cSt. These values form the basis for evaluating the viscosity–temperature behavior of the oil under engine operating conditions.

To determine the kinematic viscosity of MS-20 oil at intermediate and operating temperatures, the Walther viscosity–temperature relationship specified in ASTM D341 was employed. The method establishes a linear relationship between the double logarithm of kinematic viscosity and the logarithm of absolute temperature. Using the input viscosity values at 40°C and 100°C, the characteristic constants of the Walther equation were calculated. This equation was subsequently used to interpolate kinematic viscosity values at temperatures relevant to the M-14P engine operation (60–90°C).

The interpolated viscosity values were tabulated (Table 1) and used to construct the viscosity–temperature curve (Figure 1). These results serve as the basis for subsequent analyses of lubrication performance, including assessment of hydrodynamic lubrication conditions and evaluation of oil pressure behavior within the engine lubrication system.

Table 1. Kinematic viscosity of MS-20 oil at different temperatures (calculated using ASTM D341)

Temperature (°C)	Kinematic viscosity ν (cSt)
40	125.73
60	60.45
70	44.27
80	33.40
90	25.87
100	20.50

III. RESULTS

The interpolated kinematic viscosity values of MS-20 oil at different temperatures are summarized in Table 1. The corresponding viscosity–temperature relationship is illustrated in Figure 1.

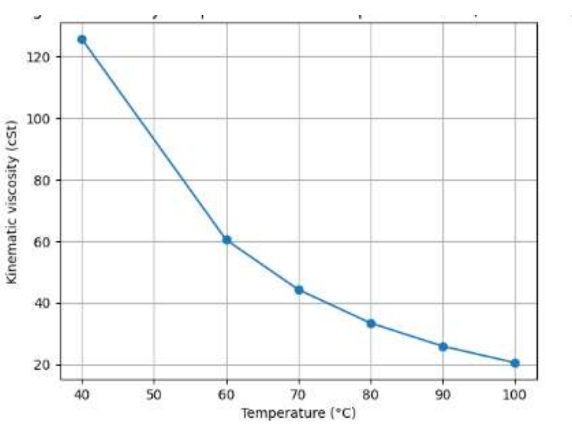

Figure 1. Viscosity–temperature relationship of MS-20 oil according to ASTM D341

Table 1 illustrates that the kinematic viscosity of MS-20 oil decreases significantly with increasing temperature. Specifically, the viscosity decreases from approximately 33.4 cSt at 80°C to 25.9 cSt at 90°C, which reflects the strong temperature dependence characteristic of monograde aviation oils.

Figure 1 demonstrates a smooth and continuous viscosity–temperature curve, exhibiting no abrupt changes or inflection points within the studied temperature range. This indicates stable viscosity behavior under normal operating conditions of the M-14P engine.

IV. DISCUSSION

The results clearly indicate that operating temperature has a pronounced effect on the kinematic viscosity of MS-20 oil. As temperature increases, viscosity decreases in a non-linear but continuous manner, which is characteristic of monograde SAE 50 oils.

Within the typical operating temperature range of the M-14P engine (80–90°C), the interpolated viscosity values remain sufficiently high to support hydrodynamic lubrication in journal bearings and other heavily loaded friction pairs. The absence of abrupt viscosity changes suggests that MS-20 oil maintains stable lubrication characteristics under normal engine operating conditions.

These findings highlight the importance of temperature control in maintaining appropriate oil viscosity and provide quantitative support for evaluating lubrication performance of the M-14P engine under varying thermal conditions.

V. CONCLUSIONS

This study analyzed the effect of engine operating temperature on the kinematic viscosity of MS-20 oil used in the M-14P aircraft engine. Using ASTM D341 interpolation, the viscosity–temperature relationship of MS-20 oil was determined over the typical operating temperature range.

The results show that kinematic viscosity decreases steadily with increasing temperature, while remaining within a suitable range for effective lubrication in the M-14P engine. The findings provide a scientific basis for understanding viscosity behavior of MS-20 oil and support further studies related to lubrication performance and operational optimization of the M-14P engine.

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