

EFFECT ON GOVERNED RPM BY VARIATIONS
OF FUEL SPECIFIC GRAVITY

Introduction

This instruction details the procedure to be adopted when fuels of varying Specific Gravity are used and their effect on Governed RPM.

Instruction

1. The governing of maximum speed on Nene 2-VH engines is a function of the top Lucas fuel pump.
2. The principle of operation of this governing device is an adjustable hydraulic device in the pump which, in conjunction with the pump servo, limits maximum pump delivery. Centrifugal pressure set up in radial drillings in the pump rotor provides the governor action. This pressure is passed to a spring tensioned diaphragm which operates a half ball relief valve in the pump. As the centrifugal pressure reaches its maximum value at maximum RPM, the half ball valve is opened, creating out of balance forces on the servo piston, which in moving, alters the swash plate angle and reduces the pump delivery. Adjustment of the diaphragm spring provides the setting of the governor, provision being made externally for this purpose on each pump. There are two fuel pumps on the Nene but engine maximum speed governing is controlled by the upper. The lower pump is set 150 RPM higher to prevent hunting between pumps.
3. It will be seen therefore that the function of the diaphragm is dependent on fuel pressure generated by the pump rotor. Pressure delivered by the rotor at any given engine RPM is proportional to the specific gravity of the fuel.
4. It will be found therefore that governor settings are affected directly by changes in specific gravity of fuel used and these changes can cause excessive variations of engine maximum governed speed at full throttle.
5. Investigations carried out have shown that specific gravity readings taken of samples of aviation kerosene supplied by three major fuel companies vary from .78 to .83. This range of specific gravity will give a variation of maximum governed Nene speed of up to 350 RPM.
6. The change in RPM is a rise for decrease in specific gravity and a reduction in RPM for an increase in specific gravity. To illustrate this point if an aircraft was fuelled at a Unit using kerosene to a specific gravity of .83 with the engine governed speed adjusted to 12,300 RPM, and the aircraft then moved to a unit using kerosene to a specific gravity of .78, it would be then found that engine maximum governed speed had risen to 12,650 RPM.
7. This variation of fuel specific gravity may always be present in supplies as the latest British specification to which RAAF fuel is supplied does not lay down any limitations in this regard. Action is being taken by this Headquarters to investigate this problem with the major oil companies involved, but it is anticipated that variations of fuel specific gravity will always exist.
8. There is no known means as yet to modify existing Lucas pumps to provide for fuel specific gravity variations and a solution does not appear practicable on the Nene itself unless a mechanical overspeed device is developed and fitted independent of the fuel pump.
9. Consequently, the problem is to be countered in Units operating Nene 2-VH engines by ensuring when receiving aircraft from contractors or other RAAF Units, that the engine maximum speed is checked and re-set to the correct maximum speed of 12,300 before allowing general flight use. Pilots should also be warned that under or overspeeding may occur with different supply fuels and in the latter case are to manually control the maximum speed until rectification action can be taken by ground staff re-setting the pump governors. Use of full throttle for the permitted 10 minutes can cause rapid deterioration of the engine if it is overspeeding. Continuous take-off periods with excessive RPM will also shorten the life of the engine.

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10. This is brought about by the fact that the life of a turbo-jet is largely dependent on its operation within specified maximum jet pipe temperatures and increase of jet pipe temperature is the normal result of higher RPM.

11. In conclusion it should be borne in mind that close adherence to the requirements of this instruction will considerably help to maintain general unit engine serviceability.

References : Files, Department of Air, 69/35/1 and 150/8/1681

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