

constant. Since this is a practical application of a turbine engine, it becomes necessary to analyze the effect of varying inlet conditions on the thrust or power produced. The three principal variables that affect inlet conditions are the speed of the aircraft, the altitude of the aircraft, and the ambient temperature. To make the analysis simpler, the combination of these three variables can be represented by a single variable called stagnation density.

The power produced by a turbine engine is proportional to the stagnation density at the inlet. The next three illustrations show how changing the density by varying altitude, airspeed, and outside air temperature affects the power level of the engine. *Figure 1-84* shows that the thrust output improves rapidly with a reduction in outside air temperature (OAT) at constant altitude, rpm, and airspeed. This increase occurs partly because the energy required per pound of airflow to drive the compressor varies directly with the temperature, leaving more energy to develop thrust. In addition, the thrust output increases since the air at reduced temperature has an increased density. The increase in density causes the mass flow through the engine to increase. The altitude effect on thrust, as shown in *Figure 1-85*, can also be discussed as a density and temperature effect. In this case, an increase in altitude causes a decrease in pressure and temperature.

Since the temperature lapse rate is lower than the pressure lapse rate as altitude is increased, the density is decreased. Although the decreased temperature increases thrust, the effect of decreased density more than offsets the effect of the colder temperature. The net result of increased altitude is a reduction in the thrust output.

The effect of airspeed on the thrust of a gas-turbine engine is shown in *Figure 1-86*. To explain the airspeed effect, it

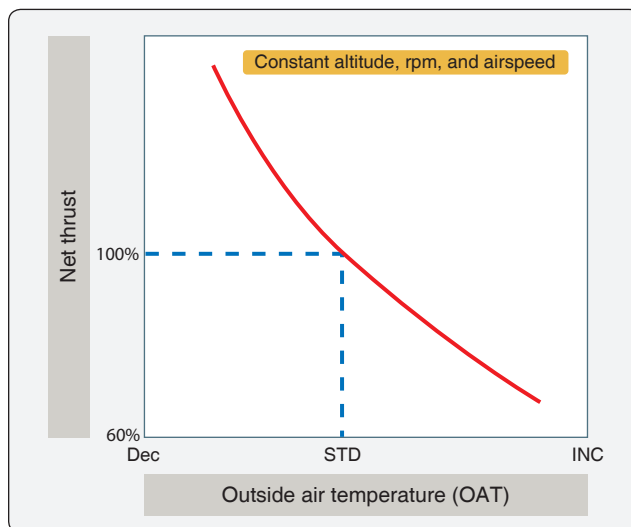


Figure 1-84. Effect of OAT on thrust output.

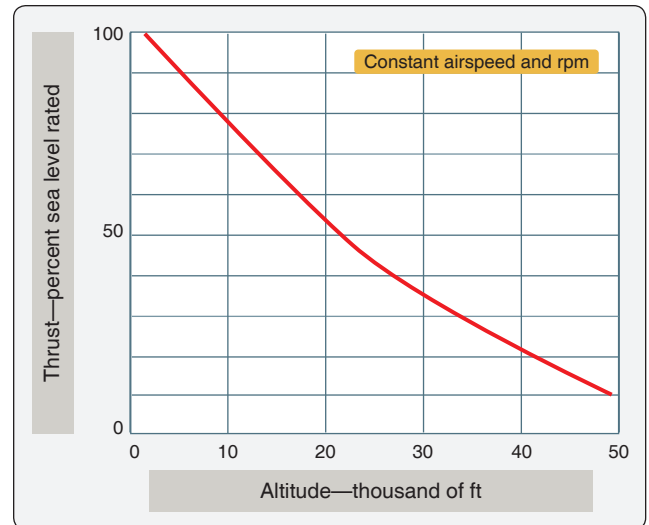


Figure 1-85. Effect of altitude on thrust output.

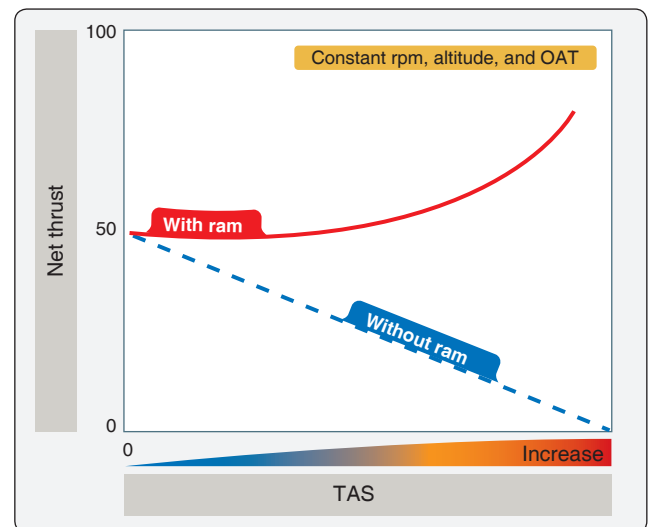


Figure 1-86. Effect of airspeed on net thrust.

is necessary to understand first the effect of airspeed on the factors that combine to produce net thrust: specific thrust and engine airflow. Specific thrust is the net thrust in pounds developed per pound of airflow per second. It is the remainder of specific gross thrust minus specific ram drag. As airspeed is increased, ram drag increases rapidly. The exhaust velocity remains relatively constant; thus, the effect of the increase in airspeed results in decreased specific thrust. [Figure 1-86] In the low-speed range, the specific thrust decreases faster than the airflow increases and causes a decrease in net thrust. As the airspeed increases into the higher range, the airflow increases faster than the specific thrust decreases and causes the net thrust to increase until sonic velocity is reached. The effect of the combination on net thrust is illustrated in *Figure 1-87*.