

Chapter 2

A Review on Various Aspects of Earth's Atmosphere

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ABSTRACT

The atmosphere is the layer of gases that surrounds the planet. The atmosphere is retained by the gravity of the planet. Hence, it is also called planetary atmosphere. The performance of the aircraft and rockets depends on the physical properties of the atmosphere in which they fly. It is therefore advisable to study the variation of pressure, temperature, and density with the altitude. The real atmosphere is composed of dust, water vapor, and moisture, and it never remains constant. Hence, a hypothetical model called a standard atmosphere was employed. This chapter elaborates the international standard atmosphere, atmospheric boundary layer, and the stability of the atmosphere.

INTRODUCTION

Earth's atmosphere (Figure 1) contains water in all phases, which is considered as one of the essential factors for the development of life. The air in this model is assumed to be dry, clean and at rest (i.e., no wind or turbulence) (Talay, 1975) with respect to the earth. An internationally accepted model was introduced by the International Civil Aviation Organization (ICAO) in 1952 and is defined as ICAO standard atmosphere or International standard atmosphere (ISA). International standard atmosphere (ISA) is a reference atmospheric model that describes the changes of the ideal gas properties of earth's atmosphere (gaseous envelope that surrounds the planet) with the altitude and elevation. It has been designed to give a common reference for atmospheric properties at various altitudes. Indicators in Aircraft Instruments and the specifications of the performance of the aircraft are derived using ISA as a reference. Hence all the aircraft performance instrumentation is calibrated for the standard atmosphere. In the standard atmosphere, the sea level pressure is 101325 N/m², density is 1.225 kg/m³, temperature is 15°C and the acceleration due to gravity is 9.81 m/s² (Calvert, 1990).

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Figure 1. Atmosphere

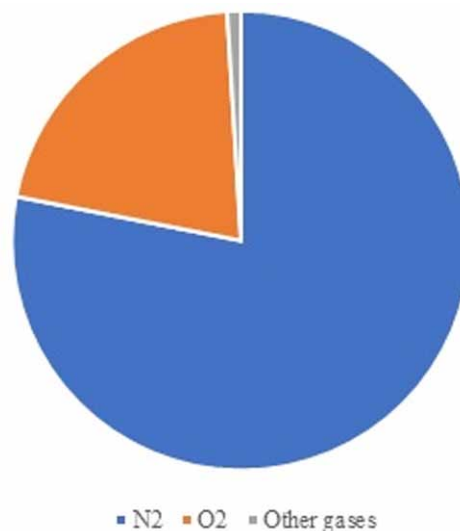


PHYSICS OF ATMOSPHERE

Atmosphere and Aerodynamics

What is the atmosphere? Earth's atmosphere is commonly termed as air. Air is the mixture of several gases (Figure 2) that is primarily composed of 78.084% of Nitrogen (N_2) and 20.947% of Oxygen (O_2) and 0.977% of other gases by volume and 75.46% of Nitrogen and 23.19% of Oxygen and 1.355 of other gases by mass (Tomasi et. al, 1998). The other gases comprise small amounts of Argon (Ar), Carbon dioxide (CO_2), Neon (Ne), Helium (He), Krypton (Kr), Xenon (Xe), Hydrogen (H_2), Nitrogen monoxide (N_2O), Methane (CH_4), Ozone (O_3), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and Iodine (I_2) (Auld and Srinivas, 2008). Over a range of altitude, the proportion varies little, nevertheless the atmosphere may be regarded as a homogeneous gas of uniform composition. So, the gaseous envelope that surrounds the planet is the atmosphere.

Figure 2. Composition of atmosphere



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