

Aerospace: How Aeronautics and Astronautics Are Defined – Atmosphere Discussion

Earth's Atmosphere

The atmosphere is a layer (or set of layers) of gases that surround a planet or other physical body and is held in place by gravity. Due to gravity's definition stating, "all things with mass or energy are brought toward (or in the direction of) one another," it would make sense that the atmosphere would follow suit.

Why though? Because the atmosphere – at least of Earth – is made up of the following elements (some dominant, others simply traces, and all have been revealed to carry mass):

- Nitrogen, oxygen, argon, and carbon dioxide
- Water vapor (which constitutes anywhere from 0.04 – 1% at sea level)
- Trace gasses (by subdivision)
 - *Greenhouse gasses* – carbon dioxide, methane, nitrous oxide, and ozone
 - *Natural origin* – pollen/spores, dust of mineral/organic composition, sea spray, and volcanic ash
 - *Industrial pollutants* – fluorine compounds, elemental mercury vapor, and chlorine
 - *Natural sources & Industrial air pollution* – sulfur dioxide and hydrogen sulfide

On Earth, the atmosphere protects life. Because humans are mostly made of water, it is important that the atmosphere creates enough pressure (or weight) to allow liquid water to exist on the surface. Photosynthesis ensues, therefore giving us breathable air. It also warms the surface through heat retention and accounts for the variations in temperature extremes found during the night and day. And the biggest benefit our atmosphere provides (outside of water and air) is that it mostly protects us from harmful ultraviolet solar radiation, solar wind, and cosmic rays.

Atmospheric pressure (or barometric pressure, if testing) varies at the different layers. What does that mean? It means the higher you go in altitude, the pressure experienced will decrease due to the diminishing mass of gases above (molecules are more spread apart and not colliding as much). This is important to know, as it will dictate specific parameters when creating the structure of a mechanical vehicle and how each component is likely to work at higher altitudes. It also indicates what needs to occur for a human to stay alive both during launch and reentry.

Following is more information on the layers of Earth's atmosphere (from the surface outward):

- Troposphere
- Stratosphere
 - Ozone layer
- Mesosphere
- Thermosphere
 - Ionosphere
 - Kármán line
- Exosphere

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The **troposphere** is the lowest level to Earth and extends 0 – 7 miles above the surface. It contains 80% of the mass, due to the four (4) layers that squash it down. The temperature here is warmer near the bottom and declines at higher altitudes. This is where most of our weather comes from (and therefore the weather turbulence we experience on planes) and is the highest layer a *propeller-driven* aircraft can reach.

The **stratosphere** is the second-lowest level, reaching from 7 – 31 miles above the surface. Protection from the sun's harmful ultraviolet radiation occurs at this point, as the **ozone** hovers about 21 – 22 miles above the surface. This layer is very stable and produces almost no clouds or other forms of weather. Its temperature is exactly opposite of the troposphere – as altitude rises, the temperature increases. And the stratosphere is the highest level a *jet-powered* aircraft can access and where weather balloons are found.

The **mesosphere** is the third highest level (or the middle if you like) from Earth's surface. It reaches from 31 – 50 miles above the surface and is where most meteors burn up. Temperature drops with increasing altitude (cold enough to form ice on objects) and creates noctilucent clouds. This area is too high for balloons and jet-powered aircraft to reach but is perfect for orbital spacecraft to fly. Sounding rockets and *rocket-powered* aircraft can access this height.

The second highest layer, the **thermosphere**, has several additional new things going on. It 'sits' 50 – 440 miles above the Earth's surface and is a water vapor free area. The height itself fluctuates due to the solar activity changes that occur over time. The temperature can reach as high as 2700° F (or 1500° C) near the top area of layer due to the low density of molecules present. The lower portion of the thermosphere contains the **ionosphere**, where solar radiation is ionized.

The Kármán line – or the location approximately 62.1 miles (or 100 km) above the Earth's surface – where human travelers are considered astronauts and no longer cosmonauts. And it is also the location where the International Space Station orbits (about 220 – 260 miles above) and all Space Shuttles have been launched to.

And farthest out sits the **exosphere**, which extends from 400 – 6,200 miles above the Earth's surface. Here is where most of the satellites we send up are orbiting. The molecules that float around here are typically so low in density and clash so irregularly that they do not behave like a gas in any way. This is where rogue particles can escape into space and are merged with the solar wind (or charged particles discharged from the Sun).

And there you have it – Earth's atmosphere and the layers we humans play in. I hope this information helps you understand a little more throughout the upcoming blogs. Please feel free to contact me via email at colleen@atwood-va-llc.com or our message section if you have any questions or concerns (if feel obliged to correct something above).