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# Dangerous O2 Levels - Rule or Guideline?


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The universally accepted minimum oxygen concentration value of 19.5% is not declared by OSHA to be safe. They were careful not to make that claim because it simply isn't factual. Their position is that anything below that should be considered UNSAFE, which still allows for O2 levels above that to also be dangerous. Remember, it's not so much as a RULE as a GUIDELINE. So, why can't they give me a nice clean rule, you may ask. How about this...

- Physiological variation between different people (we're all different, but you knew that)
- Physiological adaptation by each individual (some days are just better than others)
- Atmospheric variation (this is what we are going to look at now)
  - Altitude
  - Water vapor

## The Altitude Effect

At a lower altitude there is more oxygen in a given volume and thus in each breath, than at low higher altitude. The amount of oxygen in a given volume of air is usually measured as the partial pressure of oxygen in the mixture. It is this partial pressure that works in the lungs to push the oxygen molecules across the membranes and into the bloodstream. Physiologists are generally agreed that oxygen deficiency begins when this partial pressure of O2 in the lungs drops below 60 mm Hg. As you can see in the table below, the air that we breathe in seems to be comfortably above that level. We haven't got the air into the lungs yet, however.

| Altitude (ft) | Atmospheric Pressure (mm Hg) | Ambient O2 (mm Hg) | Alveolar O2 (mm Hg) | Alveolar CO2 (mm Hg) |
|---|---|---|---|---|
| 0 | 760 | 159 | 103 | 40 |
| 5000 | 632 | 133 | 81 | 37 |
| 10000 | 523 | 110 | 61 | 35 |
| Actual measured alveolar oxygen and carbon dioxide concentrations at different pressure altitudes. From Holmstrom, FMG: Hypoxia. In. Aerospace Medicine. Edited by HW Randall. Baltimore. The Williams & Wilkins Co., 1971. | | | | |

# The Water Vapor in All of Us

As the air moves into the lungs, it is heated by the body (to about 37°C) and humidified to about saturation. This reduces the O2 partial pressure by 9 mm Hg. Oh, we also use our lungs to breathe out the bad air, and this CO2 in the lungs further reduces the O2 partial pressure by another 40 mm Hg.

# Let's Take a Little Bit of Oxygen Away

At sea level, it would appear from the chart that we have a good comfortable margin before we run out of partial pressure. However, these numbers presume that we started at the full 20.95% oxygen. If we apply the above procedure for 19.5% O2, then we end up with only 74mm Hg oxygen partial pressure in the lungs. We are getting close to a disabling situation, and we haven't even started to factor in equipment and calibration tolerances, stuffy air from being in an enclosed space, or individual physiological differences and variation. By the way, your facility is at sea level, isn't it?

# How Close Can We Cut It?

When all of the relevant factors are considered, we may already be in a dangerous situation even before the oxygen gets down to 19.5%. Of course, setting off a general alarm at a higher level would very likely cause a noticeable number of false alarms. From the preceeding scenario, you can see that more is involved with oxygen deficiency monitoring than setting an alarm point and walking away.

# Let's Keep it Accurate

The bottom line is that our oxygen deficiency monitor needs to be accurate, visible and noticed. We can't just put it in a corner and forget about it. And we need to take an active and positive attitude towards the subject.