

## NOTES ON CO<sub>2</sub> (INDOOR AIR QUALITY)

Editor's Note: Welcome to ASHRAE Journal's Technical Q&A column. This column provides readers with an opportunity to ask technical questions and have the answers published. Each month the editors will select a question and answer. To submit a question, fill out the form provided on the ASHRAE Home Page (Go to [www.ashrae.org](http://www.ashrae.org), select ASHRAE Journal Online, then select Technology Q&A under News and Publications) or send a fax to: ASHRAE Journal Technical Q&A at (404) 321-5478. You can also mail them to: Editor, ASHRAE Journal, 1791 Tullie Circle NE, Atlanta, GA 30329-2305. Please limit questions to 75 words or less.

### **Question: What are the allowable concentrations of CO<sub>2</sub>?**

**Answer:** Concentration limits have been developed for industrial workplaces, specifically the Threshold Limit Values (TLVs) promulgated by the American Conference of Governmental Industrial Hygienists. These TLVs include a time-weight average over an 8-hour workday and a 40-hour work-week of 9 g/m<sup>3</sup> (5,000 PPM) and a short-term exposure limit of over 15 minutes of 54 g/m<sup>3</sup> (30,000 PPM). However, the applicability of industrial guidelines to nonindustrial spaces (e.g. homes, schools and office buildings) has been questioned. The 1984 World Health Organization working group consensus on indoor air pollutants states that concentrations above 12 g/m<sup>3</sup> (6,700 PPM) are of concern, and this working group was specifically addressing nonindustrial environments. In a 1989 Canadian exposure guideline for residential buildings, it was recommended that carbon dioxide concentrations be less than 6.3 g/m<sup>3</sup> (3,500 PPM). The indoor air quality procedure in ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality contains a guideline value for carbon dioxide of 1.8 g/m<sup>3</sup> (1000 PPM), however this is only one of several other requirements of the procedure. The ASHRAE guideline value is based on the association of elevated carbon dioxide concentrations with unacceptable levels of body odor, and not on any health or comfort impacts of carbon dioxide itself. Concentration limits have been developed for industrial workplaces, specifically the Threshold Limit Values (TLVs) promulgated by the American Conference of Governmental Industrial Hygienists. These TLVs include a time-weight average over an 8-hour workday and a 40-hour work-week of 9 g/m<sup>3</sup> (5,000 PPM) and a short-term exposure limit of over 15 minutes of 54 g/m<sup>3</sup> (30,000 PPM). However, the applicability of industrial guidelines to nonindustrial spaces (e.g. homes, schools and office buildings) has been questioned. The 1984 World Health Organization working group consensus on indoor air pollutants states that

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**Question: When should you be concerned about health effects from CO<sub>2</sub> exposure and at what levels?**

Answer: Two separate mechanisms are involved in health effects. The first relates to changes in acid-base status, the second to direct triggering of the common chemical sense. Mechanisms for some health effects, such as changes in blood pressure, remain unclear. Headaches have not been consistently identified even at levels of 2% to 2.8% (20,000 to 28,000 PPM) [36 to 50 g/m<sup>3</sup>], even after exercise, although inconsistent effects have been seen at those levels. At higher levels, mild performance impairment is noted up to 3% (30,000 PPM) [54 g/m<sup>3</sup>] over eight days of exposure, the lowest level at which performance levels were shown to change. Chronic exposures to levels as low as 10,000 to 15,000 PPM (18 g/m<sup>3</sup> to 27 g/m<sup>3</sup>) may cause changes in respiratory patterns, though these do not represent an acute respiratory adverse effect. Triggering the common chemical sense (mucosal irritation) occurs only at exposures above 50% (500,000 PPM) [900 g/m<sup>3</sup>]. All of these levels are well above those encountered in usually occupied space. A more detailed assessment can be found in Spacecraft Maximum Allowable Concentrations Volume 2, chapter B3.