Guide for Using TABLE C-2

The substances listed in Table C-2 are common air contaminants of concern in nonindustrial environments. The target concentrations that have been set or proposed by various national or international organizations concerned with health and comfort effects of outdoor and indoor air are listed for reference only. The table is not inclusive of all contaminants in indoor air, and achieving the target indoor concentrations for all of the listed substances does not ensure freedom from sensory irritation or from all adverse health effects for all occupants. In addition to indoor contaminant levels, the acceptability of indoor air also involves thermal conditions, indoor moisture levels as they impact microbial growth, and other indoor environmental factors. ASHRAE is not selecting or recommending default concentrations.

Health or comfort effects and exposure periods that are the basis for the guideline levels are listed in the "comments" column. For design, the goal should be to meet the guideline levels continuously during occupancy because people spend the great majority of their time indoors.

Users of this table should recognize that unlisted noxious contaminants can also cause unacceptable IAQ with regard to comfort (sensory irritation), odors, and health. When such contaminants are known or might reasonably be expected to be present, selection of an acceptable concentration and exposure may require reference to other guidelines or a review and evaluation of relevant toxicological and epidemiological literature. (Table C-2 summarizes some of this literature.)

TABLE C-2 Concentration of Interest for Selected Contaminants

(Note: References numbers that are followed by [c] and [m] list the concentrations of interest [c] and measurement methods [m]. The user of any value in this table should take into account the purpose for which it was adopted and the means by which it was developed.)

Contaminant	Sources	Concentrations of Interest	Comments	References
Carbon Monoxide (CO)	Leaking vented combustion appliances Unvented combustion appliances Parking garages Outdoor air	9 ppm (8 h)	Based on effects on persons with coronary artery disease, average exposure for eight hours. Sustained indoor concentrations exceeding outdoor concentrations may merit further investigation. Many carbon monoxide measuring instruments have limited accuracy at low levels. Sources—burning of gasoline, natural gas, coal, oil, etc. (Note: CO is unlikely to be the only contaminant of concern in parking garages or other spaces where vehicles operate.) Health effects—reduces ability of blood to bring oxygen to body cells and tissues; cells and tissues need oxygen to work. Carbon monoxide may be particularly hazardous to people who have heart or circulatory problems and people who have damaged lungs or breathing passages.	C-4 [c] C-9 [m]
Formaldehyde (HCHO)	Pressed-wood products Furniture and furnishings	0.1 mg/m3 (0.081 ppm) (30 min)	Based on irritation of sensitive people, 30-minute exposure (WHO)	C-11 [c] C-9, 26 [m]
		27 ppb (8 h)	Established as a never-to-exceed guideline to avoid irritant effects in sensitive individuals. Does not protect against formaldehyde's potential carcinogenicity (California Air Resources Board).	C-16
		45 ppb (55 µg/m^3) (1 h) 7.3 ppb (9 µg/m^3) (8 h)	Acute and 8-hour noncancer Reference Exposure Levels (RELs) developed based on current scientific database (Cal-EPA, OEHHA).	C-36
			Health effects—Acute and chronic inhalation exposure to formaldehyde in humans can result in eye, nose, and throat irritation, respiratory symptoms, exacerbation of asthma, and sensitization. Human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer. In 2004, the International Agency for Research on Cancer (IARC) concluded that "*formaldehyde is carcinogenic to humans (Group 1)*, on the basis of *sufficient evidence* in humans and *sufficient evidence* in experimental animals."	C-19, 20, 36, 40
		16 ppb	FEMA Procurement Specification for Mobile Homes	C-48

a. USEPA has promulgated a guideline value of 4 pCi/L indoor concentration. This is not a regulatory value but an action level where mitigation is recommended if the value is exceeded in long-term tests.

Conversion Factors [C-17]

Parts per million and mass per unit volume:

Measurements of indoor airborne concentrations of substances are generally converted to standard conditions of 77°F (25°C) and 29.92 in. Hg (101.325 kPa) pressure. Vapors or gases are often expressed in parts per million (ppm) by volume or in mass per unit volume. Concentrations in ppm by volume can be converted to mass per unit volume values as follows:

ppm × molecular weight/24,450 = mg/L
ppm × molecular weight/0.02445 = µg/m^3
ppm × molecular weight/24.45 = mg/m^3
ppm × molecular weight × 28.3/24,450 = mg/ft^3