

19. Building Characteristics

19.1 Introduction

Unlike previous chapters in the *Exposure Factors Handbook* that focus on human behavior or characteristics that affect exposure, Chapter 19 focuses on building characteristics. Assessment of exposure in indoor settings requires information on the availability of the chemical(s) of concern at the point of exposure, characteristics of the structure and micro-environment that affect exposure, and human presence within the building. **Chapter 19 of the *Exposure Factors Handbook*** provides recommended values on residential and non-residential building characteristics that affect exposure in an indoor environment. Information from Chapter 19 is highlighted here.

19.2 Recommended Exposure Factors

Table 19-1 presents the recommendations for residential building volumes and air exchange rates. The U.S. EPA 2010 analysis of the 2005 Residential Energy Consumption Survey (RECS) is the basis of the recommended housing volumes (U.S. DOE, 2008a). The residential air exchange rate is based on the perfluorocarbon tracer (PFT) database (Koontz and Rector, 1995). Table 19-2 presents the recommendations for non-residential buildings. These data come from the Commercial Building Energy Consumption Survey (CBECS) (U.S. DOE, 2008b). The recommended

air exchange rates for non-residential buildings come from Turk et al. (1987). The overall confidence ratings are medium for residential and non-residential building volumes. The data for air exchange rates are limited. Therefore, the recommendations for this factor have been assigned low confidence ratings and these values should be used with caution. Information on several other factors for which specific recommendations are not provided, are also presented in Chapter 19 of the Handbook.



Table 19-1. Recommendations—Residential Parameters

Volume of Residence	492 m ³ (central estimate) ^a	154 m ³ (lower percentile) ^b
Air Exchange Rate	0.45 ACH ^c (central estimate) ^d	0.18 ACH (lower percentile) ^e

^a Average value presented in Table 19-6 in the *Exposure Factors Handbook* recommended for use as a central estimate for all single family homes, including mobile homes and multi-family units.

^b 10th percentile values recommended to be used as a lower percentile estimate.

^c ACH = air changes per hour.

^d Median value recommended to be used as a central estimate (Table 19-24 in the *Exposure Factors Handbook*).

^e 10th percentile value recommended to be used as a lower percentile value (Table 19-24 in the *Exposure Factors Handbook*).

Source: U.S. EPA analysis of U.S. DOE, 2008a; Koontz and Rector, 1995.

Table 19-2. Summary of Recommended Values for Non-Residential Building Parameters

Volume of Building (m ³) ^{a,b}	Mean ^c	10 th Percentile ^d
Vacant	4,789	408
Office	5,036	510
Laboratory	24,681	2,039
Non-refrigerated warehouse	9,298	1,019
Food sales	1,889	476
Public order and safety	5,253	816
Outpatient healthcare	3,537	680
Refrigerated warehouse	19,716	1,133
Religious worship	3,443	612
Public assembly	4,839	595
Education	8,694	527
Food service	1,889	442
Inpatient healthcare	82,034	17,330
Nursing	15,522	1,546
Lodging	11,559	527
Strip shopping mall	7,891	1,359
Enclosed mall	287,978	35,679
Retail other than mall	3,310	510
Service	2,213	459
Other	5,236	425
All buildings ^e	5,575	527
Air Exchange Rate ^{f,g}	Mean (SD)1.5 (0.87) ACH Range 0.3-4.1 ACH	0.60 ACH

^a U.S. EPA analysis of U.S. DOE, 2008b.

^b Volumes were calculated assuming a ceiling height of 20 feet for warehouses and enclosed malls and 12 feet for other structures (see Table 19-20 of *Exposure Factors Handbook*).

^c Mean values are recommended as central estimates for non-residential buildings (see Table 19-20 of *Exposure Factors Handbook*).

^d 10th percentile values are recommended as lower estimates for non-residential buildings (see Table 19-20 of *Exposure Factors Handbook*).

^e Weighted average assuming a ceiling height of 20 feet for warehouses and enclosed malls and 12 feet for other structures (see Table 19-20 of *Exposure Factors Handbook*).

^f Air exchange rates for commercial buildings (see Table 19-27 of *Exposure Factors Handbook*).

^g Turk et al., 1987.

SD = Standard deviation.

ACH = Air changes per hour.

Source: U.S. EPA analysis of U.S. DOE, 2008a; Koontz and Rector, 1995.

