

November 27, 2024

Chicago Residential High-Rise Mechanical Ventilation Pilot Program Appendix

Article II. Definitions

SECTION 202 DEFINITIONS

For purposes of this appendix, the following definitions supplement or replace those found in Section 18-28-202 of the *Chicago Mechanical Code*:

AIR, MAKEUP. See *makeup air*.

AIR, TRANSFER. See *transfer air*.

BALANCED VENTILATION SYSTEM. A ventilation system that simultaneously supplies *outdoor air* to and removes *exhaust air* from a space, where the mechanical supply airflow rate and the mechanical exhaust airflow rate are each within 10 percent of the average of the two airflow rates.

BREATHING ZONE. The region within an occupied space between planes 3 and 72 inches (76 and 1829 mm) above the floor and more than 2 feet (610 mm) from the walls of the space or from fixed air-conditioning *equipment*.

BUILDING OFFICIAL. As defined in Chapter 14A-2.

CORRIDOR. As defined in Chapter 14B-2.

MAKEUP AIR. Any combination of *outdoor air* and *transfer air* intended to replace *exhaust air* and exfiltration.

MECHANICAL EXHAUST SYSTEM. A system for removing air from a room or space by mechanical means.

NET OCCUPIABLE FLOOR AREA. The floor area of an *occupiable space* defined by the inside surfaces of its walls but excluding shafts, column enclosures and other permanently enclosed, inaccessible and unoccupiable areas. Obstructions in the space such as furnishings, display or storage racks and other obstructions, whether temporary or permanent, shall not be deducted from the space area.

OCCUPIABLE SPACE. An enclosed space intended for human activities, excluding those spaces intended primarily for other purposes, such as storage rooms and *equipment* rooms, that are only intended to be occupied occasionally and for short periods of time.

PRIVATE GARAGE. As defined in Chapter 14B-2.

TRANSFER AIR. Air moved from one indoor space to another.

Article IV. Ventilation

For purposes of this appendix, the following provisions entirely replace Article IV of the *Chicago Mechanical Code*:

SECTION 401 GENERAL

401.1 Scope.

This article shall govern the *ventilation* of spaces within a building intended to be occupied. *Mechanical exhaust systems* shall also comply with Article V.

401.2 Ventilation required.

Every *occupiable space* shall be ventilated by mechanical means in accordance with Section 403.

401.3 When required.

Ventilation shall be provided during the periods that the room or space is occupied.

401.4 Intake opening location.

Air intake openings shall comply with all of the following:

1. Intake openings shall be separated from lot lines or buildings on the same lot so as to prevent obstruction or contamination of the air supply.
2. Mechanical and gravity outdoor air intake openings shall be located not less than 15 feet (4572 mm) horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3. Outdoor air intake openings shall be permitted to be located less than 15 feet (4572 mm) horizontally from streets, alleys, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.
3. Separation is not required between intake air openings and living space *exhaust air* openings of an individual *dwelling unit* or *sleeping unit* where a factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the fan manufacturer's instructions.
4. Intake openings on structures in flood hazard areas shall be at or above the elevation required by the *Chicago Building Code* for utilities and attendant *equipment*.
5. Horizontal intake openings shall not be located in a walking or driving surface, such as a sidewalk, driveway, or street. Horizontal intake openings shall be at least 12 inches (305 mm) above adjacent grade.
6. Intake openings shall not draw air from the lower level of any multi-level street or similar condition.

401.5 Intake opening protection.

Air intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles. Openings in louvers, grilles and screens shall be sized in accordance with Table 401.5. Outdoor air intake openings located in exterior walls shall meet the provisions for exterior wall opening protectives in accordance with Chapter 7 of the *Chicago Building Code* and for rodent protection and insect screens in accordance with Sections 1210 and 1211 of the *Chicago Building Code*.

**TABLE 401.5
OPENING SIZES IN LOUVERS, GRILLES AND
SCREENS PROTECTING AIR INTAKE OPENINGS**

OUTDOOR OPENING TYPE	MINIMUM AND MAXIMUM OPENING SIZES IN LOUVERS, GRILLES AND SCREENS^a
Intake openings for systems serving individual dwelling units or sleeping units	Not less than 1/4 inch and not greater than 1/2 inch
Intake openings for all other systems	Not less than 1/4 inch and not greater than 1 inch

For SI: 1 inch = 25.4 mm.

- a. For rectangular openings, the table requirements apply to the shortest side. For round openings, the table requirements apply to the diameter. For square openings, the table requirements apply to any side.

401.6 Contaminant sources.

Stationary local sources producing airborne particulates, heat, odors, fumes, spray, vapors, smoke or gases in such quantities as to be irritating or injurious to health shall be provided with an *exhaust system* in accordance with Article V or a means of collection and removal of the contaminants.

401.7 Obstruction.

Air intake openings shall be located so as to remain unobstructed during expected operational and weather conditions.

SECTION 402 [RESERVED]

SECTION 403 MECHANICAL VENTILATION

403.1 Ventilation system.

Mechanical *ventilation* shall be provided by a method of *supply air* and *return air* or *exhaust air*. The amount of *supply air* shall be approximately equal to the amount of *return air* and *exhaust air*. The system shall not be prohibited from producing negative or positive pressure where allowed by Section 18-28-501.4. The system to convey *ventilation air* shall be designed and installed in accordance with Article VI.

403.2 Outdoor air required.

The minimum outdoor airflow rate shall be determined in accordance with Section 403.3.

403.2.1 Recirculation of air.

The *outdoor air* required by Section 403.3 shall not be *recirculated air*. Air in excess of that required by Section 403.3 may be *recirculated air* in compliance with Sections 403.2.1.1 through 403.2.1.5.

403.2.1.1 Dwelling units and sleeping units.

Air may be recirculated within a *dwelling unit* or *sleeping unit*. Air shall not be recirculated from one *dwelling unit* or *sleeping unit* to another.

403.2.1.2 Dissimilar uses.

Air shall not be recirculated between spaces with dissimilar uses.

403.2.1.3 Indoor swimming pools.

Supply air to a swimming pool and associated deck areas shall not be *recirculated air* unless such air is dehumidified to maintain the relative humidity of the area at 60 percent or less. Air from this area shall not be recirculated to other spaces where more than 10 percent of the resulting supply airstream consists of *recirculated air* from these spaces. The design and installation of dehumidification systems shall comply with ANSI/ACCA 10 Manual SPS.

403.2.1.4 Designation of expected air-quality classification.

Return air, transfer air, and exhaust air leaving a space shall be designated with an expected air-quality classification not less than shown in Table 403.3.1.1, as provided in Section 403.2.1.4.3 or as *approved* by the *building official*. Air leaving spaces that are not listed in Table 403.3.1.1 shall be designated based on the most similar space listed in terms of occupant activities and building construction.

403.2.1.4.1 Mixed sources.

A mixture of air that has been transferred through or returned from spaces with different expected air-quality classifications shall be designated with the highest classification among the sources.

403.2.1.4.2 Ancillary spaces.

A Class 1 space that is ancillary to a Class 2 space shall be allowed to be classified as a Class 2 space.

403.2.1.4.3 Specific sources.

Air from a source listed in Table 403.2.1.4.3 shall be designated with an expected air-quality classification not less than shown in the table.

**TABLE 403.2.1.4.3
CLASSIFICATION OF AIR FROM SPECIFIC SOURCES**

SOURCE	CLASSIFICATION
Type I hood	4
Domestic cooking range hood or downdraft exhaust	4 ^a
Type II hood	3
Diazo printing equipment discharge	4
Hydraulic elevator machine room	2
Laboratory hoods	4
Paint spray booths	4
Refrigerating machinery rooms	3

- a. Air that passes through a listed and labeled ductless (recirculating) range hood installed in accordance with Section 18-28-505.3 and the manufacturer’s instructions shall be classified as Class 2 air.

403.2.1.4.4 Designation for unlisted uses.

Construction documents shall indicate the justification for classification of air from any use classification or source not listed in Table 403.2.1.4.3 or 403.3.1.1.

403.2.1.5 Recirculation limitations.

Use of *recirculated air* shall be limited in accordance with Table 403.2.1.5 based on the classification of the space of origin and space in which the air will be recirculated.

**TABLE 403.2.1.5
LIMITATIONS ON RECIRCULATED AIR**

CLASSIFICATION OF AIR, SPACE OF ORIGIN	RECIRCULATION WITHIN SPACE OF ORIGIN	RECIRCULATION OR TRANSFER TO OTHER SPACES			
		CLASS 1	CLASS 2	CLASS 3	CLASS 4
Class 1	Allowed	Allowed			
Class 2	Allowed	Not allowed ^b	Allowed ^a	Allowed	
Class 3	Allowed	Not allowed ^c			
Class 4	Not allowed				

- a. Provided that the other space is used for the same or similar purpose or task and involves the same or similar contaminant sources. Transfer of Class 2 air to a toilet room is allowed.
- b. Where there is a wheel-type energy recovery ventilation (ERV) unit in the exhaust system, recirculation from leakage, carry-over or transfer from the exhaust side of the ERV is allowed but shall not be counted as outdoor air. The exhaust air transfer ratio of Class 2 air shall not exceed 10% of the outdoor air intake flow at the design static pressure differential per AHRI 1060.
- c. Where there is a wheel-type energy recovery ventilation (ERV) unit in the exhaust system, recirculation from leakage, carry-over or transfer from the exhaust side of the ERV is allowed but shall not be counted as outdoor air. The exhaust air transfer ratio of Class 3 air shall not exceed 5% of the outdoor air intake flow at the design static pressure differential per AHRI 1060.

403.2.2 Transfer air.

Except where recirculation from such spaces is prohibited by Section 403.2.1, air transferred from *occupiable spaces* is not prohibited from serving as *makeup air* for required *exhaust systems* in such spaces as kitchens, *bathrooms*, *toilet rooms*, elevators and smoking lounges. The amount of *transfer air* and *exhaust air* shall be sufficient to provide the flow rates as specified in Section 403.3.1.1. The required outdoor airflow rates specified in Table 403.3.1.1 shall be introduced directly into such spaces or into the *occupiable spaces* from which air is transferred or a combination of both.

403.3 Outdoor air and local exhaust airflow rates.

Group R-2, R-3, R-4 and R-5 occupancies shall be provided with *outdoor air* and local exhaust in accordance with Section 403.3.2. Other enclosed spaces within buildings shall be provided with *outdoor air* and local exhaust in accordance with Section 403.3.1.

403.3.1 General.

The design of local *exhaust systems* and ventilation systems for *outdoor air* shall comply with Sections 403.3.1.1 through 403.3.1.4.

Exception: Group R-2, R-3, R-4 and R-5 occupancies subject to Section 403.3.2.

403.3.1.1 Outdoor airflow rate.

Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate, determined in accordance with this section. In each *occupiable space*, the ventilation system shall be designed to deliver the required rate of outdoor airflow to the *breathing zone*. The occupant load utilized for design of the ventilation system shall be the largest (peak) number of people expected to occupy the zone during typical use and not less than the number determined from the minimum design occupant density indicated in Table 403.3.1.1. Ventilation rates for uses not represented in Table 403.3.1.1 shall be those for a listed use classification that is most similar in terms of occupant density, activities and space configuration. The ventilation system shall be designed to supply the required rate of *ventilation air* continuously during the period the room or space served is occupied, except as otherwise stated in this code.

With the exception of smoking lounges, the ventilation rates in Table 403.3.1.1 are based on the absence of smoking in *occupiable spaces*. Where smoking is anticipated in an enclosed space other than a smoking lounge, the ventilation system serving the space shall be designed to provide ventilation over and above that required by Table 403.3.1.1 in accordance with accepted engineering practice to protect human health.

(Continues on next page.)

**TABLE 403.3.1.1
MINIMUM VENTILATION RATES**

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT² a	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R_a CFM/FT² a	EXHAUST AIRFLOW RATE CFM/FT² a	AIR CLASS
Animal facilities					
Animal exam room (veterinary office)	20	10	0.12	—	2
Animal imaging (MRI/CT/PET)	20	10	0.18	0.90	3
Animal operating room	20	10	0.18	3.00	3
Animal postoperative recovery room	20	10	0.18	1.50	3
Animal preparation room	20	10	0.18	1.50	3
Animal procedure room	20	10	0.18	2.25	3
Animal surgery scrub	20	10	0.18	1.50	3
Large animal holding room	20	10	0.18	2.25	3
Necropsy	20	10	0.18	2.25	3
Pet shop (animal areas)	10	7.5	0.18	0.90	3
Small animal cage room (static cages)	20	10	0.18	2.25	3
Small animal cage room (ventilated cages)	20	10	0.18	1.50	3
Correctional facilities					
Booking/waiting	50	7.5	0.06	—	2
Cell (with plumbing fixtures) ^g	25	5	0.12	1.00	2
Cell (without plumbing fixtures)	25	5	0.12	—	2
Day room	30	5	0.06	—	1
Dining hall	See “food and beverage service facilities.”				
Guard station	15	5	0.06	—	1
Dry cleaning and laundry facilities					
Commercial dry cleaning plant	30	30	—	—	3
Commercial laundry	10	5	0.12	—	2

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ² ^a	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ² ^a	EXHAUST AIRFLOW RATE CFM/FT ² ^a	AIR CLASS
Public self-service laundry	20	7.5	0.12	—	2
Self-service laundry room, central	10	5	0.12	—	2
Educational facilities					
Art classroom	20	10	0.18	0.70	2
Auditorium	See “public assembly facilities” and “theater facilities.”				
Classroom (ages 5 to 8)	25	10	0.12	—	1
Classroom (age 9 plus)	35	10	0.12	—	1
Computer lab	25	10	0.12	—	1
Day care (through age 4)	25	10	0.18	—	1
Day care sick room	25	10	0.18	—	3
Lecture classroom	65	7.5	0.06	—	1
Lecture hall (fixed seats)	150	7.5	0.06	—	1
Locker/dressing room	See “general facilities.”				
Library	See “public assembly facilities.”				
Multiuse assembly	See “public assembly facilities.”				
Music/theater/dance	35	10	0.06	—	1
Science laboratory	25	10	0.18	1.00	2
Sports locker room	See “general facilities.”				
University/college laboratory	25	10	0.18	1.00	2
Wood/metal shop	20	10	0.18	0.50	2
Food and beverage service facilities					
Bar, cocktail lounge	100	7.5	0.18	—	2
Cafeteria, fast food dining room	100	7.5	0.18	—	2

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ^{2 a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ^{2 a}	EXHAUST AIRFLOW RATE CFM/FT ^{2 a}	AIR CLASS
Commercial kitchen	See “workplace facilities, specialized.”				
Restaurant dining room	70	7.5	0.18	—	2
General facilities					
Break room (with kitchenette)	50	5	0.12	0.30	2
Break room (without kitchenette)	50	5	0.06	—	1
Conference/meeting	50	2.5	0.06	—	1
Corridor	—	—	0.06	—	1
Elevator car	—	—	—	1.00	1
Locker room for athletic, industrial or health care facilities	—	—	—	0.50	2
Locker room, other	—	—	—	0.25	2
Room with adult changing station	—	—	—	50/70 ^e	2
Shower room (per shower head)	—	—	—	20/50 ^f	2
Smoking lounge	70	60	—	Note m	3
Toilet room—public	—	—	—	50/70 ^e	2
Office-type facilities					
Call center/data entry	60	5	0.06	—	1
Conference room	50	5	0.06	—	1
Copy/printing room	5	5	0.06	0.50	2
General office	5	5	0.06	—	1
Main entry lobby	10	5	0.06	—	1
Reception area	30	5	0.06	—	1
Outpatient health care facilities^{i, j}					

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ^{2 a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ^{2 a}	EXHAUST AIRFLOW RATE CFM/FT ^{2 a}	AIR CLASS
Birthing room	15	10	0.18	—	2
Class 1 imaging room	5	5	0.12	—	1
Dental operatory ^k	20	10	0.18	—	1
General examination room	20	7.5	0.12	—	1
Other dental treatment area	5	5	0.06	—	1
Physical therapy exercise area	7	20	0.18	—	2
Physical therapy individual room	20	10	0.06	—	1
Physical therapy pool area	—	—	0.48	—	2
Prosthetics and orthotics room	20	10	0.18	—	1
Psychiatric consultation room	20	5	0.06	—	1
Psychiatric examination room	20	5	0.06	—	1
Psychiatric group room	50	5	0.06	—	1
Psychiatric seclusion room	5	10	0.06	—	1
Speech therapy room	20	5	0.06	—	1
Urgent care examination room	20	7.5	0.12	—	1
Urgent care observation room	20	5	0.06	—	1
Urgent care treatment room	20	7.5	0.18	—	1
Urgent care triage room	20	10	0.18	—	1
Parking garages and parking facilities					
Parking, enclosed (6 or more motor vehicles) ^d	—	—	—	0.75	3
<i>Private garage</i> (5 or fewer motor vehicles)	—	—	—	Note n	3

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ^{2 a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ^{2 a}	EXHAUST AIRFLOW RATE CFM/FT ^{2 a}	AIR CLASS
Private (nontransient) dwelling units and sleeping units	See Section 403.3.2				2
Public assembly facilities					
Auditorium, spectator area	150	5	0.06	—	1
Courtroom	70	5	0.06	—	1
Legislative chamber	50	5	0.06	—	1
Library	10	5	0.12	—	1
Lobby / prefunction	30	7.5	0.06	—	1
Multipurpose assembly	120	7.5	0.06	—	1
Museum (children's)	40	7.5	0.12	—	1
Museum/gallery	40	7.5	0.06	—	1
Place of religious worship	120	5	0.06	—	1
Sports and entertainment	See "sports and entertainment facilities."				
Retail and personal service facilities					
Dressing room	—	—	—	0.25	1
Sales (except as below)	15	7.5	0.12	—	1
Automotive motor-fuel dispensing station	—	—	—	1.50	3
Bank, customer lobby	15	7.5	0.06	—	1
Bank, vault or safe deposit	5	5	0.06	—	2
Barber	25	7.5	0.06	0.50	2
Beauty salon	25	20	0.12	0.60	3
Gallery/showroom	40	7.5	0.06	—	1
Mall common area	40	7.5	0.06	—	1
Nail salon ^{b, h}	25	20	0.12	0.60	3

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ^{2 a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ^{2 a}	EXHAUST AIRFLOW RATE CFM/FT ^{2 a}	AIR CLASS
Pet shop (animal areas)	See “animal facilities.”				
Supermarket	8	7.5	0.06	—	1
Shipping and receiving	2	10	0.12	—	2
Warehouse	See “storage facilities.”				
Sports and entertainment facilities					
Bowling alley (seating)	40	10	0.12	—	1
Dance floor	100	20	0.06	—	2
Gambling casino	120	7.5	0.18	—	1
Game arcade	20	7.5	0.18	—	1
Gym, sports arena (play area)	7	20	0.18	—	2
Health club, aerobics room	40	20	0.06	—	2
Health club, weight/equipment room	10	20	0.06	—	2
Ice arena without combustion engines	—	—	0.30	0.50	1
Spectator area	See “public assembly facilities.”				
Stages, studios	See “theater facilities.”				
Swimming pool (pool and deck area)	—	—	0.48	—	2
Storage facilities					
Chemical storage room	—	—	—	1.50	4
Janitor closet	—	—	—	1.00	3
Occupiable storage room for dry material	2	5	0.06	—	1
Occupiable storage room for liquids or gels	2	5	0.12	—	2
Refrigerated storage/freezer (< 50°F)	—	10	—	—	2
Soiled laundry storage room	—	—	—	1.00	3
Trash/recycling room	—	—	—	1.00	3

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ^{2 a}	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ^{2 a}	EXHAUST AIRFLOW RATE CFM/FT ^{2 a}	AIR CLASS
Warehouse ^l	0	10	0.06	—	2
Theater facilities					
Lobby	150	5	0.06	—	1
Performance area (stage, studio)	70	10	0.06	—	1
Spectator area (auditorium)	See “public assembly facilities.”				
Ticket booth	60	5	0.06	—	1
Transient residential facilities (hotels, motels, dormitories, etc.)					
Bathroom / toilet room—private	—	—	—	25/50 ^f	2
Bedroom / living room	10	5	0.06	—	1
Dormitory (barracks) sleeping area	20	5	0.06	—	1
Transportation facilities					
Platform	100	7.5	0.06	—	3
Waiting room	100	7.5	0.06	—	1
Workplace facilities, specialized					
Commercial kitchen ^b	20	7.5	0.12	0.70	2
Computer room (without printing)	4	5	0.06	—	1
Copy and printing room	4	5	0.06	0.50	2
Darkroom	—	—	—	1.00	2
Embalming	—	—	—	2.00	3
Manufacturing (no hazardous materials)	7	10	0.18	—	2
Manufacturing (some hazardous materials)	7	10	0.18	—	3
Meat processing ^c	10	15	—	—	2
Motor vehicle repair ^d	—	—	—	1.50	3

USE	MINIMUM DESIGN OCCUPANT DENSITY #/1000 FT ² a	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a CFM/FT ² a	EXHAUST AIRFLOW RATE CFM/FT ² a	AIR CLASS
Pharmacy (preparation area)	10	5	0.18	—	2
Photography studio	10	5	0.12	—	1
Shipping / receiving	2	10	0.12	—	2
Sorting, packing or light assembly	7	7.5	0.12	—	2
Woodwork	7	10	0.18	0.5	2

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 ton = 908 kg, 1 cubic foot per minute per square foot = 0.00508 m³/(s × m²), °C = [(°F) – 32]/1.8, 1 square foot = 0.0929 m².

- a. Based on net occupiable floor area.
- b. [Reserved]
- c. Spaces unheated or maintained below 50°F are not covered by these requirements unless the occupancy is continuous.
- d. Ventilation systems in enclosed parking garages shall comply with Section 404.
- e. Rates are per water closet, urinal or adult changing station. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.
- f. Rates are per room unless otherwise indicated. The higher rate shall be provided where the exhaust system is designed to operate intermittently. The lower rate shall be permitted only where the exhaust system is designed to operate continuously while occupied.
- g. [Reserved]
- h. For nail salons, each manicure and pedicure station shall be provided with a source capture system capable of exhausting not less than 50 cfm per station. Manicure tables and pedicure stations not provided with factory-installed exhaust inlets shall be provided with exhaust inlets located not more than 12 inches horizontally and vertically from the point of chemical application. Where one or more required source capture systems operate continuously during occupancy, the exhaust rate from such systems shall be permitted to be applied to the exhaust flow rate required by Table 403.3.1.1 for the nail salon.
- i. Outpatient facilities to which the rates apply are freestanding birth centers, urgent care centers, neighborhood clinics and physicians' offices, Class 1 imaging facilities, outpatient psychiatric facilities, outpatient rehabilitation facilities and outpatient dental facilities.
- j. The requirements of this table provide for acceptable IAQ. The requirements of this table do not address the airborne transmission of airborne viruses, bacteria and other infectious contagions.
- k. These rates are intended only for outpatient dental clinics where the amount of nitrous oxide is limited. They are not intended for dental operatories in institutional buildings where nitrous oxide is piped.
- l. The net occupiable floor area in warehouses shall not include the floor area of self-storage units, floor areas under rack storage or designated palletized storage floor areas.
- m. Exhaust system must be designed in accordance with accepted engineering practice to protect human health.
- n. Provide at least 1 square foot of relief openings per motor vehicle.

403.3.1.1.1 Zone outdoor airflow.

The minimum outdoor airflow required to be supplied to each zone shall be determined as a function of occupancy classification and space air distribution effectiveness in accordance with Sections 403.3.1.1.1.1 through 403.3.1.1.1.3.

403.3.1.1.1.1 Breathing zone outdoor airflow.

The outdoor airflow rate required in the *breathing zone* (V_{bz}) of the *occupiable space* or spaces in a zone shall be determined in accordance with Equation 4-1.

$$V_{bz} = R_p P_z + R_a A_z \quad \text{(Equation 4-1)}$$

where:

- A_z = Zone floor area: the *net occupiable floor area* of the space or spaces in the zone.
- P_z = Zone population: the number of people in the space or spaces in the zone.
- R_p = People outdoor air rate: the outdoor airflow rate required per person from Table 403.3.1.1.
- R_a = Area outdoor air rate: the outdoor airflow rate required per unit area from Table 403.3.1.1.

403.3.1.1.1.2 Zone air distribution effectiveness.

The zone air distribution effectiveness (E_z) shall be determined using Table 403.3.1.1.1.2.

**TABLE 403.3.1.1.2
ZONE AIR DISTRIBUTION EFFECTIVENESS^{a, b, c, d}**

AIR DISTRIBUTION CONFIGURATION	E_z
Ceiling or floor supply of cool air	1.0 ^e
Ceiling or floor supply of warm air and floor return	1.0
Ceiling supply of warm air and ceiling return	0.8 ^f
Floor supply of warm air and ceiling return	0.7
Makeup air drawn in on the opposite side of the room from the exhaust or return	0.8
Makeup air drawn in near to the exhaust or return location	0.5

For SI: 1 foot = 304.8 mm, 1 foot per minute = 0.00506 m/s, °C = [(°F) – 32]/1.8.

- a. “Cool air” is air cooler than space temperature.
- b. “Warm air” is air warmer than space temperature.
- c. “Ceiling” includes any point above the breathing zone.
- d. “Floor” includes any point below the breathing zone.
- e. Zone air distribution effectiveness of 1.2 shall be permitted for systems with a floor supply of cool air and ceiling return, provided that low-velocity displacement ventilation achieves unidirectional flow and thermal stratification.
- f. Zone air distribution effectiveness of 1.0 shall be permitted for systems with a ceiling supply of warm air, provided that supply air temperature is less than 15°F above space temperature and provided that the 150-foot-per-minute supply air jet reaches to within 4½ feet of floor level.

403.3.1.1.1.3 Zone outdoor airflow.

The zone outdoor airflow rate (V_{oz}), shall be determined in accordance with Equation 4-2.

$$V_{oz} = \frac{V_{bz}}{E_z} \quad \text{(Equation 4-2)}$$

403.3.1.1.2 System outdoor airflow.

The *outdoor air* required to be supplied by each ventilation system shall be determined in accordance with Sections 403.3.1.1.2.1 through 403.3.1.1.2.3.4 as a function of system type and zone outdoor airflow rates.

403.3.1.1.2.1 Single zone systems.

Where one air handler supplies a mixture of *outdoor air* and *recirculated air* to only one zone, the system *outdoor air* intake flow rate (V_{ot}) shall be determined in accordance with Equation 4-3.

$$V_{ot} = V_{oz} \quad \text{(Equation 4-3)}$$

403.3.1.1.2.2 100-percent outdoor air systems.

Where one air handler supplies only *outdoor air* to one or more zones, the system *outdoor air* intake flow rate (V_{ot}) shall be determined using Equation 4-4.

$$V_{ot} = S_{all\ zones} V_{oz} \quad \text{(Equation 4-4)}$$

403.3.1.1.2.3 Multiple zone recirculating systems.

Where one air handler supplies a mixture of *outdoor air* and *recirculated air* to more than one zone, the system outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Sections 403.3.1.1.2.3.1 through 403.3.1.1.2.3.4.

403.3.1.1.2.3.1 Primary outdoor air fraction.

The primary *outdoor air* fraction (Z_p) shall be determined for each zone in accordance with Equation 4-5.

$$Z_p = \frac{V_{oz}}{V_{pz}} \quad \text{(Equation 4-5)}$$

where:

V_{pz} = Primary airflow: The airflow rate supplied to the zone from the air-handling unit at which the *outdoor air* intake is located. It includes outdoor intake air and *recirculated air* from that air-handling unit but does not include air transferred or air recirculated to the zone by other means. For design purposes, V_{pz} shall be the zone design primary airflow rate, except for zones with variable air volume supply and V_{pz} shall be the lowest expected primary airflow rate to the zone when it is fully occupied.

403.3.1.1.2.3.2 System ventilation efficiency.

The system ventilation efficiency (E_v) shall be determined using Table 403.3.1.1.2.3.2 or Appendix A of ASHRAE 62.1.

**TABLE 403.3.1.1.2.3.2
SYSTEM VENTILATION EFFICIENCY^{a, b}**

<i>Max</i> (Z_p)	E_v
≤ 0.15	1
≤ 0.25	0.9
≤ 0.35	0.8
≤ 0.45	0.7

≤ 0.55	0.6
≤ 0.65	0.5
≤ 0.75	0.4
> 0.75	0.3

- a. $Max(Z_p)$ is the largest value of Z_p calculated using Equation 4-5 among all the zones served by the system.
- b. Interpolating between table values shall be permitted.

403.3.1.1.2.3.3 Uncorrected outdoor air intake.

The uncorrected outdoor air intake flow rate (V_{ou}) shall be determined in accordance with Equation 4-6.

$$V_{ou} = DS_{all\ zones}R_pP_z + S_{all\ zones}R_aA_z \quad \text{(Equation 4-6)}$$

where:

D = Occupant diversity: the ratio of the system population to the sum of the zone populations, determined in accordance with Equation 4-7.

$$D = \frac{P_s}{S_{all\ zones}P_z} \quad \text{(Equation 4-7)}$$

where:

P_s = System population: The total number of occupants in the area served by the system. For design purposes, P_s shall be the maximum number of occupants expected to be concurrently in all zones served by the system.

403.3.1.1.2.3.4 Outdoor air intake flow rate.

The outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Equation 4-8.

$$V_{ot} = \frac{V_{ou}}{E_z} \quad \text{(Equation 4-8)}$$

403.3.1.2 Exhaust ventilation.

Exhaust airflow rate shall be provided in accordance with the requirements of Table 403.3.1.1. *Outdoor air* introduced into a space by an *exhaust system* shall be considered as contributing to the outdoor airflow required by Table 403.3.1.1.

403.3.1.3 System operation.

The minimum flow rate of *outdoor air* that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3.1.1 and the actual number of occupants present. Where demand-controlled ventilation is employed to adjust the outdoor airflow rate based on the actual number of occupants present, the minimum quantity of outdoor air shall not fall below that determined from the area outdoor airflow rate column of Table 403.3.1.1 during periods when the building is expected to be occupied.

403.3.1.4 Variable air volume system control.

Variable air volume air distribution systems, other than those designed to supply only 100-percent *outdoor air*, shall be provided with controls to regulate the flow of *outdoor air*. Such control system shall be designed to maintain the flow rate of *outdoor air* at a

rate of not less than that required by Section 403.3 over the entire range of *supply air* operating rates.

403.3.2 Group R-2, R-3, R-4 and R-5 occupancies.

The design of local *exhaust systems* and ventilation systems for *outdoor air* in Group R-2, R-3, R-4 and R-5 occupancies shall comply with Sections 403.3.2.1 through 403.3.2.5.

403.3.2.1 Outdoor air for dwelling units and sleeping units.

An *outdoor air* ventilation system consisting of a *mechanical exhaust system*, supply system or combination thereof shall be installed for each *dwelling unit* and for each *sleeping unit* that is not part of a *dwelling unit*. Local exhaust or supply systems, including outdoor air ducts connected to the return side of an air handler, are permitted to serve as such a system. The *outdoor air* ventilation system shall be designed to provide the required rate of *outdoor air* continuously during the period that the *dwelling unit* or *sleeping unit* is occupied. The minimum continuous outdoor airflow rate shall be determined in accordance with Equation 4-9.

Exception: Exhaust-only mechanical *ventilation* shall not be allowed for newly established attached *dwelling units* that open directly to an enclosed *corridor* or stairway.

$$Q_{OA} = 0.03 A_{floor} + 7.5(N_{br} + 1) \quad \text{(Equation 4-9)}$$

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = conditioned floor area, ft²

N_{br} = number of bedrooms; not to be less than one

Exceptions:

1. The *outdoor air* ventilation system is not required to operate continuously where the system has controls that enable operation for not less than 1 hour of each 4-hour period. The average outdoor airflow rate over the 4-hour period shall be not less than that prescribed by Equation 4-9.
2. The minimum mechanical ventilation rate determined in accordance with Equation 4-9 shall be reduced by 30 percent provided that all of the following conditions are met:
 - 2.1. A ducted system supplies *ventilation air* directly to each bedroom and to one or more of the following rooms:
 - 2.1.1. Living room.
 - 2.1.2. Dining room.
 - 2.1.3. Kitchen.
 - 2.2. The ventilation system is a *balanced ventilation system*.
 - 2.3. Doors between *dwelling units* and common *corridors* are gasketed or made substantially airtight.

403.3.2.2 Reserved.

403.3.2.3 Local exhaust.

Local *exhaust systems* shall be provided in kitchens, *bathrooms* and *toilet rooms* and shall have the capacity to exhaust the minimum airflow rate determined in accordance with Table 403.3.2.3.

**TABLE 403.3.2.3
MINIMUM REQUIRED LOCAL EXHAUST RATES FOR
GROUP R-2, R-3 R-4 AND R-5 OCCUPANCIES**

AREA TO BE EXHAUSTED	EXHAUST RATE CAPACITY	
	DEMAND CONTROLLED ^a	CONTINUOUS
Kitchen	Vented range hood (including appliance-range hood combinations): 100 cfm Other kitchen exhaust fans, including downdraft: 300 cfm	Open kitchen: 50 cfm, with inlet located in the area with heaviest concentration of contaminants and at least 48 inches horizontally from cooktops and ranges Enclosed kitchen ^b : 5 ACH based on volume of kitchen
Bathroom or toilet room	50 cfm	20 cfm

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 square foot = 0.0929 m², 1 inch = 25.4 mm.

- a. Demand controlled local mechanical exhaust equipment shall be provided with either a manual on-off control or an automatic control that does not impede manual on control.
- b. The total area of openings between an enclosed kitchen and adjacent interior spaces shall not exceed 60 ft².

403.3.2.4 System controls.

Where provided within a *dwelling unit* or *sleeping unit*, controls for *outdoor air* ventilation systems shall include text or a symbol indicating the system’s function.

403.3.2.5 Fans.

Fans providing exhaust or *outdoor air* shall be *listed* and *labeled* to provide the minimum required air flow in accordance with ANSI/AMCA 210-ANSI/ASHRAE 51.

403.3.2.6 Outdoor air for corridors and similar spaces.

Indoor *corridors* and similar common areas that serve *dwelling units* or *sleeping units* shall be provided with *outdoor air* at a rate of not less than 0.06 cfm per square foot [0.0003 m³/(s • m²)] of *net occupiable floor area*. The minimum required *outdoor air* for a *corridor* shall not also be counted as providing required *outdoor air* for spaces opening onto the *corridor*.

403.3.2.7 Outdoor air for amenity and accessory use spaces.

Lounges, gathering areas, laundry rooms, building offices, and similar amenity or accessory use spaces in Group R-2 and R-3 occupancies shall be provided with *outdoor air* in accordance with Section 403.3.1.

403.3.2.8 Adjacent spaces and transfer air.

Measures shall be taken to minimize air movement across the boundary between a *dwelling unit* or *sleeping unit* and adjacent spaces, such as parking garages, unconditioned crawl spaces, unconditioned attics, and other *dwelling units* or *sleeping units*. Boundary wall, ceiling, and floor penetrations shall be sealed.

403.2.8.1 Adjacent parking garage.

Where a parking garage, including a *private garage*, is adjacent to a *dwelling unit* or *sleeping unit*, boundary walls, ceilings, and floors shall be air sealed to prevent the migration of contaminants. To be considered air sealed, all joints, seams, penetrations, openings between door assemblies and their respective jambs and framing, and other sources of air leakage through wall and ceiling assemblies shall be caulked, gasketed, weather stripped, wrapped, or otherwise sealed to limit air movement. Doors between a garage and a *dwelling unit* or *sleeping unit* shall be gasketed or made substantially airtight with weather stripping.

SECTION 404 ENCLOSED PARKING GARAGES

404.1 Enclosed parking garages.

Mechanical ventilation systems for enclosed parking garages shall operate continuously or shall be automatically operated by means of carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors. Such detectors shall be listed in accordance with UL 2075 and installed in accordance with their listing and the manufacturer's instructions. Automatic operation shall cycle the ventilation system between the following two modes of operation:

1. Full-on at an airflow rate of not less than 0.75 cfm per square foot [$0.0038 \text{ m}^3 / (\text{s} \cdot \text{m}^2)$] of the floor area served.
2. Standby at an airflow rate of not less than 0.05 cfm per square foot [$0.00025 \text{ m}^3 / (\text{s} \cdot \text{m}^2)$] of the floor area served.

404.2 Occupied spaces accessory to parking garages.

Offices, waiting rooms, ticket booths and similar spaces that are connected and accessory to a parking garage, other than a *private garage*, shall be maintained at a positive pressure and shall be provided with *mechanical ventilation* in accordance with Section 403.3.1.

SECTION 405 SYSTEMS CONTROL

405.1 General.

Mechanical ventilation systems shall be provided with manual or automatic controls that will operate such systems whenever the spaces are occupied. Air-conditioning systems that supply required *ventilation air* shall be provided with controls designed to automatically maintain the required *outdoor air* supply rate during occupancy.

SECTION 406 VENTILATION OF UNINHABITED SPACES

406.1 General.

Uninhabited spaces, such as crawl spaces and attics, shall be provided with *natural ventilation* openings as required by the *Chicago Building Code* or shall be provided with a *mechanical exhaust system* and *supply air system*. The mechanical exhaust rate shall be not less than 0.02 cfm per square foot ($0.00001 \text{ m}^3 / \text{s} \cdot \text{m}^2$) of horizontal area and shall be automatically controlled to operate when the relative humidity in the space served exceeds 60 percent.