# CHAPTER 4
# VENTILATION

## SECTION MC 401
## GENERAL

**401.1 Scope.** This chapter shall govern the ventilation of spaces within a building intended to be occupied. This chapter does not govern the requirements for smoke control systems. See Section 513 of this code.

**401.2 Ventilation required.** Every occupied space shall be ventilated by natural means in accordance with Section 402 or 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 Exits.** Equipment and ductwork for exit enclosure ventilation shall comply with one of the following items:

1. Such equipment and ductwork shall be located exterior to the building and shall be directly connected to the exit enclosure by ductwork enclosed in construction as required by the *New York City Building Code* for shafts.
2. Where such equipment and ductwork is located within the exit enclosure, the intake air shall be taken directly from the outdoors and the exhaust air shall be discharged directly to the outdoors, or such air shall be conveyed through ducts enclosed in construction as required by the *New York City Building Code* for shafts.
3. Where located within the building, such equipment and ductwork shall be separated from the remainder of the building, including other mechanical equipment, with construction as required by the *New York City Building Code* for shafts.

In each case, openings into fire-resistance-rated construction shall be limited to those needed for maintenance and operation and shall be protected by self-closing fire-resistance-rated devices in accordance with the *New York City Building Code* for enclosure wall opening protectives.

Exit enclosure ventilation systems shall be independent of other building ventilation systems.

**401.5 Opening location.** Outside air exhaust and intake openings shall be located a minimum of 10 feet (3048 mm) from lot lines or buildings on the same lot. Where openings front on a street or public way, the distance shall be measured to the centerline of the street or public way. Outdoor intakes for high-rise office buildings having occupied floors located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access serving spaces above the second story and serving spaces greater than 10,000 square feet (929 $m^2$) of floor area shall be located at least 20 feet (6096 mm) above ground level, at least 30 feet (9144 mm) from exhaust outlets and other exhaust discharges, and at least 20 feet (6096 mm) from areas that may collect vehicular exhaust, such as off street loading bays.

**Exception:** Group R-3.

**401.5.1 Intake openings.** Mechanical and gravity outside air intake openings, shall be located a minimum of 20 feet (6096 mm) from any hazardous or noxious contaminant such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code. Where a source of contaminant is located within 20 feet (6096 mm) of an intake opening, such opening shall be located a minimum of 2 feet (610 mm) below the contaminant source.

An outdoor air intake opening with gross area of more than 144 square inches (0.0929 $m^2$) shall be provided with fire dampers and smoke dampers, or combined fire and smoke dampers when such opening is located as follows:

1. Less than 30 feet (9144 mm) above grade.
2. Less than 30 feet (9144 mm) in any direction from any opening in another building.
3. Less than 15 feet (4572 mm) from a lot line.
4. Less than 50 feet (15 240 mm) above and less than 50 feet (15 240 mm) in any direction from a roof constructed of combustible material or a building in which the exterior walls are constructed wholly or partly of wood.

**Exceptions:**

1. Smoke dampers shall not be required for outdoor air intake openings installed in any construction required to have a fire-resistance rating that is less than 2 hours.
2. Smoke dampers shall not be required for outdoor air intake openings of systems greater than 15,000 cfm (7.1 $m^3/s$) which are provided with smoke dampers in accordance with Chapter 6 of this code and arranged so as to not introduce smoke into the building or space in which the equipment is located.

**401.5.2 Exhaust openings.** To minimize the hazard from fires and from noxious, toxic or obnoxious discharges to structures, any exhaust air discharge to the outside atmosphere shall terminate at or above the roof or setback roof of the buildings or in an exterior wall adjoining a street, yard or court. Exhaust air discharges shall be at least 10 feet (3048 mm) above the sidewalk or ground and shall terminate at least 10 feet (3048 mm) from any window in another building or from any window in a residential portion of the same building, or from any fire escape, exterior stair, or balcony. Exhaust system openings shall be provided with vanes or louvers constructed so as to direct the air away from windows, other openings, and pedestrians.

**Exception:** In Occupancy Groups R-2 and R-3 each dwelling unit may be individually exhausted directly to

the outdoors with a dedicated, continuously operated exhaust fan and shall comply with the following:

1. The exhaust system for the kitchen and the toilet/baths may be combined to the inlet of a single fan, provided such exhaust system serves only one dwelling unit.
2. The dedicated exhaust from each dwelling unit shall be directed away from any window serving the same dwelling unit from which the exhaust is taken, and in addition, such exhaust opening shall terminate at least:
   2.1. Two feet (610 mm) from any window serving the same dwelling unit.
   2.2. Four feet (1219 mm) from any window serving an adjoining dwelling unit.
   2.3. Four feet (1219 mm) from any window serving another occupancy group in the same building.
   2.4. Ten feet (3048 mm) from any outdoor air intake opening.
   2.5. Ten feet (3048 mm) above the public sidewalk adjoining the same building.
3. All other minimum distances described in Section‡ 401.5 shall be met.

**401.5.3 Flood hazard.** For structures located in areas of special flood hazard, outdoor exhaust openings shall comply with Appendix G of the *New York City Building Code*.

**401.6 Outdoor opening protection.** Air exhaust and 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 401.6, and shall be protected against local weather conditions. Outdoor air exhaust and intake openings located in exterior walls shall meet the provisions for exterior wall opening protectives in accordance with the *New York City Building Code.*

**TABLE 401.6**
**OPENING SIZES IN LOUVERS, GRILLES AND SCREENS PROTECTING OUTDOOR EXHAUST AND AIR INTAKE OPENINGS**

| OUTDOOR OPENING TYPE | MINIMUM AND MAXIMUM OPENING SIZES IN LOUVERS, GRILLES AND SCREENS MEASURED IN ANY DIRECTION |
|---|---|
| Exhaust openings | Not < $^1/_4$ inch and not > $^1/_2$ inch |
| Intake openings in residential occupancies | Not < $^1/_4$ inch and not > $^1/_2$ inch |
| Intake openings in other than residential occupancies | > $^1/_4$ inch and not > 1 inch |

For SI: 1 inch = 25.4 mm.

**401.7 Contaminant sources.** Stationary local sources producing air-borne 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 Chapter 5 or a means of collection and removal of the contaminants. Such exhaust shall discharge directly to an approved location at the exterior of the building.

## SECTION MC 402
## NATURAL VENTILATION

**402.1 General**. Natural ventilation of an occupied space shall comply with Chapter 12 of the *New York City Building Code*.

**402.2 Reserved.**

**402.3 Reserved.**

**402.4 Reserved.**

## SECTION MC 403
## MECHANICAL VENTILATION

**403.1 Ventilation system.** Mechanical ventilation shall be provided by a method of supply air and return or exhaust air. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.

Ventilation supply systems shall be designed to deliver the required rate of supply air to the occupied zone within an occupied space. The occupied zone shall have boundaries measured at 3 inches (76 mm) and 72 inches (1829 mm) above the floor and 24 inches (610 mm) from the enclosing walls.

**403.2 Outdoor air required.** The minimum ventilation rate of required outdoor air shall be determined in accordance with Section 403.3.

**403.2.1 Recirculation of air.** The air required by Section 403.3 shall not be recirculated. Air in excess of that required by Section 403.3 shall not be prohibited from being recirculated as a component of supply air to building spaces, except that:

1. Ventilation air shall not be recirculated from one dwelling unit to another or to dissimilar occupancies.
2. Supply air to a swimming pool and associated deck areas shall not be recirculated 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.
3. Where mechanical exhaust is required by Table 403.3, recirculation of air from such spaces shall be prohibited. All air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.

**403.2.2 Transfer air.** Except where recirculation from such spaces is prohibited by Table 403.3, air transferred from occupied spaces is not prohibited from serving as makeup air for required exhaust systems in such spaces as kitchens, baths, 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 Sections 403.3 and 403.3.1. The required outdoor air rates specified in Table 403.3 shall be introduced directly into such spaces or into

the occupied spaces from which air is transferred or a combination of both.

**403.3 Ventilation rate.** Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with Table 403.3 based on the occupancy of the space and the occupant load or other parameter as stated therein. The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3. Ventilation rates for occupancies not represented in Table 403.3 shall be determined by an approved engineering analysis. The ventilation system shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

**Exception:** The occupant load is not required to be determined, based on the estimated maximum occupant load rate indicated in Table 403.3, where approved statistical data document the accuracy of an alternate anticipated occupant density.

**TABLE 403.3**
**REQUIRED OUTDOOR VENTILATION AIR**

| OCCUPANCY CLASSIFICATION | ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET[a] | OUTDOOR AIR (Cubic feet per minute (cfm) per person) UNLESS NOTED[e] |
|---|---|---|
| **Correctional facilities** | | |
| Cells | | |
| without plumbing fixtures | 20 | 20 |
| with plumbing fixtures | 20 | 20 |
| Dining halls | 100 | 15 |
| Guard stations | 40 | 15 |
| **Dry cleaners, laundries** | 20 | 15 |
| Coin-operated dry cleaner | 20 | 15 |
| Coin-operated laundries | 30 | 30 |
| Commercial dry cleaner | 10 | 25 |
| Commercial laundry | 30 | 35 |
| Storage, pick up | | |
| **Education** | | |
| Auditoriums | 150 | 15 |
| Classrooms | 50 | 15 |
| Corridors | — | 0.10 cfm/ft$^2$ |
| Laboratories | 30 | 20 |
| Libraries | 20 | 15 |
| Locker rooms [b] | — | 0.50 cfm/ft$^2$ |
| Music rooms | 50 | 15 |
| Smoking lounges [b,g] | 70 | 60 |
| Training shops | 30 | 20 |
| **Food and beverage service** | | |
| Bars, cocktail lounges | 100 | 30 |
| Cafeteria, fast food | 100 | 20 |
| Dining rooms | 70 | 20 |
| Kitchens (cooking)[f,g] | 20 | 15 |

*(continued)*

**TABLE 403.3**
**REQUIRED OUTDOOR VENTILATION AIR—continued**

| OCCUPANCY CLASSIFICATION | ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET[a] | OUTDOOR AIR (Cubic feet per minute (cfm) per person) UNLESS NOTED[e] |
|---|---|---|
| **Hospitals, nursing and convalescent homes** | | |
| Autopsy rooms [b] | — | 0.50 cfm/ft$^2$ |
| Medical procedure rooms | 20 | 15 |
| Operating rooms | 20 | 30 |
| Patient rooms | 10 | 25 |
| Physical therapy | 20 | 15 |
| Recovery and ICU | 20 | 15 |
| **Hotels, motels, resorts and dormitories** | | |
| Assembly rooms | 120 | 15 |
| Bathrooms [b,g] | — | 35 cfm per room |
| Bedrooms | — | 30 cfm per room |
| Conference rooms | 50 | 20 |
| Dormitory sleeping areas | 20 | 15 |
| Gambling casinos | 120 | 30 |
| Living rooms | — | 30 cfm per room |
| Lobbies | 30 | 15 |
| **Laboratories** | | |
| Biological | 8 | 1.0 cfm/ft$^2$ |
| Chemical | 8 | 1.0 cfm/ft$^2$ |
| Industrial and nonteaching | 8 | 1.0 cfm/ft$^2$ |
| Nonproduction chemical labs [h] | as per NFPA 45 | as per NFPA 45 |
| **Offices** | | |
| Conference rooms | 50 | 20 |
| Office spaces | 7 | 20 |
| Reception areas | 60 | 15 |
| Telecommunication centers and data entry | 60 | 20 |
| **Private dwellings, single and multiple** | | |
| Garages, common for multiple units [b] | — | 1.5 cfm/ft$^2$ |
| Garages, separate for each dwelling | — | 100 cfm per car |
| Kitchens [g] | — | 100 cfm intermittent or 25 cfm continuous |
| Living areas [c] | Based upon number of bedrooms. First bedroom: 2; each additional bedroom: 1 | 0.35 air changes per hour[a] or 15 cfm per person, whichever is greater |
| Toilet rooms and bathrooms [g] | — | Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous |

*(continued)*

**TABLE 403.3**
**REQUIRED OUTDOOR VENTILATION AIR—continued**

| OCCUPANCY CLASSIFICATION | ESTIMATED MAXIMUM OCCUPANCY LOAD PERSONS PER 1,000 SQUARE FEET[a] | OUTDOOR AIR (Cubic feet per minute (cfm) per person) UNLESS NOTED[e] |
|---|---|---|
| **Public spaces** | | |
| Corridors and utilities | — | 0.05 cfm/ft$^2$ |
| Elevators[g] | — | 1.00 cfm/ft$^2$ |
| Locker rooms[b] | | 0.5 cfm/ft$^2$ |
| Shower room (per shower head)[b,g] | 70 | 50 cfm intermittent or 20 cfm continuous |
| Smoking lounges[b,g] | | 60 |
| Toilet rooms[b,g] | — | 75 cfm per water closet or urinal |
| **Retail stores, sales floors and showroom floors** | | |
| Basement and street | — | 0.30 cfm/ft$^2$ |
| Dressing rooms | — | 0.20 cfm/ft$^2$ |
| Malls and arcades | — | 0.20 cfm/ft$^2$ |
| Shipping and receiving | — | 0.15 cfm/ft$^2$ |
| Smoking lounge[sb] | 70 | 60 |
| Storage rooms | — | 0.15 cfm/ft$^2$ |
| Upper floors | — | 0.20 cfm/ft$^2$ |
| Warehouses | — | 0.05 cfm/ft$^2$ |
| **Specialty shops** | | |
| Automotive motor-fuel-dispensing stations | — | 1.5 cfm/ft$^2$ |
| Barber | 25 | 15 |
| Beauty | 25 | 25 |
| Clothiers, furniture | — | 0.30 cfm/ft$^2$ |
| Florists | 8 | 15 |
| Hardware, drugs, fabrics | 8 | 15 |
| Nail salon[b] | — | 25 |
| Pet shops | — | 1.00 cfm/ft$^2$ |
| Reducing salons | 20 | 15 |
| Supermarket | 8 | 15 |
| **Sports and amusement** | | |
| Ballrooms and discos | 100 | 25 |
| Bowling alleys (seating areas) | 70 | 25 |
| Game rooms | 70 | 25 |
| Ice arenas | — | 0.50 cfm/ft$^2$ |
| Playing floors (gymnasiums) | 30 | 20 |
| Spectator areas | 150 | 15 |
| Swimming pools (pool and deck area) | — | 0.50 cfm/ft$^2$ |
| **Storage** | | |
| Repair garages, enclosed parking garages[d] | — | 1.5 cfm/ft$^2$ |
| Warehouses | — | 0.05 cfm/ft$^2$ |

*(continued)*

**TABLE 403.3—continued**
**REQUIRED OUTDOOR VENTILATION AIR**

| OCCUPANCY CLASSIFICATION | ESTIMATED MAXIMUM OCCUPANCY LOAD PERSONS PER 1,000 SQUARE FEET[a] | OUTDOOR AIR (Cubic feet per minute (cfm) per person) UNLESS NOTED[e] |
|---|---|---|
| **Theaters** | | |
| Auditoriums | 150 | 15 |
| Lobbies | 150 | 20 |
| Stages, studios | 70 | 15 |
| Ticket booths | 60 | 20 |
| **Transportation** | | |
| Platforms | 100 | 15 |
| Vehicles | 150 | 15 |
| Waiting rooms | 100 | 15 |
| **Workrooms** | | |
| Bank vaults | 5 | 15 |
| Darkrooms | — | 0.50 cfm/ft$^2$ |
| Duplicating, printing | — | 0.50 cfm/ft$^2$ |
| Meat processing[c] | 10 | 15 |
| Pharmacy | 20 | 15 |
| Photo studios | 10 | 15 |

For SI: 1 cubic foot per minute = 0.0004719 m$^3$/s, 1 ton = 908 kg, 1 cubic foot per minute per square foot = 0.00508 m$^3$/(s • m$^2$), °C = [(°F) -32] /1.8, 1 square foot = 0.0929 m$^2$.

a. Based upon net floor area.

b. Mechanical exhaust required and the recirculation of air from such spaces as permitted by Section 403.2.1 is prohibited (see Section 403.2.1).

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. A mechanical ventilation system shall not be required in garages having a floor area not exceeding 850 square feet and used for the storage of not more than four vehicles or trucks of 1 ton maximum capacity.

e. Where the ventilation rate is expressed in cfm/ft$^2$, such rate is based upon cubic feet per minute per square foot of the floor area being ventilated.

f. The sum of the outdoor and transfer air from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 cfm/ft$^2$.

g. Transfer air permitted in accordance with Section 403.2.2.

h. Nonproduction chemical laboratories subject to Section 419 of the *New York City Building Code.*

**403.3.1 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 and the actual number of occupants present. Intermittent exhaust shall be permitted where an individual exhaust duct and fan are provided and the operation of the fan is controlled by occupants of the space being vented.

**403.3.2 Common ventilation system.** Where spaces having different ventilation rate requirements are served by a common ventilation system, the ratio of outdoor air to total supply air for the system shall be determined based on the space having the largest outdoor air requirement or shall be determined in accordance with the following formula:

$$Y = X/(1 + X - Z) \qquad \textbf{(Equation 4-1)}$$

where:

$Y = V_{oc}/V_{so}$ = Corrected fraction of outdoor air in system supply.

$X = V_{ot}/V_{zl}$ = Uncorrected fraction of outdoor air in system supply.

$Z = V_{oc}/V_{zc}$ = Fraction of outdoor air in critical space. The critical space is that space with the greatest required fraction of outdoor air in the supply to this space.

$V_{oc}$ = Corrected total outdoor airflow rate.

$V_{zl}$ = Total supply flow rate, ie., the sum of all supply for all branches of the system.

$V_{ox}$ = Sum of outdoor airflow rates for all branches on system.

$V_{oc}$ = Outdoor airflow rate required in critical spaces.

$V_{zc}$ = Supply flow rate in critical space.

**403.3.3 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 systems shall be designed to maintain the flow of outdoor air at a rate of not less than that required by Section 403 over the entire range of supply air operating rates.

**403.3.4 Balancing.** Ventilation systems shall be balanced by an approved method. Such balancing shall verify that the ventilation system is capable of supplying the airflow rates required by Section 403.

## SECTION MC 404
## ENCLOSED PARKING GARAGES

**404.1 Enclosed parking garages.** Mechanical ventilation systems for enclosed parking garages are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide of 25 parts per million (ppm) by approved automatic detection devices.

**404.2 Minimum ventilation.** Automatic operation of the system shall not reduce the ventilation rate below 0.05 cfm per square foot (0.00025 $m^3/s \bullet m^2$) of the floor area and the system shall be capable of producing a ventilation rate of 1.5 cfm per square foot (0.0076$m^3/s \bullet m^2$) of floor area.

**404.3 Occupied spaces accessory to public garages.** Connecting offices, waiting rooms, ticket booths and similar uses that are accessory to a public garage shall be maintained at a positive pressure and shall be provided with ventilation in accordance with Section 403.3.

## SECTION MC 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.

**405.2 Manual control.** Each air distribution system shall be provided with not less than one manual control to stop the operation of the supply, return, and exhaust fans(s) in an emergency. The manual control shall be provided at an approved location.

**405.2.1 Office buildings.** Any building where the main use or dominant occupancy is classified in Occupancy Group B having occupied floors located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, where a system serves a floor or floors other than the floor on which the equipment is located, shall be provided with the following controls, in addition to the controls required by this chapter:

1. Manual controls for operating individually each air supply and each exhaust or return fan in the system located as follows:
   1.1. At the Fire Command Center, and
   1.2. In the room containing the affected air-handling fans.
2. Manual controls for operating individually or in groups each remote control reversible fire shutter, when such shutters are provided in accordance with the provisions of the *New York City Building Code*, or each smoke damper provided in accordance with the provisions of the *New York City Building Code*. Such controls shall be located at the Fire Command Center.

## SECTION MC 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 *New York City Building Code* or shall be provided with a mechanical exhaust and supply air system. The mechanical exhaust rate shall be not less than 0.02 cfm per square foot (0.00001 $m^3/s \bullet m^2$) of horizontal area and shall be automatically controlled to operate when the relative humidity in the space served exceeds 60 percent.

## SECTION MC 407
## VENTILATION OF NONPRODUCTION CHEMICAL LABORATORIES

**407.1 General.** Nonproduction chemical laboratories complying with the hazardous materials quantity limitations of Section 419 of the *New York City Building Code* shall provide a mechanical ventilation system in accordance with this code and NFPA 45, except that ducts constructed of combustible materials shall not be permitted.