专业美甲服务的通风要求

联系州务院

如对新通风要求或如何使经营场所合规存在任何疑问，请致电州务院：***518-474-4429***。有关更多信息和资源，请访问我们的网站 (www.dos.ny.gov)。

承包人与设计人员的指导性文件

简介

纽约州州务院通过一项新法规，要求所有提供美甲服务的经营场所安装符合美甲美容院机械通风标准的通风设备，这些标准是《2015 年国际机械规范》(2015 International Mechanical Code, 2015 IMC) 的一部分。附录 A 是《2015 年国际机械规范》的相关规定的副本，这些标准已被纳入《纽约州统一消防与建筑规范》(New York State Uniform Fire Prevention and Building Code) 中。法规要求，到 2021 日历年，所有提供美甲服务的现有经营场所均应达到通风标准。在 2016 年 10 月 3 日当天或之后申请执照的所有新经营场所在开业时，将需要符合这些标准。

通风标准要求经营场所提供足够的通风设备（包括室外空气和废气），以便将有害污染物、烟气及微粒排放到远离顾客和工作人员的空间。这些法规还要求经营场所在各个美甲台和修脚台上配备局部排风系统（又称源采集系统），从而从源头上去除有害物质。

本文件旨在为承包人和设计人员提供足够的信息，以便其适当提供、设计和安装符合法规和《2015 年国际机械规范》中的通风要求的系统。有关符合《2015 年国际机械规范》要求的计划示例，请参见附录 B。

如有任何疑问，请致电州务院：***518-474-4429***。

通风规定

2015 年机械规范要求

《2015 年国际机械规范》要求美甲美容院安装一般通风设备（新鲜空气和废气），并要求各个美甲台和修脚台配备局部排风系统（源采集系统）。

《2015 年国际机械规范》要求的室外空气（新鲜空气）流速根据一系列因素而定，这些因素包括但不限于：美容院内人数、美容院的大小、通风管的尺寸、系统类型、空气分配系统的功效和美容院内的污染程度。对于不同的美容院，影响室外空气流速的因素也有所不同。

为了合规而采取的措施（每一步的补充内容）：

第 1 步：评估现有通风系统，以确定现有性能和空气流速
第 2 步：确定为达到要求的新通风率和排风量而应进行的变更
第 3 步：确定要使用的局部通风系统（源采集系统）类型的最佳方案
第 4 步：为美容院确定最佳总体方案

第 1 步：评估现有通风系统

确定为使现有系统合规而需采取的措施的第一步是评估现有系统。评估包括确定现有通风和排气系统的性能。这一步确定现有系统的空气流量，包括室外空气（新鲜空气）、回流空气和废气的流量，我们可以通过审阅现有竣工图、获得现有风量平衡报告或读取现有系统的风量读数来达成这一目标。确定现有系统的性能后，需制定新要求。

第 2 步：确定通风和排气要求：

在描述第 2 步之前，应先了解一些重要术语：

定义：

美甲美容院。*指提供专业美甲服务的每栋建筑或一栋建筑的一部分。*

源采集系统。*从源头上采集空气污染物并将此类污染物排到室外大气中的机械排气系统。*

要求：

1. **通风要求：**通风系统以不小于以下数值*（以较大者为准）*的速率提供室外空气和废气：

    a) 《2015 年国际机械规范》第 401 节和第 403 节中所列的美甲美容院通风标准，或
    b) 美甲美容院一个美甲台 50 立方英尺/分钟。

2. **特殊排气要求：**每个美甲台的局部排气系统（源采集系统）至少设有一个吸风口（至少能够以 50cfm 的速率排气）。每个此类吸风口应：

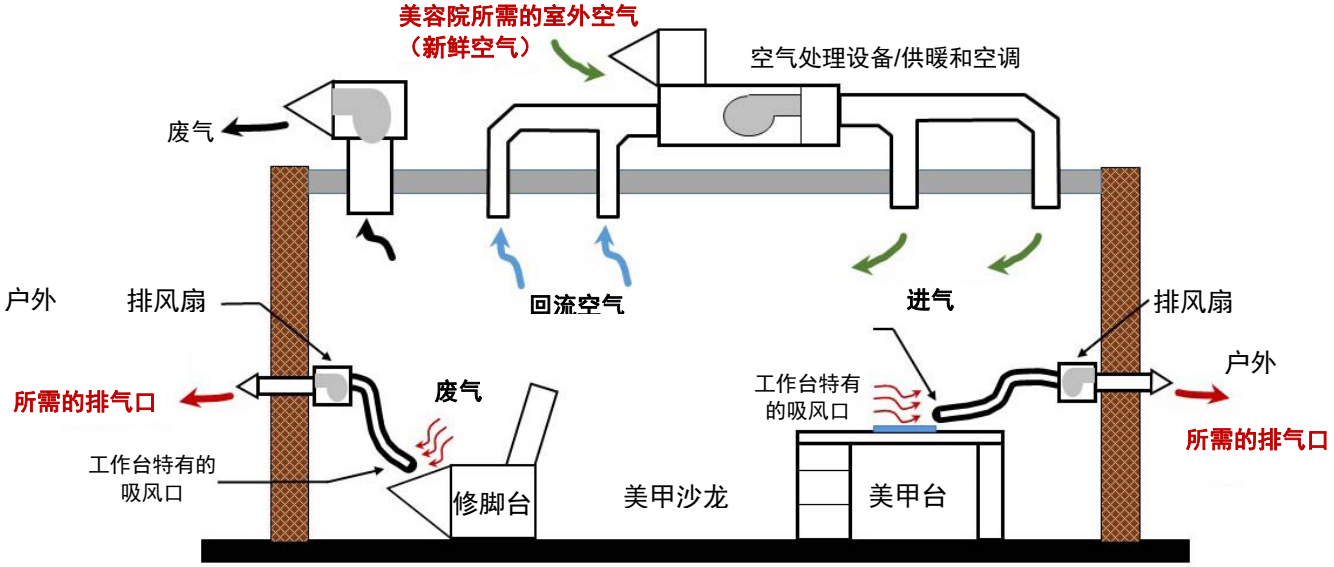
    a) 由美甲台厂商在工厂内安装好；或
    b) 现场安装在与化学品使用处或美甲时顾客指甲所放之处的水平距离和垂直距离均不超过 12 英寸的位置。

    此类系统的排风量适用于《2015 年国际机械规范》表 403.3.1.1 所要求的排气流。参见以下示例，了解局部排气系统（源采集系统）如何用于美甲台。

3. **平衡通风与排气系统。**通过以与排气速率相等的速率提供室外空气的方式达到平衡；

4. **系统运行：**美甲美容院有人时，须使系统一直保持运行状态。

以下是一般通风系统的原理图，其中展示各种不同组件共同组成一个服务于美甲美容院的完整通风系统。



通风系统样机

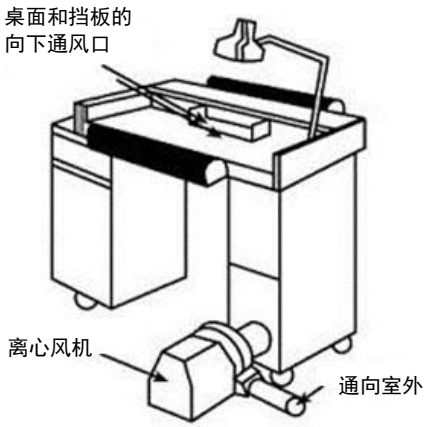
第 3 步：确定要在各个美甲台和修脚台使用的局部通风系统（源采集系统）类型的最佳方案

根据美容院内美甲台的布局、外墙暴露情况和现有排气系统，可能有几个方案符合局部排气的要求。

局部排气系统（源采集系统）方案包括：

1. 配备预装通风设备的新美甲台；或
2. 拥有现场组装的吸风口的现有美甲台；或
3. 现有美甲台改装后使用现场组装的局部排气系统；或
4. 作为美甲台附加组件单独采购的源采集系统。

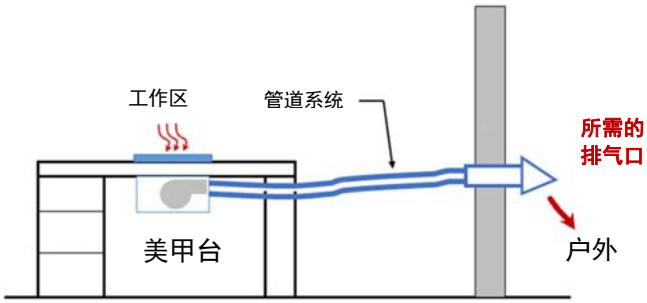
在以上所列的各个方案中，局部排气系统必须单独将废弃排到室外或与一个公用的排气管相连。



配备预装局部排气系统（源采集系统）的美甲台示例

配备预装通风系统的新美甲台

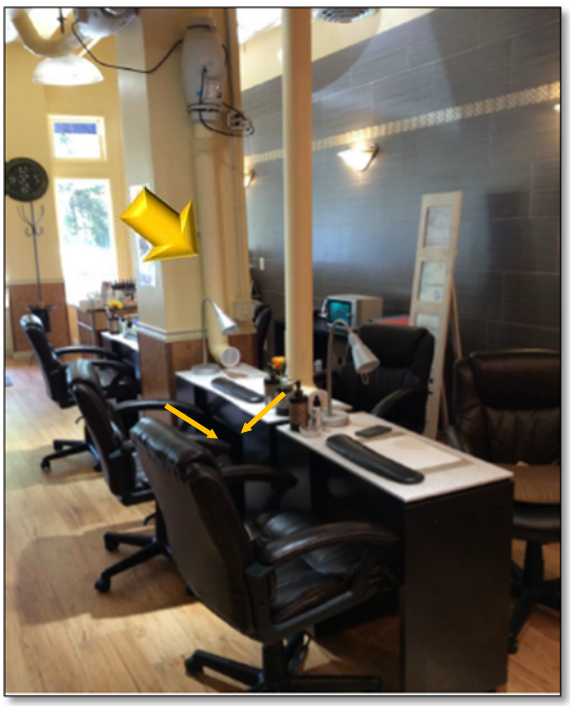
通风台设有一个风机，将化学蒸汽吸进管道，以防止它们进入室内空气中。通风台是局部排气系统的一个示例，因为它能够阻止有毒化学物进入美甲师和顾客的呼吸区。设计通风台时，必须使其能够将被污染的空气排到室外，而不是排到美容院内。

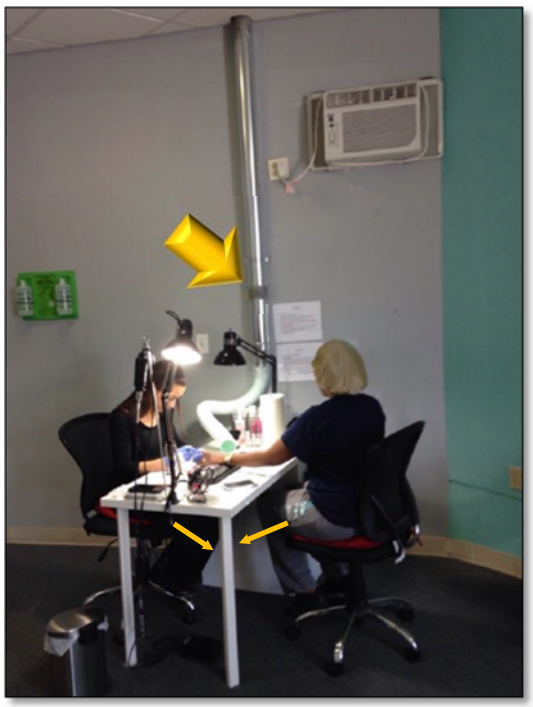


配备内置排气扇的通风台

拥有现场组装的吸风口的现有美甲台

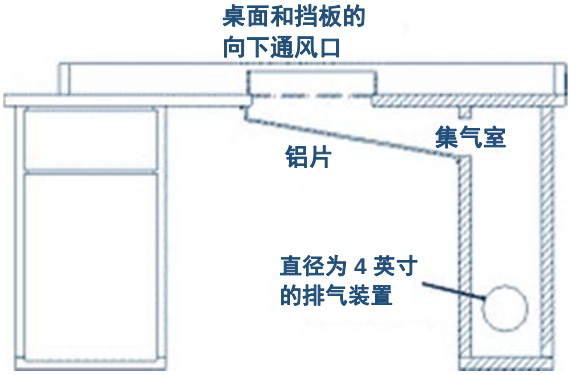
与排气管相连的固定罩或移动罩是局部排气系统（源采集系统）的一个示例。移动罩可固定在需要修剪的指甲（手或脚）上方，以在源头上采集化学蒸汽，并将它们排到室外。





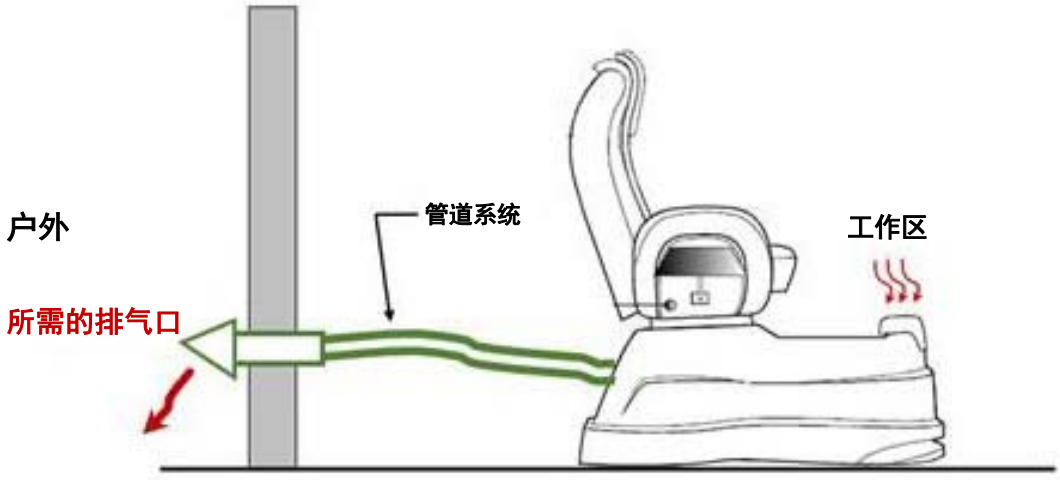
改装现有工作台

如果要将顾客正在使用的工作台改成通风式，应在桌面上设置一个进气口（称之为桌面向下通风口）。桌面向下通风口应设置在美甲师的一侧。开口处应覆盖一个滤网（或多孔板）。客户的一侧应略高于美甲师的一侧，如此一来，客户便可将手放在桌面向下通风口的上方，尽可能贴近局部排气系统（参见下图）。

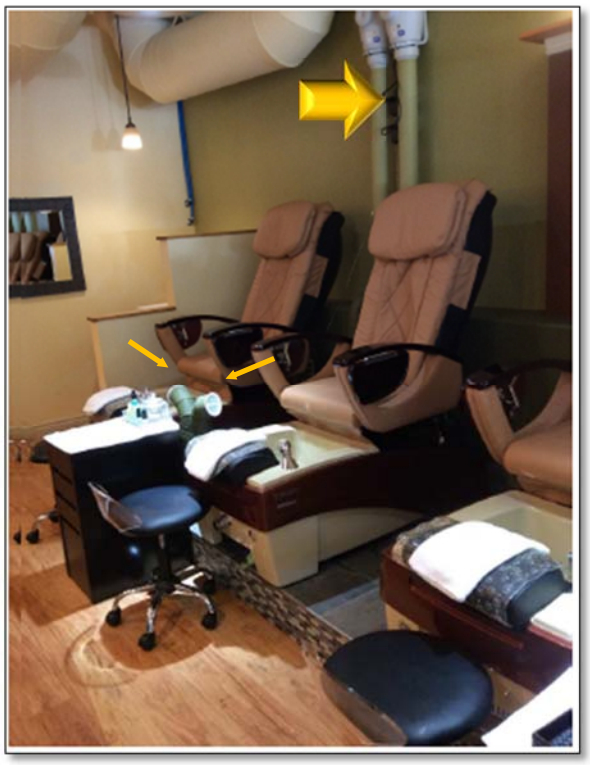


确保空气至少以 50cfm 穿过桌面的下向通风口，从而达到清除化学物的目的，但是具体设计可能需要更大的速率。

修脚台源采集系统（局部排气系统）示例：



配备通向室外的内置通风装置的修脚台



配备现场安装的排气管的修脚台

第 4 步：为美容院确定最佳总体方案

现有通风系统和现有空间配置以及预算将决定适合美容院的方案。需考虑的附加项包括：

- 外露管道和设备的大小和外观
- 优选室内和室外设备
- 规范与标准
- 冷却/加热负载
- 运行成本
- 维护成本

适合美容院的最佳方案取决于可用预算和美学需要。

应用示例：（使用《2015 年国际机械规范》第 4 章 - 通风要求）

一个面积为 1000 平方英尺的美甲美容院需装有一个单区屋顶空气处理机组，可通过管道式天花板供应寄存器和天花板回风格栅进行供暖和制冷。

请注意：此示例仅适用于单区域系统，其他类型的系统需要执行其他步骤。请参阅《2015 年国际机械规范》第 403 节。

第一步： 确定空间的人员载荷 (P_z)。

根据表 403.3.1.1，一家美甲美容院的人员密度为每 1000 平方英尺 25 人。

P_z = 1000 ft^2 x 25 = 25 人

第二步： 确定呼吸区的室外气流 (V_{bz})

$$V_{bz} = R_pP_z + R_aA_z$$ （公式 4-1）

其中：

Az = 区域建筑面积：区域内可利用的一个空间或多个空间 的净建筑面积。

Pz = 区域人口：区域内一个或多个空间里的人数。

Rp = 人口室外空气流速：每人所需的室外气流比率，参见表 403.3.1.1。

Ra = 区域室外空气流速：每单位面积区域所需的室外气流比率，参见表 403.3.1.1。

最小通风率（表 403.3.1.1 – 2015 年国际机械规范）

用房分类	人员密度 (#1000 FT^2)	呼吸区的人口室外气流比率，R_p CFM/人	呼吸区的区域室外气流比率，R_z CFM/FT^2	排风量 CFM/FT^2
美容美容院	25 年	20 年	0.12 年	0.6 年
美甲美容院	25 年	20 年	0.12 年	0.6 年

脚注请参考《2015 年国际机械规范》表 403.3.1.1

参见表 403.3.1.1

Rp = 20 CFM/人　　Ra = 0.12 CFM/平方英尺

公式 4-1 可做如下解答：

$$V_{bz} = R_pP_z + R_aA_z$$

V_{bz} =（20 cfm/人 x 25 人）+ (0.12 cfm/ft^2 x 1000 平方英尺)

V_{bz} = (500) + (120) = 620 CFM

第三步： 确定区域室外气流比率 (V_{oz})

$$V_{oz} = V_{bz}/E_z \qquad \text{公式 4-2}$$

Ez = 区域配风效率

表 403.3.1.1.1.2
区域配风效率 [a,b,c,d]

配风配置	E_z
天花板或地板送冷风	1.0[e]
天花板或地板送热风和天花板回风	1.0 年
天花板送热风和天花板回风	0.8[f]
地板送热风和天花板回风	0.7 年
在房间的另外一侧从排风和/或回风处吸入补充空气	0.8 年
在排风和/或回风位置附近吸入补充空气	0.5 年

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

a. “冷风”即温度低于空间内温度的空气。
b. “热风”即温度高于空间内温度的空气。
c. “天花板”包括呼吸区上方的任何位置。
d. “地板”包括呼吸区下方的任何位置。
e. 如果低速置换通风实现了单向流动和温度分层，则具有冷风地板送风和天花板回风的系统，其区域配风效率可为 1.2。
f. 如果送风温度高于空间温度的值低于 15°F，并且 150 英尺/分钟的送风射流在地板层 4½ 英尺以内，则带有暖风天花板送风的系统的区域配风率可为 1.0。

根据公式 4 -2：

$$Voz = Vbz/Ez$$

根据之前的步骤：V_{oz} = 620 cfm

根据表 403.1.1.1.2（以天花板送风和天花板回风为基础）

制冷模式：E_z = 1.0　　V_{oz} = 620 CFM

加热模式：E_z = 0.8　　V_{oz} = 775 CFM

所需室外空气流速：

$V_{ot} = V_{oz}$ = 775 CFM

大多数情况下，所需室外空气是保持系统平衡的决定性因素。在排气量大于所需室外空气量的情况下，需要对室外空气量进行调整以使系统保持平衡。在这种情况下，空间内可能需要近 16 个美甲台（每个 50cfm =），以使排风速率超过所需室外空气流速。如果是这种情况，则需要增加室外空气量。

确定美容院内美甲台的数量：

8 个美甲台和 2 个修脚台

所需排风量 = 10 个美甲台 x 50 cfm = 500 CFM 排风量

每处排风口可单独安装管道，或与其他排风口一起连接管道，通过管道导出至外部。对于现有系统，评估应确定当前室外空气量是否足够，并且对现有总排风量做出相应的调整或修改。

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机械工程师/承包商检查表：

现有系统评估

- ☐ 1. 美容院建筑面积（平方英尺- SF） _____
  - ☐ 1a. 美容院现有排风量 (cfm) _____
  - ☐ 1b. 美容院现有室外（新鲜）空气量 _____
  - ☐ 1c. 修脚台和美甲台的数量 _____

所需通风率和排气率

- ☐ 2. 计算所得呼吸区室外空气流速 _____(V_{bz})
  - ☐ 2a. 区域配风效率（Ez; 表 x） _____
  - ☐ 2b. 计算所得室外空气流速（Voz; 公式 x） _____
  - ☐ 2c. 美容院内的单区系统 (Vot = Voz) _____
  - ☐ 2d. 如果是多区或 100% 室外空气 – 请参阅《2015 年国际机械规范》部分
  - ☐ 2e. 美甲台所需总排风量（项目 (1c) x 50 cfm） _____
- ☐ 3. 如有需要，室外空气供应应放缓
- ☐ 4. 设计应符合所有适用的地方、州和联邦法规。
- ☐ 5. 确认推荐的系统设计已将所有美甲工作台和修脚工作台纳入考虑范围
- ☐ 6. 确保推荐的系统设计在运行时不超过工作台 5 Sones（51 dBa）的建议噪声水平。

法规

以美甲美容院为例，其机械通风系统需符合《2015 年国际机械规范》（发布日期：2014 年 5 月 30 日，第三次印刷），由国际规范理事会公司出版，并经 NYS 建筑标准和规范 2016 统一规范补充（以下简称“2015 年 IMC”）修订，使通风系统：

(i) 能够以不小于以下数值（**以较大者为准**）的速率提供室外空气

(a)《2015 年国际机械规范》第 401 节和第 403 节中所列的美甲美容院通风标准，或

(b) 美甲美容院一个美甲台 50 立方英尺/分钟。

(ii) 包括一个符合以下条件的机械排气系统：

(a) 经过专门设计和构造，从源头上采集所有化学蒸汽、烟气、粉尘和其他空气污染物，并将此类污染物排到室外大气中；

(b) 在每个美甲台至少设置一个吸风口（每个此类吸风口应由美甲台的制造商在工厂内安装好，或者现场安装在与化学品使用处或美甲时顾客指甲所放之处的水平距离和垂直距离均不超过 12 英寸的位置）。

(c) 能够以不小于以下数值的速率排放美甲美容院内的废气（以较大值为准）：(1)《2015 年国际机械规范》第 401 节和第 403 节中所列的美甲美容院通风标准，或 (2) 美甲美容院一个美甲台 50 立方英尺/分钟;

(d) 将美甲美容院内产生的所有废气（包括但不限于所有化学蒸气、烟雾、灰尘和其他气体污染物以及进行美甲专业服务时生成的或由美甲专业服务引起的所有气味）排放到室外大气中，每处排气口都应置于不会对其他人造成滋扰的地方，并且排出的废气（包括但不限于排出的化学蒸气和烟雾、灰尘和其他空气污染物和气味）不能轻易被通风系统的室外空气进气部件吸入;

(e) 将美甲美容院内产生的所有废气（包括但不限于所有化学蒸气、烟雾、灰尘和其他气体污染物以及进行美甲专业服务时生成的或由美甲专业服务引起的所有气味），以确保不会将该废气的任何部分再循环到美甲美容院或美甲美容院所在建筑物的任何其他空间内，或者转移到该建筑物的任何其他空间内的方式排出；

(iii) 通过以与排气速率相等的速率提供室外空气的方式达到平衡；

(iv) 在美甲美容院有人或有多个人使用时，应始终以本条第 (i) 款规定的最低室外气流比率以及以等于或高于本条第 (ii) 款第 (c) 项规定的最低排风速率运行。

(C) 本节第 (b) 段第 (6) 条所规定的标准或条件，不得解释为会取代、修订或影响适用于外观增强活动和/或适用于建筑物的任何更高或更严格的标准或条件。不遵守任何此类更高或更严格的标准或条件，可能会违反其他适用的法律或法规，就本案例而言，可能包括国家统一防火和建筑规范、纽约市建筑规范、其他建筑规范、国家卫生规范、国家工业规范或环境标准。

Appendix A

2015 IMC

floor area of the interior room or space, but not less than 20 square feet (1.86 m^2). The minimum openable area to the outdoors shall be based on the total floor area being ventilated.

[BG] 402.4 Openings below grade. Where openings below grade provide required *natural ventilation*, the outside horizontal clear space measured perpendicular to the opening shall be one and one-half times the depth of the opening. The depth of the opening shall be measured from the average adjoining ground level to the bottom of the opening.

SECTION 403
MECHANICAL VENTILATION

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or *exhaust air* except that mechanical ventilation air requirements for Group R-2, R-3 and R-4 occupancies three stories and less in height above grade plane shall be provided by an exhaust system, supply system or combination thereof. 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.

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

Exception: Where the *registered design professional* demonstrates that an engineered ventilation system design will prevent the maximum concentration of contaminants from exceeding that obtainable by the rate of outdoor air ventilation determined in accordance with Section 403.3, the minimum required rate of outdoor air shall be reduced in accordance with such engineered system design.

403.2.1 Recirculation of air. The outdoor 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* 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 where more than 10 percent of the resulting supply airstream consists of air recirculated from these spaces.
3. Where mechanical exhaust is required by Note b in Table 403.3.1.1, recirculation of air from such spaces shall be prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited. Where recirculation of air is prohibited, all air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.1.1.
4. Where mechanical exhaust is required by Note g in Table 403.3.1.1, mechanical exhaust is required and recirculation from such spaces is prohibited where more than 10 percent of the resulting supply airstream consists of air recirculated from these spaces. Recirculation of air that is contained completely within such spaces shall not be prohibited.

403.2.2 Transfer air. Except where recirculation from such spaces is prohibited by Table 403.3.1.1, air transferred from occupiable 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 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 occupied 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 and R-4 occupancies three stories and less in height above grade plane shall be provided with outdoor air and local exhaust in accordance with Section 403.3.2. All other buildings intended to be occupied shall be provided with outdoor air and local exhaust in accordance with Section 403.3.1.

403.3.1 Other buildings intended to be occupied. The design of local exhaust systems and ventilation systems for outdoor air for occupancies other than Group R-2, R-3 and R-4 three stories and less above grade plane shall comply with Sections 403.3.1.1 through 403.3.1.5.

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 not less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3.1.1. Ventilation rates for occupancies not represented in Table 403.3.1.1 shall be those for a listed *occupancy* classification that is most similar in terms of occupant density, activities and building construction; or 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.

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 a 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.

Exception: The occupant load is not required to be determined based on the estimated maximum occupant load rate indicated in Table 403.3.1.1 where *approved* statistical data document the accuracy of an alternate anticipated occupant density.

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.

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

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 403.3.1.1.1.2
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 and/or return	0.8
Makeup air drawn in near to the exhaust and/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.

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

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 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 return air to only one zone, the system outdoor air intake flow rate (V_{ot}) shall be determined in accordance with Equation 4-3.

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

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.

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

403.3.1.1.2.3 Multiple zone recirculating systems. Where one air handler supplies a mixture of outdoor air and recirculated return 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.

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

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]

Max (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.

$$V_{ou} = D\Sigma_{all\ zones} R_p P_z + \Sigma_{all\ zones} R_a A_z$$

(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.

$$D = \frac{P_s}{\Sigma_{all\ zones} P_z}$$ **(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.

$$V_{ot} = \frac{V_{ou}}{E_v}$$ **(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.

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.

403.3.1.5 Balancing. The *ventilation* air distribution system shall be provided with means to adjust the system to achieve not less than the minimum ventilation airflow rate as required by Sections 403.3 and 403.3.1.2. Ventilation systems shall be balanced by an *approved* method. Such balancing shall verify that the ventilation system is capable of supplying and exhausting the airflow rates required by Sections 403.3 and 403.3.1.2.

403.3.2 Group R-2, R-3 and R-4 occupancies, three stories and less. The design of local exhaust systems and ventilation systems for outdoor air in Group R-2, R-3 and R-4 occupancies three stories and less in height above grade plane shall comply with Sections 403.3.2.1 through 403.3.2.3.

403.3.2.1 Outdoor air for dwelling units. An outdoor air ventilation system consisting of a mechanical exhaust system, supply system or combination thereof shall be installed for each 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 building is occupied. The minimum continuous outdoor airflow rate shall be determined in accordance with Equation 4-9.

$$Q_{OA} = 0.01 A_{floor} + 7.5(N_{br} + 1)$$ **(Equation 4-9)**

where:

Q_{OA} = outdoor airflow rate, cfm

A_{floor} = floor area, ft^2

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

Exception: 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 air flow rate over the 4-hour period shall be not less than that prescribed by Equation 4-9.

VENTILATION

TABLE 403.3.1.1—continued
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	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]
Specialty shops				
Automotive motor-fuel dispensing stations[b]	—	—	—	1.5
Barber	25	7.5	0.06	0.5
Beauty salons[h]	25	20	0.12	0.6
Nail salons [h, h]	25	20	0.12	0.6
Embalming room[h]	—	—	—	2.0
Pet shops (animal areas)[h]	10	7.5	0.18	0.9
Supermarkets	8	7.5	0.06	—

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 upon *net occupiable floor area*.

b. Mechanical exhaust required and the recirculation of air from such spaces is prohibited. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Item 3).

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 or urinal. 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. Mechanical exhaust is required and recirculation from such spaces is prohibited except that recirculation shall be permitted where the resulting supply airstream consists of not more than 10 percent air recirculated from these spaces. Recirculation of air that is contained completely within such spaces shall not be prohibited (see Section 403.2.1, Items 2 and 4).

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. Exhaust inlets shall be located in accordance with Section 502.20. 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.

CHAPTER 5

EXHAUST SYSTEMS

SECTION 501
GENERAL

501.1 Scope. This chapter shall govern the design, construction and installation of mechanical exhaust systems, including exhaust systems serving clothes dryers and cooking appliances; hazardous exhaust systems; dust, stock and refuse conveyor systems; subslab soil exhaust systems; smoke control systems; energy recovery ventilation systems and other systems specified in Section 502.

501.2 Independent system required. Single or combined mechanical exhaust systems for environmental air shall be independent of all other exhaust systems. Dryer exhaust shall be independent of all other systems. Type I exhaust systems shall be independent of all other exhaust systems except as provided in Section 506.3.5. Single or combined Type II exhaust systems for food-processing operations shall be independent of all other exhaust systems. Kitchen exhaust systems shall be constructed in accordance with Section 505 for domestic equipment and Sections 506 through 509 for commercial equipment.

501.3 Exhaust discharge. The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a public nuisance and not less than the distances specified in Section 501.3.1. The air shall be discharged to a location from which it cannot again be readily drawn in by a ventilating system. Air shall not be exhausted into an attic, crawl space, or be directed onto walkways.

Exceptions:

1. Whole-house ventilation-type attic fans shall be permitted to discharge into the attic space of *dwelling units* having private attics.
2. Commercial cooking recirculating systems.
3. Where installed in accordance with the manufacturer's instructions and where mechanical or *natural ventilation* is otherwise provided in accordance with Chapter 4, *listed* and *labeled* domestic ductless range hoods shall not be required to discharge to the outdoors.

501.3.1 Location of exhaust outlets. The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:

1. For ducts conveying explosive or flammable vapors, fumes or dusts: 30 feet (9144 mm) from property lines; 10 feet (3048 mm) from operable openings into buildings; 6 feet (1829 mm) from exterior walls and roofs; 30 feet (9144 mm) from combustible walls and operable openings into buildings which are in the direction of the exhaust discharge; 10 feet (3048 mm) above adjoining grade.
2. For other product-conveying outlets: 10 feet (3048 mm) from the property lines; 3 feet (914 mm) from exterior walls and roofs; 10 feet (3048 mm) from operable openings into buildings; 10 feet (3048 mm) above adjoining grade.
3. For all *environmental air* exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings into buildings for all occupancies other than Group U, and 10 feet (3048 mm) from mechanical air intakes. Such exhaust shall not be considered hazardous or noxious.
4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation required by Section 1612 of the *International Building Code* for utilities and attendant equipment.
5. For specific systems see the following sections:
   - 5.1. Clothes dryer exhaust, Section 504.4.
   - 5.2. Kitchen hoods and other kitchen exhaust *equipment*, Sections 506.3.13, 506.4 and 506.5.
   - 5.3. Dust stock and refuse conveying systems, Section 511.2.
   - 5.4. Subslab soil exhaust systems, Section 512.4.
   - 5.5. Smoke control systems, Section 513.10.3.
   - 5.6. Refrigerant discharge, Section 1105.7.
   - 5.7. Machinery room discharge, Section 1105.6.1.

501.3.2 Exhaust opening protection. Exhaust openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles. Openings in screens, louvers and grilles shall be sized not less than $^1/_4$ inch (6.4 mm) and not larger than $^1/_2$ inch (12.7 mm). Openings shall be protected against local weather conditions. Louvers that protect exhaust openings in structures located in hurricane-prone regions, as defined in the *International Building Code*, shall comply with AMCA Standard 550. Outdoor openings located in exterior walls shall meet the provisions for exterior wall opening protectives in accordance with the *International Building Code*.

501.4 Pressure equalization. Mechanical exhaust systems shall be sized to remove the quantity of air required by this chapter to be exhausted. The system shall operate when air is required to be exhausted. Where mechanical exhaust is required in a room or space in other than occupancies in R-3 and *dwelling units* in R-2, such space shall be maintained with a neutral or negative pressure. If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust for a room, adequate means shall be provided for the natural or mechanical exhaust of the excess air supplied. If only a mechanical exhaust sys-

tem is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate *makeup air* shall be provided to satisfy the deficiency.

501.5 Ducts. Where exhaust duct construction is not specified in this chapter, such construction shall comply with Chapter 6.

SECTION 502
REQUIRED SYSTEMS

502.1 General. An exhaust system shall be provided, maintained and operated as specifically required by this section and for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders and other *appliances, equipment* and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas or smoke, in such quantities so as to be irritating or injurious to health or safety.

502.1.1 Exhaust location. The inlet to an exhaust system shall be located in the area of heaviest concentration of contaminants.

[F] 502.1.2 Fuel-dispensing areas. The bottom of an air inlet or exhaust opening in fuel-dispensing areas shall be located not more than 18 inches (457 mm) above the floor.

502.1.3 Equipment, appliance and service rooms. *Equipment, appliance* and system service rooms that house sources of odors, fumes, noxious gases, smoke, steam, dust, spray or other contaminants shall be designed and constructed so as to prevent spreading of such contaminants to other occupied parts of the building.

[F] 502.1.4 Hazardous exhaust. The mechanical exhaust of high concentrations of dust or hazardous vapors shall conform to the requirements of Section 510.

[F] 502.2 Aircraft fueling and defueling. Compartments housing piping, pumps, air eliminators, water separators, hose reels and similar *equipment* used in aircraft fueling and defueling operations shall be adequately ventilated at floor level or within the floor itself.

[F] 502.3 Battery-charging areas for powered industrial trucks and equipment. Ventilation shall be provided in an *approved* manner in battery-charging areas for powered industrial trucks and *equipment* to prevent a dangerous accumulation of flammable gases.

[F] 502.4 Stationary storage battery systems. Stationary storage battery systems, as regulated by Section 608 of the *International Fire Code*, shall be provided with ventilation in accordance with this chapter and Section 502.4.1 or 502.4.2.

Exception: Lithium-ion and lithium metal polymer batteries shall not require additional ventilation beyond that which would normally be required for human occupancy of the space.

[F] 502.4.1 Hydrogen limit in rooms. For flooded lead acid, flooded nickel cadmium and VRLA batteries, the ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room.

[F] 502.4.2 Ventilation rate in rooms. Continuous ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot (cfm/ft^2) [0.00508 m^3/(s • m^2)] of floor area of the room.

[F] 502.4.3 Supervision. Mechanical ventilation systems required by Section 502.4 shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

[F] 502.5 Valve-regulated lead-acid batteries in cabinets. Valve-regulated lead-acid (VRLA) batteries installed in cabinets, as regulated by Section 608.6.2 of the *International Fire Code*, shall be provided with ventilation in accordance with Section 502.5.1 or 502.5.2.

[F] 502.5.1 Hydrogen limit in cabinets. The cabinet ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the cabinet during the worst-case event of simultaneous boost charging of all batteries in the cabinet.

[F] 502.5.2 Ventilation rate in cabinets. Continuous cabinet ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot (cfm/ft^2) [0.00508 m^3/(s • m^2)] of the floor area covered by the cabinet. The room in which the cabinet is installed shall be ventilated as required by Section 502.4.1 or 502.4.2.

[F] 502.5.3 Supervision. Mechanical ventilation systems required by Section 502.5 shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

[F] 502.6 Dry cleaning plants. Ventilation in dry cleaning plants shall be adequate to protect employees and the public in accordance with this section and DOL 29 CFR Part 1910.1000, where applicable.

[F] 502.6.1 Type II systems. Type II dry cleaning systems shall be provided with a mechanical ventilation system that is designed to exhaust 1 cubic foot of air per minute for each square foot of floor area (1 cfm/ft^2) [0.00508 m^3/(s • m^2)] in dry cleaning rooms and in drying rooms. The ventilation system shall operate automatically when the dry cleaning *equipment* is in operation and shall have manual controls at an *approved* location.

[F] 502.6.2 Type IV and V systems. Type IV and V dry cleaning systems shall be provided with an automatically activated exhaust ventilation system to maintain an air velocity of not less than 100 feet per minute (0.51 m/s) through the loading door when the door is opened.

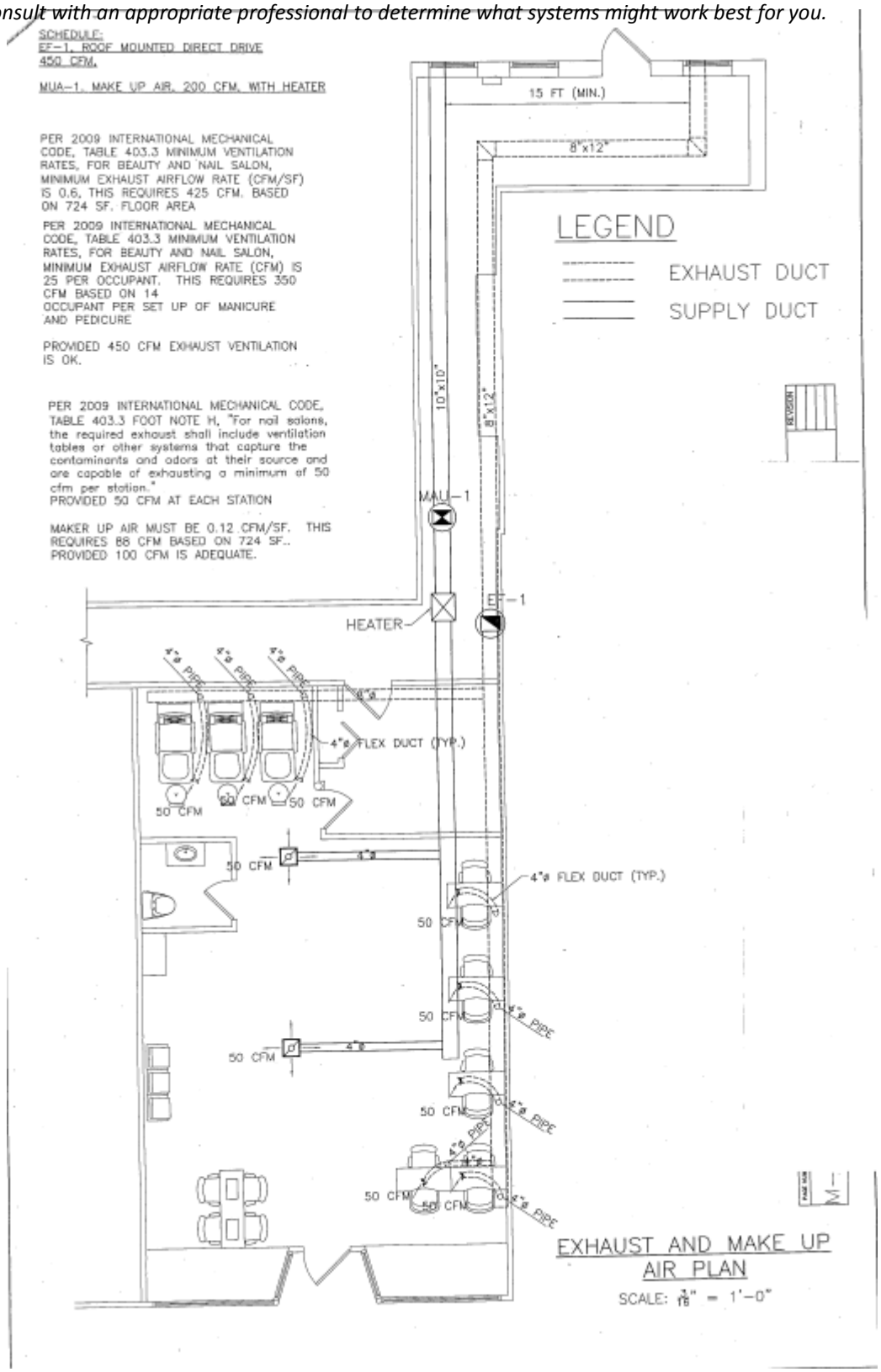
Exception: Dry cleaning units are not required to be provided with exhaust ventilation where an exhaust hood is installed immediately outside of and above the loading door which operates at an airflow rate as follows:

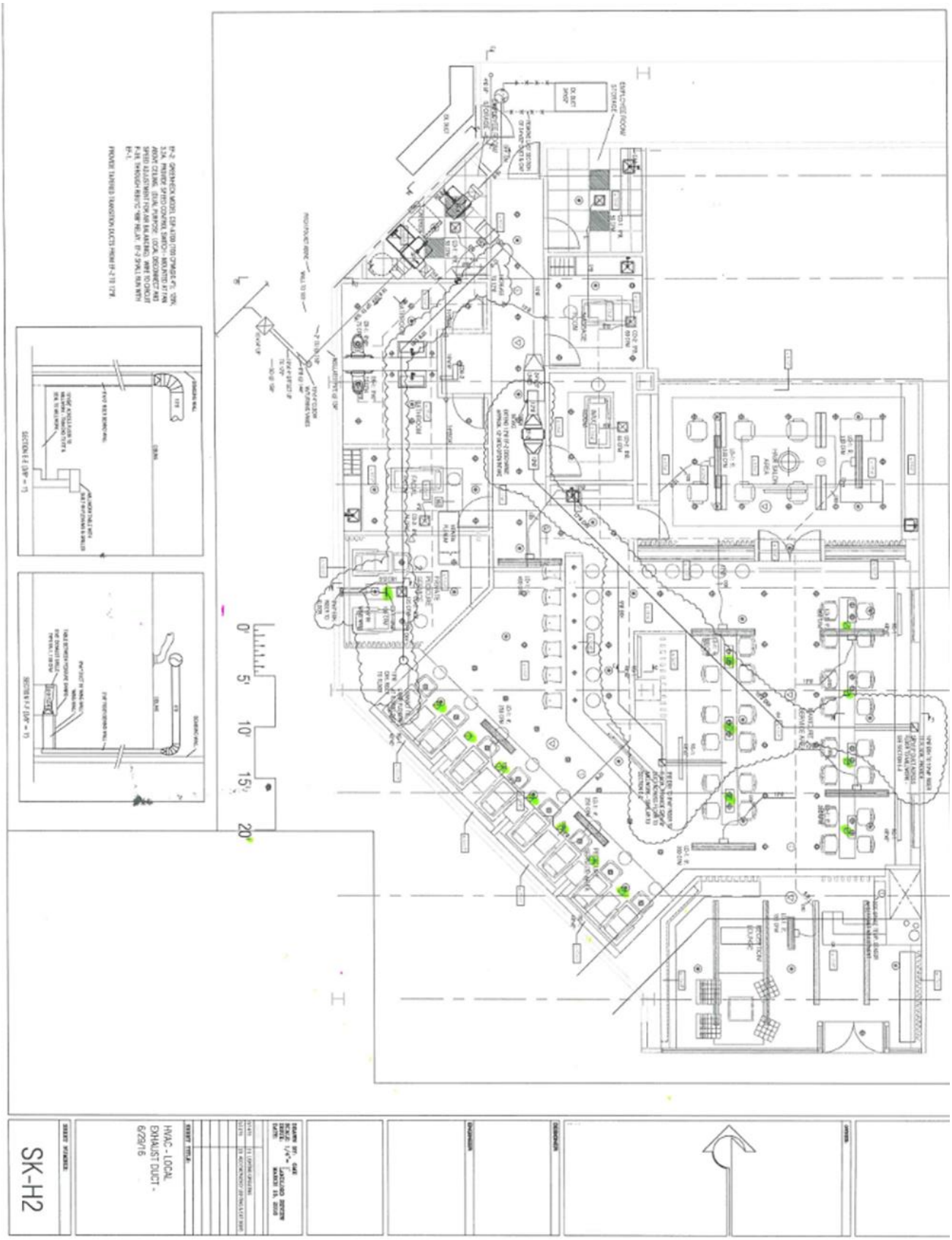
$$Q = 100 \times A_{LD} \qquad \text{Equation 5-1)}$$

502.20 Manicure and pedicure stations. Manicure and pedicure stations shall be provided with an exhaust system in accordance with Table 403.3.1.1, Note h. Manicure tables and pedicure stations not provided with factory-installed exhaust inlets shall be provided with exhaust inlets located not more than 12 inches (305 mm) horizontally and vertically from the point of chemical application.

Appendix B

These pictures and design plans are only examples of the different systems which might be available for the salon. Please consult with an appropriate professional to determine what systems might work best for you.




SK-H2
HVAC - LOCAL EXHAUST DUCT - 6/29/16
0'
5'
10'
15'
20'