7. ENERGY EFFICIENCY

7.1 Scope. This section specifies requirements for energy efficiency for buildings and appliances, for on-site renewable energy systems, and for energy measuring.

7.2 Compliance. The energy systems shall comply with Section 7.3, "Mandatory Provisions," and either

a. Section 7.4, "Prescriptive Option," or
b. Section 7.5, "Performance Option."

7.3 Mandatory Provisions

7.3.1 General. Building projects shall be designed to comply with Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 of ANSI/ASHRAE/IESNA Standard 90.1.

7.3.2 On-Site Renewable Energy Systems. Building projects shall provide for the future installation of on-site renewable energy systems with a minimum rating of 3.7 W/ft² or 13 Btu/h·ft² (40 W/m²) multiplied by the total roof area in ft² (m²). Building projects design shall show allocated space and pathways for installation of on-site renewable energy systems and associated infrastructure.

Exception: Building projects that have an annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 4.0 kW/m²·day, accounting for existing buildings, permanent infrastructure that is not part of the building project, topography, or trees, are not required to provide for future on-site renewable energy systems.

7.3.3 Energy Consumption Management

7.3.3.1 Consumption Management. Measurement devices with remote communication capability shall be provided to collect energy consumption data for each energy supply source to the building, including gas, electricity, and district energy, that exceeds the thresholds listed in Table 7.3.3.1A. The measurement devices shall have the capability to automatically communicate the energy consumption data to a data acquisition system.

For all buildings that exceed the threshold in Table 7.3.3.1A, subsystem measurement devices with remote capability (including current sensors or flowmeters) shall be provided to measure energy consumption data of each subsystem for each use category that exceeds the thresholds listed in Table 7.3.3.1B.

The energy consumption data from the subsystem measurement devices shall be automatically communicated to the data acquisition system.

7.3.3.2 Energy Consumption Data Collection. All building measurement devices shall be configured to automatically communicate the energy data to the data acquisition system. At a minimum, measurement devices shall provide daily data and shall record hourly energy profiles. Such hourly energy profiles shall be capable of being used to assess building performance at least monthly.

7.3.3.3 Data Storage and Retrieval. The data acquisition system shall be capable of electronically storing the data from the measurement devices and other sensing devices, for a minimum of 36 months, and creating user reports showing hourly, daily, monthly, and annual energy consumption.

Exception: Portions of buildings used as residential.

7.4 Prescriptive Option

7.4.1 General Comprehensive Prescriptive Requirements. When a requirement is provided below, it supersedes the requirement in ANSI/ASHRAE/IESNA Standard 90.1. For all other criteria, the building project shall comply with the requirements of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.1.1 On-Site Renewable Energy Systems. Building projects shall contain on-site renewable energy systems that provide the annual energy production equivalent of not less than 6.0 KBTU/ft² (20 kWh/m²) of conditioned space. The annual energy production shall be the combined sum of all on-site renewable energy systems.

Exception: Buildings that demonstrate compliance with both of the following are not required to contain on-site renewable energy systems:

1. An annual daily average incident solar radiation available to a flat plate collector oriented due south at an

<table>
<thead>
<tr>
<th>TABLE 7.3.3.1A Energy Source Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Source</strong></td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Electrical service</td>
</tr>
<tr>
<td>On-site renewable electric power</td>
</tr>
<tr>
<td>Gas and district services</td>
</tr>
<tr>
<td>Geothermal energy</td>
</tr>
<tr>
<td>On-site renewable thermal energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 7.3.3.1B System Energy Use Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use (Total of All Loads)</strong></td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>HVAC system</td>
</tr>
<tr>
<td>HVAC system</td>
</tr>
<tr>
<td>People moving</td>
</tr>
<tr>
<td>Lighting</td>
</tr>
<tr>
<td>Process and plug process</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
angle from horizontal equal to the latitude of the collector location less than 4.0 kW/m²·day, accounting for existing buildings, permanent infrastructure that is not part of the building project, topography, and trees,

2. Purchase of renewable electricity products complying with the Green-e Energy National Standard for Renewable Electricity Products of at least 7 kWWh/year (75 kWh/m²) of conditioned space each year until the cumulative purchase totals 70 kWWh/year (750 kWh/m²) of conditioned space.

7.4.2 Building Envelope. The building envelope shall comply with Section 5 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions:

7.4.2.1 Building Envelope Requirements. The building envelope shall comply with the requirements in Tables A-1 to A-8 in Normative Appendix A. These requirements supersede the requirements in Tables 5.5-1 to 5.5-8 of ANSI/ASHRAE/IESNA Standard 90.1.

Exception: Buildings that comply with Section 8.3.4 regardless of building area are exempt from the SHGC criteria for skylights.

7.4.2.2 Roof Insulation. Roofs shall comply with the provisions of Section 5.3.2.3 and Tables A-1 to A-8 of this standard. Section 5.5.3.1.1 of ANSI/ASHRAE/IESNA Standard 90.1 and Table 5.5.3.1 of ANSI/ASHRAE/IESNA Standard 90.1 shall not apply.

7.4.2.3 Single-Rafter Roof Insulation. Single-rafter roofs shall comply with the requirements in Table A-9 in Normative Appendix A. These requirements supersede the requirements in Section A2.4.2.4 of ANSI/ASHRAE/IESNA Standard 90.1. Section A2.4.2.4 and Table M.4.2 of ANSI/ASHRAE/IESNA Standard 90.1 shall not apply.

7.4.2.4 Vertical Fenestration Area. The total vertical fenestration area shall be less than 40% of the gross wall area. This requirement supersedes the requirement in Section 5.5.4.2.1 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.2.5 Permanent Projections. For climate zones 1-5, the vertical fenestration on the west, south, and east shall be shaded by permanent projections that have an area-weighted average PF of not less than 0.50. The building is allowed to be rotated up to 45 degrees to the nearest cardinal orientation for purposes of calculations and showing compliance.

Exception: Vertical fenestration that receives direct solar radiation for fewer than 250 hours per year because of shading by permanent external buildings, existing permanent infrastructure, or topography.

7.4.2.6 SHGC of Vertical Fenestration. For SHGC compliance, the methodology in exception (b) to Section 5.5.4.4.1 of ANSI/ASHRAE/IESNA Standard 90.1 is allowed, provided that the SHGC multipliers in Table 7.4.2.6 are used. This requirement supersedes the requirement in Table 5.5.4.4.1 of ANSI/ASHRAE/IESNA Standard 90.1. Table 5.5.4.4.1 of ANSI/ASHRAE/IESNA Standard 90.1 shall not apply. Vertical fenestration that is north-oriented shall be allowed to have a maximum SHGC of 0.10 greater than that specified in Tables A-1 through A-8 in Normative Appendix A. When this exception is utilized, separate calculations shall be performed for these sections of the building envelope, and these values shall not be averaged with any others for compliance purposes.

7.4.2.7 Vestibules. For vestibules, the exceptions to Section 5.4.3.4 of ANSI/ASHRAE/IESNA Standard 90.1 are allowed provided that climate zone 4 is deleted from exception (d) to Section 5.4.3.4 of ANSI/ASHRAE/IESNA Standard 90.1 and that climate zone 4 is added to exception (f) to Section 5.4.3.4 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.2.8 Building Envelope Trade-Off Option. The building envelope trade-off option in Section 5.6 of ANSI/ASHRAE/IESNA Standard 90.1 shall not apply unless the procedure incorporates the modifications and additions to ANSI/ASHRAE/IESNA Standard 90.1 noted in Section 7.4.2.

7.4.2.9 Fenestration Orientation. To reduce solar gains from the east and west in climate zones 1 through 4 and from the west in climate zones 5 and 6, the fenestration area and SHGC shall comply with the following requirements:

a. For climate zones 1, 2, 3, and 4:

\[(A_N \times SHGC_N + A_S \times SHGC_S) \geq 1.1 \times (A_W \times SHGC_W)
\]

b. For climate zones 5 and 6:

\[
\frac{1}{3} \times (A_N \times SHGC_N + A_S \times SHGC_S + A_W \times SHGC_W) \geq 1.1 \times (A_W \times SHGC_W)
\]

where:

- \(SHGC_x\) = the SHGC for orientation \(x\)
- \(A_x\) = fenestration area for orientation \(x\)
- \(N\) = north (oriented less than 45 degrees of true north)
- \(S\) = south (oriented less than 45 degrees of true south)
- \(E\) = east (oriented less than or equal to 45 degrees of true east)
- \(W\) = west (oriented less than or equal to 45 degrees of true west)

### TABLE 7.4.2.6 SHGC Multipliers for Permanent Projections

<table>
<thead>
<tr>
<th>PF</th>
<th>SHGC Multiplier (All Other Orientations)</th>
<th>SHGC Multiplier (North-Oriented)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.60</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;0.60-0.70</td>
<td>0.92</td>
<td>0.96</td>
</tr>
<tr>
<td>&gt;0.70-0.80</td>
<td>0.84</td>
<td>0.94</td>
</tr>
<tr>
<td>&gt;0.80-0.90</td>
<td>0.77</td>
<td>0.93</td>
</tr>
<tr>
<td>&gt;0.90-1.00</td>
<td>0.72</td>
<td>0.90</td>
</tr>
</tbody>
</table>

ANSI/ASHRAE/USGBC/IES Standard 189.1-2009
I. Vertical fenestration that complies with the exception to Section 5.5.4.4.1 (c) of ANSI/ASHRAE/IESNA Standard 90.1.

b. Buildings that have an existing building or existing permanent infrastructure within 20 ft (6 m) to the south or north that is at least half as tall as the proposed building.

c. Buildings with shade on 75% of the west- and east-oriented vertical fenestration areas from existing buildings, existing permanent infrastructure, or topography at 9 a.m. and 3 p.m. on the summer solstice.

d. Alterations and additions with no increase in vertical fenestration area.

7.4.2.10 Continuous Air Barrier. The building envelope shall be designed and constructed with a continuous air barrier that complies with Normative Appendix B to control air leakage into, or out of, the conditioned space. All air barrier components of each envelope assembly shall be clearly identified on construction documents and the joints, interconnections, and penetrations of the air barrier components shall be detailed.

Exception: Building envelopes of semiheated spaces provided that the building envelope complies with Section 5.4.3.1 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.3 Heating, Ventilating, and Air Conditioning. The heating, ventilating, and air conditioning shall comply with Section 6 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions.

7.4.3.1 Minimum Equipment Efficiencies. Projects shall comply with one of the following:

a. EPAct baseline. Products shall comply with the minimum efficiencies addressed in the National Appliance Energy Conservation Act (NAECA), Energy Policy Act (EPAct), and the Energy Independence and Security Act (EISA).

b. Higher Efficiency. Products shall comply with the greater of the ENERGY STAR requirements in Section 7.4.7.3 and the values in Normative Appendix C. These requirements supersede the requirements in Tables 6.8.1A to 6.8.1J of ANSI/ASHRAE/IESNA Standard 90.1. The building project shall comply with Sections 7.4.1.1 and 7.4.5.1 with the following modifications:

1. The on-site renewable energy systems required in Section 7.4.1.1 shall provide an annual energy production of not less than 4.0 kBtu/ft² (13 kWh/m²).

2. The peak load reduction systems required in Section 7.4.5.1 shall be capable of reducing electric peak demand by not less than 5% of the projected peak demand.

7.4.3.2 Ventilation Controls for Densely Occupied Spaces. DCV is required for densely occupied spaces. This requirement supersedes the occupant density threshold in Section 6.4.3.9 of ANSI/ASHRAE/IESNA Standard 90.1. The DCV system shall be designed to be in compliance with ANSI/ASHRAE Standard 62.1. Occupancy assumptions shall be shown in the design documents for spaces required to have DCV. All CO₂ sensors used as part of a DCV system or any other system that dynamically controls outdoor air shall meet the following requirements:

a. Spaces with CO₂ sensors or air sampling probes leading to a central CO₂ monitoring station shall have one sensor or probe for each 10,000 ft² (1000 m²) of floor space and shall be located in the room between 3 and 6 ft (1 and 2 m) above the floor.

b. CO₂ sensors must be accurate to ±50 ppm at 1000 ppm.

c. Outdoor air CO₂ concentrations shall be determined by one of the following:

1. Outdoor air CO₂ concentrations shall be dynamically measured using a CO₂ sensor located in the path of the outdoor air intake.

2. When documented statistical data are available on the local ambient CO₂ concentrations, a fixed value typical of the location where the building is located shall be allowed in lieu of an outdoor sensor.

d. Occupant CO₂ generation rate assumptions shall be shown in the design documents.

7.4.3.3 Duct and Plenum Leakage. For duct sealing, Seal Level A shall be used. This requirement supersedes the requirements in Table 6.4.4.2A of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.3.4 Economizers. Systems shall have economizers meeting the requirements in Section 6.5.1 of ANSI/ASHRAE/IESNA Standard 90.1 except as noted below.

1. The minimum size requirements for economizers are defined in Table 7.4.3.4A and supersede the requirements in Table 6.5.1 of ANSI/ASHRAE/IESNA Standard 90.1.

2. High-limit controls shall comply with Table 7.4.3.4B.

3. Rooftop units with a capacity of less than 60,000 Btu/h (18 kW) shall have two stages of capacity control, with the first stage used for cooling with the economizer and the second stage to add mechanical cooling.

4. For systems that control to a fixed leaving air temperature (i.e., VAV systems), the system shall be capable of resetting the supply air temperature up at least 5°F (3°C) during economizer operation.

Exceptions: All the exceptions in Sections 6.5.1 and 6.5.1.3 of ANSI/ASHRAE/IESNA Standard 90.1 shall apply except as noted below.

1. For units requiring an airside economizer, the economizer is allowed to be eliminated if: for products with an IEER part load minimum requirement, the product IEER rating exceeds the minimum level defined in Appendix C by the percentage shown in the Table 7.4.3.4C or, for products with only a full load minimum metric (EER or SEER), the...
TABLE 7.4.3.4A Minimum System Size for Which an Economizer is Required

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>Cooling Capacity for Which an Economizer is Required(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 1B, 2A</td>
<td>No economizer requirement</td>
</tr>
<tr>
<td>2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8</td>
<td>(\geq 33,000) Btu/h (9.7 kW)(a)</td>
</tr>
</tbody>
</table>

\(a\) Where economizers are required, the total capacity of all systems without economizers shall not exceed 480,000 Btu/h (140 kW) per building or 20% of the building’s air economizer capacity, whichever is greater.

TABLE 7.4.3.4B High Limit Shut-off Control Options for Air Economizers

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>Allowable Control Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 2A, 3A, 4A</td>
<td>Differential enthalpy(a)</td>
</tr>
<tr>
<td>1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8</td>
<td>Differential enthalpy or differential dry bulb</td>
</tr>
</tbody>
</table>

\(a\) Differential enthalpy is the enthalpy difference between the return air and the outside air.

full load efficiency exceeds the minimum level defined in Appendix C by the percentage shown in the Table 7.4.3.4C.

2. For water-cooled units with a capacity less than 54,000 Btu/h (16 kW) that are used in systems where heating and cooling loads are transferred within the building (i.e., water-source heat pump systems), the requirement for an air or water economizer can be eliminated if the condenser-water temperature controls are capable of being set to maintain full load heat rejection capacity down to a 55°F (12°C) condenser-water supply temperature and the HVAC equipment is capable of operating with a 55°F (12°C) condenser-water supply temperature.

3. All economizers shall have integrated economizer controls as defined by Section 6.5.1.3 of ANSI/ASHRAE/IESNA Standard 90.1, but Exception 6.5.1.3 (c) shall not apply.

7.4.3.5 Zone Controls. Exception (a) to Section 6.5.2.1 of ANSI/ASHRAE/IESNA Standard 90.1 shall be replaced by the following: zones for which the volume of air that is reheated, re-cooled, or mixed is not greater than the larger of (1) the design outdoor airflow rate for the zone, or (2) 15% of the zone design peak supply rate.

7.4.3.6 Fan System Power Limitation. Systems shall have fan power limitations 10% below limitations specified in Table 6.5.3.1.1A of ANSI/ASHRAE/IESNA Standard 90.1. This requirement supersedes the requirement in Section 6.5.3.1 and Table 6.5.3.1.1A of ANSI/ASHRAE/IESNA Standard 90.1. All exceptions in Section 6.5.3.1 of ANSI/ASHRAE/IESNA Standard 90.1 shall apply.

7.4.3.7 Controls. The following requirements shall apply:

a. \(DX\) systems with a capacity greater than 65,000 Btu/h (19 kW) shall have a minimum of two stages of cooling capacity.

b. Air-handling and fan-coil units with chilled-water cooling coils and supply fans with motors greater than or equal to 5 hp shall have their supply fans controlled by two-speed motors or variable-speed drives. At cooling demands less than or equal to 50%, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

1. One half of the full fan speed, or
2. The volume of outdoor air required to meet the ventilation requirements of ANSI/ASHRAE Standard 62.1.

c. All air-conditioning equipment and air-handling units with direct expansion cooling and a cooling capacity at AHRI conditions greater than or equal to 110,000 Btu/h (32.2 kW) that serve single zones shall have their supply fans controlled by two-speed motors or variable-speed drives. At cooling demands less than or equal to 50%, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

1. Two-thirds of the full fan speed, or
2. The volume of outdoor air required to meet the ventilation requirements of ANSI/ASHRAE Standard 62.1.

d. All \(DX\) and chilled-water \(VAV\) units shall be equipped with variable-speed fans that result in less than 30% power at 50% flow.

Exception: When air ventilation rates or air exchange rates require constant volume fan operation.

TABLE 7.4.3.4C Minimum Efficiency Improvement to Eliminate Airside Economizer

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>Cooling Efficiency Improvement (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 1B, 2A</td>
<td>NR</td>
</tr>
<tr>
<td>2B, 3A, 3B, 4A</td>
<td>15%</td>
</tr>
<tr>
<td>4B, 5A, 5B</td>
<td>35%</td>
</tr>
<tr>
<td>6A, 6B</td>
<td>58%</td>
</tr>
<tr>
<td>3C, 4C, 5C, 7, 8</td>
<td>NA</td>
</tr>
</tbody>
</table>

\(a\) The incremental efficiency improvement should be applied to the unit part load or annualized metric (i.e., IPLV, IEER, SEER). For products that do not have a defined part load or annualized metric, the full load EER rating shall be used.

NR - No economizers are required by the ANSI/ASHRAE/IESNA Standard 90.1.

NA - The economizer is mandatory and cannot be eliminated by a higher efficiency unit.
7.4.3.8 Exhaust Air Energy Recovery. Each fan system shall have an energy recovery system when the system's supply airflow rate exceeds the value listed in Table 7.4.3.8 based on the climate zone and percentage of outdoor air at design conditions. Where a single room or space is supplied by multiple units, the aggregate supply cfm (L/s) of those units shall be used in applying this requirement.

Energy recovery systems required by this section shall have at least 60% energy recovery effectiveness. Sixty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 60% of the difference between the outdoor air and return air enthalpies at design conditions. Provisions shall be made to bypass or control the energy recovery system to permit air economizer operation as required by Section 7.4.3.4.

7.4.3.9 Variable-Speed Fan Control for Commercial Kitchen Hoods. In addition to the requirements in Section 6.5.7.1 of ANSI/ASHRAE/IESNA Standard 90.1, commercial kitchen Type I and Type II hood systems shall have variable-speed control for exhaust and makeup air fans to reduce hood airflow rates at least 50% during those times when cooking is not occurring and the cooking appliances are up to temperature in a standby, ready-to-cook mode. All exceptions in Section 6.5.7.1 of ANSI/ASHRAE/IESNA Standard 90.1 shall apply.

7.4.3.10 Duct Insulation. Duct insulation shall comply with the minimum requirements in Tables C-9 and C-10 in Normative Appendix C. These requirements supersede the requirements in Tables 6.8.2A and 6.8.2B of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.3.11 Pipe Insulation. Pipe insulation shall comply with the minimum requirements in Table C-11 in Normative Appendix C. These requirements supersede the requirements in Table 6.8.3 of ANSI/ASHRAE/IESNA Standard 90.1. The exceptions a through e in Section 6.4.4.1.3 of ANSI/ASHRAE/IESNA Standard 90.1 shall apply.

7.4.3.12 Automatic Control of HVAC and Lights in Hotel/Motel Guest Rooms. In hotels and motels with over 50 guest rooms, the lighting switched outlets, television, and HVAC equipment serving each guest room shall be automatically controlled such that the lighting, switched outlets, and televisions will be turned off and the HVAC setpoint raised at least 5°F (3°C) in the cooling mode and lowered at least 5°F (3°C) in the heating mode whenever the guest room is unoccupied.

7.4.4 Service Water Heating. The service water heating shall comply with Section 7 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions.

### TABLE 7.4.3.8 Energy Recovery Requirement (I-P)

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>% Outside Air at Full Design Flow</th>
<th>Design Supply Fan Flow, cfm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;10% and &gt;20% and &gt;30% and &gt;40% and &gt;50% and &gt;60% and &gt;70% and &gt;80%</td>
<td></td>
</tr>
<tr>
<td>3B, 3C, 4B, 4C, 5B</td>
<td>NR and NR and NR and NR and NR and NR and NR and NR</td>
<td></td>
</tr>
<tr>
<td>1B, 2B, 5C</td>
<td>NR and NR and NR and NR and NR and NR and NR and NR</td>
<td></td>
</tr>
<tr>
<td>6B</td>
<td>NR and &gt;22,500 and &gt;11,000 and &gt;5,500 and &gt;4,500 and &gt;3,500 and &gt;2,000 and &gt;1,000 and &gt;0</td>
<td></td>
</tr>
<tr>
<td>1A, 2A, 3A, 4A, 5A, 6A</td>
<td>≥30,000 and ≥13,000 and ≥5,500 and ≥4,500 and ≥3,500 and ≥2,000 and ≥1,000 and ≥0</td>
<td></td>
</tr>
<tr>
<td>7,8</td>
<td>≥24,000 and ≥12,000 and ≥7,000 and ≥5,000 and ≥5,000 and ≥5,000 and ≥5,000 and ≥5,000</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 7.4.3.8 Energy Recovery Requirement (SI)

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>% Outside Air at Full Design Flow</th>
<th>Design Supply Fan Flow, L/s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;10% and &gt;20% and &gt;30% and &gt;40% and &gt;50% and &gt;60% and &gt;70% and &gt;80%</td>
<td></td>
</tr>
<tr>
<td>3B, 3C, 4B, 4C, 5B</td>
<td>NR and NR and NR and NR and NR and NR and NR and NR</td>
<td></td>
</tr>
<tr>
<td>1B, 2B, 5C</td>
<td>NR and NR and NR and NR and NR and NR and NR and NR</td>
<td></td>
</tr>
<tr>
<td>6B</td>
<td>NR and ≥10,619 and ≥5,191 and ≥2,596 and ≥2,124 and ≥1,652 and ≥1,180 and ≥708 and ≥0</td>
<td></td>
</tr>
<tr>
<td>1A, 2A, 3A, 4A, 5A, 6A</td>
<td>≥14,158 and ≥6,135 and ≥2,596 and ≥2,124 and ≥1,652 and ≥944 and ≥708 and ≥0</td>
<td></td>
</tr>
<tr>
<td>7,8</td>
<td>≥18,888 and ≥14,161 and ≥11,800 and ≥7,088 and ≥7,088 and ≥7,088 and ≥7,088 and ≥7,088</td>
<td></td>
</tr>
</tbody>
</table>
7.4.4.2 Service Hot-Water Piping Insulation. Pipe insulation shall comply with Section 7.4.3.11. These requirements supersede the requirements in Section 7.4.3 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.4.3 Insulation for Spa Pools. Pools heated to more than 90°F (32°C) shall have side and bottom surfaces insulated on the exterior with a minimum insulation value of R-12 (R-2.1).

7.4.5 Power. The power shall comply with Section 8 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions.

7.4.5.1 Peak Load Reduction. Building projects shall contain automatic systems, such as demand limiting or load shifting, that are capable of reducing electric peak demand of the building by not less than 10% of the projected peak demand. Standby power generation shall not be used to achieve the reduction in peak demand.

7.4.6 Lighting. The lighting shall comply with Section 9 of ANSI/ASHRAE/IESNA Standard 90.1 as modified by Addendum I and the following modifications and additions.

7.4.6.1 Lighting Power Allowance. The lighting power allowance shall be a maximum of 0.9 multiplied by the values determined in accordance with Sections 9.5 and 9.6. This requirement supersedes the requirements in Sections 9.5 and 9.6 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.6.2 Occupancy Sensor Controls. Offices 250 ft² (25 m²) or smaller; classrooms of any size; lecture, training, or vocational rooms of less than 1000 ft² (100 m²); multipurpose rooms of less than 1000 ft² (100 m²); conference rooms and meeting rooms less than 1000 ft² (100 m²); and meeting centers shall be equipped with occupant sensor(s) to automatically turn lighting OFF within 30 minutes of all occupants leaving a space and allow “manual OFF” control. In addition, all occupancy sensor controls shall be either “manual ON” or bi-level “automatic ON” programmed to a low light level combined with multi-level circuitry and “manual ON” switching for higher light levels. Where such occupancy sensors are utilized within a daylit area and daylighting controls are utilized, the occupancy sensors shall work in conjunction with the daylighting controls complying with Section 7.4.6.5.

7.4.6.3 Occupancy Sensor Controls with Multi-Level Switching or Dimming. The lighting in the following areas shall be controlled by an operator or occupant sensor with multi-level switching or dimming system that reduces lighting power a minimum of 50% when no persons are present:

a. Hallways in multifamily, dormitory, hotel, and motel buildings.

b. Commercial and industrial storage stack areas.

c. Library stack areas.

Exception: Areas lit by HID lighting with a lighting power density of 0.8 W/ft² or less.

7.4.6.4 Automatic Controls for Egress and Security Lighting. Lighting in any area within a building that is required to be continuously illuminated for reasons of building security or emergency egress shall not exceed 0.1 W/ft² (1 W/m²). Additional egress and security lighting shall be allowed, provided it is controlled by an automatic control device that turns off the additional lighting.

7.4.6.5 Automatic Controls for Lighting in Daylight Zones. Lighting in all daylight zones, including daylight zones under skylights and daylight zones adjacent to vertical fenestration, where the combined daylight zone per enclosed space is greater than 250 ft² (25 m²), shall be provided with controls that automatically reduce lighting power in response to available daylight by either:

a. Continuous daylight dimming, or

b. A combination of stepped switching and daylight-sensing automatic controls, which are capable of incrementally reducing the light level in steps automatically and turning the lights off automatically.

Exceptions:

1. Window display and exhibition lighting.

2. Conference rooms greater than 250 ft² (25 m²) that have a lighting control system with at least four scene options.

3. Lighting in conference rooms that is dimmable and controlled by dimming controls that are located within the space and accessible to the space occupants.

4. Saunas, steam rooms, and spaces containing swimming pools or spa pools.

5. Spaces where medical procedures are performed.

6. Spaces within dwelling units.

7. Spaces within hotel and motel guest rooms and suites.

8. Daylight zones where the height of existing adjacent structures above the window is at least twice the distance between the window and adjacent structures, measured from the top of the glazing.

7.4.6.6 “Manual ON” Occupancy Sensors. Occupancy sensors shall have “manual ON”, “automatic OFF” controls.

Exception: Occupancy sensor controls required in Section 7.4.6.3.

7.4.6.7 Controls for Outdoor Lighting. All outdoor lighting controls shall comply with Section 9 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions. For lighting of building facades, parking lots, garages, canopies (sales and non-sales), and all outdoor sales areas, automatic controls shall be installed to reduce the sum of all lighting power (in watts) by a minimum of 50% one hour after normal business closing and to turn off outdoor lighting within 30 minutes after sunrise.

Exceptions:

1. Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.

2. Lighting that is controlled by a motion sensor and photocontrol.

3. Lighting for facilities that have equal lighting requirements at all hours and are designed to operate continuously.

4. Temporary outdoor lighting.
5. Externally illuminated signs and signs that are internally illuminated or have integral lamps.

7.4.7 Other Equipment. The other equipment shall comply with Section 10 of ANSI/ASHRAE/IESNA Standard 90.1 with the following modifications and additions.

7.4.7.1 Electric Motors. Motors shall comply with the minimum requirements in Table C-13 in Normative Appendix C. These requirements supersede the requirements in Section 10.4.1 and Table 10.8 of ANSI/ASHRAE/IESNA Standard 90.1.

7.4.7.2 Supermarket Heat Recovery. Supermarkets with a floor area of 25,000 ft² (2500 m²) or greater shall recover waste heat from the condenser heat rejection on permanently installed refrigeration equipment meeting one of the following criteria:

1. 25% of the refrigeration system full load total heat rejection.
2. 80% of the space heat, service water heating and dehumidification reheat.

If a recovery system is used that is installed in the refrigeration system, the system shall not increase the saturated condensing temperature at design conditions by more than 5°F (3°C) and shall not impair other head pressure control/energy reduction strategies.

7.4.7.3 ENERGY STAR Equipment. The following equipment within the scope of the applicable ENERGY STAR program shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy:

a. Appliances

1. Clothes washers: ENERGY STAR Program Requirements for Clothes Washers (see also the water efficiency requirements in Section 6.3.2.2)
2. Dishwashers: ENERGY STAR Program Requirements for Dishwashers (see also the water efficiency requirements in Section 6.3.2.2)
3. Refrigerators and freezers: ENERGY STAR Program Requirements for Refrigerators and Freezers
4. Room air conditioners: ENERGY STAR Program Requirements and Criteria for Room Air Conditioners (see also the energy efficiency requirements in Section 7.4.1)
5. Room air cleaners: ENERGY STAR Program Requirements for Room Air Cleaners
6. Water coolers: ENERGY STAR Program Requirements for Bottled Water Coolers

b. Heating and Cooling

1. Residential air-source heat pumps: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners (see also the energy efficiency requirements in Section 7.4.1)

2. Residential boilers: ENERGY STAR Program Requirements for Boilers (see also the energy efficiency requirements in Section 7.4.1)
3. Residential central air conditioners: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners (see also the energy efficiency requirements in Section 7.4.1)
4. Residential ceiling fans: ENERGY STAR Program Requirements for Residential Ceiling Fans
5. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers
6. Programmable thermostats: ENERGY STAR Program Requirements for Programmable Thermostats
7. Ventilating fans: ENERGY STAR Program Requirements for Residential Ventilating Fans
8. Residential Warm Air Furnaces: ENERGY STAR Program Requirements for Warm Air Furnaces

c. Electronics

1. Cordless phones: ENERGY STAR Program Requirements for Telephony
2. Combination units (TV/VCR/DVD): ENERGY STAR Program Requirements for Televisions
3. DVD products: ENERGY STAR Program Requirements for Consumer Audio and DVD Products
4. Audio: ENERGY STAR Program Requirements for Consumer Audio and DVD Products
5. Televisions: ENERGY STAR Program Requirements for Televisions

d. Office Equipment

1. Computers: ENERGY STAR Program Requirements for Computers
2. Copiers: ENERGY STAR Program Requirements for Imaging Equipment
3. Fax machines: ENERGY STAR Program Requirements for Imaging Equipment
4. Laptops: ENERGY STAR Program Requirements for Computers
5. Mailing machines: ENERGY STAR Program Requirements for Imaging Equipment
6. Monitors: ENERGY STAR Program Requirements for Computer Monitors
7. Multifunction devices (printer/fax/scanner): Program Requirements for Imaging Equipment
8. Printers: ENERGY STAR Program Requirements for Imaging Equipment
9. Scanners: ENERGY STAR Program Requirements for Imaging Equipment

e. Water Heaters: ENERGY STAR Program Requirements for Residential Water Heaters
f. Lighting

1. Compact fluorescent light bulbs (CFLs): ENERGY STAR Program Requirements for CFLs
2. Residential light fixtures: ENERGY STAR Program Requirements for Residential Light Fixtures

g. Commercial Food Service

1. Commercial fryers: ENERGY STAR Program Requirements for Commercial Fryers
2. Commercial hot food holding cabinets: ENERGY STAR Program Requirements for Hot Food Holding Cabinets
3. Commercial solid door refrigerators and freezers: ENERGY STAR Program Requirements for Solid Door Refrigerators and Freezers
4. Commercial steam cookers: ENERGY STAR Program Requirements for Commercial Steam Cookers (see also water efficiency requirements in Section 6.4.2.2)
5. Commercial ice machines: ENERGY STAR Program Requirements for Commercial Ice Machines
6. Commercial dishwashers: ENERGY STAR Program Requirements for Commercial Dishwashers

h. Other Products

1. Battery charging systems: ENERGY STAR Program Requirements for Products with Battery Charger Systems (BCSs)
2. External power adapters: ENERGY STAR Program Requirements for Single-Voltage AC-DC and AC-AC Power Supplies
3. Vending machines: ENERGY STAR Program Requirements for Refrigerated Beverage Vending Machines

Exception: Products with minimum efficiencies addressed in the Energy Policy Act (EPAct) and the Energy Independence and Security Act (EISA) when complying with Section 7.4.3.1a.

7.5 Performance Option

7.5.1 General Comprehensive Performance Requirements. Projects shall comply with Sections 7.5.2, 7.5.3, and 7.5.4.

7.5.2 Annual Energy Cost

a. The building project shall have an annual energy cost less than or equal to that achieved by compliance with Sections 7.3 and 7.4, and Sections 5.3.2.2, 5.3.2.3, 6.3.2, 6.4.2, 8.3.1, 8.3.4, and 8.4.1. Comparisons shall be made using Normative Appendix D provided that the baseline building design is calculated in accordance with the modifications and additions in Sections 7.3.1 through 7.3.3 and Sections 7.4.1 through 7.4.7, and Sections 5.3.2.2, 5.3.2.3, 6.3.2, 6.4.2, 8.3.1, 8.3.4, and 8.4.1.

b. Credit for daylighting controls is allowed to be taken up to a distance of 2.5 times window head height where all lighting more than one window head height from the perimeter (head height is the distance from the floor to the top of the glazing) is automatically controlled separately from lighting within one window head height of the perimeter.

7.5.3 Annual Carbon Dioxide Equivalent (CO₂e). The building project shall have an annual CO₂e less than or equal to that achieved by compliance with Sections 7.3 and 7.4, and Sections 5.3.2.2, 5.3.2.3, 6.3.2, 6.4.2, 8.3.1, 8.3.4, and 8.4.1. Comparisons shall be made using Normative Appendix D provided that the baseline building design is calculated in accordance with Section 7.5.2. To determine the CO₂e value for each energy source supplied to the building project, multiply the energy consumption by the emissions factor. CO₂e emission factors shall be taken from Table 7.5.3.

7.5.4 Annual Load Factor/Peak Electric Demand. The building project shall have the same or less peak electric demand than achieved by compliance with Sections 7.3 and 7.4, and Sections 5.3.2.2, 5.3.2.3, 6.3.2, 6.4.2, 8.3.1, 8.3.4, and 8.4.1. Comparisons shall be made using Normative Appendix D provided that the baseline building design is calculated in accordance with Section 7.5.2. In addition, the building project shall have a minimum electrical annual load factor of 0.25.

<table>
<thead>
<tr>
<th>TABLE 7.5.3 CO₂e Emission Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Project Energy Source</strong></td>
</tr>
<tr>
<td>Grid delivered electricity and other fuels not specified in this table</td>
</tr>
<tr>
<td>LPG or propane</td>
</tr>
<tr>
<td>Fuel oil (residual)</td>
</tr>
<tr>
<td>Fuel oil (distillate)</td>
</tr>
<tr>
<td>Coal (except lignite)</td>
</tr>
<tr>
<td>Coal (lignite)</td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Natural gas</td>
</tr>
</tbody>
</table>

7.4.7.4 Commercial Refrigerators, Freezers, and Clothes Washers

a. Commercial refrigerators and freezers shall comply with the minimum efficiencies in Table C-14 in Normative Appendix C. Open refrigerated display cases not covered by strips or curtains are prohibited. Lighting loads, including all power supplies or ballasts, for commercial reach-in refrigerator/freezer display cases shall not exceed 42 watts per door for case doors up to 5 ft (1.5 m) in height and 46 watts per door for case doors greater than 5 ft (1.5 m) in height.

b. Commercial clothes washers shall comply with the minimum efficiencies in Table C-15 in Normative Appendix C.

7.4.8 Energy Cost Budget. The Energy Cost Budget option in Section 11 of ANSI/ASHRAE/IESNA Standard 90.1 shall not be used.
8. INDOOR ENVIRONMENTAL QUALITY (IEQ)

8.1 Scope. This section specifies requirements for indoor environmental quality, including indoor air quality, environmental tobacco smoke control, outdoor air delivery monitoring, thermal comfort, building entrances, acoustic control, daylighting, and low emitting materials.

8.2 Compliance. The indoor environmental quality shall comply with Section 8.3, “Mandatory Provisions,” and either:

a. Section 8.4, “Prescriptive Option,” or
b. Section 8.5, “Performance Option.”

Daylighting and low-emitting materials are not required to use the same option, i.e., prescriptive or performance, for demonstrating compliance.

8.3 Mandatory Provisions

8.3.1 Indoor Air Quality. The building shall comply with Sections 4 through 7 of ANSI/ASHRAE Standard 62.1 with the following modifications and additions. When a requirement is provided below, this supersedes the requirements in ANSI/ASHRAE Standard 62.1.

8.3.1.1 Minimum Ventilation Rates

a. The Ventilation Rate Procedure of ANSI/ASHRAE Standard 62.1 shall be used to design each mechanical ventilation system in the building.

b. The zone-level design outdoor airflow rates in all occupiable spaces shall be greater than or equal to the airflow calculated using the Ventilation Rate Procedure in Section 6.2 of ANSI/ASHRAE Standard 62.1.

c. The system-level design outdoor airflow rate calculation (Sections 6.2.3 through 6.2.5 of ANSI/ASHRAE Standard 62.1) shall be based on the zone-level design outdoor airflow rates calculated in Section 8.3.1.1 (b).

8.3.1.2 Outdoor Air Delivery Monitoring

8.3.1.2.1 Spaces Ventilated by Mechanical Systems. A permanently mounted, direct total outdoor airflow measurement device shall be provided that is capable of measuring the system minimum outdoor airflow rate. The device shall be capable of measuring flow within an accuracy of ±15% of the minimum outdoor airflow rate. The device shall also be capable of being used to alarm the building operator or for sending a signal to a building central monitoring system when flow rates are not in compliance.

Exception: Constant volume air supply systems that use a damper position feedback system are not required to have a direct total outdoor airflow measurement device.

8.3.1.3 Filtration and Air Cleaner Requirements

a. Particulate Matter

1. The particulate matter filters or air cleaners shall have a MERV of not less than 8 and shall comply with and be provided where required in Section 5.9 of ANSI/ASHRAE Standard 62.1.

2. In addition to Section 6.2.1.1 of ANSI/ASHRAE Standard 62.1, when the building is located in an area that is designated “non-attainment” with the National Ambient Air Quality Standards for PM_{2.5} as determined by the AHT, (in the US by the USEPA), particle filters or air-cleaning devices shall be provided to clean outdoor air prior to its introduction to occupied spaces having a MERV of not less than 13 when rated in accordance with ANSI/ASHRAE Standard 52.2.

b. In addition to Section 6.2.1.2 of ANSI/ASHRAE Standard 62.1, when the building is located in an area that is designated “non-attainment” with the National Ambient Air Quality Standards for ozone as determined by the AHT, air-cleaning devices having a removal efficiency of no less than the efficiency specified in Section 6.2.1.2 of ANSI/ASHRAE Standard 62.1 shall be provided to clean outdoor air prior to its introduction to occupied spaces.

c. Bypass Pathways. All filter frames, air cleaner racks, access doors, and air cleaner cartridges shall be sealed.

8.3.1.4 Environmental Tobacco Smoke

a. Smoking shall not be allowed inside the building. Signage stating such shall be posted within 10 ft (3 m) of each building entrance.

b. Any exterior designated smoking areas shall be located a minimum of 25 ft (7.5 m) away from building entrances, outdoor air intakes, and operable windows.

c. Section 6.2.9 of ANSI/ASHRAE Standard 62.1 shall not apply.

8.3.1.5 Building Entrances. All building entrances shall employ an entry mat system that shall have a scraper surface, an absorption surface, and a finishing surface. Each surface shall be a minimum of the width of the entry opening, and the minimum length is measured in the primary direction of travel.

Exceptions:

1. Entrances to individual dwelling units.

2. Length of entry mat surfaces is allowed to be reduced due to a barrier, such as a counter, partition, or wall, or local regulations prohibiting the use of scraper surfaces outside the entry. In this case entry mat surfaces shall have a minimum length of 3 ft (1 m) of indoor surface, with a minimum combined length of 6 ft (2 m).

8.3.1.5.1 Scraper Surface. The scraper surface shall comply with the following:

a. Shall be the first surface stepped on when entering the building.

b. Shall be either immediately outside or inside the entry.

c. Shall be a minimum of 3 ft (1 m) long.

d. Shall be either permanently mounted grates or removable mats with knobby or squeegee-like projections.

8.3.1.5.2 Absorption Surface. The absorption surface shall comply with the following:

a. Shall be either immediately outside or inside the entry.
a. Shall be the second surface stepped on when entering the building.
b. Shall be a minimum of 3 ft (1 m) long, and made from materials that can perform both a scraping action and a moisture wicking action.

8.3.1.5.3 Finishing Surface. The finishing surface shall comply with the following:

a. Shall be the third surface stepped on when entering the building.
b. Shall be a minimum of 4 ft (1.2 m) long, and made from material that will both capture and hold any remaining particles or moisture.


Exception: Spaces with special requirements for processes, activities, or contents that require a thermal environment outside that which humans find thermally acceptable, such as food storage, natatoriums, shower rooms, saunas, and drying rooms.

8.3.3 Acoustical Control

8.3.3.1 Exterior Sound. Wall and roof-ceiling assemblies that are part of the building envelope shall have a composite OITC rating of 40 or greater or a composite STC rating of 50 or greater, and fenestration that is part of the building envelope shall have an OITC or STC rating of 30 or greater for any of the following conditions:

a. Buildings within 1000 ft (300 m) of expressways.
b. Buildings within 5 mi (8 km) of airports serving more than 10,000 commercial jets per year.
c. Where yearly average day-night average sound levels at the property line exceed 65 decibels.

Exception: Buildings that may have to adhere to functional and operational requirements such as factories, stadiums, storage, enclosed parking structure, and utility buildings.

8.3.3.2 Interior Sound. Interior wall and floor/ceiling assemblies separating interior rooms and spaces shall be designed in accordance with all of the following:

a. Wall and floor-ceiling assemblies separating adjacent dwelling units, dwelling units and public spaces, adjacent tenant spaces, tenant spaces and public places, and adjacent classrooms shall have a composite STC rating of 50 or greater.
b. Wall and floor-ceiling assemblies separating hotel rooms, motel rooms, and patient rooms in nursing homes and hospitals shall have a composite STC rating of 45 or greater.
c. Wall and floor-ceiling assemblies separating classrooms from rest rooms and showers shall have a composite STC rating of 53 or greater.
d. Wall and floor-ceiling assemblies separating classrooms from music rooms, mechanical rooms, cafeterias, gymnasiums, and indoor swimming pools shall have a composite STC rating of 60 or greater.

8.3.3.3 Outdoor-Indoor Transmission Class and Sound Transmission Class. OITC values for assemblies and components shall be determined in accordance with ASTM E1332. STC values for assemblies and components shall be determined in accordance with ASTM E90 and ASTM E413.

8.3.4 Daylighting by Toplighting. There shall be a minimum fenestration area providing daylighting by toplighting for large enclosed spaces. In buildings three stories and less above grade, conditioned or unconditioned enclosed spaces that are greater than 20,000 ft² (2000 m²) directly under a roof with finished ceiling heights greater than 15 ft (4 m) and that have a lighting power allowance for general lighting equal to or greater than 0.5 W/ft² (5.5 W/m²) shall comply with the following.

Exceptions:

1. Buildings in climate zones 7 or 8.
2. Auditoria, theaters, museums, places of worship, and refrigerated warehouses.

8.3.4.1 Minimum Daylight Zone by Toplighting. A minimum of 50% of the floor area directly under a roof in spaces with a lighting power density or lighting power allowance greater than 0.5 W/ft² (5 W/m²) shall be in the daylight zone. Areas that are daylit shall have a minimum toplighting area to daylight zone area ratio as shown in Table 8.3.4.1. For purposes of compliance with Table 8.3.4.1, the greater of the space lighting power density and the space lighting power allowance shall be used.

8.3.4.2 Skylight Characteristics. Skylights used to comply with Section 8.3.4.1 shall have a glazing material or diffuser that has a measured haze value greater than 90%, tested according to ASTM D1003 (notwithstanding its scope) or other test method approved by the AHJ.

**TABLE 8.3.4.1 Minimum Toplighting Area**

<table>
<thead>
<tr>
<th>Lighting Power Density or Lighting Power Allowances in Daylight Zone, W/ft² (W/m²)</th>
<th>Minimum Toplighting Area to Daylight Zone Area Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4 W/ft² (14 W/m²) &lt; LPD</td>
<td>3.6%</td>
</tr>
<tr>
<td>1.0 W/ft² (10 W/m²) &lt; LPD &lt; 1.4 W/ft² (14 W/m²)</td>
<td>3.3%</td>
</tr>
<tr>
<td>0.5 W/ft² (5 W/m²) &lt; LPD &lt; 1.0 W/ft² (10 W/m²)</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

ANSI/ASHRAE/USGBC/IES Standard 189.1-2009
Exceptions:

1. Skylights with a measured haze value less than or equal to 90% whose combined area does not exceed 5% of the total skylight area.
2. Tubular daylighting devices having a diffuser.
3. Skylights that are capable of preventing direct sunlight from entering the occupied space below the well during occupied hours. This shall be accomplished using one or more of the following:
   a. orientation
   b. automated shading or diffusing devices
   c. diffusers
   d. fixed internal or external baffles
4. Airline terminals, convention centers, and shopping malls.

8.3.5 Isolation of the Building from Pollutants in Soil. Building projects that include construction or expansion of a ground-level foundation and which are located on brownfield sites or in "Zone 1" counties identified to have a significant probability of radon concentrations higher than 4 picocuries/liter on the USEPA map of radon zones, shall have a soil gas retarding system installed between the newly constructed space and the soil.

8.4 Prescriptive Option

8.4.1 Daylighting by Sidelighting

8.4.1.1 Minimum Effective Aperture. Office spaces and classrooms shall comply with the following criteria:

a. All north-, south-, and east-facing facades for those spaces shall have a minimum effective aperture for vertical fenestration (EA) as prescribed in Table 8.4.1.1.

b. Opaque interior surfaces in daylight zones shall have visible light reflectances greater than or equal to 80% for ceilings and 70% for partitions higher than 56 in. (1.54 m) in daylight zones.

Exceptions:

1. Spaces with programming that requires dark conditions (e.g., photographic processing).
2. Spaces with toplighting in compliance with Section 8.3.4.
3. Daylight zones where the height of existing adjacent structures above the window is at least twice the distance between the window and the adjacent structures, measured from the top of the glazing.

8.4.1.2 Office Space Shading. Each west-, south-, and east-facing facade, shall be designed with a shading PF. The PF shall be not less than 0.5. Shading is allowed to be external or internal using the interior PF. The building is allowed to be rotated up to 45 degrees for purposes of calculations and showing compliance. The following shading devices are allowed to be used:

- Louvers, sun shades, light shelves, and any other permanent device.
- Any vertical fenestration that employs a combination of interior and external shading is allowed to be separated into multiple segments for compliance purposes. Each segment shall comply with the requirements for either external or interior projection factor.
- Building self-shading through roof overhangs or recessed windows.

8.4.2 Materials. Reported emissions or VOC contents specified below shall be from a representative product sample and conducted with each product reformulation or at a minimum of every three years. Products certified under third-party certification programs as meeting the specific emission or VOC content requirements listed below are exempted from this three-year testing requirement but shall meet all the other requirements as listed below.

8.4.2.1 Adhesives and Sealants. Products in this category include carpet, resilient, and wood flooring adhesives; base cove adhesives; ceramic tile adhesives; drywall and panel adhesives; aerosol adhesives; adhesive primers; acoustic sealants; firestop sealants; HVAC air duct sealants, sealant primers; and caulks. All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of either Section 8.4.2.1.1 or 8.4.2.1.2:

8.4.2.1.1 Emissions Requirements. Emissions shall be determined according to CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350) and shall comply with the limit requirements for either office or classroom spaces regardless of the space type.

8.4.2.1.2 VOC Content Requirements. VOC content shall comply with and shall be determined according to the following limit requirements:
a. Adhesives, sealants and sealant primers: SCAQMD Rule 1168. HVAC duct sealants shall be classified as “Other” category within the SCAQMD Rule 1168 sealants table.

Exceptions to Section 8.4.2.1: The following solvent welding and sealant products are not required to meet the emissions or the VOC content requirements listed above.

1. Cleaners, solvent cements, and primers used with plastic piping and conduit in plumbing, fire suppression, and electrical systems.
2. HVAC air duct sealants when the air temperature of the space in which they are applied is less than 40°F (4.5°C).

8.4.2.2 Paints and Coatings. Products in this category include sealers, stains, clear wood finishes, floor sealers and coatings, waterproofing sealers, primers, flat paints and coatings, non-flat paints and coatings, and rust preventative coatings. Paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with either Section 8.4.2.2.1 or 8.4.2.2.2.

8.4.2.2.1 Emissions Requirements. Emissions shall be determined according to CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350) and shall comply with the limit requirements for either office or classroom spaces regardless of the space type.

8.4.2.2.2 VOC Content Requirements. VOC content shall comply with the following limit requirements:


8.4.2.3 Floor Covering Materials. Floor covering materials installed in the building interior shall comply with the following:

a. Carpet: Carpet shall be tested in accordance with and shown to be compliant with the requirements of CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350). Products that have been verified and labeled to be in compliance with Section 9 of the CA/DHS/EHLB/R-174 comply with this requirement.
b. Hard surface flooring in office spaces and classrooms: Hard surface flooring shall be tested in accordance with and shown to be compliant with the requirements of CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350).

8.4.2.4 Composite Wood, Wood Structural Panel and Agrifiber Products. Composite wood, wood structural panel, and agrifiber products used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Composite wood and agrifiber products are defined as: particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Materials considered furniture, fixtures and equipment (FF&E) are not considered base building elements and are not included in this requirement. Emissions for products covered by this section shall be determined according to and shall comply with one of the following:

a. Third-party certification shall be submitted indicating compliance with the California Air Resource Board’s (CARB) regulation, *Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products.* Third-party certifier shall be approved by CARB.
b. CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350) and shall comply with the limit requirements for either office or classroom spaces regardless of the space type.

Exception: Structural panel components such as plywood, particle board, wafer board, and oriented strand board identified as “EXPOSURE I,” “EXTERIOR,” or “HUD-APPROVED” are considered acceptable for interior use.

8.4.2.5 Office Furniture Systems and Seating. All office furniture systems and seating installed prior to occupancy shall be tested according to ANSI/BIFMA Standard M7.1 and shall not exceed the limit requirements listed in Normative Appendix E of this standard.

8.4.2.6 Ceiling and Wall Systems. These systems include ceiling and wall insulation, acoustical ceiling panels, tackable wall panels, gypsum wall board and panels, and wall coverings. Emissions for these products shall be determined according to CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350) and shall comply with the limit requirements for either office or classroom spaces regardless of the space type.

8.5 Performance Option

8.5.1 Daylighting Simulation

8.5.1.1 Usable Illuminance in Office Spaces and Classrooms. The design for the building project shall demonstrate an illuminance of at least 30 fc (300 lux) on a plane 3 ft (1 m) above the floor, within 75% of the area of the daylight zones. The simulation shall be made at noon on the equinox using an accurate physical model or computer daylighting model.

a. Computer models shall be built using daylight simulation software based on the ray-tracing or radiosity methodology.
b. Simulation shall be done using either the CIE Overcast Sky Model or the CIE Clear Sky Model.

Exception: Where the simulation demonstrates that existing adjacent structures preclude meeting the illuminance requirements.

8.5.1.2 Direct Sun Limitation on Worksurfaces in Offices. It shall be demonstrated that direct sun does not strike
8.5.2 Materials. The emissions of all the materials listed below and used within the building (defined as inside of the weatherproofing system and applied onsite) shall be modeled for individual VOC concentrations. The sum of each individual VOC concentration from the materials listed below shall be shown to be in compliance with the limits as listed in Section 4.3 of the CA/DHS/EHLB/R-174 (commonly referred to as California Section 01350) and shall be compared to 100% of its corresponding listed limit. In addition, the modeling for the building shall include at a minimum the criteria listed in Normative Appendix F. Emissions of materials used for modeling VOC concentrations shall be obtained in accordance with the testing procedures of CA/DHS/EHLB/R-174 unless otherwise noted below.

a. Tile, strip, panel, and plank products, including vinyl composition tile, resilient floor tile, linoleum tile, wood floor strips, parquet flooring, laminated flooring, and modular carpet tile.
b. Sheet and roll goods, including broadloom carpet, sheet vinyl, sheet linoleum, carpet cushion, wallcovering, and other fabric.
c. Rigid panel products, including gypsum board, other wall paneling, insulation board, oriented strand board, medium density fiber board, wood structural panel, acoustical ceiling tiles, and particleboard.
d. Insulation products.
e. Containerized products, including adhesives, sealants, paints, other coatings, primers, and other “wet” products.
f. Cabinets, shelves, and worksurfaces that are permanently attached to the building before occupancy. Emissions of these items shall be obtained in accordance with the ANSI/BIFMA Standard M7.1.
g. Office furniture systems and seating installed prior to initial occupancy. Emissions of these items shall be obtained in accordance with the ANSI/BIFMA Standard M7.1.

Exception: Salvaged materials that have not been refurbished or refinished within one year prior to installation.