



DRAFT ONLY – February 2023

# VERSION 2

# Indoor airPLUS Certified

## Verification Requirements for Homes and Apartments





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**NOTE:** Although these measures are designed to help improve IAQ in residences compared with residences built to minimum code, they alone cannot prevent all IAQ problems. For example, occupant behavior such as smoking/vaping indoors, routine cleaning practices, regular maintenance of mechanical systems, and the conscientious use of mechanical equipment during unusual events (e.g., power outages, wildfires, etc.) are also important factors that impact IAQ.

## Terms To Help Navigate This Document

**ADVISORIES** provide additional information to be considered or recommendations that are not program requirements. Recommendations in some advisories may become requirements in a future revision or version.

**EXCEPTIONS** to the requirements described in these construction specifications are noted as appropriate. For climate exceptions, refer to the 2021 International Energy Conservation Code (IECC) Climate Zone map (Figure R301.1). Climate Zone names may include a number for the temperature zone and a letter for the moisture zone (e.g., Zone 3C refers to coastal California only).

**NOTES** provide additional information to clarify specification requirements.



# Indoor airPLUS Version 2 Certification Specifications Verification Checklist



| Home/Building Address: _____   |        | City: _____  | State: ____              | Zip Code: _____          |                          |
|--|--------|--|--------------------------|--------------------------|--------------------------|
| Project Name (Multifamily only): _____   |        | Number of Units: _____   |                          |                          |                          |
| <input type="checkbox"/> New Construction<br><input type="checkbox"/> Gut Rehabilitation |        | Climate Zone (0-7): _____ Moisture Zone (A-C): _____ Radon Zone (1-3): _____<br>Termite Probability: <input type="checkbox"/> Very Heavy <input type="checkbox"/> Moderate to Heavy <input type="checkbox"/> N/A   |                          |                          |                          |
| Requirements (Refer to full Indoor airPLUS Certification Specifications for details)     |        | Must Correct   | Verified                 | N/A                      |                          |
| Section 1 – Moisture Control   |        |  |                          |                          |                          |
| Water Managed Site and Foundation  |        |  |                          |                          |                          |
| 1.1  | 1.1.1  | Impermeable surfaces sloped $\geq 0.25$ in. per ft. away from the building.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.1.2  | Exterior drains are free of debris.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.1.3  | <u>Newly installed</u> backfill tamped and final grade sloped $\geq 0.5$ in. per ft.<br>Exception: <input type="checkbox"/> Swales/drains <input type="checkbox"/> Professional verified soils <input type="checkbox"/> Graded after settling  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.2  | 1.2.1  | <u>Newly constructed</u> foundations, drain tile or CFDS is installed to discharge outside.<br>Exceptions: <input type="checkbox"/> Professional verified Group I Soils <input type="checkbox"/> Gut rehab moisture inspection   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 1.2.2  | Sump cover is mechanically attached and drain discharges $\geq 5$ ft. from foundation.<br>Exception: <input type="checkbox"/> Discharge professionally designed or verified Group I Soils  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.3  | 1.3.1  | In lowest area of basement, install floor drain with trap seal or moisture monitoring system with audible alarm.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.4  | 1.4.1  | Under <u>newly installed</u> slabs in <u>Moist (A) Zones</u> , aggregate <b>OR</b> sand with geotextile matting is installed.<br>Exceptions: <input type="checkbox"/> Slab-on-grade <input type="checkbox"/> Professional verified Group I Soils   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.4.2  | Under <u>newly installed</u> slabs in <u>Moist (A) Zones</u> , Class I vapor retarder in contact with slab above.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.4.3  | Crawlspaces without slabs in <u>Moist (A) Zones</u> , Class I vapor retarder installed with penetrations/seams/edges overlapped and sealed.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.4.4  | <u>Existing</u> slabs in <u>Moist (A) Zones</u> where Items 1.4.1 and 1.4.2 cannot be verified, a continuous/sealed Class I or Class II vapor retarder installed on top of slab. For occupiable spaces, vapor retarder is either a durable floor surface or covered by one.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.4.5  | Capillary break installed between the foundation wall (or slab) and <u>newly installed</u> sill plates.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.5  | 1.5.1  | <u>Newly installed</u> below-grade concrete/masonry walls damp-proofed; wood framed walls waterproofed.<br>Exception: <input type="checkbox"/> Gut rehab moisture inspection   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.6  | 1.6.1  | Crawlspaces and basements not vented, and perimeter walls sealed.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.6.2  | In <u>Moist (A) &amp; Marine (C) Zones</u> active dehumidification in basements or crawlspaces by HAC or supplemental system.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Water-Managed Wall Assemblies  |        |  |                          |                          |                          |
| 1.7  | 1.7.1  | Continuous water-resistive barrier installed behind cladding and a bond-break drainage plane for non-structural masonry assemblies.<br>Exception: <input type="checkbox"/> Gut rehab moisture inspection   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 1.7.2  | Flashing/drainage system at all horizontal interruptions and bottom of exterior walls.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.7.3  | Weep holes for masonry veneer and/or weep screed for stucco cladding.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.8  | 1.8.1  | <u>Newly installed</u> windows and doors fully flashed.<br>Exception: <input type="checkbox"/> Gut rehab moisture inspection   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 1.8.2  | Windows and doors-fully close/latch.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Interior Moisture Management   |        |  |                          |                          |                          |
| 1.9  | 1.9.1  | Gutter system discharges $\geq 5$ ft from foundation, into underground catchment, or sewer/rainwater management system.<br>Exceptions: <input type="checkbox"/> Slab-on-grade <input type="checkbox"/> Dry (B) Climates <input type="checkbox"/> Professional verified soils <input type="checkbox"/> Rock bed w/ liner<br><input type="checkbox"/> Rainwater harvesting systems <input type="checkbox"/> Continuous rubber membrane | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.9.2  | If utilizing item 1.9.1 exception, extra protection for splash damage included.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.9.3  | Gutters and downspouts securely installed and clear of debris.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.10   | 1.10.1 | <u>Newly installed</u> roof-to-wall intersections and roof penetrations fully flashed.<br>Exception: <input type="checkbox"/> Gut rehab moisture inspection  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 1.10.2 | <u>Newly installed</u> roofing includes kickout flashing installed at low end of roof-to-wall intersections and roof deck flashing integrated with drainage plane.<br>Exception: <input type="checkbox"/> Gut rehab moisture inspection  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.11   | 1.11.1 | <u>Newly installed</u> roofing includes self-sealing bituminous membrane at valleys and roof penetrations.<br>Exceptions: <input type="checkbox"/> Dry (B) Climates <input type="checkbox"/> 2021 IRC Section R905.2.8.2 or R905.13  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|  |   |                          |                          |                          |
|--|---|--------------------------|--------------------------|--------------------------|
|  | 1.11.2 <u>Newly installed</u> low sloped or flat roofs are sloped $\geq \frac{1}{4}$ " per ft. to drains or scuppers and drains are insulated through roof assembly; roof assembly air control layers fully connected to wall air control layers and water control layers overlap.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.12   | 1.12.1 <u>Newly installed</u> roofing, CZ 4 and up, include ice barrier over sheathing at eaves and extend from edge of roof line > 2 ft. up.<br>Exception: <input type="checkbox"/> Gut rehabilitation with R-49 Grade I attic insulation, if vented.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.12.2 Between vented attics and living space, gaps and penetrations are sealed where accessible.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.13   | 1.13.1 No active leaks or water intrusion in attics and roof assemblies.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 1.14   | 1.14.1 Moisture-resistant backing material behind tub and shower enclosures with tile or panel assemblies.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 1.15   | 1.15.1 Drain pan connected to a drain for condensate-producing HVAC equipment and secondary drain system meets 2021 IMC 307.2.3.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.15.2 For tank type hot water heater/storage where leakage could cause damage, drain pan and drain OR detection system with shutoff included.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.15.3 Non-vented clothes dryers plumbed to a drain.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.16   | 1.16.1 Supply water pipes in exterior building cavities insulated with $\geq$ R4 pipe wrap.<br>Exceptions: <input type="checkbox"/> CZ 1-3 in Dry (B) Zone <input type="checkbox"/> Cavity insulation qualifies as air barrier  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 1.17   | 1.17.1 Water-resistant flooring installed where moisture or splash damage could occur.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 1.18   | 1.18.1 No Class I vapor retarders on interior side of vapor permeable insulation in below-grade, exterior walls.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 1.18.2 In Warm Humid counties, no Class I vapor retarders on the interior side of vapor permeable insulation in above-grade exterior walls.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1.19   | 1.19.1 Interior envelope inspection: moisture intrusion and mold are not evident or are otherwise remedied.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 1.19.2 Exterior above-grade surfaces verified to be free from degradation or potential moisture intrusion.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| <b>Section 2 – Radon Testing</b>                 |   |                          |                          |                          |
| 2.1  | If radon mitigation is installed, system is: <input type="checkbox"/> Active <input type="checkbox"/> Passive <input type="checkbox"/> N/A (none installed)   |                          |                          |                          |
|  | 2.1.1 Upon construction/renovation completion, radon levels tested:<br><input type="checkbox"/> Short-term passive sampler <input type="checkbox"/> CRM<br>Initial tested level (record max result for multifamily) _____ pCi/L<br><input type="checkbox"/> Exception: no ground contact locations  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 2.1.2 Where initial short-term levels tested $\geq$ 4 pCi/L limit:<br><input type="checkbox"/> Long-term test <4 pCi/L <input type="checkbox"/> Active system installed<br>Retested Level (record max result for multifamily) _____ pCi/L   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 2.1.3 Test results documented. If installed, system manual and maintenance guides provided.<br><input type="checkbox"/> Exception: no ground contact locations  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| <b>Section 3 – Pests</b>                         |   |                          |                          |                          |
| 3.1  | 3.1.1 Exterior penetrations and joints sealed.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 3.1.2 No signs of active termite infestation or structural damage.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 3.2  | 3.2.1 Corrosion-proof pest screens installed at openings that cannot be fully sealed.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 3.2.2 Corrosion-proof screen, louver, or grille for all ventilation termination fittings.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 3.2.3 Dryer ducts include weather-resistant termination or louver.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3.3  | 3.3.1 Multifamily buildings include a plan or contract for integrated pest management.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 3.3.2 Multifamily buildings include resident guidance on housekeeping, refuse removal and reporting pest problems in owner/tenant manual.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3.4  | 3.4.1 No evidence of pest-contaminated materials within building envelope.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| <b>Section 4 – HVAC Systems</b>                  |   |                          |                          |                          |
| <i>Heating and Cooling Design and Inspection</i> |   |                          |                          |                          |
| 4.1  | 4.1.1.1 <u>Newly installed</u> dwelling-unit heating and cooling (HAC) systems meet design/documentation requirements.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 4.1.1.2 <u>Newly installed</u> common space HAC systems meet design/documentation requirements.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 4.1.2.1 <u>Newly installed</u> HAC documentation (i.e., start-up, testing ) provided to Verifier.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 4.1.2.2 Existing HAC systems assessed/serviced in accordance with ANSI/ACCA Standard 4.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.2  | 4.2.1 Humidity monitoring provided in the main living area of the dwelling unit is:<br><input type="checkbox"/> Integrated with HAC controls <input type="checkbox"/> Standalone hygrometer<br>Exception for MF: <input type="checkbox"/> RH monitoring by building management platform   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|  | 4.2.2 <u>Moist (A) CZ 1-4</u> : Equipment installed to maintain RH at or below 60% is:<br><input type="checkbox"/> Ventilating or whole-home dehumidifier <input type="checkbox"/> RH sensor is integrated w/ cooling system(s)<br>Exception for CZ 4A: <input type="checkbox"/> Humidity data recording, modeling & dehumidification readiness | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.3  | 4.3.1 <u>Newly installed</u> dwelling-unit duct systems sized according to:<br><input type="checkbox"/> ACCA Manual D <input type="checkbox"/> Other (applicable to MF only)  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 4.3.2 <u>Newly installed</u> common space duct systems sized according to ASHRAE Handbook of Fundamentals.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 4.3.3 No building cavities used as air supplies or returns.<br>Exception: <input type="checkbox"/> Returns where the HAC filter is installed at the air handler   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|  | 4.3.4 Interior of ducts inspected to be free from debris and contaminants.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|                                      |         |   |                          |                          |                          |
|--------------------------------------|---------|---|--------------------------|--------------------------|--------------------------|
|                                      | 4.3.5   | Ducts inspected to be dry, with no evidence of mold and without tears/disconnections.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.3.6   | Ducts installed outside pressure boundary are sealed at joints, seams, penetrations with compliant material.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.3.7   | Dwelling unit ducts tested to meet total duct leakage requirements. Test Result: _____  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.3.8   | Dwelling unit ducts tested to meet leakage to outdoors requirements. Test Result: _____<br>Exceptions: <input type="checkbox"/> DLTO testing not required where all ducts are within pressure boundary<br><input type="checkbox"/> Total duct leakage $\leq 4$ CFM25 per 100 sf of CFA or $\leq 40$ CFM25   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.4                                  | 4.4.1   | Air-handling equipment and/or ductwork is not located in garages.<br>Exception for MF: <input type="checkbox"/> Systems providing independent garage heating and/or ventilation   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.4.2   | Supply ducts outside the pressure boundary are insulated to R-6 (minimum).  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.5                                  | 4.5.1   | Bedrooms with ducted HAC systems are pressure-balanced. Test Result: _____<br><input type="checkbox"/> Moist (A) climate zones 1-3 verified $\pm 3$ Pa <input type="checkbox"/> All other climate zones $\pm 5$ Pa  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Mechanical Ventilation</b>        |         |   |                          |                          |                          |
| 4.6                                  | 4.6.1   | Mechanical ventilation is installed for each dwelling unit.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|                                      | 4.6.2   | Ventilation on/off control is labelled. For one-and two-family buildings and townhouses, on/off control is also readily accessible.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|                                      | 4.6.3   | Air inlets verified to pull air directly from outdoors.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.6.4   | Outdoor air inlets $\geq 2$ ft. above grade or roof deck; $\geq 3$ ft. from dryer exhausts and contamination sources exiting the roof; $\geq 10$ ft. from all other contamination source exits.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.6.5   | Ventilation is measured and documented in accordance with ANSI/RESNET/ICC Std. 380 and meets Section 4 of ASHRAE 62.2-2019.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|                                      | 4.6.6.1 | For supply or balanced ventilation, outdoor air passes through a $\geq$ MERV 11 filter prior to distribution.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.6.6.2 | Outdoor air filters are readily-accessible for maintenance.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.6.7   | Ventilation fans rated $\leq 3$ sones if intermittent and $\leq 1$ sone if continuous.<br>Exception: <input type="checkbox"/> HAC air handler <input type="checkbox"/> Remote-mounted fan   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 4.7                                  | 4.7.1   | Bathroom ventilation exhausts directly to outdoors meeting ASHRAE 62.2-2019 Section 5.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.7.2   | Bath fans rated $\leq 3$ sones if intermittent and $\leq 1$ sone if continuous.<br>Exception: <input type="checkbox"/> Remote-mounted fan   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.7.3   | Bath fans integrated with dwelling-unit ventilation have on/off controls labeled.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.7.4   | Demand-controlled bath fans include timer or occupancy/humidity sensor.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.8                                  | 4.8.1   | Demand-controlled kitchen exhaust is located at the cooktop, vented to outdoors, and Verifier-measured to meet ASHRAE 62.2-2019 Section 5.<br>Multifamily exception: <input type="checkbox"/> Cooktop is electric, recirculation hood has charcoal filter, continuous exhaust rate met<br>Exception to measurement: <input type="checkbox"/> Microwave-range hood meets additional requirements | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.8.2   | If continuous exhaust is present in the kitchen, grille meets cooktop separation distance and has MERV 3 or washable filter.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.8.3   | Continuous kitchen exhaust rated $\leq 1$ sone at airflow $\geq 25$ cfm.<br>Exception: <input type="checkbox"/> Fans exceeding 400 cfm or remote-mounted fan  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.9                                  | 4.9.1   | Common space ventilation air provided directly from outdoors.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.9.2   | Common space ventilation and exhaust measured to meet or exceed ASHRAE 62.1-2019.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.9.3.1 | Common space ventilation outdoor air passes through MERV 11 or higher filter prior to distribution.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.9.3.2 | Outdoor air intake, filter, fan unit are accessible for maintenance.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.10                                 | 4.10.1  | Central vacuum systems exhaust to outdoors and $\geq 10$ ft. from ventilation air inlets.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.10.2  | Vented clothes dryers exhaust to outdoors.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Filtration and Air Cleaning</b>   |         |   |                          |                          |                          |
| 4.11                                 | 4.11.1  | Ducted HAC systems include 2" filter slot. Filters rated MERV 11 or higher installed at final inspection.<br>Exception for existing HAC systems in dwelling units: <input type="checkbox"/> MERV 8 plus portable air cleaners   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.11.2  | HAC return air filters are accessible for cleaning and/or replacement.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.11.3  | Filter access panels are gasketed and/or sealed.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.11.4  | All return air and mechanically supplied outdoor air pass through the filter.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.11.5  | Electronic air cleaners do not exceed ozone emission limits of 0.005 ppm.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 4.11.6  | Ozone generators or devices intentionally using ozone not installed.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 4.12                                 | 4.12.1  | No requirement. See Advisories for supplemental air cleaning for non-ducted HAC systems.  |                          |                          | -                        |
| 4.13                                 | 4.13.1  | Where gas-phase air cleaning devices are installed, ozone is not intentionally used.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.14                                 | 4.14.1  | Where provided, UVGI or other electronic air cleaners (e.g., plasma generators, PCOs, etc.) must not exceed ozone emissions of 0.005ppm.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Section 5 – Pollutant Control</b> |         |   |                          |                          |                          |
| 5.1                                  | 5.1.1   | Combustion furnaces, boilers, water heaters mechanically drafted or direct-vented.<br>Exception: <input type="checkbox"/> Naturally drafted appliances meet max depressurization and exhaust reqs.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 5.1.2   | Fireplaces mechanically drafted or direct-vented.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|                                      | 5.1.2.1 | Liquid or gas-burning fireplaces have tempered glass front or gasketed door.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|   |  |  |                          |                          |                          |
|---|--|--|--------------------------|--------------------------|--------------------------|
|   | 5.1.3  | No unvented combustion appliances other than cooktops/ranges/ovens.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.1.4  | Existing chimneys and flues pass professional Level II inspection per NFPA 211.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 5.1.5  | Solid fuel-burning appliances meet the following requirements (check where applicable):<br><input type="checkbox"/> site-built masonry fireplaces sealed to prevent use or retrofitted<br><input type="checkbox"/> factory-built wood burning fireplaces have dedicated outdoor air & meet UL 127<br><input type="checkbox"/> wood stoves/inserts meet UL 1482 Section 3.8 and EPA Performance Standards<br><input type="checkbox"/> pellet stoves meet ASTM E1509 and EPA Performance Standards | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5.2   | 5.2.1  | CO alarms installed in all dwelling units and located as follows:<br>5.2.1.1 Where fuel burning appliances permanently installed; and<br>5.2.1.2 On every habitable level; and<br>5.2.1.3 Within 21' of a sleeping room  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.2.2  | CO alarms and detectors listed and labeled in accordance with required standards.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.2.3  | CO alarms are hardwired with battery backup.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.2.4  | CO alarm sounds when the test button is pushed.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.2.5  | CO alarms are protected from dust, paint, and contaminants during construction.  | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| 5.3   | 5.3.1  | Occupant provided with EPA's brochure or resource guide on secondhand smoke.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.3.2  | For multifamily buildings, smoking/vaping prohibition is posted in common areas and communicated in lease agreement.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 5.3.3  | For multifamily buildings, where provided, designated outdoor smoking/vaping areas located a minimum of 25 ft from entries, outdoor air intakes, and operable windows.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5.4   | 5.4.1 Airtightness testing in accordance with ANSI/RESNET/ICC Std. 380 is met:<br><input type="checkbox"/> Detached homes > 1,000 ft <sup>2</sup> , ≤ 5 ACH50 <input type="checkbox"/> All other homes/units ≤ 0.30 CFM50/sf encl.<br>Test Result: _____ | <input type="checkbox"/>   | <input type="checkbox"/> | -                        |                          |
| 5.5   | 5.5.1  | Walls/ceilings between garages and occupied spaces are air-sealed and doors are gasketed/weather-stripped.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 5.5.2  | Detached one- and two- family homes and townhouses with attached garages:<br><input type="checkbox"/> Pressure test conducted to verify effectiveness of garage-to-house air barrier; OR<br><input type="checkbox"/> Exhaust fan installed in garage and Verifier-measured airflow ≥ 100 cfm   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5.6   | 5.6.1  | No combustible liquid or gas fuels stored within the building's thermal/pressure boundary.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 5.6.2  | Supplemental portable combustion equipment not operated or stored within the building's thermal/pressure boundary.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
| <b>Section 6 – Building Materials (newly installed)</b> |  |  |                          |                          |                          |
| 6.1   | 6.1.1  | Paints, finishes, and coatings meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 6.1.2  | Paints, finishes, and coatings meet SCAQMD Rule 1113 OR CARB VOC content limits.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.2   | 6.2.1  | Carpet and carpet cushions meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.3   | 6.3.1  | Adhesives and sealants meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 6.3.2  | Adhesives and sealants meet SCAQMD Rule 1168 VOC content limits.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.4   | 6.4.1  | Hard surface flooring and underlayment meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.5   | 6.5.1  | Interior gypsum board and joint compound meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.6   | 6.6.1  | Insulation materials meet VOC emission limits in CDPH Standard Method V1.2-2017.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.7   | 6.7.1  | Gut rehabs: Visual inspection for Asbestos Containing Material (ACM):<br><input type="checkbox"/> ACM not found <input type="checkbox"/> ACM inspected and removed/encapsulated by qualified Asbestos Inspector, with documentation collected  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.8   | 6.8.1  | Buildings built prior to 1978 assessed for lead-based paint, with documentation collected.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|   | 6.8.2  | If lead-based paint identified, risk assessment conducted by certified professional and mitigated as required.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Section 7 – Operation and Maintenance</b>            |  |  |                          |                          |                          |
| 7.1   | 7.1.1  | Instruction manuals provided for all specified appliances and systems.   | <input type="checkbox"/> | <input type="checkbox"/> | -                        |
|   | 7.1.2  | Owner-occupied units: O&M recommendations and filter change schedule provided.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Verifier Organization</b>                            |  | <b>Home Certification Organization</b>   |                          |                          |                          |
| <b>Verifier Name</b>                                    |  | <b>Pre-Insulation Inspection Date</b>  |                          | <b>Initials</b>          |                          |
| <b>Verifier Name</b>                                    |  | <b>Final Inspection Date</b>   |                          | <b>Initials</b>          |                          |

## Guidance for Completing the Indoor airPLUS Verification Checklist

1. Only homes or apartments verified to comply with these specifications can earn the Indoor airPLUS Certified label. See the Indoor airPLUS National Program Requirements for full descriptions of the certification process; program eligibility; and partnership, training, and credentialing requirements. Indoor airPLUS requirements are not intended to supersede where local jurisdictions may have more stringent requirements (e.g., duct leakage allowances). Verification is not complete until this checklist is completed in full and signed.
2. Check one box per line. Check “N/A” for specifications that do not apply for specific conditions (e.g., climate, building type) according to the exceptions described in the Indoor airPLUS requirements. Items may be verified visually by the Verifier on-site during construction/rehabilitation, by reviewing photographs taken during construction/rehabilitation, by reviewing material or equipment documentation, or through equivalent methods as appropriate. Requirements that refer to existing building elements only apply to features that exist as part of a gut rehabilitation.
3. The Verifier who conducted the verification, or a responsible party from the Verifier’s company, must sign the completed checklist. If a quality assurance review indicates that items have not been successfully completed, the Verifier will be responsible for facilitating corrective action.
4. The Verifier shall retain the Indoor airPLUS Verification Checklist for the home or multifamily building for a minimum of 10 years from final verification. The Verifier shall coordinate with their HCO/Designee and/or builder/owner to provide an Indoor airPLUS label and certificate for each qualified home/unit.
5. Verifiers who operate under an approved sampling protocol are permitted to verify any checklist item using an HCO-approved sampling protocol for Indoor airPLUS homes/units.

***For further information on the Indoor airPLUS program, visit [www.epa.gov/indoorairplus](http://www.epa.gov/indoorairplus).***

# Indoor airPLUS Certification Specifications

## Version 2



### 1. Moisture Control

#### Water-Managed Site and Foundation

##### 1.1 Site Drainage

- 1.1.1** Impermeable surfaces (e.g., patio, porch, or plaza slabs; sidewalks; ramps; driveways) are sloped  $\geq 0.25$  in. per ft. away from the building to the edge of surface, to a swale or drain, or a minimum of 10 ft.
- 1.1.2** Exterior drains shall be free of debris.
- 1.1.3** Final grade sloped 0.5 in. per ft away from the building either a minimum of 10 ft OR to a swale or drain. Newly installed or disturbed backfill has been tamped.

##### Exceptions:

- E1.1.3** Tamping of backfill is not required if either:
  - i. Proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or Professional Engineer; **OR**
  - ii. The builder has scheduled a site visit to provide in-fill and final grading after settling has occurred.

##### 1.2 Foundation Drainage

- 1.2.1** For newly constructed foundations, drain tile or Composite Foundation Drainage System (CFDS) is installed at basement and crawlspace walls and sloped to discharge to outside grade (daylight) or to a sump pump, sewer, or runoff management system.

##### Notes:

- N1.2.1a** For drain tile: top of pipe is installed below the bottom of the concrete slab or crawlspace floor; AND pipe is pre-wrapped with filter fabric or is surrounded with  $\geq 6$  in. of  $\frac{1}{2}$  to  $\frac{3}{4}$  in. washed or clean gravel, with gravel layer fully wrapped with fabric cloth. Drain tile is level or sloped to discharge to outside grade (daylight) or to a sump pump. If drain tile is on interior side of footing, then a channel is provided through footing to exterior side.
- N1.2.1b** For CFDS: the system must include a soil strip drain or another ICC-ES evaluated perimeter drainage system to be eligible for use.

##### Exceptions:

- E1.2.1a** A foundation drainage system is not required when a certified hydrologist, soil scientist, or Professional Engineer has determined that the foundation rests on Group I Soils (i.e., well-drained ground or sand-gravel mixtures), as defined by 2021 IRC Table R405.1.
- E1.2.1b** In a building undergoing gut-rehabilitation, where a foundation drain cannot be verified, an interior moisture management inspection can be used in lieu of drainage system verification. See Item 1.19 for inspection criteria. Where an interior drain tile is installed to mitigate moisture intrusion in an existing foundation, a channel to the exterior through the footing is not required.

- 1.2.2** Where a sump pit is installed, covers shall be mechanically attached with full gasket seal or equivalent. Sump drainage shall be discharged a minimum of 5 ft. from the foundation.

##### Exception:

- E1.2.2** Discharging a minimum of 5 ft. from the foundation is not required when a certified hydrologist, soil scientist, or Professional Engineer has designed an alternative management system or determined that the foundation rests on Group I Soils.

##### Advisories:

- A1.2.2a** The point of discharge should be as far away from the building's foundation as practically feasible and discharge piping should be installed below grade or otherwise protected.
- A1.2.2b** In CZ 4 and higher for wet sites with deeper foundations, a freeze guard or a similar fitting with integral openings is recommended where the pipe exits.

##### 1.3 Bulk Water Prevention

- 1.3.1** In buildings with a basement or crawlspace, a floor drain or moisture monitoring system is installed in the lowest floor area to mitigate risk from internal bulk water events. Floor drains shall include trap seal protection according to 2021 IRC P3201.2.1. Sump pits are



permitted to have drains integrated with the sump cover, so long as the cover is mechanically attached with a full gasket seal and the integral drain has a trap or similar means to reduce soil gas entry. A moisture monitoring system shall emit an audible alarm and/or send notifications via a web-based app when water is detected.

**Advisories:**

**A1.3a** Combination foundations (e.g., basement with separated crawlspace) are recommended to have a means of discharging bulk water from each separate foundation area in the case of interior water events (e.g., plumbing malfunction, flooding, etc.).

**A1.3b** Any trapped drains, other than floor drains, without trap seal protection that do not receive regular water input should be filled with mineral oil to reduce the potential for evaporation.

**A1.3c** Moisture monitoring systems, where installed, should have the ability to shut off water supply in the event of a plumbing malfunction.

#### 1.4 Capillary Break and Vapor Retarder

**1.4.1** Under newly installed concrete slabs in Moist (A) Zones, as defined by 2021 IECC Figure R301.1, a capillary break is installed by using either:

**1.4.1.1** A 4 in. (min.) layer of ½ in. diameter or greater clean aggregate; **OR**

**1.4.1.2** Continuous geotextile drainage matting installed according to the manufacturer's instructions.

**Exceptions:**

**E1.4.1a** Slab-on-grade foundations.

**E1.4.1a** Buildings built on free-draining soils are recommended, but not required, to meet the above capillary break requirements. Free-draining soils are identified as Group I (Table R405.1, 2021 IRC) by a certified hydrologist, soil scientist, or Professional Engineer through a site visit.

**1.4.2** Under newly installed concrete slabs in Moist (A) Zones, a Class I vapor retarder (as defined by the 2021 IRC) is installed in direct contact with the concrete slab by overlapping seams and/or sealing joints and penetrations.

**1.4.3** For crawlspaces without concrete slabs in Moist (A) Zones, a Class I vapor retarder is installed by sealing or taping all seams and penetrations and sealing to walls and piers (e.g., with adhesive and furring strips or similar mechanical fasteners and sealant).

**Advisories:**

**A1.4.3a** Where crawlspace floors are not covered with a concrete slab, a vapor barrier rated Class A in accordance with ASTM E1745 is recommended.

**A1.4.3b** Prior to installing the vapor retarder, prepare the ground by leveling and removing obstructions capable of causing tears or punctures.

**1.4.4** For existing slabs located in Moist (A) Zones, where the presence of a capillary break (Item 1.4.1) and Class I vapor retarder (Item 1.4.2) cannot be visually verified, a continuous and sealed Class I or Class II vapor retarder is installed on top of the slab. In such cases, up to 10% of the slab surface may be exempted from this requirement (e.g., for the bottom plates in walls). In addition, for existing slabs in occupiable space, the vapor retarder shall also be a durable floor surface or covered by a durable floor surface.

**Exception:**

**E1.4.4** Garages and utility areas are not subject to these requirements for existing slabs.

**1.4.5** A continuous capillary break is installed between the foundation wall (or slab) and newly installed sill plates.

**Advisory:**

**A1.4.5** Capillary break is also recommended to be installed under or on top of all newly installed concrete footers using either 6 mil (or thicker) polyethylene sheeting, bituminous membrane, or liquid waterproofing.

#### 1.5 Damp-Proofing and Waterproofing Below-Grade Exterior Walls

**1.5.1** For the below-grade exterior of newly installed concrete and/or masonry walls, finish with damp-proofing coating. For the below-grade exterior of newly installed wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.

**Exception:**

**E1.5.1** For below-grade walls in buildings undergoing gut rehabilitation, interior surfaces of foundation walls are inspected and verified to have no signs of active moisture intrusion. See Item 1.19 for inspection criteria.

#### 1.6 Basement and Crawlspace Conditioning

**1.6.1** Seal crawlspace and basement perimeter walls to prevent outside air infiltration. Vented crawlspaces and basements are not permitted.

**Note:**

**N1.6.1** Homes/buildings in areas designated as 100-year flood zones may need to utilize insulated, weather-stripped flood vents to meet the above requirement. Additional local requirements may also apply per jurisdiction. For more information on designated 100-year flood zones, see FEMA’s definition of Special Flood Hazard Areas: [www.fema.gov/flood-zones](http://www.fema.gov/flood-zones).

**1.6.2** In Moist (A) Zones and Marine (C) Zones, as defined by 2021 IECC Figure R301.1, where a basement or crawlspace is not served by a Heating and Cooling (HAC) system with humidity controls as outlined in Item 4.2.2, provide supplemental active dehumidification, sized for the total volume of the basement and/or crawlspace according to manufacturer’s recommendations. Dehumidifier shall be programmed to maintain relative humidity (RH) at or below 60 percent and shall be continuously drained to the outside or to a sump pump.

**Advisories:**

**A1.6a** To avoid humidity issues during “swing seasons” or low-load periods where space conditioning systems may not be operating regularly, EPA recommends an active dehumidification system (in lieu of or in addition to the HAC system) in crawlspaces and basements.

**A1.6b** Where whole-home dehumidification or HAC systems are utilized to condition below-grade spaces, EPA recommends locating the humidity sensor in the basement or crawlspace.

**A1.6c** A humidity monitoring device that includes a digital display of indoor temperature and RH and the ability to record data, either on-board or via a web-based app, is recommended in basements and crawlspaces in addition to similar RH monitoring in the main living area of the home/unit.

## Water-Managed Wall Assemblies

### 1.7 Drainage Plane and Flashing

**1.7.1** A continuous Water-Resistive Barrier (WRB) is installed behind exterior wall cladding that overlaps flashing and is fully sealed at all penetrations. Behind all stucco and non-structural masonry cladding wall assemblies, an additional bond-break drainage plane is provided between WRB and cladding.

**Exception:**

**E1.7.1** In a building undergoing gut-rehabilitation where the WRB and drainage plane cannot be verified, an interior moisture management inspection can be used in lieu of WRB verification. See Item 1.19 for inspection criteria.

**1.7.2** Flashing or an equivalent drainage mechanism is installed at all horizontal interruptions and the bottom of exterior walls to direct water away from the WRB and foundation.

**1.7.3** Weep holes for masonry veneer and weep screed for stucco cladding systems are included, per manufacturer specifications.

**Advisories:**

**A1.7a** Liquid or fluid applied membranes and integrated sheathing systems with sealed/taped seams should be applied and/or sealed on clean surfaces and according to manufacturer’s instructions to perform as a WRB.

**A1.7b** Rainscreen assemblies with a minimum 1/2 in. air space or drainage mat are recommended between the cladding and drainage plane.

### 1.8 Exterior Window and Door Openings

**1.8.1** Newly installed windows and doors must be fully flashed. Apply a formed pan, flexible tape, or liquid applied pan flashing from the interior edge of sill framing, terminating over the front edge of framing and WRB and covering the sill corners, to direct the movement of water away from the opening and wall assembly. Install side flashing that extends over pan flashing and top flashing that extends over side flashing, or equivalent details for structural masonry or structural concrete walls.

**Exception:**

**E1.8.1** In a building undergoing gut-rehabilitation where flashing cannot be verified, an interior moisture management inspection can be used in lieu of flashing verification. Where moisture intrusion is evident around fenestrations, the fenestration must be removed and flashed as newly installed per 1.8.1. See Item 1.19 for inspection criteria.

**Advisories:**

**A1.8.1a** Where flexible tape or liquid applied pan flashing is utilized to form a pan, a pitched sill is recommended.

**A1.8.1b** When selecting new fenestration, the ANSI/NFRC 500-2020 Condensation Index (CI) should be used to limit surface condensation based on the local design temperature, Relative Humidity (RH), and the dew point.

**1.8.2** Windows and doors must fully close and latch.

## Water-Managed Roof Assemblies

### 1.9 Gutters, Downspouts, and Roof Water Drainage

**1.9.1** Direct roof water away from the building using gutters, downspouts, and lateral piping or other non-porous diverters that discharge either:

- 1.9.1.1 A minimum of 5 ft. from foundation on a sloping finish grade, **OR**
- 1.9.1.2 Into an underground catchment system not connected to the foundation drain system that discharges water  $\geq$  10 ft. from foundation, **OR**
- 1.9.1.3 Into an approved sewer or rainwater management system.

**Exceptions:**

- E1.9.1a Buildings with slab-on-grade foundations;
  - E1.9.1b Buildings in Dry (B) climates as shown in 2021 IECC Figure R301.1 and Table R301.1;
  - E1.9.1c Building sites with no expansive or collapsible soils, as determined by a certified hydrologist, soil scientist, or Professional Engineer during site preparation;
  - E1.9.1d A roof design that deposits rainwater to a grade-level rock bed with a waterproof liner and a lateral drain pipe that meets the above discharge requirements;
  - E1.9.1e A rainwater harvesting system that drains overflow to meet the above discharge requirements;
  - E1.9.1f A continuous rubber membrane (e.g., EPDM) aligned with the foundation wall from final grade to  $\geq$  8 in. below grade and sloping  $\geq$  0.5 in. per ft. away from the building for at least 5 ft., with Group I Soils (as defined by 2021 IRC Table R405.1), covering the membrane to within 3 in. of final grade.
- 1.9.2 Buildings meeting a gutter installation exception from above, must provide protection for water splash damage using one of the following methods:
- 1.9.2.1 Extend the foundation walls at least 16 in. above final grade; **OR**
  - 1.9.2.2 Provide a drip line at eaves that is horizontally 16 in. away from the edge of the foundation wall; **OR**
  - 1.9.2.3 Use cladding materials that are decay and rot resistant and can tolerate regular wetting extending at least 16 in. above final grade; **OR**
  - 1.9.2.4 Where wood siding is used without any of the above protections, a rainscreen assembly with a minimum  $\frac{1}{2}$  in. air space between the cladding and drainage plane is required.
- 1.9.3 Gutters and downspouts, where provided, are verified to be securely installed and substantially clear of debris.

**1.10 Roof to Wall Intersections and Roof Penetrations**

- 1.10.1 Fully flash all newly installed roof-to-wall intersections and all newly installed roof penetrations using step flashing for conventional roofs or continuous flashing for metal and rubber membrane roofs.
- 1.10.2 Install kickout flashing at the low end of newly installed roof-to-wall intersections. Flashing shall extend at least 4 in. on the wall surface above the roof deck and shall be integrated with drainage plane above. Intersecting wall siding should terminate a minimum of 1 in. above roof, or higher per manufacturer's recommendations.

**Exception:**

- E1.10 In a building undergoing gut-rehabilitation where flashing cannot be verified, an interior moisture management inspection can be used in lieu of flashing verification. Where moisture intrusion is evident at roof-to-wall intersections and roof penetrations, the roofing material must be removed and flashed as newly installed per 1.10.1 and/or 1.10.2, as necessary. See Item 1.19 for inspection criteria.

**1.11 Roof Valleys and Decking**

- 1.11.1 Newly installed roofing includes a self-sealing bituminous membrane or the equivalent at all valleys and roof decking penetrations for durability at potential failure points.

**Exceptions:**

- E1.11.1a Not required in Dry (B) climates as shown in 2021 IECC Figure R301.1 and Table R301.1.
  - E1.11.1b Any option in 2021 IRC Sections R905.2.8.2 or R905.13 are permitted.
- 1.11.2 Newly installed low sloped or flat roofs (<2:12 pitch) shall meet the following criteria:
- 1.11.2.1 Sloped to drains or scuppers at a minimum  $\frac{1}{4}$  in. per ft.;
  - 1.11.2.2 Roof drains insulated through roof assembly to reduce the possibility of condensation;
- Advisory:**
- A1.11.2.2 EPA recommends installing 3 in. of vapor impermeable insulation (i.e., ccSPF) for a length (vertical and/or horizontal) of 3 ft. from the drain penetration at the roof deck.
- 1.11.2.3 Roof assembly air control layer must be connected over other roof elements (e.g., curbs and blocking) and connected to the wall air control layer;

**1.11.2.4** Materials that form the water control layer must overlap each other in shingle fashion or be sealed in a watertight manner.

**Exception:**

**E1.11** In a building undergoing gut-rehabilitation, where components of the roofing assembly cannot be verified from above, an interior moisture management inspection can be performed. Where moisture intrusion is evident through the building envelope, the affected roofing material(s) or component(s) must be removed and treated as newly installed per the applicable requirements of Item 1.11, as necessary. See Item 1.19 for interior inspection criteria.

**1.12 Ice Dam Prevention**

**1.12.1** In 2021 IECC Climate Zones 4 & higher, for all newly installed roofing, include ice barrier over the sheathing at eaves to provide protection from ice dams. Extend a self-sealing bituminous membrane (or equivalent) from the edge of the roof line to > 2 ft. up roof deck from the interior plane of the exterior wall.

**Exception:**

**E1.12.1** For gut rehabilitations in 2021 IECC Climate Zones 4 & higher, where ice flashing per Item 1.12.1 cannot be verified under existing roofing in homes with vented attics, install insulation to meet or exceed R-49 (or equivalent U-factor). Ensure Grade I insulation per ANSI/RESNET/ICC 301-2022 installed throughout and terminates at the interior face of the exterior wall below.

**Advisory:**

**A1.12.1a** EPA recommends installing roof membrane prior to the drip edge installation and lapped down minimum of 1 in. onto the face of the fascia. After installation of the membrane and drip edge, install an additional self-sealing strip at least 4 in. wide on top of the drip edge.

**A1.12.1b** For attics vented at the eaves, wind baffles are installed in every rafter cavity that extend up the roofline from the outside edge of the exterior wall and terminate inside the attic above the level of the insulation. Either the baffle, or other blocking type, shall fully block the vertical edge of the insulation between the width of the bay from the vented eave to prevent wind washing.

**1.12.2** Where accessible, verify gaps and penetrations have been substantially sealed between vented attics and the living space (e.g., tops of balloon-framed cavities, chases, wiring and plumbing penetrations, top plates, etc.).

**1.13 Interior Roof Deck Inspection**

**1.13.1** In all accessible attic and roof assemblies, visually verify no active water leaks, as evidenced from active water intrusion or staining on roof decking and/or ceiling materials. Any active water leaks must be repaired.

**Note:**

**N1.13.1** Structural materials with staining from former leaks are permitted to remain uncoated/untreated, so long as they are not in the occupiable spaces of the building. Roof sheathing and materials with visible water stains within an unoccupied attic do not need to be replaced unless the structural integrity of the material has been compromised from water damage. Refer to Item 1.19 for inspection/remediation criteria for mold and fungal growth.

**Interior Moisture Management**

**1.14 Moisture-Resistant Backing Materials**

**1.14.1** Where installed, backers for wall tile and wall panels in tub and shower enclosures shall be cement board complying with ASTM C1288 or ISO 8336, Category C, or equivalent moisture-resistant material. Paper-faced backerboard shall not be used.

**Note:**

**N1.14.1** In addition to fiber-cement board, fiber-mat reinforced cementitious panels complying with ASTM C1325; glass mat water-resistant gypsum panels complying with ASTM C1178; water-resistant fiber-reinforced gypsum panels complying with Section 6 of ASTM C1278; or materials that have been evaluated by ICC-ES per AC 115 may also be used to meet this requirement. Paper-faced backerboard may only be used behind monolithic enclosures or waterproof membranes that have been evaluated by ICC-ES per AC 115, and then only if it has received a rating of 10 when tested in accordance with ASTM D3273.

**1.15 Appliance Drainage**

**1.15.1** For each condensate-producing HVAC component, a corrosion-resistant drain pan (e.g., galvanized steel, plastic) included that drains to a conspicuous point of disposal in case of blockage. Backflow prevention valve included if connected to a shared drainage system. Where damage to building materials could occur as a result of overflow from the equipment, a secondary drain system is included meeting one of the auxiliary protection methods outlined by 2021 IMC section 307.2.3.

**1.15.2** Tank-type water heaters and hot water storage tanks located where water leakage from the tank could cause damage, shall be installed:

**1.15.2.1** Over a corrosion-resistant drain pan that drains to a conspicuous point of disposal; **OR**

**1.15.2.2** On an impervious surface with a floor drain within 2' and moisture proof material at least 6" high installed around the room perimeter; **OR**

**1.15.2.2** With a leak detection system including an automatic water supply shutoff installed at the water tank.

**1.15.3** Non-vented (condensing or heat pump) clothes dryers shall be plumbed to a drain according to the manufacturer's instructions.

### 1.16 Water Supply Pipes

**1.16.1** Insulate hot and cold water supply pipes in exterior building cavities with minimum R4 pipe wrap.

For water supply pipes in exterior building cavities that are not accessible in gut rehabilitations, see also Item 1.19 - Materials with Signs of Water Damage or Mold.

**Exceptions:**

**E1.16.1a** Climate Zones 1-3 located in Dry (B) Zones, as defined by 2021 IECC Figure R301.1.

**E1.16.1b** When cavity insulation qualifies as an air barrier and pipes are located within the interior 50% of the wall cavity.

**Advisories:**

**A1.16.1a** Pipes should be installed as close as possible to conditioned space while maintaining Grade I insulation installation to reduce risk of freezing and/or condensation.

**A1.16.1b** Insulate hot and cold water supply pipes in exterior building cavities with minimum R4 pipe wrap in all climate zones.

### 1.17 Water-Resistant Flooring

**1.17.1** In areas where moisture or splash damage could occur (e.g., kitchens, bathrooms, entryways, laundry areas, and utility rooms) water-resistant hard-surface flooring is installed within 4 ft. of any plumbing fixture or exterior door. Wall-to-wall carpeting is permitted in adjacent spaces (e.g., hallways) beginning at the interior of the jamb or opening.

**Note:**

**N1.17.1** Wood flooring, either pre-finished or site-finished, or sub-flooring rated APA "Exposure 1" or "Exterior" can be utilized in these areas, as long as any composite wood material or site-applied finish comply with Items 6.1 and 6.2, respectively.

### 1.18 Class I Vapor Retarders

**1.18.1** Class I vapor retarders not installed on the interior side of vapor permeable insulation in below-grade exterior walls.

**1.18.2** In Warm Humid counties as defined by 2021 IECC Section R301.2, Class I vapor retarders are not installed on the interior side of vapor permeable insulation in above-grade exterior walls except at shower and tub walls.

**Note:**

**N1.18.2** Class I vapor retarders, such as mirrors, may be used if mounted with clips or other spacers that allow air to circulate behind.

### 1.19 Materials with Signs of Water Damage or Mold

**1.19.1** Interior Inspection

**1.19.1.1** The Verifier shall perform an inspection to identify areas of moisture intrusion in the building envelope. Inspection of wall sheathing behind exterior cladding must be done prior to insulation and interior finishes. Where moisture intrusion is evident behind cladding and fenestrations, cladding must be removed to address the integrity of flashing and the WRB. Where moisture intrusion is evident through roof assemblies, sufficient roofing materials must be removed to adequately repair leaks.

**Note:**

**N1.19.1** Where preliminary interior inspection reveals areas of building envelope degradation or potential moisture intrusion, the Verifier shall determine if envelope repairs are required. Surfaces are not required to appear "new" cosmetically; however, areas of rot and decay must be repaired, including proper flashing and/or sealant to minimize moisture intrusion in the building assembly.

**1.19.1.2** If visual mold and/or stains from water or fungal growth or moisture issues (e.g., condensation on pipes, leaks around windows, doors, wall penetrations, roofs, flashing, foundations, plumbing components, and fixtures, etc.) are evident, the source is identified, addressed, and remedied. Remediation of mold shall be addressed by one of the following options:

- i. If an area of suspected mold is less than 10 square feet, remediation can be addressed by the building owner (Refer to [Mold Cleanup Tips and Techniques](#)).
- ii. Areas of suspected mold larger than 10 square feet, or areas of any size that have been damaged by water containing sewage, shall be remediated in accordance with the recommendations in the EPA guide, "[Mold Remediation in Schools and Commercial Buildings](#)" or the guidelines of the American Conference of Governmental Industrial Hygienists (ACGIH). States and local agencies may require certification, trainings, or examinations for practitioners in the industry of mold remediation and environmental management. See EPA's list of state contacts to inquire about local requirements and recommended credentials at [www.epa.gov/indoor-air-quality-iaq/epa-regional-office-and-state-indoor-air-quality-information](http://www.epa.gov/indoor-air-quality-iaq/epa-regional-office-and-state-indoor-air-quality-information).

**1.19.1.3** During construction and/or renovation, building materials with visible signs of water damage or mold are not installed or allowed to remain. Lumber with “sap stain fungi” is exempt from Item 1.19.1 as long as the lumber is structurally intact.

**1.19.1.4** Framing members and insulation products having high moisture content are not enclosed (e.g., with drywall).

**Note:**

**N1.19.1.2** For wet-applied insulation, follow the manufacturer’s drying recommendations.

**Advisory:**

**A1.19.1.2** EPA recommends that lumber moisture content be  $\leq 18\%$ .

**1.19.2** Exterior Inspection

**1.19.2.1** Exterior above-grade surfaces (e.g., fenestrations, siding, flashing, roof-to-wall connections) are visually verified to be free from degradation or potential moisture intrusion. If evident, the source is identified, addressed, and remedied.

**Note:**

**N1.19.2** Exterior surfaces can be inspected from the ground or from building openings (e.g., fenestrations). Where preliminary exterior inspection reveals areas of building envelope degradation or potential moisture intrusion, the Verifier shall determine if closer inspection and/or envelope repairs are required. Surfaces are not required to appear “new” cosmetically; however, areas of rot and decay must be repaired, including proper flashing and/or sealant to minimize moisture intrusion in the building assembly.

**Advisories:**

**A1.19a** Exterior wood surfaces should be back primed and coated with stain, paint, or equivalent.

**A1.19b** Install water-resistive barriers and protect building openings/fenestration immediately following rough framing.

**A1.19c** Remove standing water and use fans and/or dehumidifiers to remove moisture.

**A1.19d** If standing water or ice is found to be present following the completion of rough framing and dry-in activities, the Verifier should request a root cause analysis and corrective action plan to be included with final verification documents.

## 2. Radon

### 2.1 Radon Testing

**Intro:** Radon testing applies regardless of EPA Radon Zone or the presence of a radon mitigation system.

**2.1.1** Upon completion of construction/rehabilitation, conduct radon testing in any building with ground-contact locations (as defined by [ANSI/AARST MAMF 2017 with 01/2021 additions](#)). Single-family residences follow procedures outlined in [ANSI/AARST MAH 2019](#). All other residential or mixed-use buildings follow procedures outlined in ANSI/AARST MAMF 2017 with 01/2021 additions. Testing is not required where the occupied space is located above an unenclosed open space. Employ one of the following methods:

**2.1.1.1** Implement short-term tests (2 to 7 days) using passive samplers according to the instructions by the test kit manufacturer (unless otherwise required by state radon programs and/or local requirements); **OR**

**2.1.1.2** Where continuous radon monitor (CRM) equipment is used, testing is performed by a qualified radon professional, as defined by [Section 2.4 of ANSI/AARST MAMF 2017 with 01/2021 revisions](#).

**2.1.2** Where initial radon testing results in  $\geq 4$  pCi/l levels, either:

**2.1.2.1** Perform a long-term test (minimum 90 days) using a qualified radon professional to confirm average seasonal radon levels are  $< 4$  pCi/l.; **OR**

**2.1.2.2** Install an active radon mitigation system and retest demonstrating that radon levels have been reduced to  $< 4$  pCi/l. Single-family residences shall install an active system(s) in accordance with [ANSI/AARST SGM-SF 2017 with 12/20 revisions](#) and retest according to Section 7.3 of ANSI/AARST MAH 2019. All other residential or mixed-use buildings shall install an active system(s) in accordance with [ANSI/AARST RMS-MF 2018 with 12/2020 revisions](#) and retest according to Section 7.3 of ANSI/AARST MAMF 2017 with 01/2021 additions.

**2.1.3** Test results shall be included in the Occupant & Maintenance Manual(s) and maintained with Indoor airPLUS certification documents by the Verifier. Where radon systems (active or passive) are installed during construction or renovation, equipment manuals and maintenance guidance shall be included in the Occupant & Maintenance Manual(s).

**Exception:**

**E2.1** Buildings with no ground contact locations (as defined by [ANSI/AARST MAMF 2017 with 01/2021 revisions](#)).

**Advisory:**

- A2.1** Where radon reduction methods are employed during construction, EPA recommends following “[ANSI/AARST CCAH 2020](#)” for one- and two-family dwellings and townhomes and “[ANSI/AARST CC-1000 2018](#)” for multifamily buildings and mixed-use properties. Additional voluntary consensus standards for best practices in radon measurement and mitigation can be found at <https://standards.aarst.org/>.

### 3. Pest Barriers

#### 3.1 Termite/Insect Prevention

- 3.1.1** Exterior penetrations (i.e., plumbing, electrical, etc.) and joints between the foundation and exterior wall assemblies are sealed where accessible.
- 3.1.2** There shall be no visible signs of active termite infestation or structural damage. Where active termite infestation is visible or suspected, see Item 3.4 for inspection and attestation requirements by a certified professional.

#### Advisories:

- A3.1a** In jurisdictions designated by the code official as having a “Moderate to Heavy” termite infestation probability (e.g., 2021 IRC Table R301.2):
- i. Foundation walls are recommended to be solid concrete or masonry with a top course of solid block, bond beam, or concrete-filled block.
  - ii. Interior, ground-contact concrete slabs are recommended to be constructed with 6 x 6 in. welded wire fabric, or the equivalent, and concrete walls should be constructed with reinforcing rods to reduce cracking.
- A3.1b** In jurisdictions designated by the code official as having a “Very Heavy” termite infestation probability (e.g., 2021 IRC Table R301.2):
- i. Foam plastic insulation is not recommended to be installed on the exterior face of below-grade foundation walls or under slabs.
  - ii. Foam plastic insulation installed on the exterior of above-grade foundation walls should be covered with moisture-resistant, pest-proof material (e.g., fiber cement board or galvanized insect screen at the bottom-edge of openings) and should be kept a minimum of 6 in. above the final grade and landscape bedding materials.
  - iii. Foam plastic insulation applied to the interior side of conditioned crawlspace walls is recommended to be kept a minimum of 3 in. below the sill plate.
  - iv. Install a sealed termite shield extending a minimum of  $\frac{3}{4}$ ” past the edges of the foundation wall assembly.
- A3.1c** When sealing gaps larger than 1/4 in., which can provide potential points of entry for rodents, copper or stainless-steel wool is recommended in addition to sealant.
- A3.1d** Install a steel mesh barrier termite control system and implement bi-annual inspections for termite nests and shelter tubes.

#### 3.2 Rodent/Bird Screens for Building Openings

- 3.2.1** Corrosion-proof rodent/bird screens (e.g., copper or stainless-steel mesh) provided for all architectural openings that cannot be fully sealed.
- 3.2.2** Corrosion-proof screen, louver, or grille provided for all ventilation termination fittings. Openings in the screen/louver/grille must be no smaller than 1/4 in. square and no larger than 1/2 in. in any dimension in accordance with 2021 IRC 303.6. Screens for radon exhaust systems are not required, but where provided, screen mesh shall be no smaller than 1/2 in. square.
- 3.2.3** Dryer ducts include a weather-resistant termination or louver in accordance with dryer manufacturer’s instructions. Where dryer vents include a grille, the majority of openings must be no less than ½ inch in any direction.

#### Advisory:

- A3.2** Provide screens for all operable windows to prevent pest entry.

#### 3.3 Multifamily Pest Management

- 3.3.1** Multifamily buildings include a pest management plan for the building maintenance staff or a documented contract with a pest management company aligning with the principles outlined in the EPA’s guide on [Integrated Pest Management in Buildings](#).
- 3.3.2** In owner/tenant manual, provide guidance for residents on housekeeping practices, refuse removal, and reporting pest problems promptly to building management.

#### Advisory:

- A3.3** Multifamily buildings are recommended to include sanitary floor drains in common trash/recycling rooms, with trap seal protection according to 2021 IRC P3201.2.1.

#### 3.4 Pest-Contaminated Materials

- 3.4.1** There shall be no evidence of pest-contaminated materials inside the building envelope, inclusive of walls, floor systems, and attics.

**Notes:**

- N3.4.1a** Non-structural pest-contaminated materials shall be replaced, as necessary. Structural materials with prior pest contamination do not need to be removed if they have been cleaned and have not lost structural integrity.
- N3.4.1b** Where there are signs of pest infestation, or where pest contamination is suspected (e.g., due to odors, feces, etc.) a pest professional certified by the state or local jurisdiction, GreenPro, GreenShield, or an equivalent Integrated Pest Management (IPM) certification must inspect and provide documentation that pest infestations have been remediated or were not found during professional inspection.

**Advisory:**

- A3.4** A letter from a structural engineer is recommended, but not required, for pest damaged structural building components.

## 4. Heating, Cooling, and Ventilation Systems

### Heating and Cooling Design and Inspection

#### 4.1 Heating and Cooling (HAC) Systems

**Intro:** Item 4.1 addresses design load calculations and system sizing specific to heating and cooling systems. For requirements related to ventilation, see Items 4.6-4.9.

##### System Design

- 4.1.1** All newly installed HAC systems serving dwelling units shall meet the design and documentation requirements of Sections 3-4 of ANSI/ACCA 5 QI – 2015, or Chapter 17 of the 2021 ASHRAE Handbook of Fundamentals.
- 4.1.2** All newly installed HAC systems serving common spaces shall meet the design and documentation requirements of ANSI/ASHRAE/ACCA Standard 183 or Chapter 17 of the 2021 ASHRAE Handbook of Fundamentals.

**Note:**

- N4.1a** Where heating equipment also provides domestic hot water, calculations must be performed to determine how to size the system to satisfy both loads in accordance with manufacturer's guidance.
- N4.1b** While heating-dominant climates are allowed to over-size with respect to the cooling load to achieve higher energy efficiency in the winter, this design choice may impact the ability of the system to effectively provide humidity control (see Item 4.2).

##### System Performance

- 4.1.3** For all newly installed HAC systems, documentation shall be provided to the Verifier, including start-up and air balancing reports or results of functional performance tests.
- 4.1.4** All existing HAC system components shall be assessed in accordance with the applicable minimum inspection standards of ANSI/ACCA Standard 4 (Maintenance of Residential HVAC Systems), and the associated maintenance and service tasks shall be performed in accordance with the standard.
- Note:**
- N4.1.4** Where inspection of existing HAC equipment reveals significant dirt, debris, biofilm, or fungal growth, clean and repair in accordance with ANSI/ACCA Standard 6 (Restoring the Cleanliness of HVAC Systems) or replace the system according to the newly installed criteria above.

**Advisories:**

- A4.1a** Air-handling equipment that move less than 3,000 cfm of air should have a manufacturer's designation for air leakage less than or equal to 2% of the design airflow rate when tested in accordance with ANSI / ASHRAE Std. 193.
- A4.1b** Although not required to meet this specification, Chapter 1 of the ASHRAE Handbook of Fundamentals or ACCA Manual P should be used to identify conditions that might lead to moisture issues and to verify that the design specifications fall within the 'Comfort Zone' on the psychrometric chart as defined by ANSI/ASHRAE 55.
- A4.1c** , EPA recommends, but does not require showing that airflows from air balancing reports for all HAC supply registers and return grilles were measured using ANSI / ACCA 5 QI-2015 protocol and verified within the greater of  $\pm 20\%$  or  $\pm 25$  CFM of the design airflow.
- A4.1d** Multi-zone ductless systems may require supplementary dehumidification due to a lack of general distribution or circulation, the use of individual room controls, and the impact of door closures.

#### 4.2 Humidity Control

- 4.2.1** A humidity monitoring device is provided in the main living area of the dwelling unit that includes a digital display of indoor temperature and relative humidity (RH) either on-board or via a web-based app. This requirement shall be met by either:
- 4.2.1.1** An RH monitor integrated with a thermostat or other central HAC controls; **OR**



**4.2.1.2** A standalone digital hygrometer, either permanently mounted or portable.

**Exception:**

**E4.2.1** Multifamily buildings other than townhouses are not required to include a digital display for either dwelling units or common spaces, so long as remote RH monitoring is achieved by a building management platform.

**Advisory:**

**A4.2.1** The ability to record RH data, either on-board or via a web-based app, for a minimum of 30 days is recommended.

**4.2.2** Dwelling units in Moist (A) climate zones 1-4, as defined by 2021 IECC Figure R301.1, shall have equipment designed and installed with sufficient latent capacity to maintain indoor RH at or below 60 percent. This requirement shall be met by either:

- i. A ventilating or whole-home dehumidifier, plumbed to a discharge drain, and either integrated with a central HVAC system or ducted to serve the main body of the dwelling unit; OR
- ii. All cooling systems equipped with additional controls to operate in dehumidification mode (i.e., systems that utilize humidity sensor feedback in the control algorithm to provide dehumidification, either automatically or on-demand, even when cooling is not required).

**Note:**

**N4.2.2a** “Whole-building dehumidifiers” are typically installed within the HAC ductwork to dehumidify multiple rooms and are often permanent. They may be installed separately from the HAC system and generally process indoor air only. “Ventilating dehumidifiers” process both indoor and outdoor air.

**N4.2.2b** Cooling systems only meet this requirement if they contain RH sensors that automatically turn the system off upon reaching the RH setpoint AND either prevent over-cooling or provide re-heat in order to maintain indoor temperature setpoints. For systems that limit over-cooling, the system is allowed to turn off without reaching the RH setpoint. Cooling systems with on-demand ‘dry mode’, like ductless mini-splits, must still meet the same requirements above.

**Exception:**

**E4.2.2** Dwelling units in Climate Zone 4A meet this requirement if all of the following are provided:

- i. The installed humidity monitoring device has the ability to record RH data, either on-board or via a web-based app, for a minimum of 60 days.
- ii. The building owner is provided an estimate of the projected hours per year when the building/unit will exceed 60% RH, using residential building modeling tools with hourly simulations.
- iii. Where the hours exceed 876 (i.e., 10% of the year), a dedicated space, drain, and electrical hook-up is provided to facilitate the future installation of a supplemental dehumidification system.

**Advisories:**

**A4.2a** EPA recommends, but does not require, that cooling systems in hot/humid climates utilize controls for immediate blower shutoff after condenser shutoff, to prevent re-evaporation of moisture off the wet coil.

**A4.2b** An additional dehumidification system (in lieu of additional HAC controls) is recommended in “Warm-Humid” climates, as defined by 2021 IECC Figure R301.1.

**A4.2c** EPA recommends maintaining indoor relative humidity (RH) between 40%-60% during most times of the year. In some instances, particularly during winter months, buildings may have extremely low humidity levels, which can create favorable conditions for transmission of respiratory pathogens. In such case, humidification may be helpful to reduce risks of pathogen transmission, improve occupant comfort, and/or to reduce cracking of wood flooring, furniture, or instruments. Humidification is currently neither required nor prohibited to earn the Indoor airPLUS label. In cases where humidification is included in a ducted HAC system, EPA recommends including automatic controls that limit the indoor relative humidity to 40%. If condensation is discovered on windows or ductwork, the humidifier should be adjusted to a lower maximum RH set point. Builders should also provide owners/occupants with instructions from the manufacturer on proper use and maintenance of the humidifier, including the recommendation to use distilled water.

**A4.2d** EPA recommends that the indoor dew point temperature be maintained below 60 °F (15 °C) whenever the outdoor air dew point is above 60 °F (15 °C).

### 4.3 Heating and Cooling (HAC) Duct Systems

**Intro:** Item 4.3 applies to all ducted systems providing heating and/or cooling (HAC) to the building. HAC ductwork must be inspected and tested per the following requirements.

**Duct Design**

**4.3.1** In detached one- and two-family buildings and townhouses, all newly installed duct systems are sized according to ACCA Manual D. All other dwelling units with newly installed duct systems may use an equivalent duct design standard. The duct system shall be designed to account for the pressure drop associated with a minimum 2” deep filter rated MERV 13 or higher (see Item 4.11 for filter requirements).

- 4.3.2** In common spaces, all newly installed duct systems are sized according to the ASHRAE Handbook of Fundamentals or other equivalent computation procedure. The duct system shall be designed to account for the pressure drop associated with a MERV 11 or higher filter (see Item 4.11).
- 4.3.3** Building framing cavities, such as any framing space (i.e., between wall studs, floor joists, or ceiling joists), shall not be used as supply or return ducts or plenums.

**Exception:**

**E4.3.3** Building framing cavities may be used for returns where the HAC filter is installed at the air handler.

**Advisory:**

**A4.3.3** A right-sized, fully ducted return is recommended to help ensure adequate return air through the filter to the air-handling equipment, rather than a transfer grille or louvered door to the space containing the air-handling equipment.

**Duct Inspection**

- 4.3.4** Inspect ductwork by removing registers, grilles, and diffusers to verify ducts and duct boots are dry, substantially free of loose dust and debris, and free of visible mold growth, rodents, or insects. When installed during new construction, cleanliness of duct boots can be confirmed by the Verifier using documentation provided by the HVAC contractor or builder at the time of register/diffuser installation.

**Note:**

**N4.3.4** Where duct systems are found to have excessive dust and debris, duct boots must be thoroughly vacuumed prior to final inspection. Where duct systems are found to have visible mold growth or vermin infestation, ducts shall be cleaned in accordance with [ANSI/ACCA Standard 6 \(Restoring the Cleanliness of HVAC Systems\)](#). Prior to cleaning, retrofitting, or replacing any ducts or components of the duct system, the cause or causes of moisture or mold growth must be determined and corrected.

- 4.3.5** Ducts shall be in good condition (e.g., connected to boots, no tears in flex ducts), and exterior surfaces of ducts and insulation in and around insulated ducts shall be dry and free of mold.

**Advisory:**

**A4.3.5** Metal supply ductwork that provides space cooling should be insulated (R-4 or greater) even when located within conditioned space, and the duct insulation should be sealed to the duct boots.

- 4.3.6** Ductwork installed outside the pressure boundary is sealed at transverse joints, longitudinal seams, duct wall penetrations, and duct boots sealed to drywall or subfloor using mastic systems, internal aerosol-based sealant, or UL-listed tapes used in accordance with their listing. Cloth duct tape is prohibited in all locations.

**Advisories:**

**A4.3.6a** Where tape is used for duct sealing, EPA recommends that it meet the applicable requirements of UL 181A or UL 181B.

**Duct System Performance**

- 4.3.7** For dwelling unit systems, Verifier-measured total duct leakage tested in accordance with ANSI/RESNET/ICC Std. 380, meets one of the following two options:

Rough-in: The greater of  $\leq 4$  CFM25 per 100 sq. ft. of CFA or  $\leq 40$  CFM25, with air handler & all ducts, building cavities used as ducts, & duct boots installed—For duct systems with three or more returns, the greater of  $\leq 6$  CFM25 per 100 sq. ft. of CFA or  $\leq 60$  CFM25.

Final: The greater of  $\leq 8$  CFM25 per 100 sq. ft. of CFA or  $\leq 80$  CFM25, with the air handler & all ducts, building cavities used as ducts, duct boots, & register grilles atop the finished surface (e.g., drywall, floor) installed. For duct systems with three or more returns, the greater of  $\leq 12$  CFM25 per 100 sq. ft. of CFA or  $\leq 120$  CFM25.

**Note:**

**N4.3.7** Registers atop carpets are permitted to be removed and the face of the duct boot temporarily sealed during testing.

- 4.3.8** For dwelling unit systems, Verifier-measured duct leakage to outdoors is  $\leq 4$  CFM25 per 100 sq. ft. of CFA or  $\leq 40$  CFM25 as tested in accordance with ANSI/RESNET/ICC Std. 380.

**Exception:**

**E4.3.8a** Testing of duct leakage to outdoors (DLTO) is not required if all ducts are within the pressure boundary of the building.

**E4.3.8b** DLTO testing can also be waived in accordance with Section 5.5.2 of ANSI/RESNET/ICC Std. 380 if total duct leakage at rough-in or final is  $\leq 4$  CFM25 per 100 sq. ft. of conditioned floor area or  $\leq 40$  CFM25, whichever is larger.

**4.4 Location of Heating and Cooling (HAC) Air-Handling Equipment and Ductwork**

- 4.4.1** Do not locate air-handling equipment or ductwork in garages.

**Note:**

**N4.4.1** In one- and two-family buildings and townhouses with attached garages, ducts and equipment may be located in building framing cavities adjacent to garage walls or ceilings if they are separated from the garage space with a continuous thermal barrier and air barrier. Mechanical rooms with air-handling equipment adjacent to the garage are permitted to have a garage-side access door, so long as the door is insulated, gasketed or weather-stripped, and has self-closing hinges. These allowances are not permitted for dwelling units that are above or adjacent to parking garages in multifamily buildings.

**Exception:**

**E4.4.1** This requirement does not apply to homes or buildings where the system provides heating and/or ventilation only for the garage, independent of systems that serve dwelling units.

**Advisories:**

**A4.4.1a** Air-handling equipment should be installed in a location accessible to the occupant, HVAC technician, or building maintenance staff to facilitate cleaning, maintenance, and to provide access to the heating and cooling cores and condensate pans. EPA recommends that access to an unvented attic should be provided by a permanent stair, a pull-down stair or ladder with a minimum capacity of 300 pounds (136 kg), or direct access to the equipment from a door (e.g., knee wall or unfinished mechanical room).

**A4.4.1b** In flood-prone areas, the HAC air-handling equipment is recommended to be installed above the 100 year flood level.

**A4.4.1c** All HAC air-handling equipment and ductwork is recommended to be installed within the thermal and air barrier boundary to minimize the potential for future leakage to outdoors and associated pressure imbalances.

**4.4.2** Supply ducts located outside the building's thermal and pressure boundary shall be insulated to R-6 (minimum) to prevent condensation forming on the duct surfaces.

#### 4.5 Pressure-Balanced Bedrooms

**4.5.1** Where ducted systems provide heating and/or cooling to the bedroom, bedrooms shall be pressure-balanced using any combination of transfer grilles, jump ducts, dedicated return ducts, and undercut doors, meeting the following climate-specific requirements:

**4.5.1.1** In Moist (A) zones 1-3, as defined by 2021 IECC Figure R301.1, bedrooms shall achieve a Verifier-measured pressure differential  $\geq -3$  Pa and  $\leq +3$  Pa with respect to the main body of the dwelling unit when all air handlers are operating.

**4.5.1.2** In all other climate zones, bedrooms shall achieve a Verifier-measured pressure differential  $\geq -5$  Pa and  $\leq +5$  Pa.

**Note:**

**N 4.5.1**

Item 4.5.1 does not apply to ventilation ducts, exhaust ducts, or non-ducted systems. For an HVAC system with a multi-speed fan, the highest design fan speed shall be used when verifying this requirement. For an HVAC system with multiple zones, this requirement shall be verified with all zones calling for heating or cooling simultaneously; additional testing of individual zones is not required. When verifying this requirement, doors separating bedrooms from the main body of the house (e.g., a door between a bedroom and a hallway) shall be closed and doors to rooms that can only be entered from the bedroom (e.g., a closet, a bathroom) shall be open.

## Mechanical Ventilation

### 4.6 Dwelling-Unit Mechanical Ventilation

**Intro:** Item 4.6 applies to all dwelling-unit mechanical ventilation systems.

#### Ventilation System Design

**4.6.1** Provide each dwelling unit with a mechanical ventilation system.

**Advisories:**

**A4.6.1a** EPA recommends a "balanced" ventilation system be designed and installed to provide ventilation air directly to the dwelling unit from the outdoors. A "balanced" system may be an HRV or ERV but may also be a combination of mechanical supply and exhaust systems, without any heat or energy recovery, such as outdoor air supplied through the HAC air handler with a separate exhaust system. Where the supply and exhaust systems in a "balanced" system operate independently, EPA recommends, but does not require, simultaneous operation.

**A4.6.1b** EPA recommends installing ventilation equipment with automated fault detection and diagnostics for airflow rate, filter maintenance, and automatic balancing features to maintain balanced airflow rate in variable conditions and through the equipment life. EPA also recommends installing ventilation equipment with the capability to modify ventilation rates and run-times in response to monitored pollutants. Also note that IAQ contaminant monitoring systems may require regular maintenance, calibration, and/or replacement of sensor equipment.

**A4.6.1c** Where installing balanced or supply ventilation systems, EPA recommends multiple supply points to properly distribute outdoor air to all living spaces for all system types.

**A4.6.1d** Where installing heat or energy recovery ventilation systems, EPA recommends the following:

- i. Minimize intake and exhaust duct length.
- ii. Install the room exhaust points high on the walls or in the ceiling.

**A4.6.1e** Where installing powered supply ventilation, EPA recommends the following:

- i. Locate the supply air grille(s) where it will not deliver unconditioned air near occupants OR supply outdoor air at a minimum temperature of 60°F for a floor diffuser or minimum temperature of 54°F for a high wall or ceiling diffuser.

**4.6.2** In all dwelling units, mechanical ventilation override control is labelled. In detached one- and two-family buildings and townhouses the override control must also be readily accessible to the occupant.

**4.6.3** Where included in the system design, air inlets are visually verified to pull air directly from outdoors, and not from attic, crawlspace, garage, or adjacent dwelling units. For exhaust-only systems, designated air inlets are not required.

**4.6.4** Where included in the system design, outdoor air inlets are located  $\geq 2$  ft. above grade or roof deck;  $\geq 3$  ft. distance from dryer exhausts and sources exiting the roof; and  $\geq 10$  ft. of stretched-string distance from known contamination sources not exiting the roof.

**Advisories:**

**A4.6.4a** Ventilation equipment should be installed in a location accessible to the occupant, HVAC technician, or building maintenance staff to facilitate cleaning, maintenance, and to provide access to the heat exchange cores and/or condensate pans (if applicable).

**A4.6.4b** Outdoor air inlets should be located so that entering air is not obstructed by snow, plantings, or other material, and in such a location to promote periodic cleaning.

**Ventilation Rates and Run Times**

**4.6.5** Total outdoor air supplied to or exhausted from the dwelling unit shall be measured in accordance with ANSI/RESNET/ICC Std. 380 and documented to meet or exceed the dwelling-unit mechanical ventilation rates and run-time (continuous or intermittent) required in Section 4 of ASHRAE 62.2-2019, or later versions. Alternatively, the Verifier may collect and review a report provided by a certified air-balancing contractor.

**Ventilation Filtration**

**4.6.6** Ventilation filtration shall be designed as follows:

**4.6.6.1** Where supply or balanced ventilation systems are installed, prior to distribution outdoor air supplied to the dwelling unit shall pass through a filter rated MERV 11 or higher according to ASHRAE 52.2-2017 or ISO ePM2.5 according to ISO 16890. Outdoor air supplied directly to a duct system that passes through the filter of the HAC air handler satisfies this requirement.

**Advisories:**

**A4.6.6.1a** The ventilation system should be designed to account for the pressure drop associated with the filter.

**A4.6.6.1b** Where supply or balanced ventilation systems are installed, EPA recommends filters rated MERV 13 or higher according to ASHRAE 52.2-2017 or ISO ePM1 according to ISO 16890.

**4.6.6.2** The ventilation filter shall be readily-accessible to the occupant, HVAC technician, or building maintenance staff.

**Advisory:**

**A4.6.6.2** The outdoor air intake, fan unit, and heat exchanger (if applicable) should be installed in locations accessible to the occupant or building maintenance staff to facilitate cleaning, maintenance, and to provide access to the heat exchange cores and/or condensate pans (if applicable).

**Sound Rating**

**4.6.7** Dwelling unit mechanical ventilation fans located within the dwelling unit shall be rated for sound at a maximum of 1.0 sone.

**Exception:**

**E4.6.7** Sound ratings are not required for HAC air handlers used as part of the ventilation system and remote-mounted fans located outside the habitable space, bathrooms, toilets, and hallways, with at least 4 ft of ductwork between the fan and the intake grille.

**4.7 Dwelling Unit Bathroom Exhaust**

**Intro:** Item 4.7 applies to all dwelling-unit bathroom ventilation systems.

**4.7.1** In each bathroom, provide local mechanical exhaust ventilation directly to the outdoors, meeting ASHRAE 62.2-2019 Section 5 requirements.

**Note:**

**N4.7.1** Per ASHRAE 62.2, a bathroom is any room containing a bathtub, a shower, a spa, or a similar source of moisture.

- 4.7.2** Where provided, continuously-operating bathroom exhaust fans shall be rated for sound at a maximum of 1 sone at an airflow of 20 cfm or greater. Where provided, demand-controlled (i.e., intermittent) bathroom exhaust fans shall be rated for sound at a maximum of 3 sones at an airflow no less than 50 cfm.

**Exception:**

- E4.7.2** Sound ratings are not required for remote-mounted fans located outside habitable spaces, bathrooms, toilets, and hallways, with at least 4 ft of ductwork between the fan and the intake grille..

- 4.7.3** Where the bathroom exhaust fan is part of the dwelling unit mechanical ventilation, the on/off control must be labelled or marked to clearly identify its dual function.

- 4.7.4** When using demand-controlled exhaust from bathrooms to meet ASHRAE 62.2-2019 Section 5 requirements, fans shall be provided with a manually-operated timer or automatic controls based on humidity or occupancy, such that the fan can be operated when bathroom is occupied and for a minimum of 20 minutes after vacated, or until humidity is less than 60%.

#### 4.8 Dwelling-Unit Kitchen Exhaust

- 4.8.1** In each kitchen, provide demand-controlled mechanical exhaust at each cooktop or range vented directly to the outdoors, meeting ASHRAE 62.2-2019 Section 5 requirements by either a:

**4.8.1.1** Range hood or appliance-range hood combination with a minimum Verifier-measured exhaust rate of 100 cfm; **OR**

**4.8.1.2** Downdraft kitchen exhaust fan with a minimum Verifier-measured exhaust rate of 300 cfm or 5 ACH for enclosed kitchens.

**Note:**

- N4.8.1** Where microwave-range hoods are installed, Verifier shall verify that the microwave-range hood is configured to vent outdoors, rather than recirculate.

**Exceptions:**

**E4.8.1a** While demand-controlled kitchen exhaust is recommended, for units in multifamily buildings, continuous exhaust vented to the outdoors (e.g., HRV/ERV or ceiling/wall mounted fan) may be used in lieu of a demand-controlled exhaust fan at the cooktop, if the following requirements are met:

- i. Cooktop is electric,
- ii. A recirculation range hood with a charcoal filter is installed over the cooktop,
- iii. Continuous kitchen exhaust rate of either:
  - a. 5 ACH, OR
  - b. 50 cfm if the edge of the exhaust fan or intake grille is located within 10 ft of the edge of the cooktop or range, as measured horizontally on the floor plan, OR
  - c. 25 cfm if local mechanical kitchen exhaust is provided using a balanced system and the building has a Verifier-measured whole-building infiltration rate  $\leq 1.0$  ACH50 or  $\leq 0.05$  CFM50 per sq. ft. of enclosure area.

Exception 4.8.1a does not apply to two-family buildings or townhouses. (See 4.8.2)

**E4.8.1b** Where microwave-range hoods are installed, measuring the exhaust airflow is not required if the following requirements are all met:

- i. Cooktop is electric,
- ii. Measured duct length does not exceed 25 ft and contains no more than 3 elbows,
- iii. Duct sizing meets Compliance Option 3 of the [ENERGY STAR Kitchen Exhaust Guidance](#),
- iv. Microwave-range hood is HVI or AHAM certified, or equivalent, and rated for at least 100 cfm at 0.25 in. WC (ratings at 0.1 in. WC are not acceptable for airflow but are permitted for sound).

- 4.8.2** For all dwelling units, where continuous exhaust is present in the kitchen area and separate from the range hood, do not locate ventilation grilles above or inside a 45-degree angle projected outwards from the cooking equipment element closest to the grille and install a MERV 3 or washable filter in the ventilation grille to trap grease. In detached one- and two-family homes and townhouses, continuous exhaust may be present in the kitchen, but may not be used in lieu of a demand-controlled exhaust fan.

- 4.8.3** Continuous kitchen exhaust fans shall be rated for sound at a maximum of 1 sone at an airflow no less than 25cfm.

**Exception:**

- E4.8.3** Sound ratings are not required for remote-mounted fans located outside habitable spaces, bathrooms, toilets, and hallways, with at least 4 ft (1 m) of ductwork between the fan and the intake grille.

**Advisory:**

- A4.8.3** Demand-controlled kitchen exhaust fans are recommended to be rated for sound at a maximum of 2 sones at one or more airflow settings no less than 100 cfm.

**Advisories:**

- A4.8a** Range hoods and microwave-range hoods are recommended to have a minimum capture efficiency of 70%, as tested in accordance with current (or amended) editions of ASTM E3087, or equivalent.
- A4.8b** Demand-controlled kitchen exhaust fans capable of exhausting air at rates greater than 160 cfm are recommended; for gas cooktops and ranges, EPA recommends rates greater than 200 cfm. Where exhaust rates are 200 cfm or greater, units should be provided with makeup air at rates equal or similar to the exhaust air rate.
- A4.8c** Range hoods with “smart” controls that meet UL requirements for safety are recommended that will activate/deactivate the hood automatically based on operation or using sensors such as temperature, humidity, mixed gas, or a combination thereof.
- A4.8d** To improve installed performance, EPA recommends the following:
- i. Select products that are rated for airflow and sound in accordance with HVI 920, or equivalent, by an administration and certification body that is accredited in accordance with ISO 17065 and accredited by an accreditation body operating in accordance with ISO 17011.
  - ii. Select products that are rated for airflow at a minimum static pressure of 0.375 in. WC.
  - iii. For kitchen exhaust fans, even when Verifier-measurement of airflow is required, follow the prescriptive duct sizing requirements in Table 5-3 of ASHRAE 62.2-2019 or the [ENERGY STAR Kitchen Exhaust Guidance](#).
  - iv. Select static vents and termination fittings certified to meet the required cfm at 0.05 in. WC in accordance with HVI 916 or equivalent.

**4.9 Common Space Ventilation Requirements****Ventilation System Design**

- 4.9.1** Provide outdoor air ventilation and exhaust in common spaces of multifamily buildings. Air inlets are visually verified to pull outdoor air directly from outdoors, and not from attic, crawlspace, garage, or adjacent dwelling units.

**Ventilation Rates and Run Times**

- 4.9.2** Ventilation and exhaust airflows shall be measured and documented to meet or exceed rates required by ASHRAE 62.1-2019. Alternatively, the Verifier may collect and review a report provided by a certified air-balancing contractor.

**Ventilation Filtration and Maintenance**

- 4.9.3** Ventilation filtration shall be designed as follows:

- 4.9.3.1** Prior to distribution, outdoor air supplied to common spaces in multifamily buildings shall pass through a filter rated MERV 11 or higher according to ASHRAE 52.2-2017 or ISO ePM2.5 according to ISO 16890.
- 4.9.3.2** The outdoor air intake, the filter, the fan unit, and the heat exchanger (if applicable) shall be installed in locations accessible to the building maintenance staff to facilitate cleaning and maintenance.

**Advisories:**

- A4.9.3a** The ventilation system should be designed to account for the pressure drop associated with the filter.
- A4.9.3b** EPA recommends filters rated MERV 13 or higher according to ASHRAE 52.2-2017 or ISO ePM1 according to ISO 16890.

**4.10 Other Ventilation Requirements**

- 4.10.1** Central vacuum systems, where installed, shall exhaust to the outdoors at least 10 ft. from ventilation system air inlets.
- 4.10.2** Vented clothes dryers shall exhaust to the outdoors per the manufacturer’s instructions.

**Advisories:**

- A4.10a** If the dryer exhaust duct exceeds the manufacturer’s recommendations in length, diameter, turns, etc., a dryer exhaust duct power ventilator (DEDPV) certified for safety under UL507 should be installed.
- A4.10b** Vented clothes dryers can exhaust in excess of 200 cfm when in use, causing depressurization. Providing a make-up air system with a tight fitting back-draft damper and automatic switch or timer switch is recommended.

**Filtration and Air Cleaning****4.11 Particle Filtration for Ducted Heating and Cooling (HAC) Serving Dwelling Units and Common Spaces**

- 4.11.1** For all ducted HAC systems serving dwelling units and common spaces, filter slots shall be a minimum of 2in. in depth with filters rated MERV 11 or higher according to ASHRAE 52.2-2017 or ISO ePM2.5 according to ISO 16890 installed prior to final inspection. Alternatively, MERV 8 filters are permitted where a stand-alone portable air cleaner is provided for each of the two largest living spaces in the home/apartment. See Item 4.12 for design criteria.

**Advisories:**

**A4.11.1a** While not required, filter slots are recommended to be a minimum of 4in. in width to allow for deeper pleated filters and reduced pressure drop across the filter.

**A4.11.1b** Air filter installation locations should be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop. The labels should be permanently affixed to the air filter installation location and visible to a person replacing the air filter.

**A4.11.1c** To reduce the likelihood of construction dust contaminating the ducts and air handler, the HAC system should not be used as temporary space conditioning during construction activities with increased dust (e.g., drywall sanding, floor sanding).

**A4.11.1d** Where ducted HAC systems can account for the higher static pressure, EPA recommends filters rated MERV 13 or higher according to ASHRAE 52.2-2017 or ISO ePM1 according to ISO 16890.

- 4.11.2** Return air filters shall be installed in locations accessible to the occupant or building maintenance staff for cleaning and/or replacement.

- 4.11.3** Filter access panels are equipped with gasketed material or comparable sealing mechanism to ensure access panels fit snugly against the exposed edge of the installed filter to prevent air bypass.

**Advisory:**

**A4.11.3** Filters perform best when the filter rack design includes the following features, which are also included in some manufacturers' filter media boxes:

- i. Flexible, airtight (e.g., closed-cell foam) gasket material on the surface that contacts the air-leaving (downstream) side of the filter.
- ii. Friction fit or spring clips installed on the upstream side of the filter to hold it firmly in place.

- 4.11.4** All return air and mechanically supplied outdoor air pass through filter prior to conditioning.

**Advisory:**

**A4.11.4** To improve filtration during time periods where the HAC is not operating frequently (e.g., shoulder seasons), EPA recommends controls that operate the air handler daily at a minimum runtime (20-30%) to provide filtration or the alternatives in Item 4.12 that do not utilize the HAC system.

- 4.11.5** Ducted electronic air cleaners (i.e., duct-mounted electrostatic air cleaners, air ionizers, and lamps that emit ultraviolet (UV) radiation between 100 and 280 nm (UVC)) are tested according to UL 2998 or CSA Standard C22.2 No. 187:20 and must not exceed ozone emission limits of 0.005 parts per million. Such devices are permitted, but are not required, in Indoor airPLUS labeled buildings and apartments.

- 4.11.6** Ozone generators and devices intentionally using ozone to treat or condition air are prohibited.

**Advisory:**

**A4.11.6** Ozone is a lung irritant that poses health risks. Even at concentrations below public health standards, ozone reacts with chemicals emitted by common indoor sources such as household cleaning products, air fresheners, deodorizers, certain paints, polishes, wood flooring, carpets, and linoleum. The chemical reactions produce harmful byproducts that may be associated with adverse health effects in some sensitive populations.

#### **4.12 Particle Filtration for Non-Ducted HAC Systems Serving Dwelling Units**

- 4.12.1** While these Indoor airPLUS specifications currently have no requirement for Item 4.12, please see the following notes and advisories.

**Note:**

**N4.12** The use of high capture filters installed in ducted HAC systems can be a practical method to filter particles of indoor origin. To be most effective, such systems must operate regularly to circulate air through the filter. Ductless mini-splits generally include a washable filter without a MERV rating, designed primarily to protect the equipment from debris and larger particles. As such, in homes/apartments using only ductless mini-splits, hydronic systems, electric resistance heat, or combinations thereof, particle filtration may be more challenging, but can be improved by meeting the following optional recommendations.

**Advisory:**

- A4.12** In dwelling units and common spaces with no ducted HAC system (e.g., ductless mini-splits, fully hydronic systems, electric resistance heat, or combinations thereof), provide one of the following methods of indoor air filtration to reduce exposure to particles of indoor origin:

- i. Non-ducted, forced-air HAC systems include a filter rated MERV 11 or higher according to ASHRAE 52.2-2017 or rated ePM2.5 according to ISO 16890; **OR**
- ii. A stand-alone portable air cleaner is provided for each of the two largest living spaces in the home/unit, sized to meet the square footage of each room, based on the verified Clean Air Delivery Rate and room size calculation per ANSI/AHAM Standard AC-1. (Maximum room size for a verified air cleaner is equal to the verified Smoke CADR value x 1.55.) Air cleaners must meet ozone emission limits of UL 2998; **OR**
- iii. Transfer fan is installed with a minimum MERV 11 filter designed to operate during all occupiable hours and to exchange air between the two largest living spaces (at minimum).

#### 4.13 Gas-Phase Air Cleaning Devices

**4.13.1** Where installed, gas-phase air cleaning devices do not intentionally use ozone to treat or condition air.

##### Advisories:

**4.13a** Gaseous pollutants include inorganic gases such as combustion gases (e.g., carbon monoxide and nitrogen dioxide), ozone, and organic chemicals that are not attached to particles. Hundreds of different gaseous pollutants have been detected in indoor air. Gas-phase air cleaning technology includes adsorbent media (e.g., activated carbon), chemisorbent media (e.g., media coated or impregnated with reactive compounds), catalytic oxidation, plasma, and intentional ozone generation. A summary of gas-phase cleaning technology can be found in Residential Air Cleaners – A Technical Summary, along with other resources on [Air Cleaners and Air Filters in the Home](#).

**4.13b** When utilized with in-duct HAC systems, gas-phase filters that contain sorbents should generally be located downstream of particle air filters.

#### 4.14 Microbial Disinfection

**4.14.1** Where installed, ultraviolet germicidal irradiation (UVGI) or other electronic air cleaners (e.g., plasma generators, photocatalytic oxidizers (PCOs), etc.) must not exceed ozone emission limits of 0.005 parts per million as specified in UL 2998.

##### Advisories:

**A4.14a** Ultraviolet germicidal irradiation (UVGI) air cleaners are designed to use UV lamps to kill or deactivate microorganisms such as viruses, bacteria, and fungal spores and fragments that are airborne or growing on surfaces (e.g., cooling coils, drain pans, ductwork, filters). UVGI lamps for in-duct airstream irradiation are tested using ANSI/ASHRAE Standard 185.1, and UVGI lamps for in-duct surface irradiation are tested using ANSI/ASHRAE Standard 185.2. Prolonged direct UVGI exposure can destroy vegetative microbial growth. However, typical UVGI air cleaners designed for use in buildings do not deliver sufficient UV doses to effectively kill or deactivate most airborne microorganisms because the exposure period is too short and/or the intensity is too low. Thus, UVGI does not appear to be effective as a sole control device. When UVGI is used, it should be used in addition to—not as a replacement for—conventional particle filtration systems. A summary of UVGI cleaning technology can be found in Residential Air Cleaners – A Technical Summary, along with other resources on [Air Cleaners and Air Filters in the Home](#).

**A4.14b** When UVGI lamps are installed in HAC systems, access panels for AHUs should be interlocked with automatic shutoff mechanisms to prevent accidental exposure to UV radiation, and an inspection window that blocks UV energy (e.g., plastic or glass) is recommended to be installed to be able to confirm lamp operation. Builders should ensure that homeowners and occupants are aware of the hazards related to accidental UV exposure and should brief them on the maintenance and usage requirements for any UVGI system installed.

**A4.14c** Ozone is a lung irritant that poses health risks. Even at concentrations below public health standards, ozone reacts with chemicals emitted by common indoor sources such as household cleaning products, air fresheners, deodorizers, certain paints, polishes, wood flooring, carpets, and linoleum. The chemical reactions produce harmful byproducts that may be associated with adverse health effects in some sensitive populations, including formaldehyde, other aldehydes, ketones, and peroxides. Usage of technologies that emit ozone should be carefully considered before being installed in buildings, and builders should ensure that homeowners and occupants are fully informed about the potential hazards and emission byproducts that may result from usage of these devices.

## 5. Pollutant Control

### 5.1 Combustion Appliances

**5.1.1** Combustion furnaces, boilers, and water heaters located within the building's pressure boundary are mechanically drafted or direct-vented.

##### Exception:

**E5.1.1** Furnaces, boilers, and water heaters are permitted to be naturally drafted, but must pass the maximum depressurization testing per ANSI/BPI 1200-S-2017 Standard or ANSI/ACCA 12 QH-2018 and shall exhaust to the outdoors no less than 2 ft higher than any obstructions within a 10 ft radius.

##### Advisory:

**A5.1.1** EPA recommends replacing naturally drafted appliances with mechanically drafted or direct vent appliances, including where combustion appliances are located in basements, crawlspaces, and/or garages outside the pressure boundary.



**5.1.2** Fireplaces located within the building's pressure boundary are mechanically drafted or direct vented.

**5.1.2.1** Liquid or gas-burning fireplaces shall have a permanently affixed tempered glass front or gasketed door.

**5.1.3** No unvented combustion appliances other than cooktops, ranges, or ovens are located within the building's pressure boundary. See Item 4.8 for kitchen exhaust requirements.

**5.1.4** Existing chimneys and flues still in service have passed a Level II inspection according to NFPA 211, as performed by a CSIA certified chimney sweep (or other similar certification).

#### **Solid fuel burning fireplaces and appliances**

**5.1.5** Meet the following energy efficiency and emissions standards and restrictions for all fireplaces and other solid fuel-burning and space-heating appliances located within the building's pressure boundary:

**5.1.5.1** Site-built masonry fireplaces designed for open fires are sealed to prevent use or retrofitted with other compliant appliances;

**Exception:**

**E5.1.5.1** "Masonry heaters" as defined by ASTM E1602 and section 2112.1 of the 2018 International Building Code (i.e., fireplaces engineered to store and release substantial portions of heat generated from a rapid burn).

**5.1.5.2** Factory-built wood-burning fireplaces shall have a dedicated outside air supply and meet the certification requirements of UL 127.

**Advisory:**

**A5.1.5.2** Factory-built wood burning fireplaces qualified under EPA's wood-burning fireplace program are recommended. See: <https://www.epa.gov/burnwise/voluntary-fireplace-program>.

**5.1.5.3** Wood stove and fireplace inserts as defined in section 3.8 of UL 1482 shall meet the certification requirements of that standard, AND they shall meet the emission requirements of the EPA's New Source Performance Standards for new residential wood heaters. See: <https://www.epa.gov/residential-wood-heaters/final-2020-new-source-performance-standards-residential-wood-heaters>.

**5.1.5.4** Pellet stoves shall meet the requirements of ASTM E1509, AND they shall meet the emission requirements of the EPA New Source Performance Standards for new residential wood heaters.

#### **5.2 Carbon Monoxide Alarms**

**5.2.1** All dwelling units shall have a carbon monoxide (CO) alarm installed and located in accordance with all of the following:

**5.2.1.1** In the same room as permanently installed fuel burning appliances.

**5.2.1.2** Centrally located on every habitable level.

**5.2.1.3** Within 21 ft (6.4 m) of any door to a sleeping room.

**Advisory:**

**A5.2.1** Avoid placing CO alarms near heating vents, in kitchens, above fuel burning appliances, or in locations that can be covered by furniture or draperies.

**5.2.2** Single and multiple station CO alarms shall be listed and labeled in accordance with UL 2034 or CSA 6.19-01. CO detectors for use in CO detection systems shall be listed and labeled in accordance with UL 2075.

**5.2.3** CO alarms shall be powered from the building's wiring with battery backup. CO alarms in buildings without a commercial power source are permitted to be battery operated.

**5.2.4** CO alarm must sound when the test button is pushed.

**5.2.5** Where CO alarms are installed prior to construction finishes, alarms shall be protected from dust, paint, and other contaminants.

**Note:**

**N5.2** The above requirements are not intended to supersede or replace applicable laws or codes in force by the authority having jurisdiction. Additional local requirements may apply.

**Advisory:**

**A5.2** For added protection for young children, expectant parents, older adults, and persons with medical conditions who may be more vulnerable to lower levels of carbon monoxide, EPA recommends that CO detectors are installed that display and alarm at levels that are lower than UL 2034 alarm thresholds.

#### **5.3 Pollutant Control from Smoking and Vaping**

**5.3.1** Occupant has been provided with EPA's brochure on [Secondhand Tobacco Smoke and the Health of Your Family](#) or with a link to EPA's resources on [Secondhand Smoke and Smoke-free Homes](#).

- 5.3.2** In multifamily buildings, smoking and vaping are prohibited in indoor common areas, including but not limited to, corridors, vestibules, stairwells, and community rooms, and the prohibition is posted in a prominent entryway or lobby. The prohibition is explicitly communicated in the building rental or lease agreements or in condo or co-op association covenants and restrictions, with provisions for enforcement.
- 5.3.3** In multifamily buildings, when designated outdoor smoking/vaping areas are provided, they are located a minimum of 25 ft. from entries, outdoor air intakes and operable windows, and signage is provided.

**Advisories:**

- A5.3a** EPA recommends prohibiting smoking and vaping of tobacco or other substances throughout the entire building, including within living units, on patios, and balconies. Communicate these additional prohibitions in the building rental or lease agreements or in condo or co-op association covenants and restrictions and include provisions for enforcement.
- A5.3b** Exposure to contaminants is not limited to tobacco smoke. EPA advises building owner manuals to include information on the dangers of personal-use products, which produce harmful contaminants, such as smoking tobacco and other substances, vaping, and burning candles or incense.

#### 5.4 Pollutant Control through Minimized Infiltration

- 5.4.1** Conduct airtightness testing in accordance with procedures in ANSI/RESNET/ICC Std. 380, demonstrating compliance with the following leakage rates, as applicable to the type of dwelling unit:
- 5.4.1.1** For detached homes > 1,000 ft<sup>2</sup>, Verifier-measured airtightness shall be no greater than 5 ACH50. For detached homes ≤ 1,000 ft<sup>2</sup>, Verifier-measured airtightness shall be no greater than 0.30 CFM50 per square foot of dwelling unit enclosure area.
- 5.4.1.2** For all other dwelling units, the average compartmentalization of all Verifier-measured airtightness test results shall be no greater than 0.3 CFM50 per square foot of dwelling unit enclosure area. In multifamily buildings, where sampling of compartmentalization tests is permitted, test at least 20% of the dwelling units that are adjacent to the garage.

#### 5.5 Attached Garages and Parking Structures

- 5.5.1** Common walls and ceilings between attached garages and occupied spaces, including common spaces, are air-sealed before installing insulation. Doors between occupied spaces, including common spaces, and attached garages are made substantially air-tight with weather stripping or equivalent gasket.
- 5.5.2** In detached one- and two-family buildings and townhouses, meet one of the following two requirements:
- 5.5.2.1** Verify that the garage-to-house air barrier can maintain a pressure difference of greater than 45 Pa while the house maintains a 50 Pa pressure difference with respect to the outdoors. All operable garage openings shall be closed during this test; **OR**
- 5.5.2.2** Equip the attached garage with an exhaust fan that is vented directly outdoors. The installed fan shall have a minimum Verifier-measured airflow of 100 cfm, or greater if required by the authority having jurisdiction. The fan shall be wired for continuous operation or with automatic fan controls (e.g., a motion detector) that activate the fan whenever the garage is occupied and operate for at least 1 hour after the garage has been vacated.

**Advisories:**

- A5.5a** EPA recommends installing a garage exhaust fan capable of moving 0.75 cfm per square foot if the occupant is expected to occupy the garage for work or recreational activities over extended periods of time.
- A5.5b** EPA recommends installing ENERGY STAR certified exhaust fans to reduce energy consumption and sound levels.
- A5.5c** EPA recommends providing occupants with information in the Owner and Occupant Information Kit on the importance of, and methods for, ensuring adequate ventilation in the garage while occupied for extended periods of time.
- A5.5d** EPA recommends installing automatic closers on doors between occupied spaces and attached garages.
- A5.5e** In multifamily buildings, where an exhaust system is installed in a shared parking garage, the system should be equipped with controls that sense CO and NO<sub>2</sub>, providing a minimum continuous ventilation rate of 0.05 cfm/ft<sup>2</sup> in standby mode, and 0.75 cfm/ft<sup>2</sup> otherwise.

#### 5.6 Combustible Fuels

- 5.6.1** There shall be no combustible liquid or gas fuels (e.g., fuel oil, gasoline, kerosene, propane, ethanol, etc.) stored within the thermal and pressure boundary upon final verification.
- 5.6.2** Supplemental portable combustion equipment (e.g., portable generators, lawn maintenance equipment, etc.) shall not be operated or stored within the thermal and pressure boundary upon final verification.

## 6. Building Materials

**Intro:** The following section applies to newly installed materials and finishes. Surfaces in garages are exempt for the purpose of these requirements.

**Notes:**

- N6a** The evaluation, certification, and labeling of products for indoor emissions of volatile organic compounds (VOCs) is complex and evolving. EPA has not established threshold levels for indoor VOC concentrations or VOC emissions from any of the product categories addressed in these specifications. The standards and rules referenced in these specifications considered analyses that are designed to reduce human exposure indoors to individual VOCs of potential concern for human health effects, and to reduce ambient air emissions.
- N6b** EPA recommends ventilating the building with outside air at the highest rate and duration practical during the installation of products that are known sources of contaminants (e.g., composite woods, carpet and padding, adhesives, site-applied finishes) and during the period between finishing and occupancy.
- N6c** Interior architectural coatings, gypsum board, and other products that are formulated to remove formaldehyde and other aldehydes in indoor air and are tested and labeled in accordance with ISO 16000-23, Indoor air – Part 23, may or may not be compliant with the VOC standards in this section. EPA has not independently evaluated data on the relative efficacy and long-term impacts of sorptive materials addressed by the ISO 16000-23 standard.
- N6d** Download [How to Find Indoor airPLUS Compliant Low Emission Products](#), which provides guidance on identifying products that are compliant with these specifications, including the identification of product certification and labeling programs that are acceptable. *[Note: This guidance will be updated when these new specifications are finalized. The current version of this document is applicable to Version 1 of the Indoor airPLUS Construction Specifications.]*

**6.1 Composite Wood**

- 6.1.1** For structural plywood and oriented strand board (OSB), install only products that are rated as “Exterior” or “Exposure 1”, in compliance with Voluntary Product Standard PS 1-19, Structural Plywood or Voluntary Product Standard PS 2-18, Performance Standard for Wood-Based Structural-Use Panels.

**6.2 Interior Paints, Finishes, and Coatings**

- 6.2.1** Site-applied paints, finishes, and coatings (including such products with sealing or waterproofing properties) shall not exceed maximum VOC emission levels in accordance with and determined by California Department of Public Health (CDPH), “[Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.2—2017.](#)”
- 6.2.2** In addition, such products must also meet VOC content limits for their respective category, and VOC content limits for any colorants added to the final product, as identified in:
- 6.2.2.1** South Coast Air Quality Management District (SCAQMD), “[Rule 1113 – Architectural Coatings, Amended February 5, 2016.](#)” OR
- 6.2.2.2** California Air Resources Board (CARB), “[Suggested Control Measure for Architectural Coatings, May 2020.](#)”

**Notes:**

- N6.2a** Some liquid finishing products labeled as “sealants” by the manufacturer may actually be better categorized as a coating or finish. For the purposes of this requirement, Indoor airPLUS references the SCAQMD definition of “coating” in Rule 1113—“a material which is applied to a surface in order to beautify, protect, or provide a barrier to such surface.” A low-emission “sealant”, as required by Indoor airPLUS Item 6.3, is defined by SCAQMD Rule 1168 as “any material with adhesive properties that is designed to fill, seal, waterproof, or weatherproof gaps or joints between two surfaces. Sealants include caulks.”

**6.3 Carpets and Cushions**

- 6.3.1** Carpet and carpet cushions must be low-emitting products with maximum VOC emission levels in accordance with and determined by [CDPH Standard Method V1.2-2017.](#)

**6.4 Adhesives and Sealants**

- 6.4.1** Site-applied interior adhesives and sealants shall not exceed maximum VOC emission levels in accordance with and determined by CDPH Standard Method V1.2-2017.
- 6.4.2** In addition, such products must also meet VOC content limits for their respective category, and VOC content limits for any colorants added to the final product, as identified in SCAQMD, “[Rule 1168 – Adhesives and Sealant Applications, amended October 2017.](#)”

**Note:**

- N6.4** Some liquid finishing products labeled as “sealants” by the manufacturer may actually be better categorized as a coating or finish, and thus apply to Item 6.1. For the purposes of this requirement, Indoor airPLUS references the SCAQMD definition of “sealant” in Rule 1168— “any material with adhesive properties that is designed to fill, seal, waterproof, or weatherproof gaps or joints between two surfaces. Sealants include caulks.”

**6.5 Hard Surface Flooring**

- 6.5.1** Interior hard surface flooring materials and underlayments shall not exceed maximum VOC emission levels in accordance with and determined by [CDPH Standard Method V1.2-2017.](#)

**Exception:**

**E6.5.1** Materials that are inherently non-emitting sources of VOCs, which include stone, ceramic, metals, glass, concrete, and clay brick.

## 6.6 Gypsum Board

**6.6.1** Interior gypsum board and joint compound shall not exceed maximum VOC emission levels in accordance with and determined by [CDPH Standard Method V1.2-2017](#).

## 6.7 Insulation

**6.7.1** Insulation materials installed in wall, floor, or ceiling cavities, as well as on the interior surface of foundation walls shall have maximum VOC emission levels in accordance with, and determined using [CDPH Standard Method V1.2-2017](#).

### Exceptions:

**E6.7.1a** Pipe insulation.

**E6.7.1b** Board insulation installed outside the exterior sheathing.

## 6.8 Asbestos

**6.8.1** Verifier has visibly inspected all accessible areas of the building, including ductwork in basements, crawlspaces, and attics, and identified possible asbestos containing materials (ACM). Where ACM are not found or are documented to have been previously mitigated or encapsulated by a licensed professional, no further action is necessary. Where ACM is suspected to be present, Verifiers shall not conduct any air infiltration or duct testing until Item 6.8.1.1 and 6.8.1.2 have been satisfied.

**6.8.1.1** Where ACM are suspected to be present and not properly encapsulated, a qualified Asbestos Inspector shall verify upon completion of retrofit activities that ACM has been properly removed and disposed of or has been properly encapsulated.

**6.8.1.2** The verification report shall also include proof of accreditation to perform asbestos inspections and/or mitigation work. Documentation shall be collected and maintained by the Verifier.

### Advisories:

**A6.8a** EPA recommends, but does not require, the Asbestos Inspector to be a separate entity from the Verifier and contractor performing asbestos work.

**A6.8b** Persons who inspect, repair, or remove asbestos-containing materials should be trained and accredited by a state program at least as stringent as the [EPA Asbestos Model Accreditation Plan \(MAP\)](#). Ensure workers hired to handle asbestos are trained and accredited. [State agencies](#) have the most up-to-date listings of accredited professionals in your area.

**A6.8c** For more information, visit [www.epa.gov/asbestos](http://www.epa.gov/asbestos).

## 6.9 Lead-Based Paint

**6.9.1** For homes and multifamily buildings undergoing gut rehabilitation that were built before 1978 and have not previously been found to be free of lead-based paint by a certified inspector, a lead-based paint inspection or risk assessment shall be conducted by a certified inspector or certified risk assessor. Documentation shall be collected and maintained by the Verifier.

**6.9.2** When a lead-based paint inspection results in the identification of lead-based paint, conduct a risk assessment with a certified risk assessor.

**6.9.2.1** Any lead-based paint hazards identified in a risk assessment must be mitigated according to the recommendations in the report, and in compliance with [EPA lead-based paint regulations](#) and any state or local lead-based paint regulations.

**6.9.2.2** Any abatements conducted as a result of the risk assessment must be conducted under the [EPA Lead Abatement Program](#), or an [authorized program](#) if one exists for the particular state or tribe.

**6.9.3** When disturbing more than 6 ft<sup>2</sup> of interior surfaces or 20 sq.ft. of exterior painted surfaces containing lead-based paint (as indicated in the inspection or risk assessment required above), the [EPA Lead Renovation, Repair, and Painting \(RRP\) Program](#) or an authorized program (if one exists for the particular state or tribe) must be followed.

### Advisory:

**A6.9.3** In addition to practices required by the EPA or an authorized program, conduct the following as indicated by the Department of Housing and Urban Development's (HUD) Lead Safe Housing Rule:

- i. Lower the threshold for an interior painted surface area from 6 sq.ft. to 2 sq.ft.
- ii. After the job is complete, conduct a clearance examination using [EPA's dust-lead clearance levels](#).

## 7. Occupant Education

### 7.1 Owner and Occupant Information Kit

- 7.1.1** For newly installed appliances and systems, instruction manuals are provided to the occupant, building owner, or property manager for the following: HAC systems and accessories, ventilation systems (both local and whole-dwelling), air cleaners, dehumidifiers, moisture and/or IAQ monitors, combustion appliances, sump pumps, and radon systems (if installed).
- 7.1.2** For owner-occupied units, provide the occupant with operations and maintenance recommendations, including suggested schedules and sources for the replacement of filters in all ventilation and air handling equipment.

**Advisory:**

- A7.1** Provide the homebuyer or building manager with information that addresses the importance of ensuring that manually controlled ventilation options (e.g., bathroom, kitchen, or garage exhaust fans; operable windows, doors, etc.) are used when strong pollutant sources are present, such as when using common household products (e.g., cleaning products, pesticides) and when using the garage for hobbies or other pollutant generating activities.

## Abbreviations & Acronyms

|                       |  |                 |   |
|-----------------------|--|-----------------|---|
| AARST                 | American Association of Radon Scientists and Technologists                                     | EPA             | Environmental Protection Agency   |
| ANSI/AARST CC-1000    | Soil Gas Control Systems in New Construction of Buildings                                      | FEMA            | Federal Emergency Management Agency   |
| ANSI/ AARST CCAH      | Reducing Radon in New Construction of One & Two Family Dwellings & Townhouses                  | ft.             | Feet  |
| ANSI/AARST MAH        | Protocol for Conducting Measurement of Radon and Radon Decay Products in Homes                 | HAC             | Heating and cooling   |
| ANSI/AARST MAMF       | Protocol for Conducting Measurement of Radon and Radon Decay Products in Multifamily Buildings | HCO             | Home Certification Organization   |
| AC115                 | Acceptance Criteria for Waterproof Membranes for Flooring and Shower Lining                    | HUD             | Department of Housing and Urban Development                                   |
| ACCA                  | Air Conditioning Contractors of America  | HVAC            | Heating, ventilating, and air conditioning                                    |
| ACCA Manual D         | Residential Duct Design  | IAQ             | Indoor Air Quality  |
| ACGIH                 | American Conference of Governmental Industrial Hygienists                                      | ICC             | International Code Council  |
| ACM                   | Asbestos containing materials  | IECC            | International Energy Conservation Code  |
| AHAM                  | Association of Home Appliance Manufacturers  | IMC             | International Mechanical Code   |
| ANSI                  | American National Standards Institute  | In.             | inches  |
| ANSI/ASHRAE 62.1-2019 | Ventilation for Acceptable Indoor Air Quality  | IRC             | International Residential Code  |
| ANSI/ASHRAE 62.2-2019 | Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings                | ISO             | International Organization for Standardization                                |
| APA                   | The Engineered Wood Association  | MERV            | Minimum Efficiency Reporting Value defined in ASHRAE 52.2-2017                |
| ASHRAE                | American Society of Heating, Refrigerating, and Air Conditioning Engineers                     | MF              | Multifamily   |
| ASTM                  | American Society for Testing and Materials   | mil             | Common term to describe plastic sheeting thickness; 1 mil equals 0.001 inches |
| CADR                  | Clean Air Delivery Rate  | min.            | Minimum   |
| CARB                  | California Air Resources Board   | NFPA            | National Fire Protection Association  |
| CSIA                  | Chimney Safety Institute of America  | NO <sub>2</sub> | Nitrogen Dioxide  |
| ccSPF                 | Closed Cell Spray Polyurethane Foam  | NFRC            | National Fenestration Rating Council  |
| CDPH                  | California Department of Public Health   | Pa              | Pascal  |
| CFDS                  | Composite Foundation Drainage System   | pCi/L           | Picocuries per liter  |
| cfm                   | Cubic feet per minute  | RH              | Relative humidity   |
| CI                    | Condensation Index   | SCAQMD          | South Coast Air Quality Management District                                   |
| CO                    | Carbon monoxide  | spec.           | Specification   |
| CZ                    | Climate Zone   | sq. ft.         | Square foot   |
| DLTO                  | Duct Leakage to Outdoors   | UL              | Underwriter Laboratories  |
|                       |  | UV              | Ultraviolet light   |
|                       |  | UVC             | UV: 200 nm to 280 nm  |
|                       |  | UVGI            | Ultraviolet germicidal irradiation  |
|                       |  | VOC             | Volatile Organic Compound   |
|                       |  | w.c.            | Water column  |
|                       |  | WRB             | Water resistive barrier   |

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ACCA Manual P: Psychrometrics.

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ANSI/AARST MAMF 2017: Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily Buildings.

ANSI/AARST RMS-MF 2018: Radon Mitigation for Multifamily Buildings

ANSI/AARST SGM-SF 2017: Soil Gas Mitigation Standards for Exiting Homes

ANSI/ACCA 5 QI – 2015: ANSI/ACCA HVAC Quality Installation Specifications

ANSI/ACCA 12 QH – 2018: Home Evaluation and Performance Improvement

ANSI/ACA Standard 6: Restoring the Cleanliness of HVAC Systems

ANSI/AHAM Standard AC-1-2020: Portable Electric Room Air Cleaners – Method for Measuring Performance of Portable Household Electric Room Air Cleaners

ANSI/ASHRAE/ACCA Standard 4-2013: Maintenance of Residential HVAC Systems

ANSI/ASHRAE 55-2020: Thermal Environmental Conditions for Human Occupancy

ANSI/ASHRAE Standard 193-2010 (RA2014): Method of Test for Determining the Airtightness of HVAC Equipment

ANSI/ASHRAE Standard 185.1-2020: Method of Testing UV-C Lights for Use in Air-Handling Units or Air Ducts to Inactivate Airborne Microorganisms

ANSI/ASHRAE Standard 185.2-2020: Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts to Inactivate Microorganisms on Irradiated Surfaces

ANSI/BPI 1200-S 2017: Standard Practice for Basic Analysis of Buildings

ANSI/RESNET/ICC Standard 380-2019: Standard for Testing Airtightness of Building, Dwelling Unit, and Sleeping Unit Enclosures; Airtightness of Heating and Cooling Air Distribution Systems; and Airflow of Mechanical Ventilation Systems.

ANSI/RESNET/ICC 301-2022: Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units

ANSI/ASHRAE/ACCA Standard 183, 2013 or 2017: Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.

ANSI/NFRC 500-2020: Procedure for Determining Fenestration Product Condensation Index Ratings

APA: American Plywood Association provides a voluntary product standard for structural plywood and oriented strand board (OSB). <http://www.apawood.org/plywood>.

ASHRAE Handbooks: ASHRAE Handbook Series. American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

ASHRAE 52.2: ANSI/ASHRAE Standard 52.2-2017: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. 2017. American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

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CSA Standard C22.2: Electrostatic air cleaners. 2020. Canadian Standards Association.

ENERGY STAR Residential New Construction Programs: U.S. Environmental Protection Agency.  
[http://www.energystar.gov/index.cfm?c=bldrs\\_lenders\\_raters.nh\\_v3\\_guidelines](http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_guidelines).

ENERGY STAR Kitchen Exhaust Guidance: Item 8.1 of the National Rater Field Checklist requires that a local mechanical exhaust system be installed in each kitchen and exhaust directly to the outdoors.

EPA How to Find Indoor airPLUS Compliant Low Emission Products provides guidance on identifying compliant products.  
<http://www.epa.gov/indoorairplus/indoor-airplus-compliant-low-emission-products>.

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EPA's Secondhand Tobacco Smoke and the Health of Your Family. Informational handout on the dangers of secondhand smoke from the EPA.

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HVI 920: Product Performance Certification Procedure Including Verification and Challenge updated February 28, 2020.

HVI 916: Air Flow Test Procedure updated September 29, 2015

ICF: International Builders Code 2018

ICC-ES per AC 115 (from N1.14.1)

IECC: International Energy Conservation Code. 2021. International Code Council, Inc.

IRC: International Residential Code for One- and Two-Family Dwellings. 2021. International Code Council, Inc.

ISO ePM1: Based on ISO 16890 refers to the particle size fraction in the range from 0.3  $\mu\text{m}$  to 1  $\mu\text{m}$

ISO ePM2.5: Based on ISO 16890 refers to the particle size fraction in the range from 0.3  $\mu\text{m}$  to 2.5  $\mu\text{m}$

ISO 16890-1: 2016: Establishes an efficiency classification system of air filters for general ventilation based upon particulate matter (PM).

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ISO 17011: 2004: Specifies general requirements for accreditation bodies assessing and accrediting conformity assessment bodies (CABs).

ISO 16000-23:2018: Specifies a general laboratory test method for evaluating the reduction of formaldehyde and other carbonyl compounds.

NFPA 72: Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment. 2012. National Fire Protection Association.

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# Climate Zones of the Continental United States

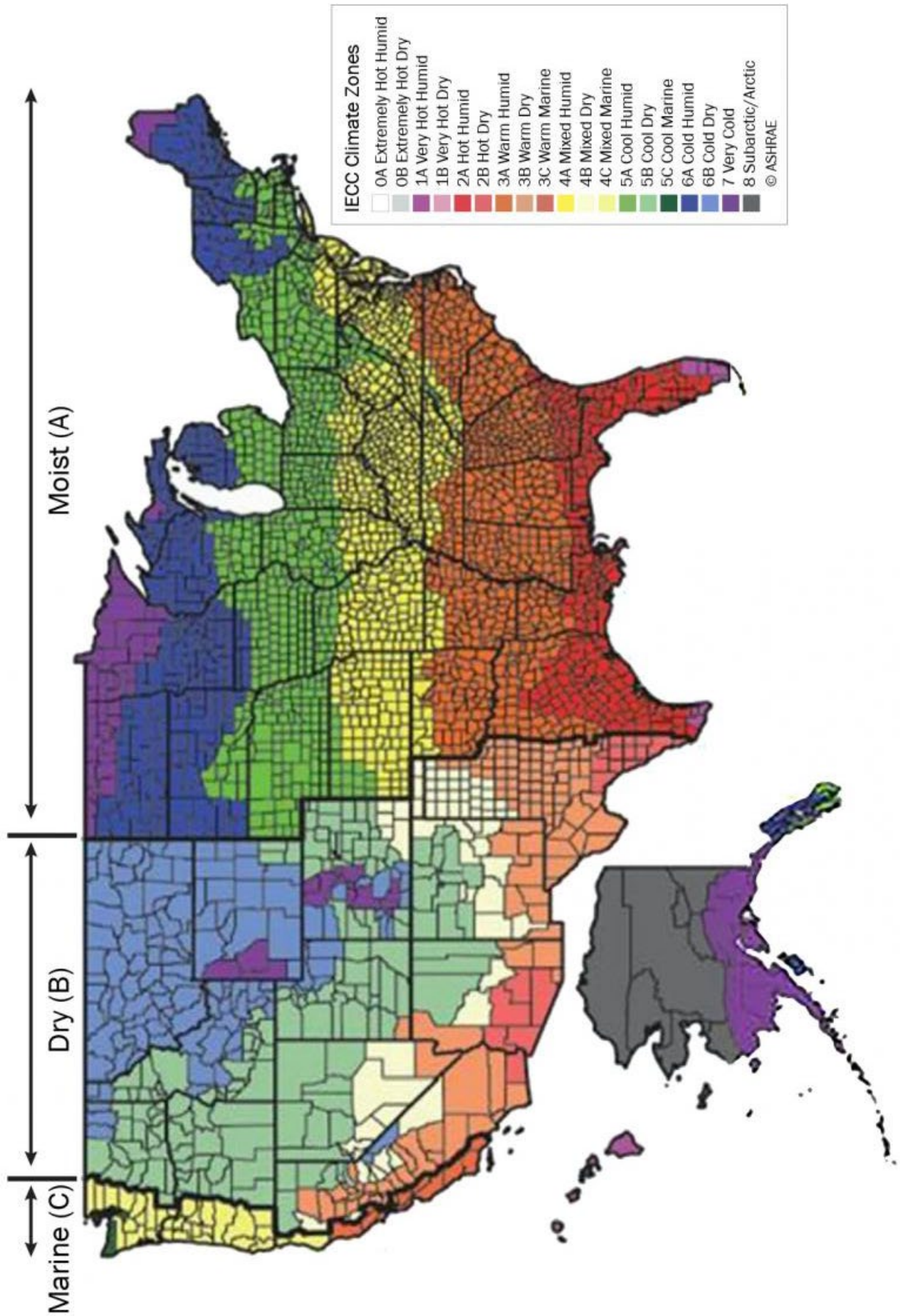


Figure R301.1 Climate Zones of the Continental United States. International Energy Conservation Code



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