National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

HVAC Designer Responsibilities:

- Complete one National HVAC Design Report for each building / project, which includes system design for all unique unit plans and common spaces. [1]
- Obtain efficiency features (e.g., window performance, insulation levels, and infiltration rate) from the builder, architect, or Rater.
- Provide the completed National HVAC Design Report to the Rater and the person / company completing the National HVAC Functional Testing Checklist.

1. Design Overview

1.1 Designer name: _____ Designer company: _____ Date: _____

1.2 Select which party you are providing these design services to: ☐ Builder / Developer ☐ FT Agent ☐ MEP / Credentialed HVAC contractor

1.3 Name of company you are providing these design services to (if different than Item 1.1): _____

1.4 Project address: _____ City: _____ State: _____ Zip code: _____

2a. Dwelling Unit & Common Space Mechanical Ventilation Design [2, 3]						**Designer Verified**
Airflow:						
2.1 Dwelling unit ventilation airflow design rate & run-time meet the requirements of Section 4 of ASHRAE 62.2 [4]-☐ 2010 ☐ 2013						☐
2.2 Common space outdoor airflow design rate meet the requirements of Section 6 of ASHRAE 62.1 [5]-☐ 2010 ☐ 2013, without exceeding 2013 rates by more than 50%						☐
2.3 Access points to measure airflow rate are provided and accessible by the Rater						☐
List unique unit plan for which 62.2 ventilation rates were calculated in the spaces to the right: [6]						
2.4 # of bedrooms:						
2.5 Square footage:						
2.6 Ventilation airflow rate required by ASHRAE 62.2:						
2.7 Ventilation airflow rate designed:						
2.7.1 If applicable, run-time per cycle (minutes):						
2.7.2 If applicable, cycle time (minutes):						
List common space for which 62.1 ventilation rates were calculated in the spaces to the right: [6]						
2.8 Ventilation airflow rate required by ASHRAE 62.1:						
2.9 Ventilation airflow rate designed:						
System Type & Controls:						
List Ventilation System ID in the spaces to the right: [6]						
2.10 Specified system type: (e.g., supply, exhaust, balanced, ERV, HRV)						
2.11 Specified system type: (e.g., in-unit, central)						
2.12 Manufacturer:						
2.13 Model Number:						
2.14 Area / space(s) that system serves: (e.g., Unit A kitchens, corridor, community room)						
2.15 Specified control location: (e.g., Master bath, utility):						
2.16 Specified controls allow the systems to operate automatically, without occupant intervention. In a multi-family dwelling unit, the override control is not required to be readily accessible to the occupant. However, in such cases, EPA recommends but does not require that the control be readily accessible to others (e.g., building maintenance staff) in lieu of the occupant						☐
2.17 No outdoor air intakes designed to connect to the return side of the dwelling unit HVAC system, unless specified controls operate intermittently and automatically based on a timer and restrict intake when not in use (e.g., motorized damper) [7]						☐
Sound:						
2.18 If located in the dwelling unit, the fan of the specified system is rated ≤ 3 sones if intermittent and ≤ 2 sones if continuous, or exempted [8]						☐
Efficiency:						
2.19 If system utilizes the dwelling unit HVAC fan, then the specified fan type in Item 4.12 is ECM / ICM, or the specified controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling						☐
2.20 If in-unit bathroom fans or in-line fans are specified as part of the dwelling unit mechanical ventilation system, then they are ENERGY STAR certified [9]						☐
2.21 If central exhaust fans, ≤ 1 HP, are specified as part of the dwelling unit mechanical ventilation system, then they are direct-drive, ECM, with variable speed controllers. If > 1 HP, they are specified with NEMA Premium™ Motors						☐

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Air Inlet Locations: (Complete this section if system has specified air inlet location(s); otherwise check "N/A") [10]	☐ N/A
2.22 Inlet(s) pull ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit	☐
2.23 Inlet(s) are ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. from dryer exhausts and sources exiting the roof	☐
2b. Dwelling Unit Local Mechanical Exhaust Design – System(s) are designed that mechanically exhaust air from each dwelling unit kitchen and bathroom directly to the outdoors or to ventilation risers and meet the continuous and/or intermittent rates [11]	☐

Location		**Continuous Rate**	**Intermittent Rate**[13]	**Exhaust Fan Type**
Kitchen	Airflow	≥ 5 ACH, based on kitchen volume[13, 14, 15]	≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume [13, 14, 15, 16]	☐ Continuous ☐ Intermittent ☐ In-unit fan ☐ Central / shared fan
	Sound	Recommended if in-unit: ≤ 1 sone	Recommended if in-unit: ≤ 3 sones	
Bathroom	Airflow	≥ 20 CFM	≥ 50 CFM	☐ Continuous ☐ Intermittent ☐ In-unit fan ☐ Central / shared fan
	Sound	Required if in-unit: ≤ 2 sones	Recommended if in-unit: ≤ 3 sones	

2c. Common Space Minimum Exhaust Rates – System(s) are designed that mechanically exhaust air from each common space, as required by ASHRAE 62.1-2010 or 2013	☐

Location	**ASHRAE 62.1 Rate**	**Design Rate**	**Location**	**ASHRAE 62.1 Rate**	**Design Rate**
Janitor Room	1 cfm/ft^2		Common space kitchen [17]	50 cfm / 100 cfm	
Trash / Recycling Room	1 cfm/ft^2		Common space bathroom [18]	50 cfm per toilet / urinal	
Parking Garage	0.05 cfm/ft^2, standby 0.75 cfm/ft^2, full-on		☐ Garage exhaust fan controls include CO and NO2 sensors		

3. Heating & Cooling Loads

Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces) [19] ☐ N/A

3.1 Loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013 / 2017 ASHRAE Fundamentals ☐ Other per AHJ [20]
Townhouses only: Loads must be calculated room-by-room.

3.2 Check one box only to indicate whether the Dwelling Unit Loads is unit-specific or represents the design of more than one unit: [21]
☐ Unit-specific design ☐ Group design [22] ____ total groups for this project, representing ____ units
☐ Worst-case design (If the top floor unit with the greatest CFA and window area results in total heat gain <18 kBtuh, it may represent all other units if cooling system selected for all is single-speed & <20 kBtuh or two-speed / variable-speed & <25 kBtuh

3.3 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling ☐

3.4 Outdoor design temperatures used in loads: (See Footnote 23 and energystar.gov/hvacdesigntemps) [23]
County & State selected: _____ Cooling season: _____°F Heating season: _____°F

List the unit plan for which Loads were calculated: [6]								
3.5 Location of Unit: top, mid, bottom, corner, interior								
3.6 Number of occupants used in loads: [21, 24]								
3.7 Total occupant gains (Btuh): [21]								
3.8 Conditioned floor area used in loads: [21]								
3.9 Window area used in loads: [21]								
3.10 Predominant window SHGC used in loads: [21, 25]								
3.11 Infiltration (ACH / ACH50 / CFM) used in loads: [26]								
3.12 Mechanical ventilation (CFM) used in loads: [21]								
3.13 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): [21]								
3.14 Sensible Heat Gain At Design Conditions (kBtuh): [21]								
3.15 Latent Heat Gain At Design Conditions (kBtuh):								
3.16 Total Heat Gain at Design Conditions (kBtuh): [21]								
3.17 Total Heat Loss at Design Conditions (kBtuh):								

3.18 Common Space Heating & Cooling Loads [6]

Common Space Name: _____ Design Conditions: Total Heat Gain: _____(kBtuh) Total Heat Loss: _____(kBtuh)
Common Space Name: _____ Design Conditions: Total Heat Gain: _____(kBtuh) Total Heat Loss: _____(kBtuh)
Common Space Name: _____ Design Conditions: Total Heat Gain: _____(kBtuh) Total Heat Loss: _____(kBtuh)

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

3.19 Building Heating & Cooling Loads [6] (only required when shared systems such as central boilers or chillers are specified) ☐ N/A							
System Name: _____Design Conditions: Total Heat Gain: _____(kBtuh) Total Heat Loss: _____(kBtuh)							
System Name: _____Design Conditions: Total Heat Gain: _____(kBtuh) Total Heat Loss: _____(kBtuh)							
4. Heating & Cooling Equipment Selection							
4.1 Equipment selected per ACCA Manual S (see Footnote 27) [27]							☐
4.2 Prescriptive Path: Equipment serving dwelling units and common spaces meet the efficiency levels specified in the Exhibit X of the National Rater Field Checklist. Electric resistance heating is not specified in dwelling units						☐	☐ N/A
4.3 ERI Path: Equipment serving common spaces but not serving dwelling units meet the efficiency levels specified in the Exhibit X of the National Rater Field Checklist. Also see Exhibit X for restrictions on electric resistance						☐	☐ N/A
Cooling Equipment [6] (Complete all applicable items; otherwise check "N/A") ☐ N/A							
List Cooling Equipment ID in the spaces to the right:							
4.4 Equipment type: (e.g., PTAC / AC, Chiller / CT, PTHP / WLHP / GSHP / ASHP / VRF)							
4.5 Area / Space(s) that system serves:							
4.6 Chiller / condenser / outdoor unit manufacturer:							
4.7 Chiller / condenser / outdoor unit model #:							
4.8 Evaporator / indoor unit manufacturer:							
4.9 Evaporator / indoor unit model #:							
4.10 AHRI reference #: [28]							
4.11 AHRI listed efficiency:							
4.12 Evaporator fan type: PSC, ECM / ICM Other:							
4.13 Compressor speed: Single, Two, Variable							
4.14 Turn down ratio (for variable speed equipment):							
4.15 Latent capacity at design conditions (kBtuh): [29]							
4.16 Sensible capacity at design conditions (kBtuh): [29]							
4.17 Total capacity at design conditions (kBtuh): [29]							
4.18 Cooling sizing % = Total capacity (Item 4.17) divided by Total Heat Gain of space(s) in Item 4.5:							
4.19 Meets cooling sizing limit: (see below for A, B, C, D or N/A) [19]							
4.20 If "B", list Load sensible heat ratio = Max. sensible heat gain (Item 3.14) / Max. total heat gain (Item 3.16): [30]							
4.21 If "B", calculate HDD / CDD ratio: [30]							

Equipment Type & Climate Condition	**Compressor Type (Per Item 4.13)**		
	Single-Speed	Two-Speed	Variable-Speed
A: For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate [30]	Recommended: 90 – 115% Allowed: 90 – 130%	Recommended: 90 – 120% Allowed: 90 – 140%	Recommended: 90 – 130% Allowed: 90 – 160%
B: For Cooling Mode of Heat Pump in Condition B Climate [30]	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh
C: For low-load spaces (≤15 kBtuh) [31]	≤ 20 kBtuh		
D: For low-load spaces (≤18 kBtuh) [31]		≤ 25 kBtuh	≤ 25 kBtuh

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Heating Equipment [6] (Complete all applicable items; otherwise check "N/A")							☐ N/A
List Heating Equipment ID in the spaces to the right:							
4.22 Electric equipment type: PTHP, WLHP, GSHP, ASHP, VRF, Boiler, Furnace, Electric Resistance							
4.23 Gas Equipment type: HW PTAC / fan coil, Gas-Fired PTAC, Boiler, Furnace							
4.24 Area / Space(s) that system serves:							
4.25 Manufacturer & model:							
4.26 Listed efficiency:							
4.27 Equipment output capacity:							
4.28 Air-source heat pump output capacity (17°F):							
4.29 Type of Venting: Natural Draft, Mechanically Drafted, Direct Vent [32]							
4.30 Furnace heating sizing % = Total capacity (Item 4.27) divided by Total Heat Loss of space(s) in Item 4.24:							
4.31 Meets furnace sizing limit: (see below for A, B, C, or N/A)							

A: For low-load spaces (≤ 10 kBtuh), furnace output capacity is ≤ 40 kBtuh	
B: When Used for Heating Only	C: When Paired With Cooling
100 – 400%	Recommended: 100 – 140% Allowed: 100 – 400%

Equipment Controls	
4.32 All equipment controls below have been included where applicable in the HVAC Design	☐
4.33 All heating and cooling systems serving a dwelling unit shall have thermostatic controls within the dwelling unit which are not located on exterior walls	
4.33.1 Prescriptive Path: Dwelling unit thermostats are programmable	☐
4.34 Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems	
4.35 Freeze protection systems, such as heat tracing of piping and heat exchangers, including self-regulating heat tracing, and garage / plenum heaters shall include automatic controls capable of shutting off the systems when pipe wall or garage / plenum temperatures are above 40°F. Where heat tracing is specified for freeze protection, controls must be based on pipe wall temperature and a minimum of R-3 pipe insulation is also required	
4.36 Snow- and ice-melting systems shall include automatic controls capable of shutting off the systems when the pavement temperature is above 50°F and no precipitation is falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F so that the potential for snow or ice accumulation is negligible	

Hydronic Distribution	☐ N/A
4.37 All hydronic distribution requirements below have been included where applicable in the HVAC Design	☐
4.38 All terminal heating and cooling distribution equipment must be separated from the riser or distribution loop by a control valve or terminal distribution pump, so that heated or cooled fluid is not delivered to the dwelling unit distribution equipment when there is no call from the thermostat	
4.39 Terminal units must be equipped with pressure independent balancing valves or pressure independent control valves	
4.40 Piping of a heating or cooling system (e.g., steam, hot or chilled water, brine, refrigerant) shall be thermally insulated in accordance with ASHRAE 90.1-2007, Table 6.8.3. Construction documents must account for piping total thickness including required insulation when passing through planks or any other penetrations and shall specify that the piping must be inspected before access is covered up: Heating System: Pipe size:____ inches Insulation thickness:___ inches Pipe size:____ inches Insulation thickness:___ inches Cooling System: Pipe size:____ inches Insulation thickness:___ inches Pipe size:____ inches Insulation thickness:___ inches	
4.41 For circulating pumps serving hydronic heating or cooling systems with three-phase motors, 1 horse-power or larger, motors shall meet or exceed efficiency standards for NEMA Premium™ motors. If 5 horse-power or larger, must also be specified with variable frequency drives	

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

5. Dwelling Unit Duct Design (Complete if heating or cooling equipment will be installed with ducts; otherwise check "N/A") ☐ N/A

5.1 Duct system designed for the equipment selected in Section 4, per ☐ ACCA Manual D ☐ Other: _____ ☐

5.2 Room-by-room design airflows documented below (which should sum to the mode with the higher Design HVAC fan airflow) [6, 33, 34]

Name of the unit plan:	Name of the unit plan:
Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM	Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM
Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____	Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____
Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC	Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC

	Room Name	Design Airflow (CFM)		Room Name	Design Airflow (CFM)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
	Total for all rooms			Total for all rooms	

6. Duct Quality Installation - *Applies to Heating, Cooling, Ventilation, Exhaust, & Pressure Balancing Ducts, Unless Noted in Footnote*

6.1 All duct quality installation requirements below have been included where applicable in the HVAC Design ☐

6.2 Ductwork specified without kinks, sharp bends, compressions, or excessive coiled flexible ductwork [38]

6.3 All supply and return ducts not in conditioned space, including connections to trunk ducts, are insulated to ≥ R-6 [39]

6.3.1 Prescriptive Path: Dwelling unit ductwork meets the location and insulation requirements specified in the ENERGY STAR MF Reference Design

Dwelling Unit

6.4 At least one MERV 6 or higher filter specified for each ducted mechanical system serving an individual dwelling unit and is in a location that facilitates access and regular service by the occupant or building owner. Filter access panel specified with a gasket or comparable sealing mechanism. All return air and mechanically supplied outdoor air designed to pass through filter prior to conditioning

6.5 Ductwork air-sealing specified such that Rater-measured total duct leakage is ≤ 4 CFM25 per 100 ft^2 of CFA at rough-in or ≤ 8 CFM25 per 100 ft^2 at final, or if there are no ducted returns, ≤ 3 CFM25 per 100 ft^2 of CFA at rough-in or ≤ 6 CFM25 per 100 ft^2 at final. [40] Additionally, for Townhouses only, Rater-measured duct leakage to outdoors is ≤ 4 CFM25 per 100 ft^2 of CFA or ≤ 40 CFM25 [41]

6.6 Bedrooms with a design supply airflow ≥ 150 CFM (as reported in Item 5.2) are specified with any combination of transfer grilles, jump ducts, dedicated return ducts, and/or undercut doors to achieve a Rater-measured pressure differential ≥ - 5 Pa and ≤ 5 Pa with respect to the main body of the dwelling unit when all air handlers are operating

Common Space

6.7 Duct design specifies that all supply, return, and exhaust ductwork and all plenums shall be sealed at all transverse joints, longitudinal seams, and duct wall penetrations

6.8 Central exhaust systems (that serve four or more dwelling units): Ductwork air-sealing specified such that measured duct leakage does not exceed 25% of exhaust fan flow at rough-in (e.g., including trunks, branches, and take-offs) or 30% of exhaust fan flow at final (e.g., inclusive of all ductwork between the fan and the grilles) [42]

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Footnotes:

1. This report shall represent system design for all unique unit plans and common spaces. The term 'common space' refers to any spaces on the property that serve a function in support of the residential part of the building that is not part of a dwelling or sleeping unit. This includes spaces used by residents, such as corridors, stairs, lobbies, laundry rooms, exercise rooms, residential recreation rooms, or parking garages used exclusively by residents, building staff, and their guests. This also includes offices used by building management, administration or maintenance and all special use areas located on the property to serve and support the residents such as day-care facilities, gyms, dining halls, etc. This report is designed to meet ASHRAE 62.1-2010 / 2013, ASHRAE 62.2-2010 / 2013, and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new multifamily buildings when compared to multifamily buildings built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems (e.g., those caused by a lack of maintenance or occupant behavior). Therefore, system designs documented through the use of this report are not a guarantee of proper ventilation, indoor air quality, or HVAC performance.
2. The dwelling-unit mechanical ventilation system shall have at least one supply or exhaust fan with associated ducts and controls. Local exhaust fans are allowed to be part of a dwelling-unit mechanical ventilation system. Designers may provide supplemental documentation as needed to document the system design.
3. In "Warm-Humid" climates as defined by 2009 IECC Figure 301.1 (i.e., CZ 1 and portions of CZ 2 and 3A below the white line), it is recommended, but not required, that equipment be specified with sufficient latent capacity to maintain indoor relative humidity at ≤ 60%.
4. Airflow design rates and run-times shall be determined using ASHRAE 62.2-2010 or later. Designers are permitted, but not required, to use published addenda and/or the 2013 version of the standard to assess compliance.
5. Airflow design rates shall be determined using ASHRAE 62.1-2010 or later. Designers are permitted, but not required, to use published addenda and/or the 2013 version of the standard to assess compliance.
6. If the tables provided cannot accommodate all the unit plans, spaces, or systems in the project, use the tables in Appendix A to supplement the Design Report.
7. In addition, consult manufacturer requirements to ensure return air temperature requirements are met.
8. Dwelling-unit mechanical ventilation fans shall be rated for sound at no less than the airflow rate in Item 2.7. Fans exempted from this requirement include HVAC air handler fans, remote-mounted fans, and intermittent fans rated ≥ 400 CFM. To be considered for this exemption, a remote-mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways and there shall be ≥ 4 ft. ductwork between the fan and intake grill. Per ASHRAE 62.2-2010, habitable spaces are intended for continual human occupancy; such space generally includes areas used for living, sleeping, dining, and cooking but does not generally include bathrooms, toilets, hallways, storage areas, closets, or utility rooms.
9. Bathroom fans with a rated flow rate ≥ 500 CFM are exempted from the requirement to be ENERGY STAR certified.
10. EPA requires rodent / insect screens with < 0.5 inch mesh to be installed at ventilation air inlets. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the building maintenance staff.
11. Continuous bathroom local mechanical exhaust fans shall be rated for sound at no less than the design airflow rate. Intermittent bathroom and both intermittent and continuous kitchen local mechanical exhaust fans are recommended, but not required, to be rated for sound at no less than the design airflow rate. Per ASHRAE 62.2-2010, an exhaust system is one or more fans that remove air from the building, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope (e.g., bath exhaust fans, range hoods, clothes dryers). Per ASHRAE 62.2-2010, a bathroom is any room containing a bathtub, shower, spa, or similar source of moisture.
12. An intermittent mechanical exhaust system, where provided, shall be designed to operate as needed by the occupant. Control devices shall not impede occupant control in intermittent systems.
13. Kitchen volume shall be determined by drawing the smallest possible rectangle on the floor plan that encompasses all cabinets, pantries, islands, peninsulas, ranges / ovens, and the kitchen exhaust fan, and multiplying by the average ceiling height for this area. In addition, the continuous kitchen exhaust rate shall be ≥ 25 CFM, per 2009 IRC Table M1507.3, regardless of the rate calculated using the kitchen volume. Cabinet volume shall be included in the kitchen volume.
14. While not required, the prescriptive duct sizing requirements in Table 5.3 of ASHRAE 62.2-2010 are recommended to be used for kitchen exhaust fans based upon the rated airflow of the fan at 0.25 IWC.
15. As an alternative, dwelling units are permitted to use a continuous kitchen exhaust rate of 25 CFM per 2009 IRC Table M1507.3, if they are either a) PHIUS+ or PHI certified, or b) provide both dwelling unit ventilation and local mechanical kitchen exhaust using a balanced system, and have a Rater-verified whole-building infiltration rate ≤ 0.05 CFM50 per ft^2 of Enclosure Area, and a Rater-verified dwelling unit compartmentalization rate ≤ 0.30 CFM50 per ft^2 of Enclosure Area if multiple dwelling units are present in the building. 'Enclosure Area' is defined as the area of the surfaces that bound the volume being pressurized / depressurized during the test.
16. All intermittent kitchen exhaust fans must be capable of exhausting at least 100 CFM. In addition, if the fan is not part of a vented range hood or appliance-range hood combination (i.e., if the fan is not integrated with the range), then it must also be capable of exhausting ≥ 5 ACH, based on the kitchen volume.
17. For continuous system operation, the lower rate may be used. Otherwise, use the higher rate. Commercial kitchens shall be designed to provide a minimum continuous rate of 0.70 cfm/ft^2.
18. As an alternative, for a toilet room intended to be occupied by one person at a time, a minimum continuous rate of 25 cfm is permitted.
19. This section / item applies to split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal) heat pumps up to 65 kBtuh with forced-air distribution systems and to furnaces up to 225 kBtuh with forced-air distribution system serving individual dwelling units. Forced-air distribution systems are those that supply air through ductwork exceeding 0 ft. in length. This section / item therefore does not apply to non-ducted systems, such as non-ducted mini-splits, multi-splits, PTHP's, or PTAC's.

20. Select “2013 / 2017 ASHRAE Fundamentals” if using Chapter 17 of the 2013 or 2017 ASHRAE Handbook of Fundamentals. Select “Other per AHJ” if the Authority Having Jurisdiction where the unit will be certified mandates the use of a load calculation methodology other than Unabridged ACCA Manual J v8 or 2013 ASHRAE Fundamentals.
21. Check the box for “unit-specific design” if the design was created for the specific plan configuration (i.e., elevation, option, orientation, and county) of the unit to be certified. Check the box for “group design” if designs were created for unit plans that are repeated throughout the project / building with potentially different configurations (i.e., different elevations and/or orientations). Check the box for “worst-case design” if loads for the unit with the largest heat gain in the project / building are less than 18 kBtuh and are being used to represent all other units. Only one box may be checked. Regardless of the box checked, the system design as documented on this HVAC Design Report must fall within the following tolerances for the unit to be certified:
    - Item 3.4: The outdoor design temperature used in loads are within the limits defined at energystar.gov/hvacdesigntemps.
    - Item 3.6: The number of occupants used in loads is within ± 2 of the dwelling unit to be certified.
    - Item 3.7: Total occupant gains used in loads shall not exceed 645 Btuh per occupant.
    - Item 3.8: The conditioned floor area used in loads is between 100 ft^2 smaller and 300 ft^2 larger than the dwelling unit to be certified.
    - Item 3.9: The window area used in loads is between 15 ft^2 smaller and 60 ft^2 larger than the dwelling unit to be certified, or for dwelling units with > 500 ft^2 of window area, between 3% smaller and 12% larger.
    - Item 3.10: The predominant window SHGC is within 0.1 of the predominant value in the dwelling unit to be certified.
    - Item 3.12: The mechanical ventilation rate used in loads is the same as the value in Section 2a for the given unit plan.
    - Item 3.13: The sum of the internal gains associated with lighting and appliances used in loads shall not exceed 3,600 Btuh.
    - Items 3.14 & 3.16: The sensible & total heat gain are documented for the orientation of the dwelling unit to be certified.
    - Item 4.18: The cooling sizing % is within the cooling sizing limit selected.

    Provide the National HVAC Design Report to the party you are providing these design services to (i.e., a builder / developer, Functional Testing Agent (FT Agent), and/or MEP / credentialed HVAC contractor) and to the Rater. The report is only required to be provided once per project / building. As long as a report has been provided that falls within these tolerances for the units to be certified, no additional work is required. However, if no report falls within these tolerances or if any aspect of the system design changes, then an additional report will need to be generated prior to certification.

    Visit energystar.gov/hvacdesign for a tool to assist with group designs and for more information.
22. For each unique unit floorplan, determine the orientation with the largest and smallest Total Heat Gain. Orientation represents the direction that the front door of the dwelling unit is facing. The designer is only required to document the loads for the orientation(s) that the dwelling unit might be built in. For example, if a unit plan will only be built in a specific orientation (e.g., facing South), then the designer only needs to document the loads for this one orientation. Verify that the difference in Total Heat Gain between the orientation with the largest and smallest value is ≤ 6 kBtuh. If not, then treat that orientation as a unique unit plan.
23. Visit energystar.gov/hvacdesigntemps for the maximum cooling season design temperature and minimum heating season design temperature permitted for ENERGY STAR. For “County & State, or US Territory, selected”, select the County and State or US Territory (i.e., Guam, Northern Mariana Islands, Puerto Rico, or US Virgin Islands), where the unit is to be certified. The same design report is permitted to be used in other counties, as long as the design temperature limits in those other counties meet or exceed the cooling and heating season temperature limits for the county selected. For example, if Fauquier County, VA, is used for the load calculations, with a 1% cooling temperature limit of 93°F, then the same report could be used in Fairfax County (which has a higher limit of 94°F) but not in Arlington County (which has a lower limit of 92°F). If a jurisdiction-specified design temperature is used that exceeds the limit in the ENERGY STAR Certified Homes Design Temperature Limit Reference Guide, designers must submit a Design Temperature Exception Request. Visit energystar.gov/hvacdesigntemps for a copy of this form.
24. To determine the number of occupants among all HVAC systems in the dwelling unit, calculate the number of bedrooms, as defined below, and add one. This number of occupants must be within ± 2 of the dwelling unit to be certified.

    A bedroom is defined by ANSI / RESNET / ICC Standard 301-2014 as a room or space 70 ft^2 or greater size, with egress window and closet, used or intended to be used for sleeping. A “den”, “library”, or “home office” with a closet, egress window, and 70 ft^2 or greater size or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.

    An egress window, as defined in 2009 IRC section R310, shall refer to any operable window that provides for a means of escape and access for rescue in the event of an emergency. The egress window definition has been summarized for convenience. The egress window shall:
    - have a sill height of not more than 44 inches above the floor; AND
    - have a minimum net clear opening of 5.7 ft^2; AND
    - have a minimum net clear opening height of 24 in.; AND
    - have a minimum net clear opening width of 20 in.; AND
    - be operational from the inside of the room without the use of keys, tools or special knowledge.
25. “Predominant” is defined as the SHGC value used in the greatest amount of window area in the dwelling unit.
26. Infiltration rate shall use “Tight” values for the cooling season infiltration rate and “Tight” values for the heating season infiltration rate, as defined by Table 5A or 5B of ACCA Manual J, Eighth Edition, Version Two. Alternatively, infiltration rate shall not exceed 0.24 air changes per hour.
27. Equipment shall be selected using the maximum total heat gain and the total heat loss in Section 3 per ACCA Manual S, Second Edition, except that cooling ranges above ACCA Manual S limits are temporarily allowed, per Item 4.19.

28. If an AHRI Reference # is not available, OEM-provided documentation shall be attached with the rated efficiency of the specific combination of indoor and outdoor components of the air conditioner or heat pump, along with confirmation that the two components are designed to be used together.
29. Capacity will be listed as the capacity at design conditions, from OEM expanded performance data, and shall include the capacity of all systems providing space cooling to the dwelling unit.
30. Per ACCA Manual S, Second Edition, if the load sensible heat ratio is ≥ 95% and the HDD / CDD ratio is ≥ 2.0, then the Climate is Condition B, otherwise it is Condition A.
31. As an alternative for low-load dwelling units, a system match-up including a single-speed compressor with a total capacity ≤ 20 kBtuh is permitted to be used in spaces with a total cooling load ≤ 15 kBtuh. A system match-up including a two-speed or variable-speed compressor with a total capacity ≤ 25 kBtuh is permitted to be used in spaces with a total cooling load ≤ 18 kBtuh.
32. Per the 2009 International Mechanical Code, a direct-vent furnace or boiler is one that is constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outside atmosphere; a mechanical draft system is a venting system designed to remove flue or vent gases by mechanical means consisting of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure; and a natural draft system is a venting system designed to remove flue or vent gases under non-positive static vent pressure entirely by natural draft. Naturally drafted equipment is only allowed if located in a space outside the pressure boundary, where the envelope assemblies separating it from conditioned space are insulated and air-sealed.
33. Designers may provide supplemental documentation with room-by-room and total design airflows in lieu of completing Item 5.5. Sample supplemental documentation can be found at energystar.gov/newhomeshvacdesign.
34. Orientation-specific room-by-room design airflows are recommended, but not required, to distribute airflow proportional to load, thereby improving comfort and efficiency.
35. Design HVAC fan airflow is the design airflow for the blower in CFM, as determined using the manufacturer's expanded performance data.
36. Design HVAC fan speed setting is the fan speed setting on the control board (e.g., low, medium, high) that corresponds with the Design HVAC fan airflow.
37. Design total external static pressure is the pressure corresponding to the Design HVAC fan airflow, inclusive of external components (e.g., evaporator coil, whole-house humidifier, or ≥ MERV 6 filter).
38. Kinks are to be avoided and are caused when ducts are bent across sharp corners such as framing members. Sharp bends are to be avoided and occur when the radius of the turn in the duct is less than one duct diameter. Compression is to be avoided and occurs when flexible ducts in unconditioned space are installed in cavities smaller than the outer duct diameter and ducts in conditioned space are installed in cavities smaller than inner duct diameter. Ducts shall not include coils or loops except to the extent needed for acoustical control.
39. Item 6.3 does not apply to ducts that are a part of local mechanical exhaust or exhaust-only dwelling-unit ventilation systems. EPA recommends, but does not require, that all metal ductwork not encompassed by Section 6 (e.g., exhaust ducts, duct boots, ducts in conditioned space) also be insulated and that insulation be sealed to duct boots to prevent condensation.
40. Item 6.5 only applies to heating, cooling, and balanced ventilation ducts that only serve one dwelling unit. Duct leakage testing is not required if the ducts and air handler are in conditioned space and the total supply duct length of the system, including all supply trunks and branches, is ≤ 10 ft. For balanced ventilation ducts that are not connected to space heating or cooling systems, a Rater is permitted to visually verify, in lieu of duct leakage testing, that all seams and connections are sealed with mastic or metal tape and all duct boots are sealed to floor, wall, or ceiling using caulk, foam, or mastic tape.
41. Duct leakage shall be determined and documented by a Rater in accordance with ANSI / RESNET / ICC Std. 380. Leakage limits shall be assessed on a per-system, rather than per-dwelling unit, basis. For a duct system with one or two returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 4 CFM25 per 100 ft^2 of CFA or ≤ 40 CFM25 at 'rough-in' or the greater of ≤ 8 CFM25 per 100 ft^2 of CFA or ≤ 8 CFM25 at 'final'. For a duct system with three or more returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 6 CFM25 per 100 ft^2 of CFA or ≤ 60 CFM25 at 'rough-in' or the greater of ≤ 12 CFM25 per 100 ft^2 of CFA or ≤ 120 CFM25 at 'final'. For a duct system without any ducted returns, the total Rater-measured duct leakage is permitted to be the greater of ≤ 3 CFM25 per 100 ft^2 of CFA or ≤ 30 CFM25 at 'rough-in' or the greater of ≤ 6 CFM25 per 100 ft^2 of CFA or ≤ 60 CFM25 at 'final' and, the Rater-measured pressure difference between the space containing the air handler and the conditioned space, with the air handler running at high speed, is ≤ 5 Pa. For systems > 1 ton, increase by 1 Pa per half ton.
42. Exhaust fan flow shall be the lesser of the rated fan flow and at rough-in, 133% of the sum of the design airflow of the dwelling units that are exhausted by that central fan or at final, 143% of the sum of the design airflow of the dwelling units that are exhausted by that central fan.

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Appendix A – Supplementary tables for Section 2 and 3

2a. Dwelling Unit & Common Space Mechanical Ventilation Design [2, 3]						
List unique unit plan for which 62.2 ventilation rates were calculated in the spaces to the right:						
2.4 # of bedrooms:						
2.5 Square footage:						
2.6 Ventilation airflow rate required by ASHRAE 62.2:						
2.7 Ventilation airflow rate designed:						
2.7.1 If applicable, run-time per cycle (minutes):						
2.7.2 If applicable, cycle time (minutes):						

List common space for which 62.1 ventilation rates were calculated in the spaces to the right:						
2.8 Ventilation airflow rate required by ASHRAE 62.1:						
2.9 Ventilation airflow rate designed:						

System Type & Controls:						
List Ventilation System ID in the spaces to the right:						
2.10 Specified system type: (e.g., supply, exhaust, balanced, ERV, HRV)						
2.11 Specified system type: (e.g., in-unit, central)						
2.12 Manufacturer:						
2.13 Model Number:						
2.14 Area / space(s) that system serves: (e.g., Unit A kitchens, corridor, community room)						
2.15 Specified control location: (e.g., Master bath, utility)						

3. Heating & Cooling Loads								
Dwelling Unit Heating & Cooling Loads (only required for ducted split AC, unitary AC, ASHP, WSHP, GSHP, and furnaces) [19] ☐ N/A								
List the unit plan for which Loads were calculated:								
3.5 Location of Unit: top, mid, bottom, corner, interior								
3.6 Number of occupants used in loads: [21, 24]								
3.7 Total occupant gains (Btuh): [21]								
3.8 Conditioned floor area used in loads: [21]								
3.9 Window area used in loads: [21]								
3.10 Predominant window SHGC used in loads: [21, 25]								
3.11 Infiltration (ACH / ACH50) used in loads: [26]								
3.12 Mechanical ventilation (CFM) used in loads:								
3.13 Non-occupant Internal gains (appliance, equipment and lighting) used in loads (Btuh): [21]								
3.14 Sensible Heat Gain At Design Conditions (kBtuh): [21]								
3.15 Latent Heat Gain At Design Conditions (kBtuh):								
3.16 Total Heat Gain at Design Conditions (kBtuh): [21]								
3.17 Total Heat Loss at Design Conditions (kBtuh):								

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Appendix A – Supplementary tables for Section 3

3.18 Common Space Heating & Cooling Loads		
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
Common Space Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)

Building Heating & Cooling Loads (only required when shared systems such as central boilers or chillers are specified)		
System Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)
System Name: _____	Design Conditions: Total Heat Gain: _____(kBtuh)	Total Heat Loss: _____(kBtuh)

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Appendix A – Supplementary tables for Section 4

4. Heating & Cooling Equipment Selection							
Cooling Equipment (Complete all applicable items; otherwise check "N/A")							☐ N/A
List Cooling Equipment ID in the spaces to the right:							
4.4 Equipment type: (PTAC / AC, Chiller / CT, PTHP / WLHP / GSHP / ASHP / VRF)							
4.5 Area / Space(s) that system serves:							
4.6 Chiller / condenser / outdoor unit manufacturer:							
4.7 Chiller / condenser / outdoor unit model #:							
4.8 Evaporator / indoor unit manufacturer:							
4.9 Evaporator / indoor unit model #:							
4.10 AHRI reference #: [28]							
4.11 AHRI listed efficiency:							
4.12 Evaporator fan type: PSC, ECM / ICM Other:							
4.13 Compressor speed: Single, Two, Variable							
4.14 Turn down ratio (for variable speed equipment):							
4.15 Latent capacity at design conditions (kBtuh): [29]							
4.16 Sensible capacity at design conditions (kBtuh): [29]							
4.17 Total capacity at design conditions (kBtuh): [29]							
4.18 Cooling sizing % = Total capacity (Item 4.17) divided by Total Heat Gain of space(s) in Item 4.5:							
4.19 Meets cooling sizing limit: (A, B, C, D or N/A) [19]							
4.20 If "B", list Load sensible heat ratio = Max. sensible heat gain (Item 3.14) / Max. total heat gain (Item 3.16): [30]							
4.21 If "B", calculate HDD / CDD ratio: [30]							

	Compressor Type (Per Item 4.13)		
Equipment Type & Climate Condition	Single-Speed	Two-Speed	Variable-Speed
A: For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate [30]	Recommended: 90 – 115% Allowed: 90 – 130%	Recommended: 90 – 120% Allowed: 90 – 140%	Recommended: 90 – 130% Allowed: 90 – 160%
B: For Cooling Mode of Heat Pump in Condition B Climate [30]	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh	90% - 100%, plus 15 kBtuh
C: For low-load spaces (≤15 kBtuh) [31]	≤ 20 kBtuh		
D: For low-load spaces (≤18 kBtuh) [31]		≤ 25 kBtuh	≤ 25 kBtuh

Heating Equipment (Complete all applicable items; otherwise check "N/A")							☐ N/A
List Heating Equipment ID in the spaces to the right:							
4.22 Electric equipment type: PTHP, WLHP, GSHP, ASHP, VRF, Boiler, Furnace, Electric Resistance							
4.23 Gas Equipment type: HW PTAC / fan coil, Gas-Fired PTAC, Boiler, Furnace							
4.24 Area / Space(s) that system serves:							
4.25 Manufacturer & model:							
4.26 Listed efficiency:							
4.27 Equipment output capacity:							
4.28 Air-source heat pump output capacity (17°F):							
4.29 Type of Venting: Natural Draft, Mechanically Drafted, Direct Vent [32]							
4.30 Furnace heating sizing % = Total capacity (Item 4.27) divided by Total Heat Loss of space(s) in Item 4.24:							
4.31 Meets furnace sizing limit: (A, B, C, or N/A)							

A: For low-load spaces (≤ 10 kBtuh), furnace output capacity is ≤ 40 kBtuh	
B: When Used for Heating Only	C: When Paired With Cooling
100 – 400%	Recommended: 100 – 140% Allowed: 100 – 400%

National HVAC Design Report [1]
ENERGY STAR Multifamily New Construction Version 1 / 1.1

Appendix A – Supplementary tables for Section 5

5. Dwelling-Unit Duct Design

5.2 Room-by-room design airflows documented below (which should sum to the mode with the higher Design HVAC fan airflow) [33, 34]

Name of the unit plan:			Name of the unit plan:		
Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM			Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM		
Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____			Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____		
Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC			Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC		
	Room Name	Design Airflow (CFM)		Room Name	Design Airflow (CFM)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
	Total for all rooms			Total for all rooms	

Name of the unit plan:			Name of the unit plan:		
Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM			Design HVAC fan airflow: [35] Cooling mode _____ CFM Heating mode _____ CFM		
Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____			Design HVAC fan speed setting (e.g., low, medium, high): [36] Cooling mode _____ Heating mode _____		
Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC			Design total external static pressure (corresponding to the mode with the higher airflow above): [37] _____ IWC		
	Room Name	Design Airflow (CFM)		Room Name	Design Airflow (CFM)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
	Total for all rooms			Total for all rooms	