ENERGY STAR Single-Family New Homes
National HVAC Design Report, Version 3.1 / 3.2 / 3.3 (Rev. 14) [1]

HVAC Designer Responsibilities:

- Complete one National HVAC Design Report for each system design for a house plan, created for either the specific plan configuration (i.e., elevation, option, orientation, & county) of the home to be certified or for a plan that is intended to be built with different configurations (i.e., different elevations, options, and/or orientations). Visit www.energystar.gov/newhomeshvacdesign and see Footnote 2 for more information. [2]
- Obtain efficiency features (e.g., window performance, insulation levels, and infiltration rate) from the builder or Rater. [3]
- Provide the completed National HVAC Design Report to the builder or credentialed HVAC contractor and to the Rater.

1. Design Overview

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

1.2 Select which party you are providing these design services to: ☐ Builder or ☐ Credentialed HVAC contractor

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

1.4 Area that system serves: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other _____

1.5 Is cooling system for a temporary occupant load? [4] ☐ Yes ☐ No

1.6 House plan: _____ Check box to indicate whether the system design is site-specific or part of a group: [2]

☐ Site-specific design. Option(s) & elevation(s) modeled: _____

☐ Group design. Group #: _____ out of _____ total groups for this house plan. Configuration modeled: _____

2. Dwelling Unit Mechanical Ventilation System Design ("Vent System") [5, 6, 7] & Inlets in Return Duct [8]		Designer Verified
Airflow:		
	2.1 Ventilation airflow design rate & run-time meet the requirements of ASHRAE 62.2-2010 or later. [9]	☐
	2.2 Ventilation airflow rate required by 62.2 for a continuous system: _____ CFM	-
	2.3 Design for this system: Vent. airflow rate: _____ CFM Run-time per cycle: _____ minutes Cycle time: _____ minutes	-
System Type & Controls:		
	2.4 Specified system type: ☐ Supply ☐ Exhaust ☐ Balanced	-
	2.5 Specified control location: _____ (e.g., Master bath, utility room)	-
	2.6 Specified controls allow the system to operate automatically, without occupant intervention.	☐
	2.7 Specified controls include a readily-accessible ventilation override and a label has also been specified if its function is not obvious (e.g., a label is required for a toggle wall switch, but not for a switch that's on the ventilation equipment).	☐
	2.8 For any outdoor air inlet designed to connect to a ducted return of the HVAC system, specified controls automatically restrict airflow using a motorized damper during ventilation off-cycle and occupant override. [8, 10]	☐
Sound:	2.9 The fan of the specified system is rated ≤ 3 sones if intermittent and ≤ 1 sone if continuous, or exempted. [11]	☐
Efficiency:		
	2.10 If Vent System controller operates the HVAC fan, then HVAC fan operation is intermittent and either the fan type in Item 4.7 is ECM / ICM or the controls will reduce the run-time by accounting for HVAC system heating or cooling hours. [12]	☐
	2.11 If bathroom fans are specified as part of the system, then they are ENERGY STAR certified. [13]	☐
Air Inlet Location: (Complete this section if system has a specified air inlet location; otherwise check "N/A"). [14]		☐ N/A
	2.12 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit.	☐
	2.13 Inlet is ≥ 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 known sources exiting the roof. [15]	☐

3. Room-by-Room Heating & Cooling Loads [16]

3.1 Room-by-room loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013 ASHRAE Fundamentals ☐ Other per AHJ [17] -

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

3.3 Outdoor design temperatures used in loads: (See Footnote 18 and www.energystar.gov/hvacdesigntemps) [18] -
County & State, or US Territory, selected: _____ Cooling season: _____°F Heating season: _____°F

3.4 Number of occupants used in loads: [19] _____ -

3.5 Conditioned floor area used in loads: [20] _____ Sq. Ft. -

3.6 Window area used in loads: [21] _____ Sq. Ft. -

3.7 Predominant window SHGC used in loads: [22] _____ -

3.8 Infiltration rate used in loads: [23] Summer: _____ Winter: _____ -

3.9 Mechanical ventilation rate used in loads: _____ CFM -

Loads At Design Conditions (kBtuh)		N	NE	E	SE	S	SW	W	NW	
Cooling	3.10 Sensible heat gain (By orientation [24]):									-
	3.11 Latent heat gain (Not by orientation):									-
	3.12 Total heat gain (By orientation [24]):									-
	3.13 Maximum – minimum total heat gain (Item 3.12) across orientations = _____ kBtuh						Variation is ≤ 6 kBtuh. [24, 25]			☐
Heating	3.14 Total heat loss (Not by orientation):									-

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4. Heating & Cooling Equipment Selection [16]	**Designer Verified**
4.1 Equipment selected per ACCA Manual S (see Footnote 26 & 27). [26, 27]	☐
Air Conditioner / Heat Pump (Complete if air conditioner or heat pump will be installed; otherwise check "N/A")	☐ N/A
4.2 Equipment type: ☐ Cooling-only air conditioner or ☐ Cooling & heating heat pump	-
4.3 Condenser manufacturer & model: _____	-
4.4 Evaporator / fan coil manufacturer & model: _____	-
4.5 AHRI reference #: [28] _____	-
4.6 Rated cooling efficiency: [29] _____ / _____ Rated heating efficiency: [30] _____	-
4.7 Evaporator fan type: ☐ PSC ☐ ECM / ICM ☐ Other: _____	-
4.8 Compressor type: ☐ Single-speed ☐ Two-speed ☐ Variable-speed	-
4.9 Latent capacity at design conditions, from OEM expanded performance data: [31] _____ kBtuh	-
4.10 Sensible capacity at design conditions, from OEM expanded performance data: [31] _____ kBtuh	-
4.11 Total capacity at design conditions, from OEM expanded performance data: [31] _____ kBtuh	-
4.12 Air-source heat pump capacity: At 17°F: _____ kBtuh At 47°F: _____ kBtuh ☐ N/A	-
4.13 Cooling sizing % = Total capacity (Item 4.11) divided by maximum total heat gain (Item 3.12): _____ %	-
4.14 Complete this Item if Condition B Climate will be used to select sizing limit in Item 4.15. Otherwise, check "N/A": [32] ☐ N/A	-
4.14.1 Load sensible heat ratio = Max. sensible heat gain (Item 3.10) / Max. total heat gain (Item 3.12) = _____ %	
4.14.2 HDD / CDD ratio (Visit www.energystar.gov/hvacdesigntemps to determine this value for the design location) = _____	
4.15 Check box of applicable cooling sizing limit from chart below: [26, 27]	-

Equipment Type (Per Item 4.2) & Climate Condition (Per Item 4.14)	Compressor Type (Per Item 4.8)		
	Single-Speed	Two-Speed	Variable-Speed
For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate	☐ Recommended: 90 – 115% Allowed: 90 – 130%	☐ Recommended: 90 – 120% Allowed: 90 – 140%	☐ Recommended: 90 – 130% Allowed: 90 – 160%
For Cooling Mode of Heat Pump in Condition B Climate	☐ 90% - 100%, plus 15 kBtuh	☐ 90% - 100%, plus 15 kBtuh	☐ 90% - 100%, plus 15 kBtuh

4.16 Cooling sizing % (4.13) is within cooling sizing limit (4.15).	☐
Furnace (Complete if furnace will be installed; otherwise check "N/A").	☐ N/A
4.17 Furnace manufacturer & model: _____	-
4.18 Rated heating efficiency: _____ AFUE	-
4.19 Total capacity: [33] _____ kBtuh	-
4.20 Heating sizing % = Total capacity (Item 4.19) divided by total heat loss (Item 3.14): _____ %	-
4.21 Check box of applicable heating sizing limit from chart below:	-

When Used for Heating Only	When Paired With Cooling
☐ 100 – 140%	☐ Recommended: 100 – 140% Allowed: 100 – 400%

4.22 Heating sizing % (4.20) is within heating sizing limit (4.21).	☐
5. Duct Design (Complete if heating or cooling equipment will be installed with ducts; otherwise check "N/A"). [16]	☐ N/A
5.1 Duct system designed for the equipment selected in Section 4, per ACCA Manual D.	☐
5.2 Design HVAC fan airflow: [34] Cooling mode _____ CFM Heating mode _____ CFM	-
5.3 Design HVAC fan speed setting (e.g., low, medium, high): [35] Cooling mode _____ Heating mode _____	-
5.4 Design total external static pressure (corresponding to the mode with the higher airflow in Item 5.2): [36] _____ IWC	-
5.5 Room-by-room design airflows documented below (which must sum to the mode with the higher airflow in Item 5.2): [37, 38]	-

	Room Name	Design Airflow (CFM)		Room Name	Design Airflow (CFM)		Room Name	Design Airflow (CFM)
1			12			23		
2			13			24		
3			14			25		
4			15			26		
5			16			27		
6			17			28		
7			18			29		
8			19			30		
9			20			31		
10			21			32		
11			22			Total for all rooms		

Footnotes

1. This report is designed to meet ASHRAE 62.2-2010 or later and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new homes when compared to homes 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.

   This report 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 (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts). For all other permutations of equipment (e.g., boilers, mini-split / multi-split systems) and distribution systems, Section 1 and 2 are required and Sections 3 through 5 are recommended, but not required.

2. The report shall represent a single system design for a house plan. Check the box for "site-specific design" if the design was created for the specific plan configuration (i.e., elevation, option, orientation, and county) of the home to be certified. Check the box for "group design" if the design was created for a plan that is intended to be built with potentially different configurations (i.e., different elevations, options, and/or orientations). Regardless of the box checked, the system design as documented on this National HVAC Design Report must fall within the following tolerances for the home to be certified:

   - Item 3.3: The outdoor design temperature used in loads are within the limits defined at www.energystar.gov/hvacdesigntemps.
   - Item 3.4: The number of occupants used in loads is within ± 2 of the home to be certified.
   - Item 3.5: The conditioned floor area used in loads is between 100 sq. ft. smaller and 300 sq. ft. larger than the home to be certified.
   - Item 3.6: The window area used in loads is between 15 sq. ft. smaller and 60 sq. ft. larger than the home to be certified, or, for homes to be certified with >500 sq. ft. of window area, between 3% smaller and 12% larger.
   - Item 3.7: The predominant window SHGC is within 0.1 of the predominant value in the home to be certified.
   - Items 3.10 - 3.12: The sensible, latent, & total heat gain are documented for the orientation of the home to be certified.
   - Item 3.13: The variation in total heat gain across orientations is ≤ 6 kBtuh.
   - Item 4.16: 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 or credentialed HVAC contractor) and to the Rater. The report is only required to be provided once per system design, even if multiple homes are built using this design (e.g., in a production environment where the same plan is built multiple times, only one report is required). As long as a report has been provided that falls within these tolerances for the home 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. Homes certified under Rev. 14 of the program requirements are permitted to use any Revision of the National HVAC Design Report between Rev. 08 and Rev. 14. Visit www.energystar.gov/newhomeshvacdesign for a tool to assist with group designs and for more information.

3. The term 'Rater' refers to the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater or Approved Inspector, as defined by ANSI / RESNET / ICC 301, or an equivalent designation as determined by a Home Certification Organization (HCO); and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/newhomestraining.

4. Check "Yes" if this system is to handle temporary occupant loads. Such a system may be required to accommodate a significant number of guests on a regular or sporadic basis and shall be handled by a supplemental cooling system (e.g., a small, single-package unit or split-coil unit) or by a system that can shift capacity from zone to zone (e.g., a variable volume system).

5. As defined by ANSI / RESNET / ICC 301-2019, a Dwelling Unit Mechanical Ventilation System is a ventilation system consisting of powered ventilation equipment such as motor-driven fans and blowers and related mechanical components such as ducts, inlets, dampers, filters and associated control devices that provides dwelling-unit ventilation at a known or measured airflow rate.

6. The 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. For example, for Item 2.3, designers are permitted to provide multiple combinations of a design ventilation airflow rate, run-time per cycle, and cycle time. When multiple combinations are provided, the Rater will be required to first assess the run-time setting of the installed system and use that to determine the corresponding design ventilation rate. The Rater-measured ventilation rate then must fall within the program-specified tolerance relative to that design ventilation rate.

7. 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%.

8. Item 2.8 applies to any outdoor air inlet connected to a ducted return of the dwelling unit HVAC system, regardless of its intended purpose (e.g., for ventilation air, make-up air, combustion air). This Item does not apply to HVAC systems without a ducted return. For example, if an outdoor air inlet connected to a ducted return is used as a dedicated source of outdoor air for an exhaust ventilation system (e.g., bath fan), the outdoor airflow must be automatically restricted when the exhaust fan is not running and in the event of an override of the exhaust ventilation system. Note that a Rater will generally measure the ventilation rate at the highest HVAC fan speed applicable to ventilation mode (e.g., if the inlet only opens when the HVAC is in 'fan-only' mode, it will be tested in this mode) to verify that it is ≤ 15 CFM or 15% above design value. As an alternative, measurement of the outdoor airflow can be waived if a Constant Airflow Regulating (CAR) damper with a manufacturer-specified maximum flow rate no higher than 15 CFM or 15% above the ventilation design value is installed on the inlet.

9. 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 more recent editions of the standard to assess compliance.

10. In addition, consult manufacturer requirements to ensure return air temperature requirements are met.

11. Dwelling Unit Mechanical Ventilation System fans shall be rated for sound at no less than the airflow rate in Item 2.3. 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.

12. Note that the 'fan-on' setting of a thermostat would not be an acceptable controller because it would continuously operate the HVAC fan.
13. Bathroom fans with a rated flow rate ≥ 500 CFM are exempted from the requirement to be ENERGY STAR certified.
14. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, the EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the occupant.
15. Two alternatives to the required 10 ft. distance are provided: 1) inlets providing outdoor air to a dwelling unit are permitted to be ≥ 5 ft. of stretched-string distance from outlets of both exhaust dwelling-unit mechanical ventilation systems and local mechanical exhaust systems, and 2) the outlet and inlet of ERV's and HRV's may use a smaller distance if allowed by the manufacturer of the system. If the second alternative is used, the manufacturer's instructions shall be collected for documentation purposes.
16. Homes certified through the Caribbean Program Requirements, Version 3, or a home with ≤ 50% air-conditioned occupiable space certified through the Pacific Program Requirements, Version 3.2, are exempt from completing Sections 3, 4, and 5 of this report.
17. Select "2013 ASHRAE Fundamentals" if using Chapter 17 of the 2013 ASHRAE Handbook of Fundamentals. Select "Other per AHJ" if the Authority Having Jurisdiction where the home will be certified mandates the use of a load calculation methodology other than Unabridged ACCA Manual J v8 or 2013 ASHRAE Fundamentals.
18. Visit www.energystar.gov/hvacdesigntemps for the maximum cooling season design temperature and minimum heating season design temperature permitted for ENERGY STAR Single-Family New Homes. 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 home 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 Frederick 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 Albemarle County (which has a lower limit of 92 °F). If a jurisdiction-specified design temperature is used that exceeds the limit in the Design Temperature Limit Reference Guide, designers must submit a Design Temperature Exception Request available at www.energystar.gov/hvacdesigntemps.
19. To determine the number of occupants among all HVAC systems in the home, calculate the number of bedrooms, as defined below, and add one. This number of occupants must be within ± 2 of the home to be certified, unless Item 1.5 indicates that the system is a cooling system for temporary occupant loads.

    A bedroom is defined by ANSI / RESNET / ICC 301-2014 as a room or space 70 sq. ft. 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 sq. ft. 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 in. above the floor; AND
    - have a minimum net clear opening of 5.7 sq. ft., height of 24 in., and width of 20 in.; AND
    - be operational from the inside of the room without the use of keys, tools or special knowledge.
20. The difference between the Conditioned Floor Area (CFA) used in the design and the actual home to be certified must fall within the tolerance specified in Footnote 2, as verified by a Rater. Be advised, the Rater will calculate CFA using the definition in ANSI / RESNET / ICC 301-2019, which defines this value, in part, as the floor area of the Conditioned Space Volume within a building or Dwelling Unit, not including the floor area of attics, crawlspaces, and basements below air sealed and insulated floors. See https://codes.iccsafe.org/content/RESNET3012019P1/3-definitions- for the complete definition.
21. The difference between the window area used in the design and the actual home to be certified must fall within the tolerance specified in Footnote 2, as verified by a Rater. Be advised, the Rater will calculate window area using the on-site inspection protocol provided in Normative Appendix B of ANSI / RESNET / ICC 301-2019, which instructs the Rater to measure the width and height of the rough opening for the window and round to the nearest in., and then to use these measurements to calculate window area, rounding to the nearest tenth of a sq. ft. See https://codes.iccsafe.org/content/RESNET3012019P1/normative-appendix-b-inspection-procedures-for-minimum-rated-features for the complete protocol.
22. "Predominant" is defined as the SHGC value used in the greatest amount of window area in the home.
23. Infiltration rate shall reflect the value used in the confirmed or projected ERI rating for home to be certified. Alternatively, use "Average" or "Semi-loose" values for the cooling season infiltration rate and "Semi-tight" or "Average" values for the heating season infiltration rate, as defined by ACCA Manual J, Eighth Edition, Version Two.
24. Orientation represents the direction that the front door of the house is facing. The designer is only required to document the loads for the orientation(s) that the house might be built in. For example, if a house plan will only be built one time in a specific orientation (e.g., a site-specific design), then the designer only needs to document the loads for this one orientation.
25. Determine the orientation with the largest and smallest Total Heat Gain. Verify that the difference in Total Heat Gain between the orientation with the largest and smallest value is ≤ 6 kBtuh. If not, then assign the orientations into one or more groups until the difference is ≤ 6 kBtuh and then complete a separate National HVAC Design Report for each group.
26. Equipment shall be selected using the maximum total heat gain in Item 3.12 and the total heat loss in Item 3.14 per ACCA Manual S, Second Edition, except that cooling ranges above ACCA Manual S limits are temporarily allowed, per Item 4.15.
27. As an alternative for low-load spaces, 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.

28. If the equipment contains multiple components, the AHRI Reference # shall represent the rated efficiency of the specific combination of indoor and outdoor components. The EPA recommends, but does not require, that the rating also encompass the furnace when such a rating is available. If an AHRI Reference # is not available, OEM-provided documentation shall be attached with the rated efficiency of the specific combination of indoor & outdoor components of the air conditioner or heat pump, along with confirmation that the components are designed to be used together.
29. For example, if the metric for the rated efficiency is SEER, SEER2, EER, or EER2, then its SEER, SEER2, EER, or EER2 rating shall be reported. If both SEER and EER (or SEER2 and EER2) are available, then both values shall be reported. When ratings are available using both AHRI 210/240-2017 (e.g., SEER) and -2023 (SEER2), then only the former (e.g., SEER) need be reported.
30. For example, if the metric for the rated efficiency is HSPF, HSPF2, or COP, then its HSPF, HSPF2, or COP rating shall be reported. When ratings are available using both AHRI 210/240-2017 (e.g., HSPF) and -2023 (HSPF2), then only the former (e.g., HSPF) need be reported.
31. The full system capacity at design conditions, from OEM expanded performance data, shall be listed. For two-speed equipment, the full system capacity shall reflect the capacity at the maximum available compressor speed. For variable-speed equipment, it shall reflect the capacity when the compressor operates at the AHRI rating speed.
32. 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.
33. The full system capacity shall be listed. For two-stage and modulating furnaces, the full system capacity shall reflect the maximum output available.
34. Design HVAC fan airflow is the design airflow for the blower in CFM, as determined using the manufacturer's expanded performance data.
35. Design HVAC fan speed setting is the setting on the control board (e.g., low, medium, high) corresponding to the Design HVAC fan airflow.
36. 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).
37. 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 www.energystar.gov/newhomeshvacdesign.
38. Orientation-specific room-by-room design airflows are recommended, but not required, to distribute airflow proportional to load, thereby improving comfort and efficiency.