FULL AIRFLOW ZONE SYSTEM (FAZS™) OCTOBER 25, 2023

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FULL AIRFLOW ZONE SYSTEM

FAZS™ ENERGY STAR PRESENTATION SECTIONS

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ENERGY STAR PARTNERS ARE THE TIP OF THE SPEAR FOR IMPROVING HOW HOMES ARE BUILT!

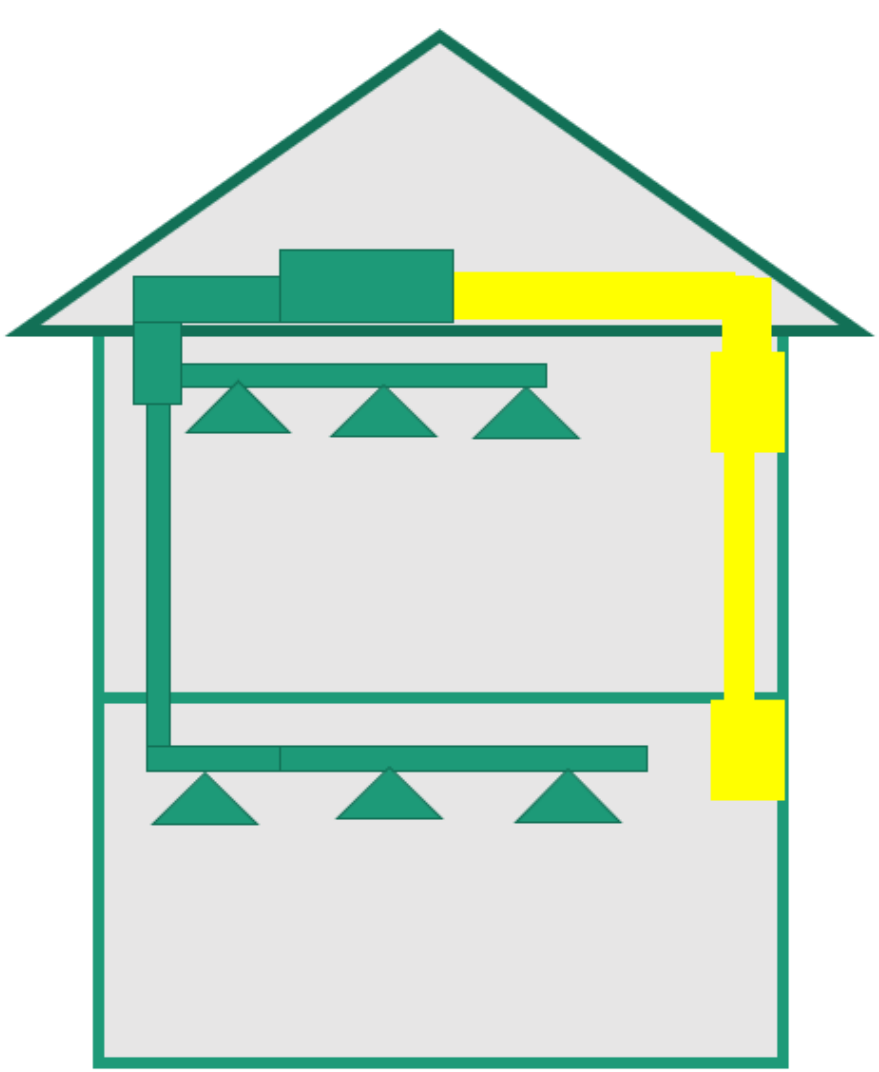
ENERGY STAR (ES) is a voluntary program that requires, contractor certifications, verification, and design practices beyond the code requirements.

Building industry leaders participating in the ES program are industry innovators who promote advancements in the home building industry.

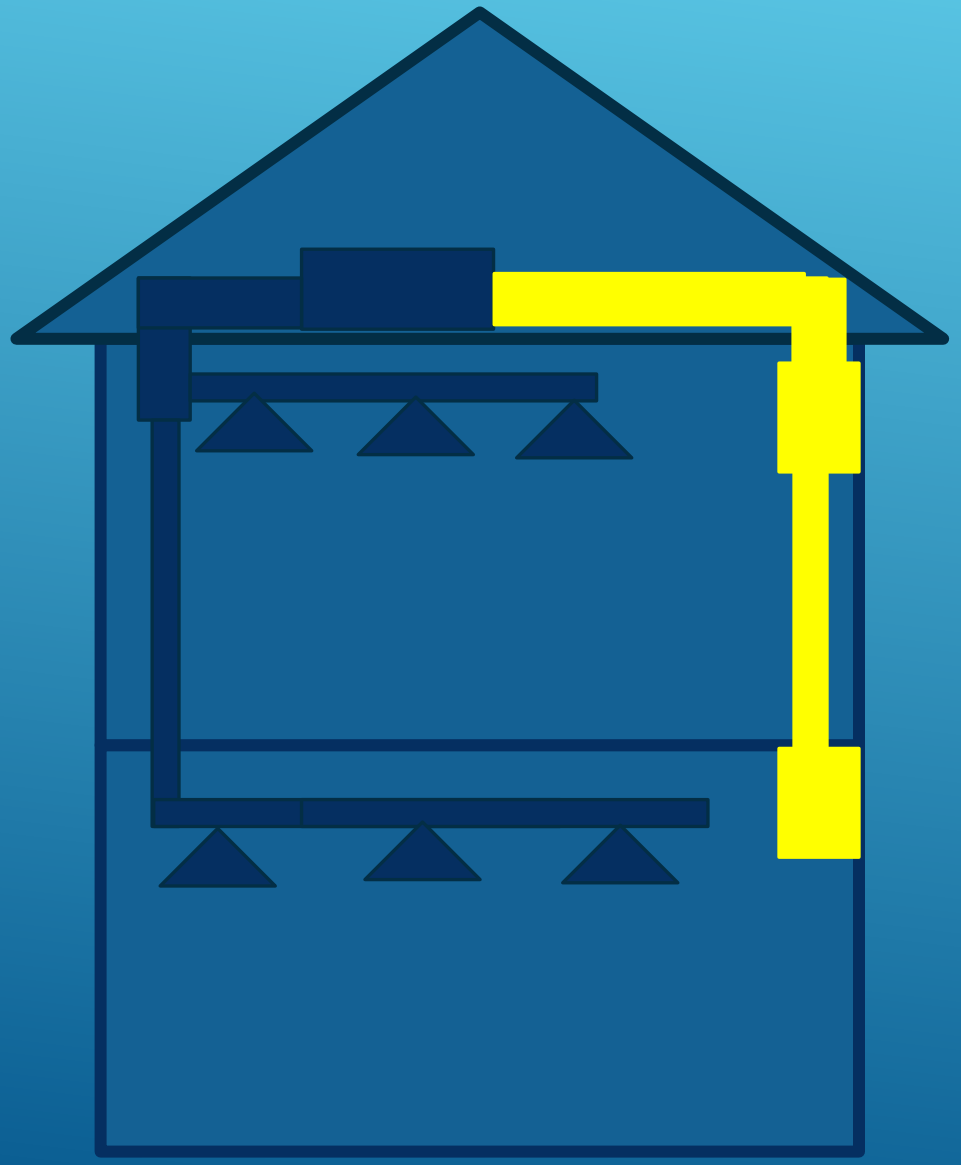
Over the last two decades the program's participants have developed the skills required to correctly design and install a Full Airflow Zone System.

CAN TRADITIONAL FORCED AIR HVAC EQUIPMENT BE USED TO HEAT AND COOL NEW ENERGY EFFICIENT & LOW LOAD HOMES?

It is impossible to meet the heating and cooling load requirements in the relatively large spaces using the small amount of airflow provided by a single zone forced air heating ventilation and air-conditioning (HVAC) system.



TRADITIONAL NEW HOME SINGLE ZONE FORCED AIR HVAC SYSTEM



Typical design limitations and challenges:

- Uneven heating and cooling hot and cold spots and drafts.
- One zone for whole house one thermostat on first floor does not control temperatures in other areas.
- Duct sizing not based on actual airflow to outlets.
- Duct sizing dependent on home's orientation.
- Typically one return per floor or a single return in a hall.
- Airflow through diffusers the same for winter and summer.
- Duct size based on largest heating or cooling value.
- System's maximum airflow always less than duct design size.
- Kitchens run extra warm in winter.
- Upstairs will tend to run warmer in the summer.
- Downstairs will tend to run cooler in the winter.
- Whole home must run in one mode: cooling or heating.

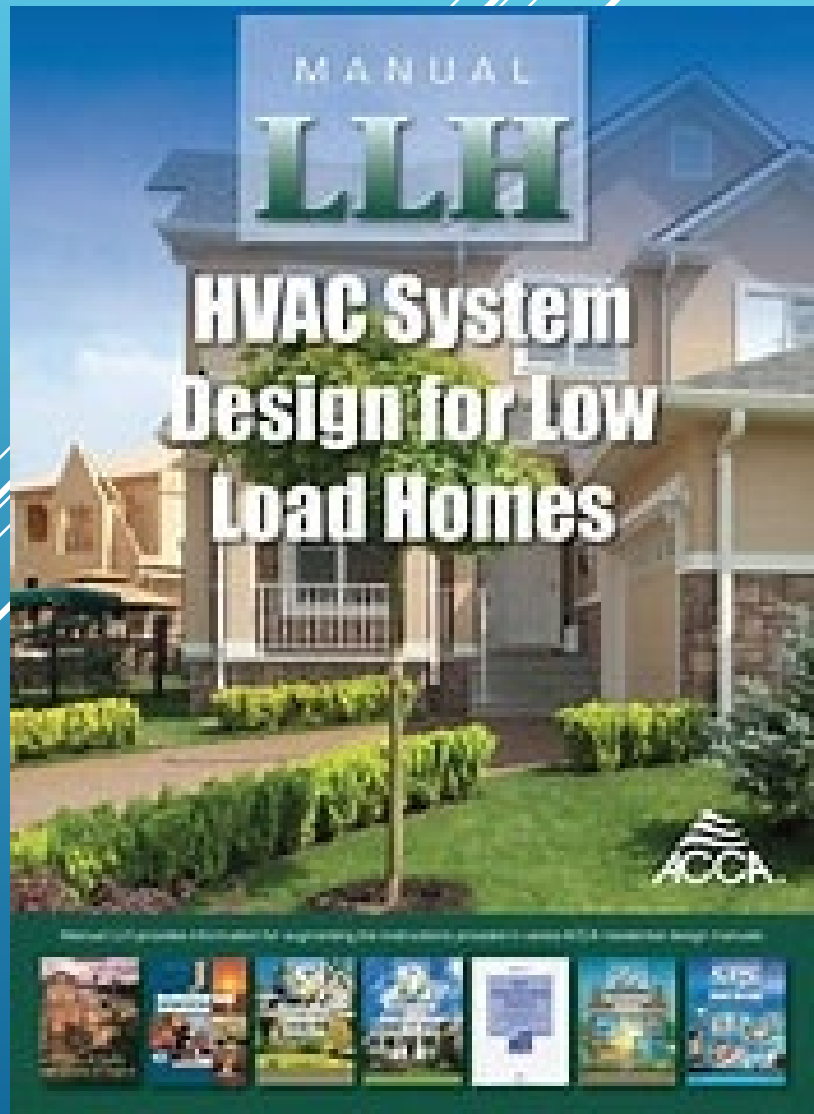
CAPACITY DEPLOYMENT SYSTEM

ACCA Manual LLH HVAC System Design for Low Load Homes

Provides a method for using forced air HVAC equipment:

Section 14-Example 4

“The capacity deployment system Concept was conceived and defined by Don Prather, ACCA Technical Services.”



CAPACITY DEPLOYMENT SYSTEM AKA FULL AIRFLOW ZONE SYSTEM (FAZS™)

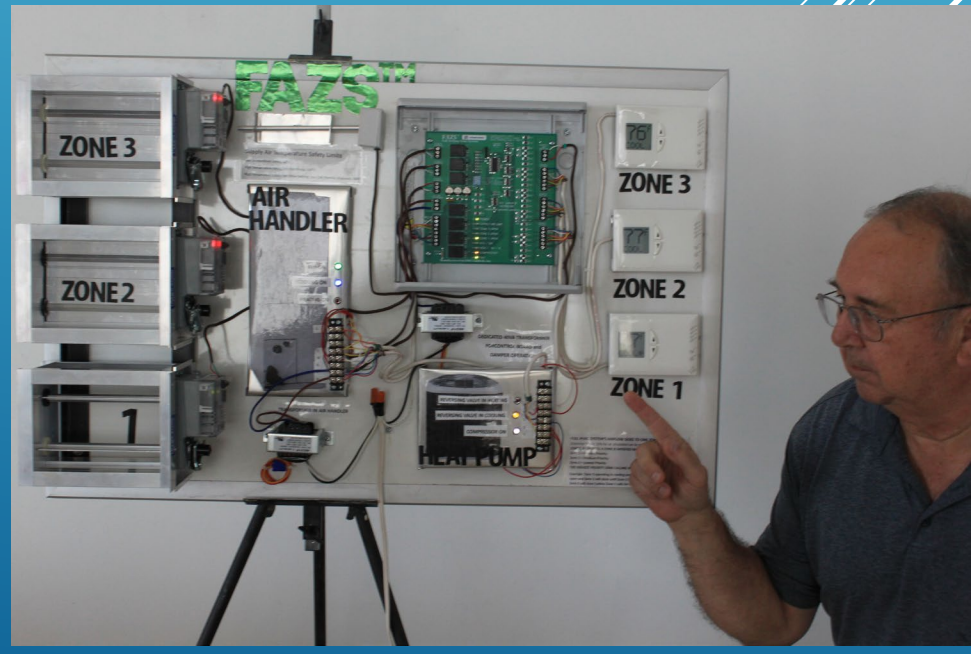
The Full Airflow Zone System control board is the only zone control that is designed to meet the control requirements specified for a capacity deployment system.

FULL AIRFLOW ZONE SYSTEM

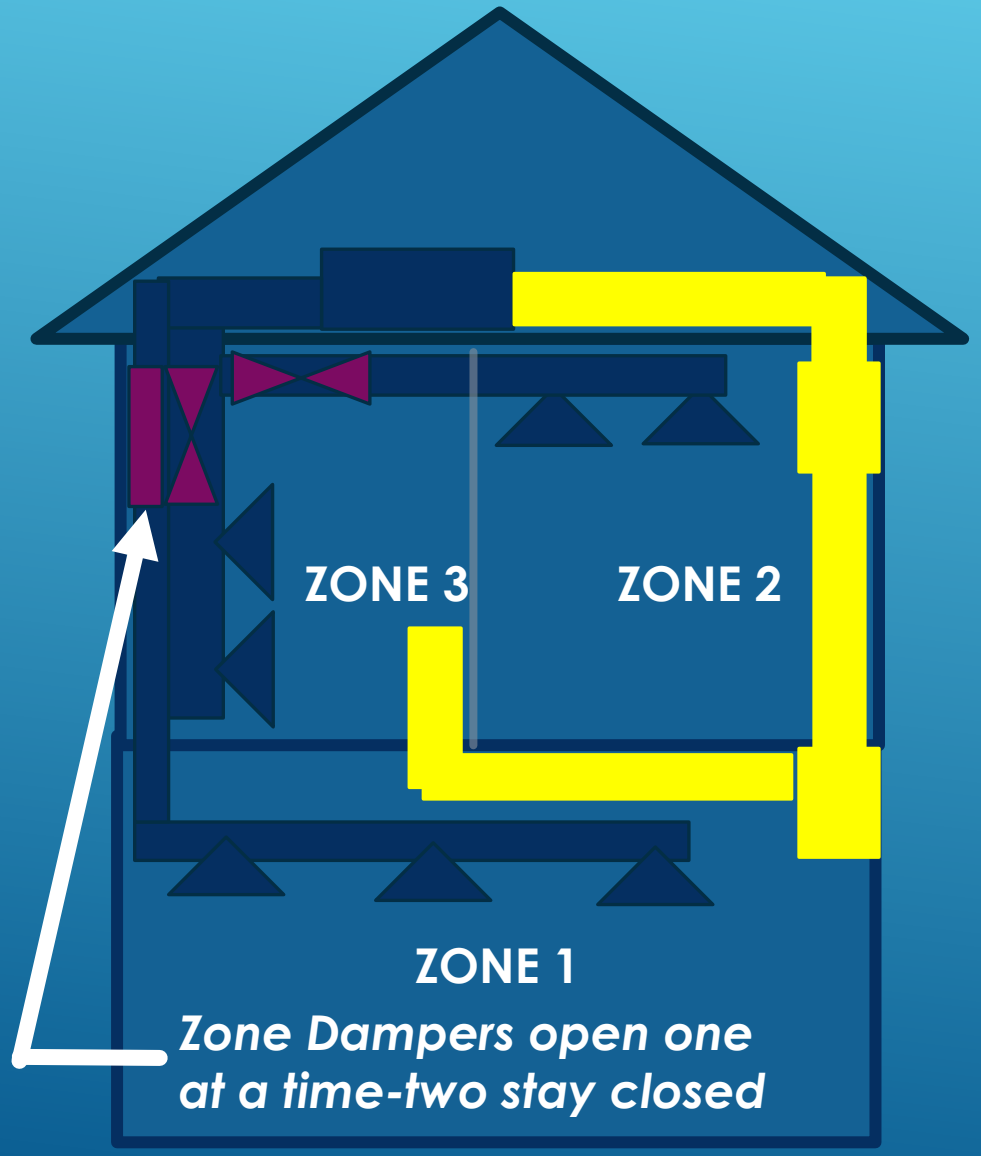
FAZS™ CONCEPT IN TWO SENTENCES

FAZS™ is three zone control board that opens one zone at a time based on priority.

Provides a simple solution that meets the design requirements for multi-story, low load, and net zero homes using basic builder grade forced air HVAC equipment.



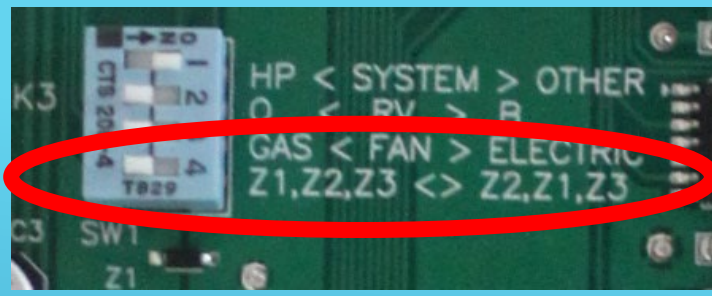
New Home With FAZS™ 3 Zone HVAC equipment



Traditional HVAC Control issues solved by Full Airflow Zone System Control and duct design:

- Even heating and cooling based on zone design.
- Three zones with thermostatic control increases comfort control.
- Duct sizing based on full airflow to each zone.
- Duct sizing not dependent on home orientation.
- Return air path from each room with a supply diffuser.
- Airflow works for winter and summer applications.
- Airflow designed based on full airflow exceeds all heating or cooling requirements for the zone calling.
- System's maximum airflow = duct design value.
- Kitchen designed issues solved by zoning scheme.
- Upstairs will operate at set temperatures year round.
- Downstairs will operate at set temperatures year round.
- Zones operate independently in cooling or heating.
- Zones are supplied by more than design airflow to heat and cool zones quickly and satisfy variable heating and cooling requirements thus, saving energy.

FAZS™ CONTROLS DECREASE HVAC CONTRACTOR CALL BACKS



- Zone systems are designed to improve comfort control.
- Zones satisfy in order based on priority.
- Puts 90% of the HVAC system's cooling/heating Btu's in the zone calling and reaches the set point faster than a traditional single or multi-zone system.
- Keeps the south facing great room cool on a hot day when a afternoon party is going on.
- Let's zones independently call for heating or cooling.
- Control board has a switch that changes the priority between zone 1 and zone 2 in case the home owner uses the system differently from original set up.

WHY THE FAZS™ CONTROL WAS BUILT

No existing zone control met the requirements specified for a capacity deployment system.

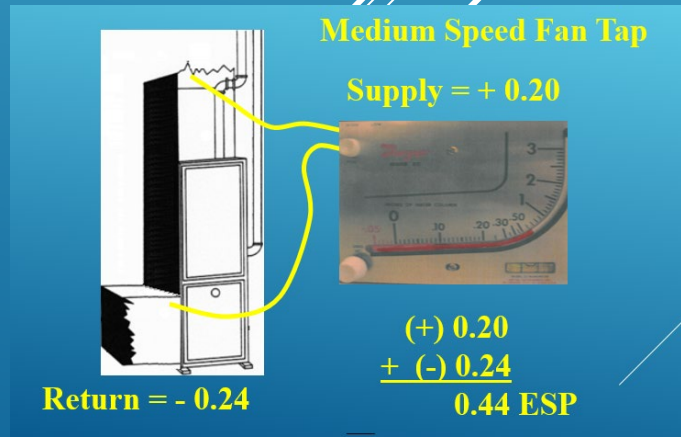
After developing the concept Don felt he had a fiduciary responsibility to make the required control sequence available.

FAZS™ BUILT IN THE USA

- The new control operating sequence was patented.
- An existing EWC 3 zone control board was reprogrammed with the unique control sequence and endurance tested by EWC.
- The first board produced was installed in 2021 and field tested for over two years.

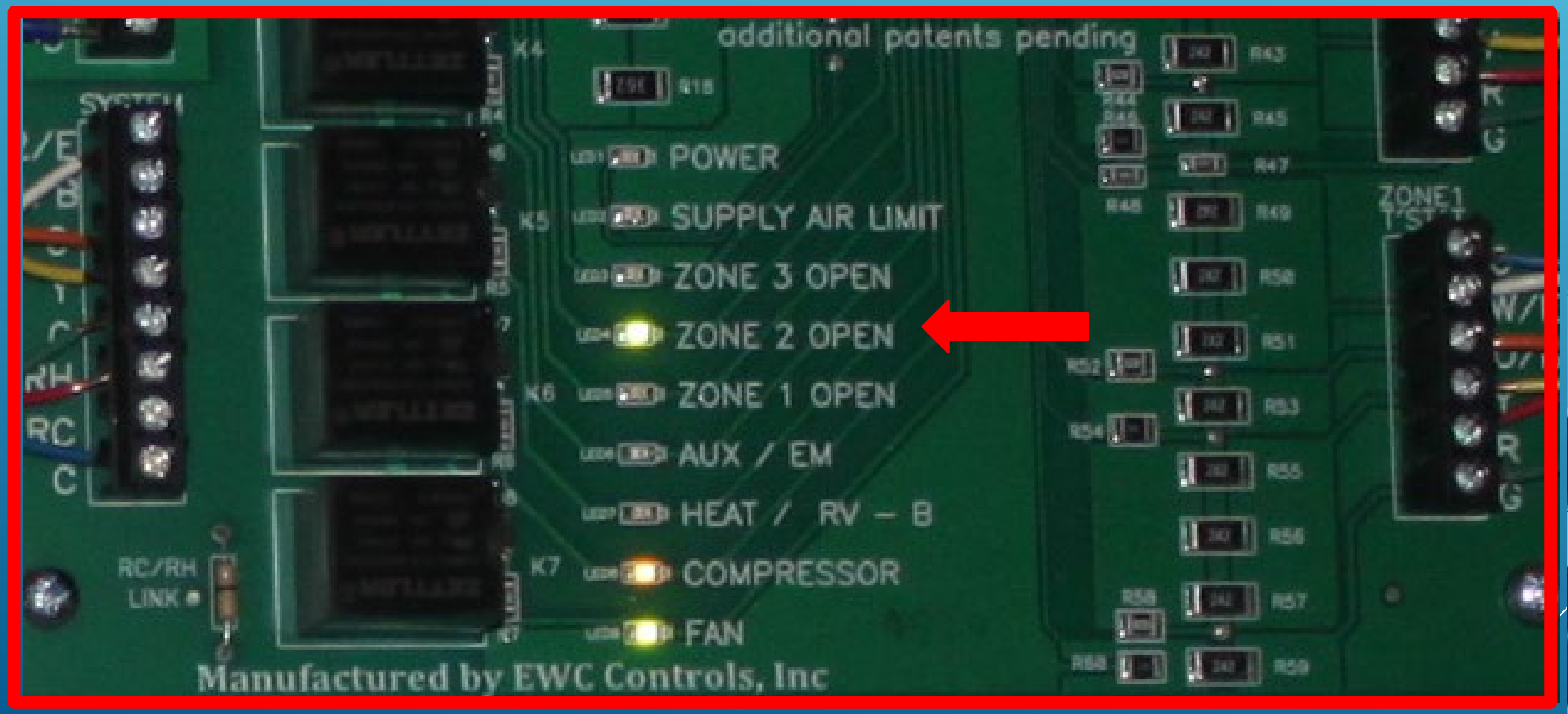
HOW TO SET THE THREE THERMOSTATS FOR EQUIPMENT EXTERNAL STATIC PRESSURE (ESP) OEM AIRFLOW CHECK

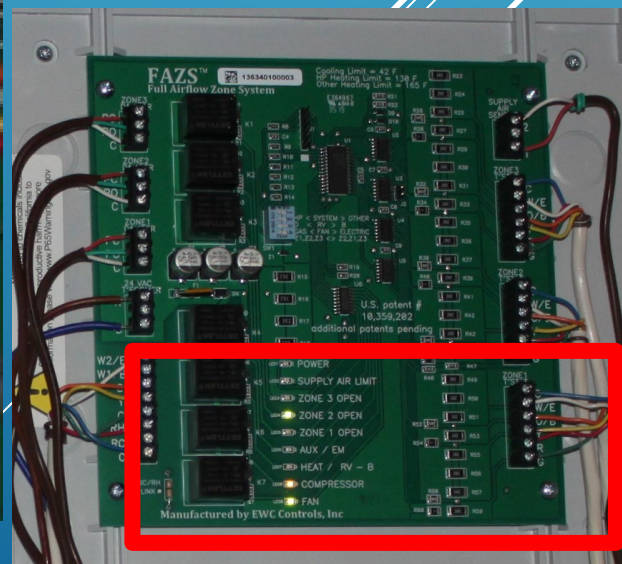
1. Raise or lower the 3 zone thermostats so they won't call for heating or cooling (If the system is on, set zone 3 to stay on).
2. To facilitate a fast change between zones raise or lower the Zone 3 thermostat so the system stays-on/comes-on and runs. Measure Zone 3 ESP.
3. Raise or lower Zone 2 and when Zone 3's zone damper is closed Measure the ESP for Zone 2.
4. Raise or lower Zone 1 and when Zone 2's zone damper is closed Measure Zone 1 ESP.



ONE LIGHT ON MEANS ONE ZONE OPEN

When the system transitions from one zone to a higher priority zone the higher priority zone opens and it's light comes on then the lower priority zone closes and it's light goes out. Pictured below is zone 2 open all other zones closed.





SYSTEM CHECK BASED ON ESP AND OEM DATA

The Zone with the highest ESP is the worst case scenario for the as-built operating system. The other two zones will operate more efficiently.

For all further equipment verification testing set the HVAC system on the zone that has the highest ESP.

Note: When HVAC duct designs are done correctly there will not be a large difference in the 3 zone ESP values (if there is a large difference check the duct for damage or blockage).

FAZS™ IS CODE COMPLIANT

ANSI/RESNET/ACCA 310-2020

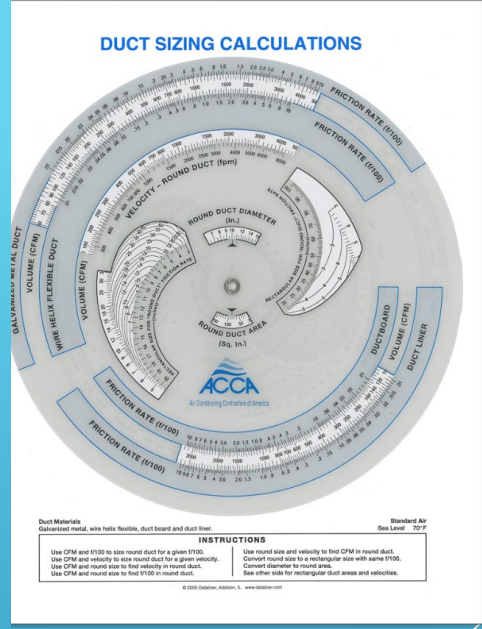
Manual J8 load required for design.

ASHRAE 62.2 should be used. Preferably with a fan powered ERV or HRV for energy savings and volume control.

Manual S equipment selection should be used closer to the 95% sizing value than to the higher values allowed.

Manual D final numbers for duct design are modified for full airflow distribution thus, exceeding Manual D's minimum duct sizing requirements.

MANUAL D DUCT DESIGN UPGRADE



Duct design programs do not have a way for the designer to allow 90% of the airflow into one zone at a time. The solution is to do a traditional Manual D for each zone's supply and return duct runs that allows for 90% of the designed airflow.

Finally, to ensure comfortable airflow the supply diffusers and return grills should be sized based on the final duct size for the rooms in the zone.

EXAMPLE BELOW FOR 2-TON OEM 800 CFM SYSTEM PROVIDING 720 CFM TO ZONES *(MANUAL D SPEEDSHEET)*

Friction Rate Worksheet			
Step 1) Manufacturer's Blower Data			
	External static pressure (ESP)	0.5	IWC
	CFM from manufacturers tables	Heating	Cooling
		720	720
	Fan Speed	Med	Med

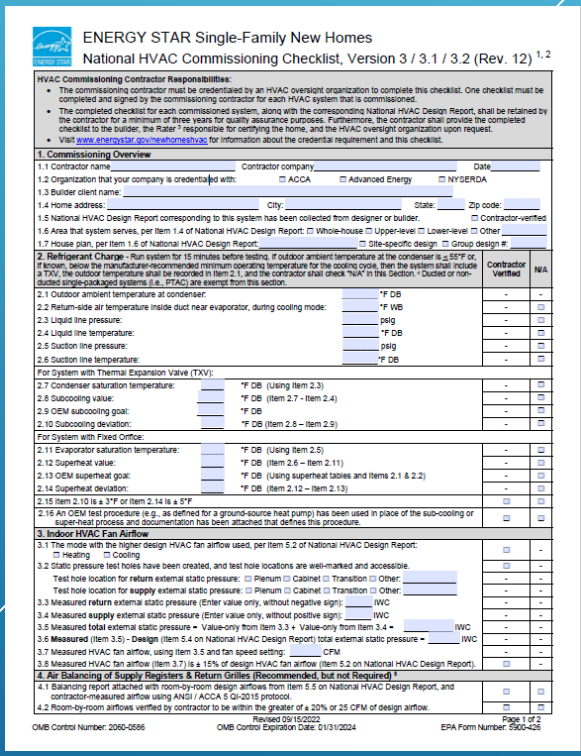
ACCA Manual D, 3rd Edition (D3) -- Residential Duct Systems, 2009 - 2016 (Worksheet 1)

		Supply-side Runouts								Equivilent Rect. Duct		Equivilent
ID	Room ID	H-Btuh	C-Btuh	Htg Cfm	Clg Cfm	Dsn Cfm	Round Size	Velocity	Final Size	Height	Width	Flex
SR-1	GR&K	21600	21600	720	720	720	12	917	13			12
SR-2	MBR & Den											
SR-3	BR 2 &BR 3											
SR-4												

Note: FROM OEM TABLE 800 CFM × 0.9 = 720 CFM

FAZS™ CONTROL DEVELOPED FOR ES USE

As Technical Service Manager at ACCA for over 12 years Don Prather worked on all of the codes and standards related to residential and light commercial HVAC applications. He was on the committee that helped in the creation of the ES HVAC commissioning check list. He also worked with the groups that developed the rater field check list. The ES reports and check lists work well when recording FAZS™ information.



ENERGY STAR Single-Family New Homes
National HVAC Commissioning Checklist, Version 3 / 3.1 / 3.2 (Rev. 12) [1,2]

HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist. One checklist must be completed and signed by the commissioning contractor for each HVAC system that is commissioned.
- The completed checklist for each commissioned system, along with the corresponding National HVAC Design Report, shall be retained by the contractor for a minimum of three years for quality assurance purposes. Furthermore, the contractor shall provide the completed checklist to the builder, the Rater [3] responsible for certifying the home, and the HVAC oversight organization upon request.
- Visit www.energystar.gov/newhomeshvac for information about the credential requirement and this checklist.

1. Commissioning Overview

1.1 Contractor name_____ Contractor company_____ Date_____
1.2 Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy ☐ NYSERDA
1.3 Builder client name: _____
1.4 Home address: _____ City: _____ State: ____ Zip code: ____
1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder. ☐ Contractor-verified
1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other _____
1.7 House plan, per Item 1.6 of National HVAC Design Report: _____ ☐ Site-specific design ☐ Group design #: _____

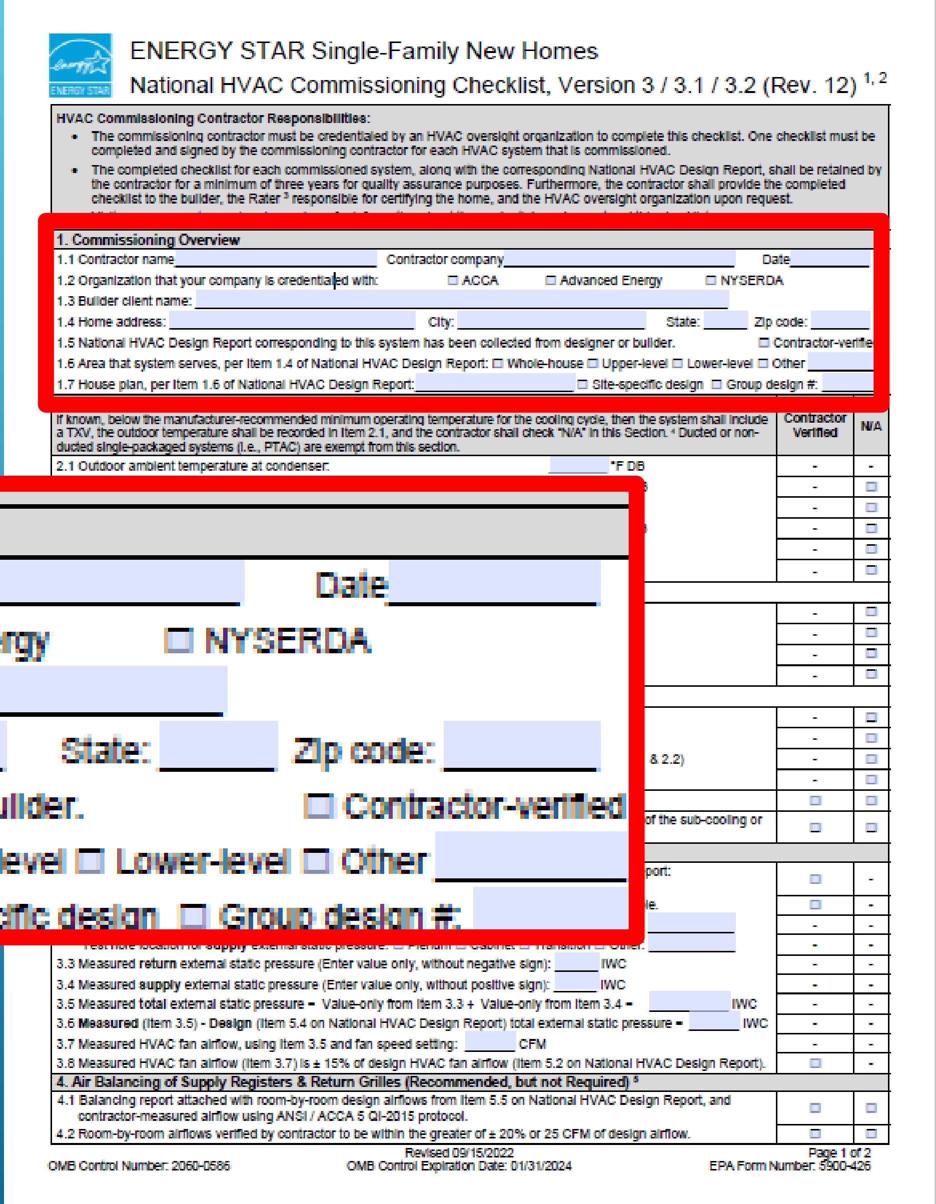
2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≥ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section.			Contractor Verified	N/A
2.1 Outdoor ambient temperature at condenser:	____	°F DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode:	____	°F WB	-	☐
2.3 Liquid line pressure:	____	psig	-	☐
2.4 Liquid line temperature:	____	°F DB	-	☐
2.5 Suction line pressure:	____	psig	-	☐
2.6 Suction line temperature:	____	°F DB	-	☐
For System with Thermal Expansion Valve (TXV):				
2.7 Condenser saturation temperature:	____	°F DB (Using Item 2.3)	-	☐
2.8 Subcooling value:	____	°F DB (Item 2.7 – Item 2.4)	-	☐
2.9 OEM subcooling goal:	____	°F DB	-	☐
2.10 Subcooling deviation:	____	°F DB (Item 2.8 – Item 2.9)	-	☐
For System with Fixed Orifice:				
2.11 Evaporator saturation temperature:	____	°F DB (Using Item 2.5)	-	☐
2.12 Superheat value:	____	°F DB (Item 2.6 – Item 2.11)	-	☐
2.13 OEM superheat goal:	____	°F DB (Using superheat tables and Items 2.1 & 2.2)	-	☐
2.14 Superheat deviation:	____	°F DB (Item 2.12 – Item 2.13)	-	☐
2.15 Item 2.10 is ± 3°F or Item 2.14 is ± 5°F			☐	☐
2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the sub-cooling or superheat process and documentation has been attached that defines this procedure.			☐	☐
3. Indoor HVAC Fan Airflow				
3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of National HVAC Design Report: ☐ Heating ☐ Cooling			☐	-
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.			☐	-
Test hole location for **return** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____			-	-
Test hole location for **supply** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____			-	-
3.3 Measured **return** external static pressure (Enter value only, without negative sign):	____	IWC	-	-
3.4 Measured **supply** external static pressure (Enter value only, without positive sign):	____	IWC	-	-
3.5 Measured **total** external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 =	_____	IWC	-	-
3.6 **Measured** (Item 3.5) - **Design** (Item 5.4 on National HVAC Design Report) total external static pressure =	____	IWC	-	-
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting:	____	CFM	-	-
3.8 Measured HVAC fan airflow (Item 3.7) is ± 15% of design HVAC fan airflow (Item 5.2 on National HVAC Design Report).			☐	-
4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) [4]				
4.1 Balancing report attached with room-by-room design airflows from Item 5.5 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol.			☐	☐
4.2 Room-by-room airflows verified by contractor to be within the greater of ± 20% or 25 CFM of design airflow.			☐	☐

Revised 09/16/2022 Page 1 of 2
OMB Control Number: 2060-0586 OMB Control Expiration Date: 01/31/2024 EPA Form Number: 5900-426

ENERGY STAR NATIONAL HVAC COMMISSIONING SINGLE-FAMILY CHECKLIST (1)

Section 1: No change for a FAZS™

1.6 Filled in for the area of all three Zones.



ENERGY STAR Single-Family New Homes
National HVAC Commissioning Checklist, Version 3 / 3.1 / 3.2 (Rev. 12) [1, 2]

HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist. One checklist must be completed and signed by the commissioning contractor for each HVAC system that is commissioned.
- The completed checklist for each commissioned system, along with the corresponding National HVAC Design Report, shall be retained by the contractor for a minimum of three years for quality assurance purposes. Furthermore, the contractor shall provide the completed checklist to the builder, the Rater [3] responsible for certifying the home, and the HVAC oversight organization upon request.

1. Commissioning Overview

1.1 Contractor name ____ Contractor company ____ Date ____
1.2 Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy ☐ NYSERDA
1.3 Builder client name: ____
1.4 Home address: ____ City: ____ State: ____ Zip code: ____
1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder. ☐ Contractor-verified
1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other ____
1.7 House plan, per Item 1.6 of National HVAC Design Report: ____ ☐ Site-specific design ☐ Group design #: ____

If known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section. | Contractor Verified | N/A

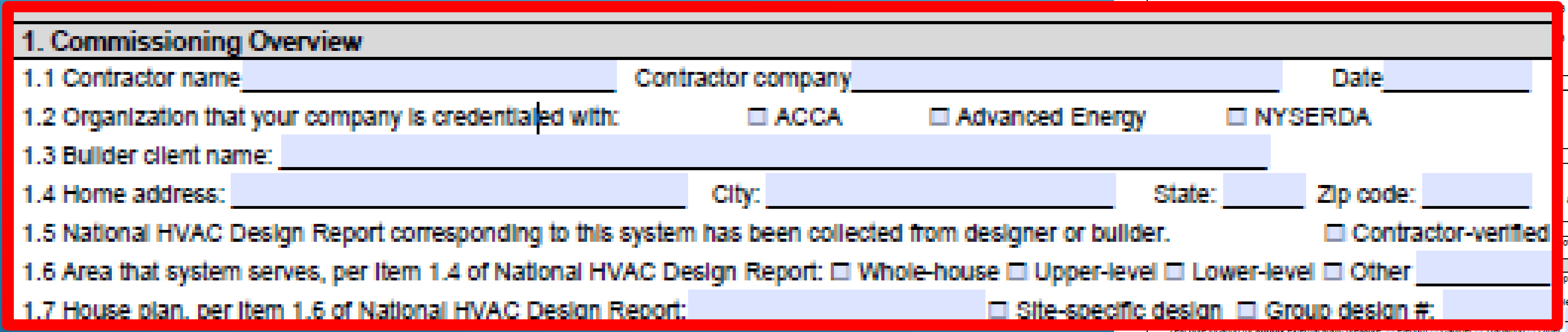
2.1 Outdoor ambient temperature at condenser: ____ °F DB

3.3 Measured return external static pressure (Enter value only, without negative sign): ____ IWC
3.4 Measured supply external static pressure (Enter value only, without positive sign): ____ IWC
3.5 Measured total external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = ____ IWC
3.6 Measured (Item 3.5) - Design (Item 5.4 on National HVAC Design Report) total external static pressure = ____ IWC
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: ____ CFM
3.8 Measured HVAC fan airflow (Item 3.7) is ± 15% of design HVAC fan airflow (Item 5.2 on National HVAC Design Report).

4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) [5]

4.1 Balancing report attached with room-by-room design airflows from Item 5.5 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol.
4.2 Room-by-room airflows verified by contractor to be within the greater of ± 20% or 25 CFM of design airflow.

OMB Control Number: 2060-0586 | Revised 09/15/2022 OMB Control Expiration Date: 01/31/2024 | Page 1 of 2 EPA Form Number: 5900-426



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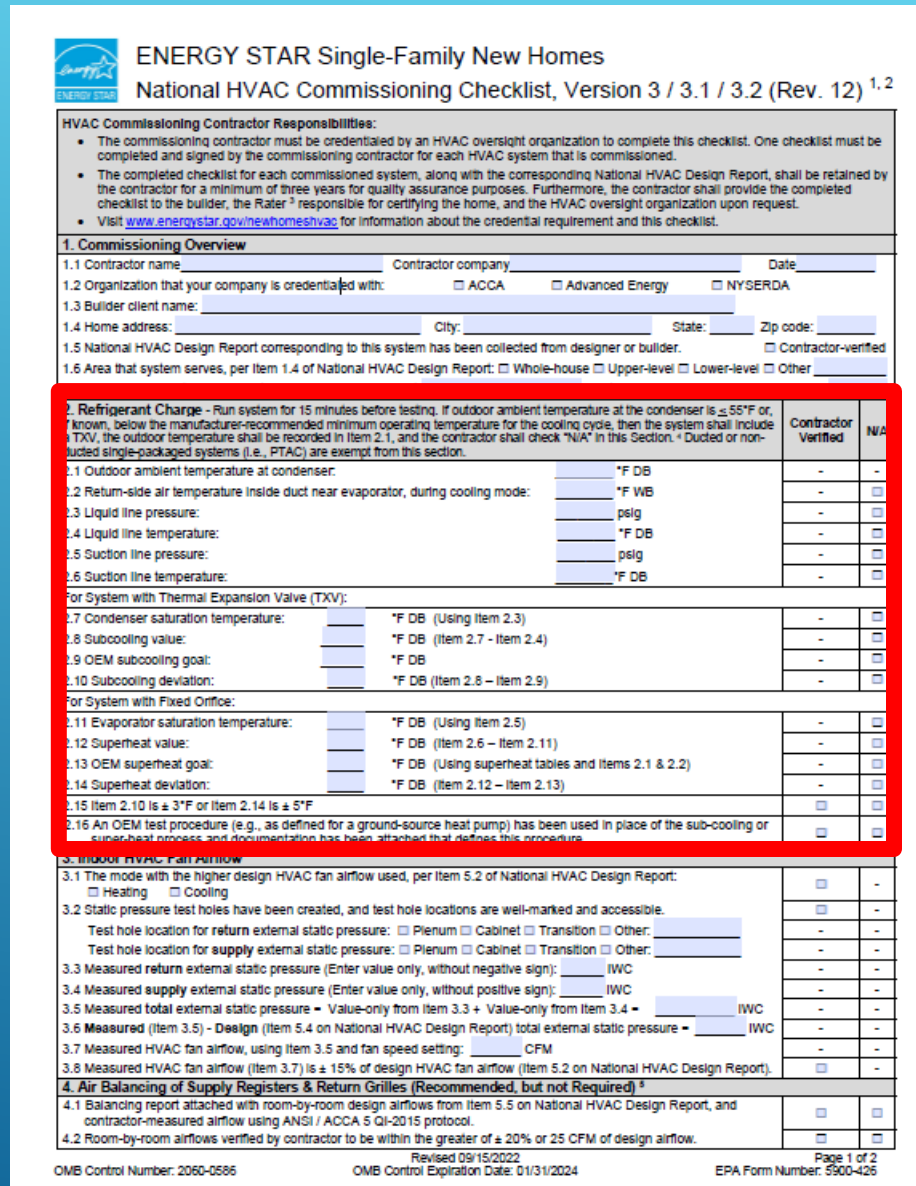
1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other ____
1.7 House plan, per Item 1.6 of National HVAC Design Report: ____ ☐ Site-specific design ☐ Group design #: ____

ENERGY STAR NATIONAL HVAC COMMISSIONING SINGLE-FAMILY CHECKLIST (2)

Section 2: No change for a FAZS™ Take measurements with Zone that has the highest ESP operating.

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section.			Contractor Verified	N/A
2.1 Outdoor ambient temperature at condenser:	_____	°F DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode:	_____	°F WB	-	☐
2.3 Liquid line pressure:	_____	psig	-	☐
2.4 Liquid line temperature:	_____	°F DB	-	☐
2.5 Suction line pressure:	_____	psig	-	☐
2.6 Suction line temperature:	_____	°F DB	-	☐
For System with Thermal Expansion Valve (TXV):				
2.7 Condenser saturation temperature:	____	°F DB (Using Item 2.3)	-	☐
2.8 Subcooling value:	____	°F DB (Item 2.7 - Item 2.4)	-	☐
2.9 OEM subcooling goal:	____	°F DB	-	☐
2.10 Subcooling deviation:	____	°F DB (Item 2.8 – Item 2.9)	-	☐
For System with Fixed Orifice:				
2.11 Evaporator saturation temperature:	____	°F DB (Using Item 2.5)	-	☐
2.12 Superheat value:	____	°F DB (Item 2.6 – Item 2.11)	-	☐
2.13 OEM superheat goal:	____	°F DB (Using superheat tables and Items 2.1 & 2.2)	-	☐
2.14 Superheat deviation:	____	°F DB (Item 2.12 – Item 2.13)	-	☐
2.15 Item 2.10 is ± 3°F or Item 2.14 is ± 5°F			☐	☐
2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the sub-cooling or super-heat process and documentation has been attached that defines this procedure.			☐	☐



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National HVAC Commissioning Checklist, Version 3 / 3.1 / 3.2 (Rev. 12) [1, 2]

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1.1 Contractor name_____ Contractor company_____ Date_____

1.2 Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy ☐ NYSERDA

1.3 Builder client name: _____

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

1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder. ☐ Contractor-verified

1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other _____

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section.			Contractor Verified	N/A
2.1 Outdoor ambient temperature at condenser:	_____	°F DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode:	_____	°F WB	-	☐
2.3 Liquid line pressure:	_____	psig	-	☐
2.4 Liquid line temperature:	_____	°F DB	-	☐
2.5 Suction line pressure:	_____	psig	-	☐
2.6 Suction line temperature:	_____	°F DB	-	☐
For System with Thermal Expansion Valve (TXV):				
2.7 Condenser saturation temperature:	____	°F DB (Using Item 2.3)	-	☐
2.8 Subcooling value:	____	°F DB (Item 2.7 - Item 2.4)	-	☐
2.9 OEM subcooling goal:	____	°F DB	-	☐
2.10 Subcooling deviation:	____	°F DB (Item 2.8 – Item 2.9)	-	☐
For System with Fixed Orifice:				
2.11 Evaporator saturation temperature:	____	°F DB (Using Item 2.5)	-	☐
2.12 Superheat value:	____	°F DB (Item 2.6 – Item 2.11)	-	☐
2.13 OEM superheat goal:	____	°F DB (Using superheat tables and Items 2.1 & 2.2)	-	☐
2.14 Superheat deviation:	____	°F DB (Item 2.12 – Item 2.13)	-	☐
2.15 Item 2.10 is ± 3°F or Item 2.14 is ± 5°F			☐	☐
2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the sub-cooling or super-heat process and documentation has been attached that defines this procedure.			☐	☐

3. Indoor HVAC Fan Airflow

3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of National HVAC Design Report: ☐ Heating ☐ Cooling	☐	-
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.	☐	-
Test hole location for **return** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
Test hole location for **supply** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
3.3 Measured **return** external static pressure (Enter value only, without negative sign): _____ IWC	-	-
3.4 Measured **supply** external static pressure (Enter value only, without positive sign): _____ IWC	-	-
3.5 Measured **total** external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = _____ IWC	-	-
3.6 **Measured** (Item 3.5) - **Design** (Item 5.4 on National HVAC Design Report) total external static pressure = _____ IWC	-	-
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM	-	-
3.8 Measured HVAC fan airflow (Item 3.7) is ± 15% of design HVAC fan airflow (Item 5.2 on National HVAC Design Report).	☐	-

4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) [5]

4.1 Balancing report attached with room-by-room design airflows from Item 5.5 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol.	☐	☐
4.2 Room-by-room airflows verified by contractor to be within the greater of ± 20% or 25 CFM of design airflow.	☐	☐

ENERGY STAR NATIONAL HVAC COMMISSIONING SINGLE-FAMILY CHECKLIST (3)

Section 3: No change for a FAZS™
Note: For clarity write on sheet the Number for the zone tested.

ENERGY STAR Single-Family New Homes
National HVAC Commissioning Checklist, Version 3 / 3.1 / 3.2 (Rev. 12) [1, 2]

HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist. One checklist must be completed and signed by the commissioning contractor for each HVAC system that is commissioned.
- The completed checklist for each commissioned system, along with the corresponding National HVAC Design Report, shall be retained by the contractor for a minimum of three years for quality assurance purposes. Furthermore, the contractor shall provide the completed checklist to the builder, the Rater [3] responsible for certifying the home, and the HVAC oversight organization upon request.
- Visit www.energystar.gov/newhomeshvac for information about the credential requirement and this checklist.

1. Commissioning Overview

1.1 Contractor name _____ Contractor company _____ Date _____
1.2 Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy ☐ NYSERDA
1.3 Builder client name: _____
1.4 Home address: _____ City: _____ State: _____ Zip code: _____
1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder. ☐ Contractor-verified
1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other _____
1.7 House plan, per Item 1.6 of National HVAC Design Report: _____ ☐ Site-specific design ☐ Group design #: _____

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section.

	Contractor Verified	N/A

3. Indoor HVAC Fan Airflow

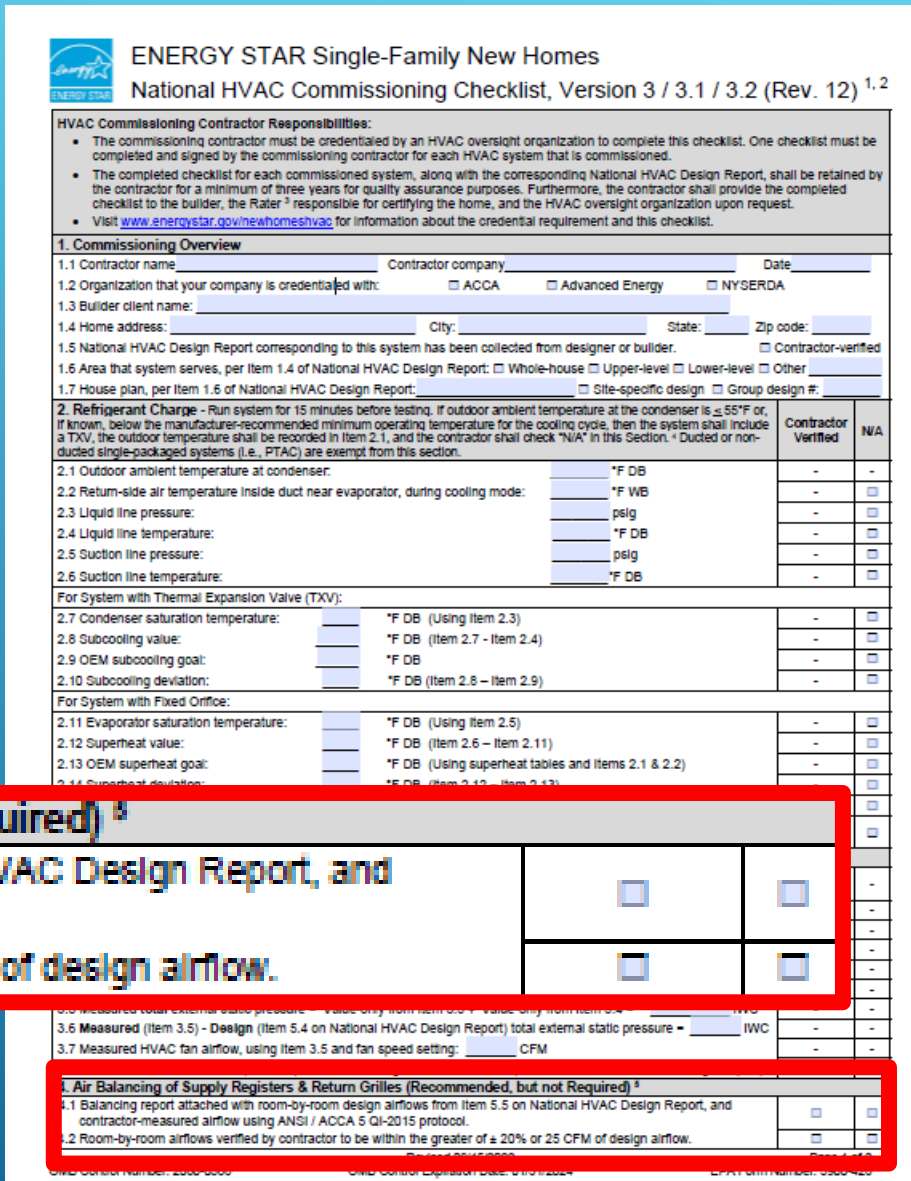
3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of National HVAC Design Report: ☐ Heating ☐ Cooling	☐	-
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.	☐	-
Test hole location for **return** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
Test hole location for **supply** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
3.3 Measured **return** external static pressure (Enter value only, without negative sign): _____ IWC	-	-
3.4 Measured **supply** external static pressure (Enter value only, without positive sign): _____ IWC	-	-
3.5 Measured **total** external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = _____ IWC	-	-
3.6 **Measured** (Item 3.5) - **Design** (Item 5.4 on National HVAC Design Report) total external static pressure = _____ IWC	-	-
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM	-	-
3.8 Measured HVAC fan airflow (Item 3.7) is ± 15% of design HVAC fan airflow (Item 5.2 on National HVAC Design Report).	☐	-

Zone 2 on

ENERGY STAR NATIONAL HVAC COMMISSIONING SINGLE-FAMILY CHECKLIST (4)

Section 4: No change for a FAZS™

Each room in a zone must have a return path and should have the correct proportional amount of airflow.



ENERGY STAR Single-Family New Homes
National HVAC Commissioning Checklist, Version 3 / 3.1 / 3.2 (Rev. 12) [1, 2]

HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist. One checklist must be completed and signed by the commissioning contractor for each HVAC system that is commissioned.
- The completed checklist for each commissioned system, along with the corresponding National HVAC Design Report, shall be retained by the contractor for a minimum of three years for quality assurance purposes. Furthermore, the contractor shall provide the completed checklist to the builder, the Rater [3] responsible for certifying the home, and the HVAC oversight organization upon request.
- Visit www.energystar.gov/newhomeshvac for information about the credential requirement and this checklist.

1. Commissioning Overview

1.1 Contractor name _____ Contractor company _____ Date _____

1.2 Organization that your company is credentialed with: ☐ ACCA ☐ Advanced Energy ☐ NYSERDA

1.3 Builder client name: _____

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

1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder. ☐ Contractor-verified

1.6 Area that system serves, per Item 1.4 of National HVAC Design Report: ☐ Whole-house ☐ Upper-level ☐ Lower-level ☐ Other _____

1.7 House plan, per Item 1.6 of National HVAC Design Report: _____ ☐ Site-specific design ☐ Group design #: _____

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. [4] Ducted or non-ducted single-packaged systems (i.e., PTAC) are exempt from this section.		Contractor Verified	N/A
2.1 Outdoor ambient temperature at condenser:	_____ °F DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode:	_____ °F WB	-	☐
2.3 Liquid line pressure:	_____ psig	-	☐
2.4 Liquid line temperature:	_____ °F DB	-	☐
2.5 Suction line pressure:	_____ psig	-	☐
2.6 Suction line temperature:	_____ °F DB	-	☐
For System with Thermal Expansion Valve (TXV):			
2.7 Condenser saturation temperature:	____ °F DB (Using Item 2.3)	-	☐
2.8 Subcooling value:	____ °F DB (Item 2.7 - Item 2.4)	-	☐
2.9 OEM subcooling goal:	____ °F DB	-	☐
2.10 Subcooling deviation:	____ °F DB (Item 2.8 – Item 2.9)	-	☐
For System with Fixed Orifice:			
2.11 Evaporator saturation temperature:	____ °F DB (Using Item 2.5)	-	☐
2.12 Superheat value:	____ °F DB (Item 2.6 – Item 2.11)	-	☐
2.13 OEM superheat goal:	____ °F DB (Using superheat tables and Items 2.1 & 2.2)	-	☐

3.6 **Measured** (Item 3.5) - **Design** (Item 5.4 on National HVAC Design Report) total external static pressure = _____ IWC - -

3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM - -

4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) [5]

4.1 Balancing report attached with room-by-room design airflows from Item 5.5 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol. ☐ ☐

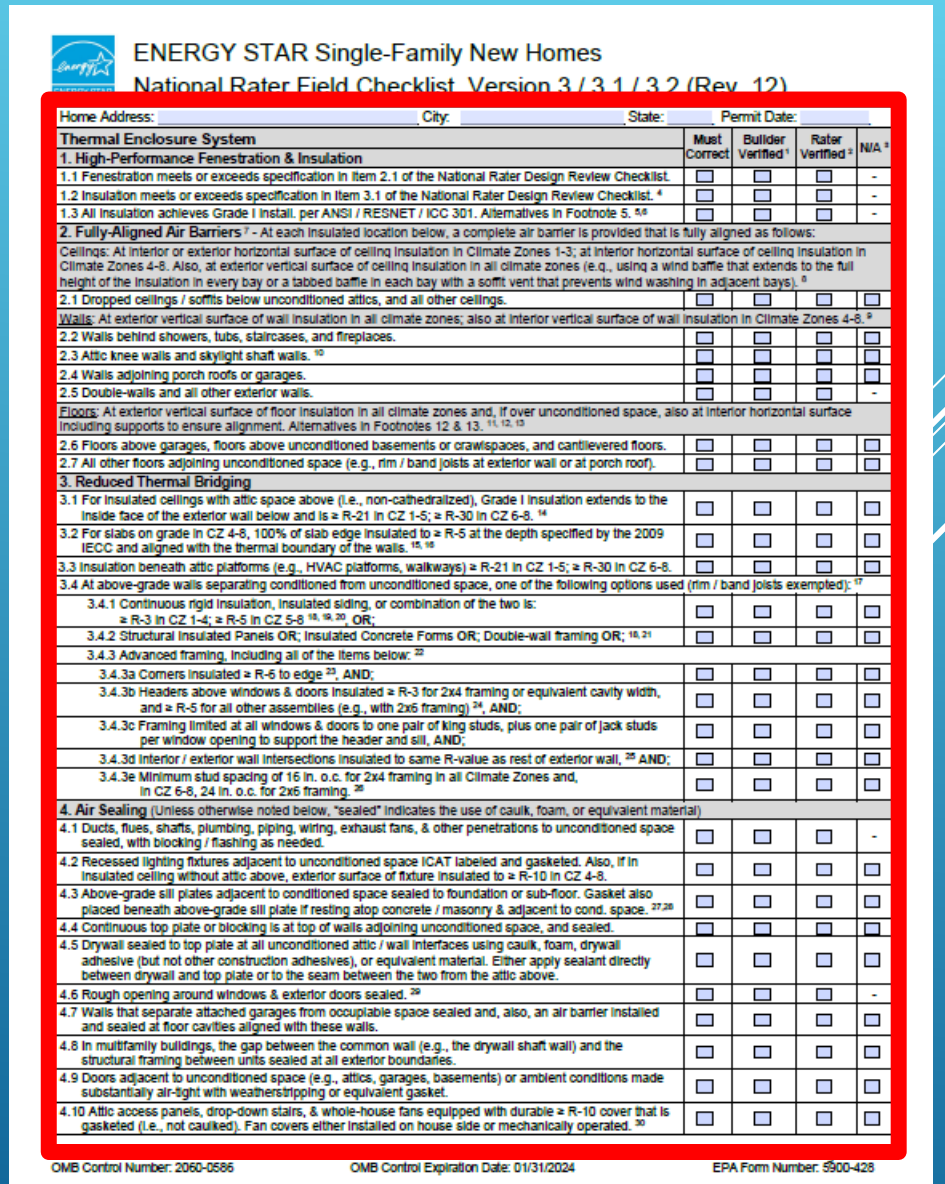
4.2 Room-by-room airflows verified by contractor to be within the greater of ± 20% or 25 CFM of design airflow. ☐ ☐

Commissioning Sheet Completed

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL RATER FIELD CHECKLIST (1)

Sections 1-4 on page 1:

No change for a FAZS™



ENERGY STAR Single-Family New Homes
National Rater Field Checklist, Version 3 / 3.1 / 3.2 (Rev. 12)

Home Address: City: State: Permit Date:

Thermal Enclosure System	Must Correct	Builder Verified [1]	Rater Verified [2]	N/A [3]
1. High-Performance Fenestration & Insulation				
1.1 Fenestration meets or exceeds specification in Item 2.1 of the National Rater Design Review Checklist.	☐	☐	☐	-
1.2 Insulation meets or exceeds specification in Item 3.1 of the National Rater Design Review Checklist. [4]	☐	☐	☐	-
1.3 All insulation achieves Grade I install. per ANSI / RESNET / ICC 301. Alternatives in Footnote 5. [5,6]	☐	☐	☐	-
2. Fully-Aligned Air Barriers [7] - At each insulated location below, a complete air barrier is provided that is fully aligned as follows:				
Ceilings: At interior or exterior horizontal surface of ceiling insulation in Climate Zones 1-3; at interior horizontal surface of ceiling insulation in Climate Zones 4-8. Also, at exterior vertical surface of ceiling insulation in all climate zones (e.g., using a wind baffle that extends to the full height of the insulation in every bay or a tabbed baffle in each bay with a soffit vent that prevents wind washing in adjacent bays). [8]				
2.1 Dropped ceilings / soffits below unconditioned attics, and all other ceilings.	☐	☐	☐	☐
Walls: At exterior vertical surface of wall insulation in all climate zones; also at interior vertical surface of wall insulation in Climate Zones 4-8. [9]				
2.2 Walls behind showers, tubs, staircases, and fireplaces.	☐	☐	☐	☐
2.3 Attic knee walls and skylight shaft walls. [10]	☐	☐	☐	☐
2.4 Walls adjoining porch roofs or garages.	☐	☐	☐	☐
2.5 Double-walls and all other exterior walls.	☐	☐	☐	-
Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. Alternatives in Footnotes 12 & 13. [11,12,13]				
2.6 Floors above garages, floors above unconditioned basements or crawlspaces, and cantilevered floors.	☐	☐	☐	☐
2.7 All other floors adjoining unconditioned space (e.g., rim / band joists at exterior wall or at porch roof).	☐	☐	☐	☐
3. Reduced Thermal Bridging				
3.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below and is ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8. [14]	☐	☐	☐	☐
3.2 For slabs on grade in CZ 4-8, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with the thermal boundary of the walls. [15,16]	☐	☐	☐	☐
3.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1-5; ≥ R-30 in CZ 6-8.	☐	☐	☐	☐
3.4 At above-grade walls separating conditioned from unconditioned space, one of the following options used (rim / band joists exempted): [17]				
3.4.1 Continuous rigid insulation, insulated siding, or combination of the two is: ≥ R-3 in CZ 1-4; ≥ R-5 in CZ 5-8 [18,19,20], OR;	☐	☐	☐	☐
3.4.2 Structural Insulated Panels OR; Insulated Concrete Forms OR; Double-wall framing OR; [18,21]	☐	☐	☐	☐
3.4.3 Advanced framing, including all of the items below: [22]				
3.4.3a Corners insulated ≥ R-6 to edge [23], AND;	☐	☐	☐	☐
3.4.3b Headers above windows & doors insulated ≥ R-3 for 2x4 framing or equivalent cavity width, and ≥ R-5 for all other assemblies (e.g., with 2x6 framing) [24], AND;	☐	☐	☐	☐
3.4.3c Framing limited at all windows & doors to one pair of king studs, plus one pair of jack studs per window opening to support the header and sill, AND;	☐	☐	☐	☐
3.4.3d Interior / exterior wall intersections insulated to same R-value as rest of exterior wall, [25] AND;	☐	☐	☐	☐
3.4.3e Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in CZ 6-8, 24 in. o.c. for 2x6 framing. [26]	☐	☐	☐	☐
4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material)				
4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed.	☐	☐	☐	-
4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to ≥ R-10 in CZ 4-8.	☐	☐	☐	☐
4.3 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete / masonry & adjacent to cond. space. [27,28]	☐	☐	☐	☐
4.4 Continuous top plate or blocking is at top of walls adjoining unconditioned space, and sealed.	☐	☐	☐	☐
4.5 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above.	☐	☐	☐	☐
4.6 Rough opening around windows & exterior doors sealed. [29]	☐	☐	☐	-
4.7 Walls that separate attached garages from occupiable space sealed and, also, an air barrier installed and sealed at floor cavities aligned with these walls.	☐	☐	☐	☐
4.8 In multifamily buildings, the gap between the common wall (e.g., the drywall shaft wall) and the structural framing between units sealed at all exterior boundaries.	☐	☐	☐	☐
4.9 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with weatherstripping or equivalent gasket.	☐	☐	☐	☐
4.10 Attic access panels, drop-down stairs, & whole-house fans equipped with durable ≥ R-10 cover that is gasketed (i.e., not caulked). Fan covers either installed on house side or mechanically operated. [30]	☐	☐	☐	☐

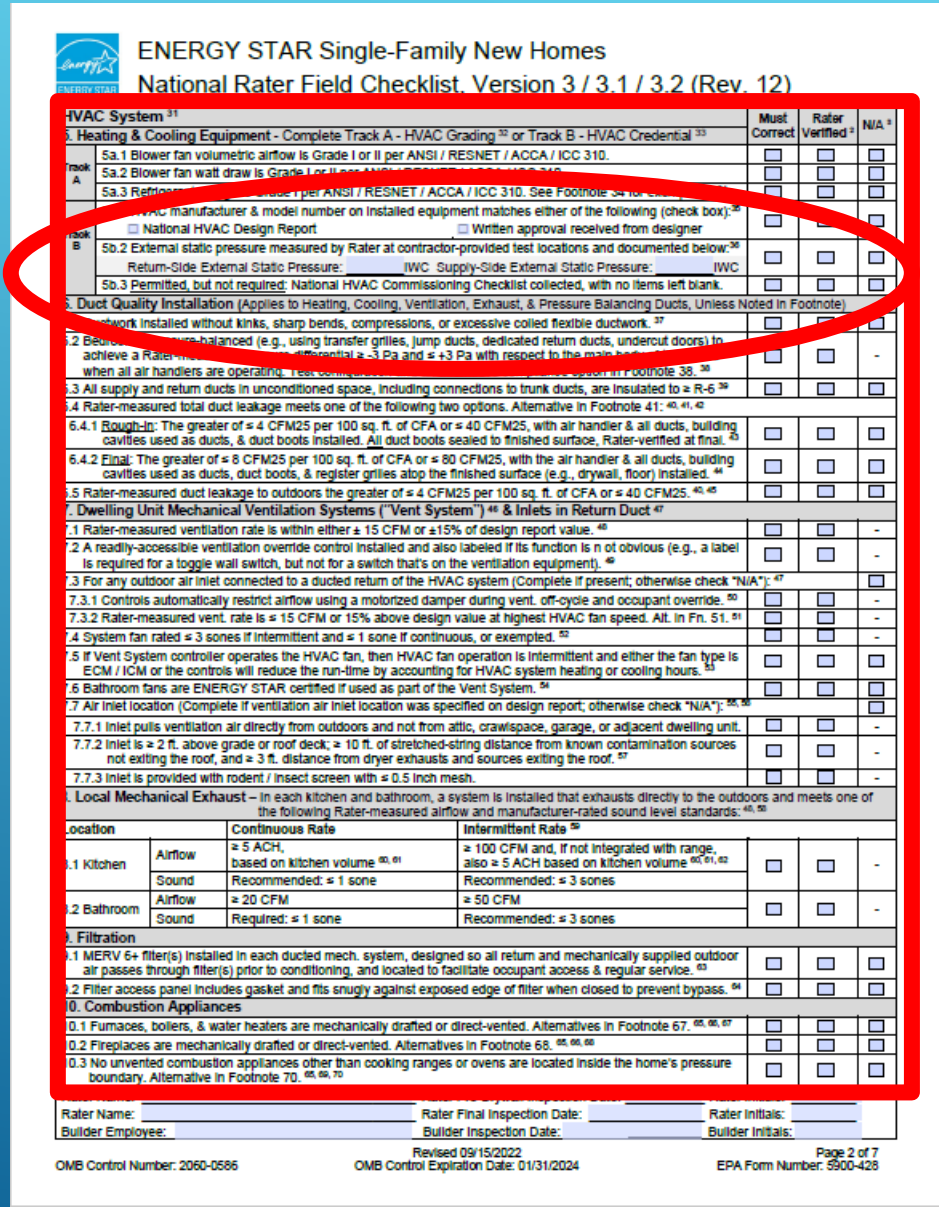
OMB Control Number: 2060-0586 OMB Control Expiration Date: 01/31/2024 EPA Form Number: 5900-428

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL RATER FIELD CHECKLIST (2)

Sections 2-10 on page 2:

No change for a FAZS™

Note: For Section 5 Track B ESP should be measured in the mode used by the HVAC contractor and the zone noted on page one of the contractor's ES report sheet.



ENERGY STAR Single-Family New Homes
National Rater Field Checklist, Version 3 / 3.1 / 3.2 (Rev. 12)

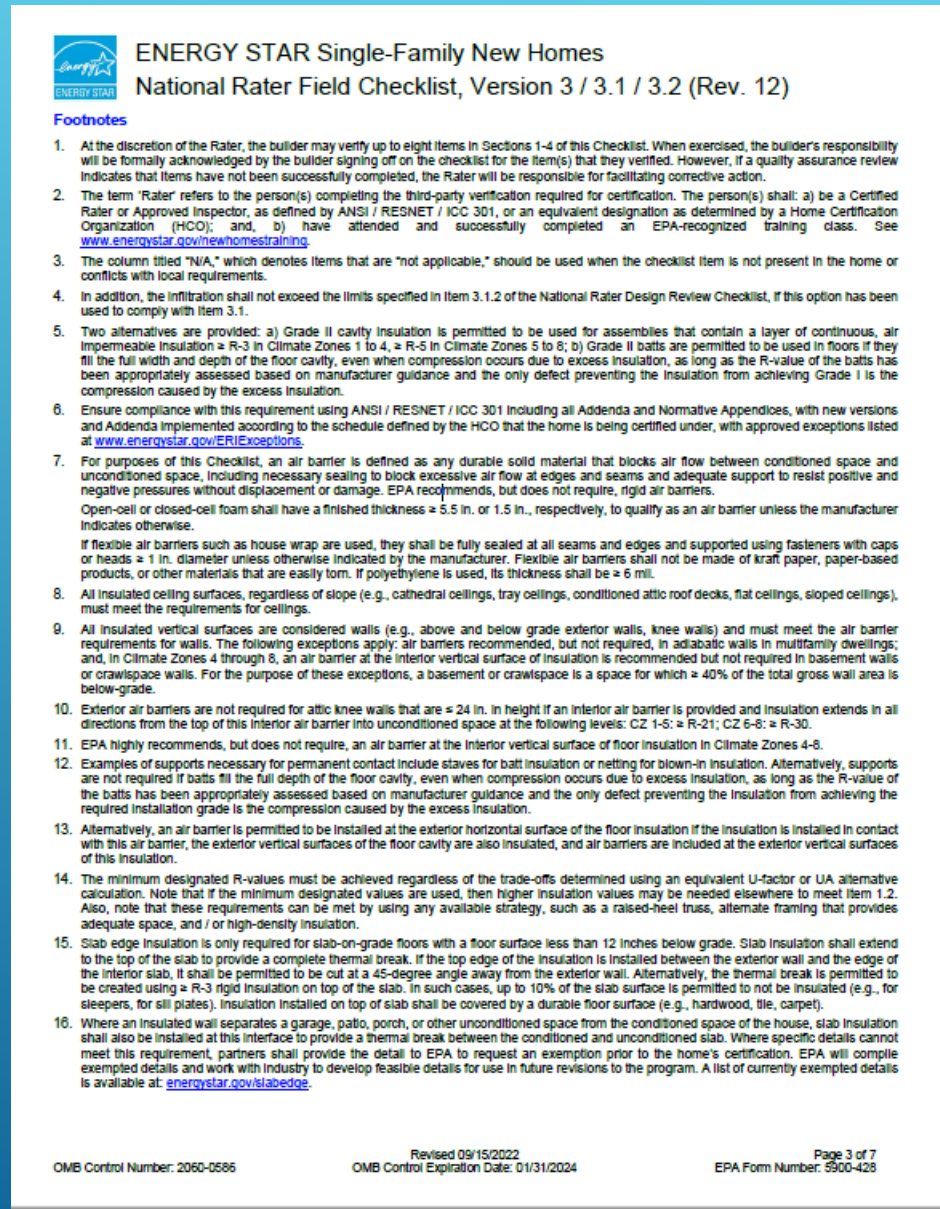
HVAC System [31]		Must Correct	Rater Verified [2]	N/A [3]
5. Heating & Cooling Equipment - Complete Track A - HVAC Grading [32] or Track B - HVAC Credential [33]				
Track A	5a.1 Blower fan volumetric airflow is Grade I or II per ANSI / RESNET / ACCA / ICC 310.	☐	☐	☐
	5a.2 Blower fan watt draw is Grade I or II per ANSI / RESNET / ACCA / ICC 310.	☐	☐	☐
	5a.3 Refrigerant charge is Grade I per ANSI / RESNET / ACCA / ICC 310. See Footnote 34 for [illegible]	☐	☐	☐
Track B	HVAC manufacturer & model number on installed equipment matches either of the following (check box): [35] ☐ National HVAC Design Report ☐ Written approval received from designer	☐	☐	☐
	5b.2 External static pressure measured by Rater at contractor-provided test locations and documented below: [36] Return-Side External Static Pressure: _____ IWC Supply-Side External Static Pressure: _____ IWC	☐	☐	☐
	5b.3 Permitted, but not required: National HVAC Commissioning Checklist collected, with no items left blank.	☐	☐	☐
6. Duct Quality Installation (Applies to Heating, Cooling, Ventilation, Exhaust, & Pressure Balancing Ducts, Unless Noted in Footnote)				
	6.1 Duct network installed without kinks, sharp bends, compressions, or excessive coiled flexible ductwork. [37]	☐	☐	☐
	6.2 Bedroom[illegible] pressure-balanced (e.g., using transfer grilles, jump ducts, dedicated return ducts, undercut doors) to achieve a Rater-[illegible] differential ≥ -3 Pa and ≤ +3 Pa with respect to the main [illegible] when all air handlers are operating. Test conditions [illegible] specified in Footnote 38. [38]	☐	☐	-
	6.3 All supply and return ducts in unconditioned space, including connections to trunk ducts, are insulated to ≥ R-6 [39]	☐	☐	☐
	6.4 Rater-measured total duct leakage meets one of the following two options. Alternative in Footnote 41: [40, 41, 42]			
	6.4.1 Rough-in: The greater of ≤ 4 CFM25 per 100 sq. ft. of CFA or ≤ 40 CFM25, with air handler & all ducts, building cavities used as ducts, & duct boots installed. All duct boots sealed to finished surface, Rater-verified at final. [43]	☐	☐	☐
	6.4.2 Final: The greater of ≤ 8 CFM25 per 100 sq. ft. of CFA or ≤ 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. [44]	☐	☐	☐
	6.5 Rater-measured duct leakage to outdoors the greater of ≤ 4 CFM25 per 100 sq. ft. of CFA or ≤ 40 CFM25. [40, 45]	☐	☐	☐
7. Dwelling Unit Mechanical Ventilation Systems ("Vent System") [46] & Inlets in Return Duct [47]				
	7.1 Rater-measured ventilation rate is within either ± 15 CFM or ±15% of design report value. [48]	☐	☐	-
	7.2 A readily-accessible ventilation override control installed and also labeled if its function is n ot obvious (e.g., a label is required for a toggle wall switch, but not for a switch that's on the ventilation equipment). [49]	☐	☐	-
	7.3 For any outdoor air inlet connected to a ducted return of the HVAC system (Complete if present; otherwise check "N/A"): [47]			☐
	7.3.1 Controls automatically restrict airflow using a motorized damper during vent. off-cycle and occupant override. [50]	☐	☐	-
	7.3.2 Rater-measured vent. rate is ≤ 15 CFM or 15% above design value at highest HVAC fan speed. Alt. in Fn. 51. [51]	☐	☐	-
	7.4 System fan rated ≤ 3 sones if intermittent and ≤ 1 sone if continuous, or exempted. [52]	☐	☐	-
	7.5 If Vent System controller operates the HVAC fan, then HVAC fan operation is intermittent and either the fan type is ECM / ICM or the controls will reduce the run-time by accounting for HVAC system heating or cooling hours. [53]	☐	☐	☐
	7.6 Bathroom fans are ENERGY STAR certified if used as part of the Vent System. [54]	☐	☐	☐
	7.7 Air inlet location (Complete if ventilation air inlet location was specified on design report; otherwise check "N/A"): [55, 56]			☐
	7.7.1 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit.	☐	☐	-
	7.7.2 Inlet is ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources not exiting the roof, and ≥ 3 ft. distance from dryer exhausts and sources exiting the roof. [57]	☐	☐	-
	7.7.3 Inlet is provided with rodent / insect screen with ≤ 0.5 inch mesh.	☐	☐	-
8. Local Mechanical Exhaust – In each kitchen and bathroom, a system is installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: [40, 58]				
Location		Continuous Rate	Intermittent Rate [59]	
8.1 Kitchen	Airflow	≥ 5 ACH, based on kitchen volume [60, 61]	≥ 100 CFM and, if not integrated with range, also ≥ 5 ACH based on kitchen volume [60, 61, 62]	☐ ☐ -
	Sound	Recommended: ≤ 1 sone	Recommended: ≤ 3 sones	
8.2 Bathroom	Airflow	≥ 20 CFM	≥ 50 CFM	☐ ☐ -
	Sound	Required: ≤ 1 sone	Recommended: ≤ 3 sones	
9. Filtration				
	9.1 MERV 6+ filter(s) installed in each ducted mech. system, designed so all return and mechanically supplied outdoor air passes through filter(s) prior to conditioning, and located to facilitate occupant access & regular service. [63]	☐	☐	☐
	9.2 Filter access panel includes gasket and fits snugly against exposed edge of filter when closed to prevent bypass. [64]	☐	☐	☐
10. Combustion Appliances				
	10.1 Furnaces, boilers, & water heaters are mechanically drafted or direct-vented. Alternatives in Footnote 67. [65, 66, 67]	☐	☐	☐
	10.2 Fireplaces are mechanically drafted or direct-vented. Alternatives in Footnote 68. [65, 66, 68]	☐	☐	☐
	10.3 No unvented combustion appliances other than cooking ranges or ovens are located inside the home's pressure boundary. Alternative in Footnote 70. [65, 69, 70]	☐	☐	☐

Rater Name: _____ Rater Final Inspection Date: _____ Rater Initials: _____
Builder Employee: _____ Builder Inspection Date: _____ Builder Initials: _____

ENERGY STAR SINGLE FAMILY NEW HOMES NATIONAL RATER FIELD CHECKLIST (3-7)

Pages 3-7 Footnotes

No change for a FAZS™



ENERGY STAR Single-Family New Homes
National Rater Field Checklist, Version 3 / 3.1 / 3.2 (Rev. 12)

Footnotes

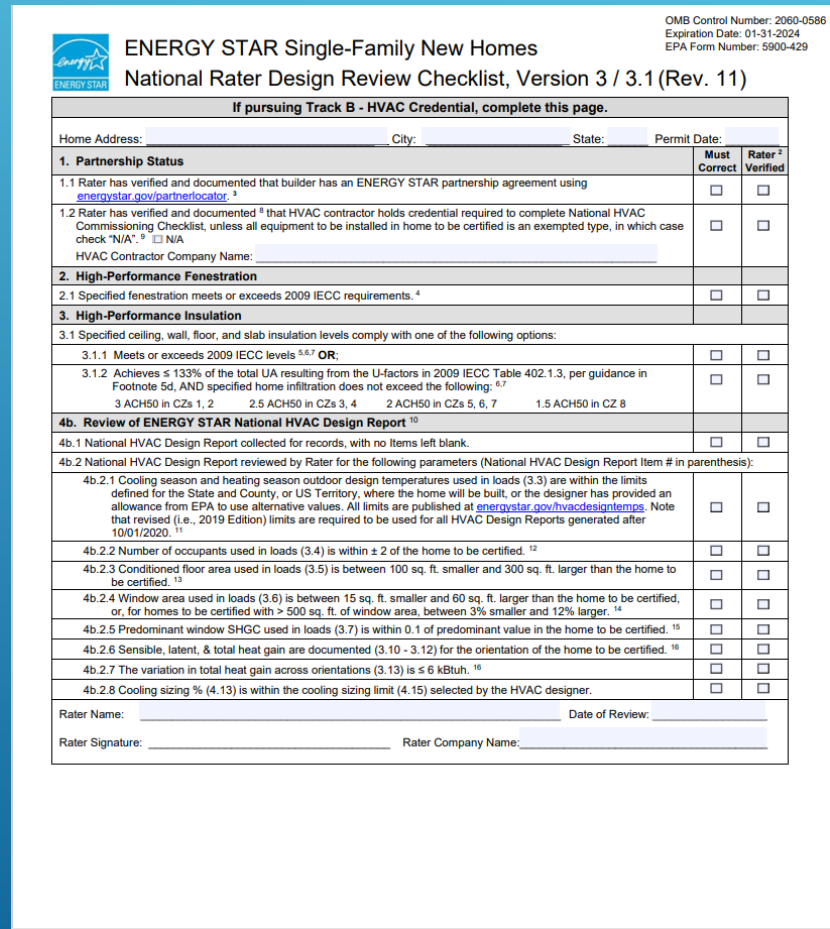
1. At the discretion of the Rater, the builder may verify up to eight items in Sections 1-4 of this Checklist. When exercised, the builder's responsibility will be formally acknowledged by the builder signing off on the checklist for the item(s) that they verified. However, if a quality assurance review indicates that items have not been successfully completed, the Rater will be responsible for facilitating corrective action.
2. 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.
3. The column titled "N/A," which denotes items that are "not applicable," should be used when the checklist item is not present in the home or conflicts with local requirements.
4. In addition, the infiltration shall not exceed the limits specified in Item 3.1.2 of the National Rater Design Review Checklist, if this option has been used to comply with Item 3.1.
5. Two alternatives are provided: a) Grade II cavity insulation is permitted to be used for assemblies that contain a layer of continuous, air impermeable insulation ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8; b) Grade II batts are permitted to be used in floors if they fill the full width and depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving Grade I is the compression caused by the excess insulation.
6. Ensure compliance with this requirement using ANSI / RESNET / ICC 301 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO that the home is being certified under, with approved exceptions listed at www.energystar.gov/ERIExceptions.
7. For purposes of this Checklist, an air barrier is defined as any durable solid material that blocks air flow between conditioned space and unconditioned space, including necessary sealing to block excessive air flow at edges and seams and adequate support to resist positive and negative pressures without displacement or damage. EPA recommends, but does not require, rigid air barriers.

   Open-cell or closed-cell foam shall have a finished thickness ≥ 5.5 in. or 1.5 in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise.

   If flexible air barriers such as house wrap are used, they shall be fully sealed at all seams and edges and supported using fasteners with caps or heads ≥ 1 in. diameter unless otherwise indicated by the manufacturer. Flexible air barriers shall not be made of kraft paper, paper-based products, or other materials that are easily torn. If polyethylene is used, its thickness shall be ≥ 6 mil.
8. All insulated ceiling surfaces, regardless of slope (e.g., cathedral ceilings, tray ceilings, conditioned attic roof decks, flat ceilings, sloped ceilings), must meet the requirements for ceilings.
9. All insulated vertical surfaces are considered walls (e.g., above and below grade exterior walls, knee walls) and must meet the air barrier requirements for walls. The following exceptions apply: air barriers recommended, but not required, in adiabatic walls in multifamily dwellings; and, in Climate Zones 4 through 8, an air barrier at the interior vertical surface of insulation is recommended but not required in basement walls or crawlspace walls. For the purpose of these exceptions, a basement or crawlspace is a space for which ≥ 40% of the total gross wall area is below-grade.
10. Exterior air barriers are not required for attic knee walls that are ≤ 24 in. in height if an interior air barrier is provided and insulation extends in all directions from the top of this interior air barrier into unconditioned space at the following levels: CZ 1-5: ≥ R-21; CZ 6-8: ≥ R-30.
11. EPA highly recommends, but does not require, an air barrier at the interior vertical surface of floor insulation in Climate Zones 4-8.
12. Examples of supports necessary for permanent contact include staves for batt insulation or netting for blown-in insulation. Alternatively, supports are not required if batts fill the full depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving the required installation grade is the compression caused by the excess insulation.
13. Alternatively, an air barrier is permitted to be installed at the exterior horizontal surface of the floor insulation if the insulation is installed in contact with this air barrier, the exterior vertical surfaces of the floor cavity are also insulated, and air barriers are included at the exterior vertical surfaces of this insulation.
14. The minimum designated R-values must be achieved regardless of the trade-offs determined using an equivalent U-factor or UA alternative calculation. Note that if the minimum designated values are used, then higher insulation values may be needed elsewhere to meet Item 1.2. Also, note that these requirements can be met by using any available strategy, such as a raised-heel truss, alternate framing that provides adequate space, and / or high-density insulation.
15. Slab edge insulation is only required for slab-on-grade floors with a floor surface less than 12 inches below grade. Slab insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using ≥ R-3 rigid insulation on top of the slab. In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
16. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the house, slab insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the home's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: energystar.gov/slabedge.

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL RATER DESIGN REVIEW CHECKLIST PAGE 2

No change in how the form is filled out for a FAZS™ controlled home



OMB Control Number: 2060-0586
Expiration Date: 01-31-2024
EPA Form Number: 5900-429

ENERGY STAR Single-Family New Homes
National Rater Design Review Checklist, Version 3 / 3.1 (Rev. 11)

If pursuing Track B - HVAC Credential, complete this page.

Home Address: _____ City: _____ State: _____ Permit Date: _____

1. Partnership Status	**Must Correct**	**Rater [2] Verified**
1.1 Rater has verified and documented that builder has an ENERGY STAR partnership agreement using energystar.gov/partnerlocator. [3]	☐	☐
1.2 Rater has verified and documented [8] that HVAC contractor holds credential required to complete National HVAC Commissioning Checklist, unless all equipment to be installed in home to be certified is an exempted type, in which case check "N/A". [9] ☐ N/A HVAC Contractor Company Name: _____	☐	☐
2. High-Performance Fenestration		
2.1 Specified fenestration meets or exceeds 2009 IECC requirements. [4]	☐	☐
3. High-Performance Insulation		
3.1 Specified ceiling, wall, floor, and slab insulation levels comply with one of the following options:		
3.1.1 Meets or exceeds 2009 IECC levels [5,6,7] **OR**;	☐	☐
3.1.2 Achieves ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, per guidance in Footnote 5d, AND specified home infiltration does not exceed the following: [6,7] 3 ACH50 in CZs 1, 2 2.5 ACH50 in CZs 3, 4 2 ACH50 in CZs 5, 6, 7 1.5 ACH50 in CZ 8	☐	☐
4b. Review of ENERGY STAR National HVAC Design Report [10]		
4b.1 National HVAC Design Report collected for records, with no Items left blank.	☐	☐
4b.2 National HVAC Design Report reviewed by Rater for the following parameters (National HVAC Design Report Item # in parenthesis):		
4b.2.1 Cooling season and heating season outdoor design temperatures used in loads (3.3) are within the limits defined for the State and County, or US Territory, where the home will be built, or the designer has provided an allowance from EPA to use alternative values. All limits are published at energystar.gov/hvacdesigntemps. Note that revised (i.e., 2019 Edition) limits are required to be used for all HVAC Design Reports generated after 10/01/2020. [11]	☐	☐
4b.2.2 Number of occupants used in loads (3.4) is within ± 2 of the home to be certified. [12]	☐	☐
4b.2.3 Conditioned floor area used in loads (3.5) is between 100 sq. ft. smaller and 300 sq. ft. larger than the home to be certified. [13]	☐	☐
4b.2.4 Window area used in loads (3.6) 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. [14]	☐	☐
4b.2.5 Predominant window SHGC used in loads (3.7) is within 0.1 of predominant value in the home to be certified. [15]	☐	☐
4b.2.6 Sensible, latent, & total heat gain are documented (3.10 - 3.12) for the orientation of the home to be certified. [16]	☐	☐
4b.2.7 The variation in total heat gain across orientations (3.13) is ≤ 6 kBtuh. [16]	☐	☐
4b.2.8 Cooling sizing % (4.13) is within the cooling sizing limit (4.15) selected by the HVAC designer.	☐	☐

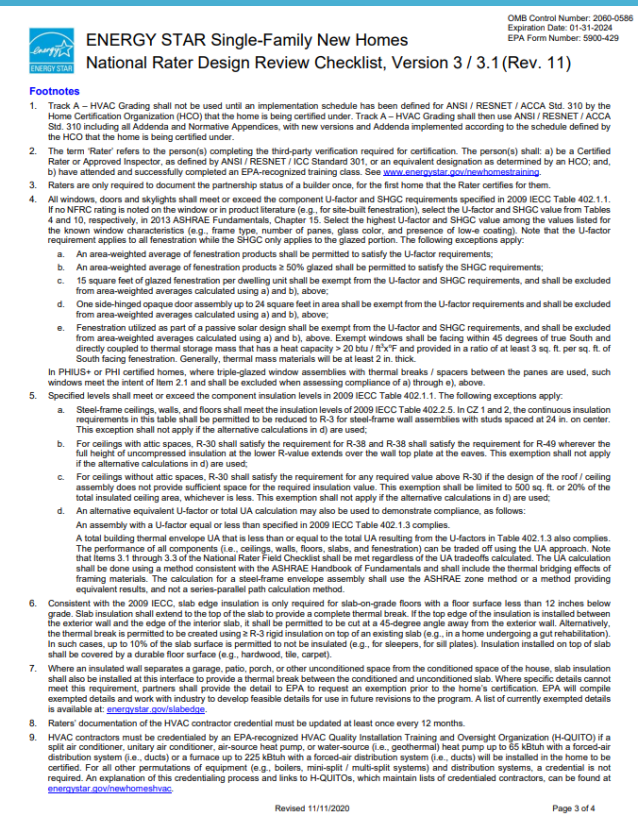
Rater Name: _____ Date of Review: _____

Rater Signature: _____ Rater Company Name: _____

ENERGY STAR SINGLE FAMILY NEW HOMES NATIONAL RATER DESIGN REVIEW CHECKLIST PAGES 3&4

No change in how the form is filled out for a FAZS™ controlled home

Rater new home review finished.



OMB Control Number: 2060-0586
Expiration Date: 01-31-2024
EPA Form Number: 5900-429

ENERGY STAR Single-Family New Homes
National Rater Design Review Checklist, Version 3 / 3.1 (Rev. 11)

Footnotes

1. Track A – HVAC Grading shall not be used until an implementation schedule has been defined for ANSI / RESNET / ACCA Std. 310 by the Home Certification Organization (HCO) that the home is being certified under. Track A – HVAC Grading shall then use ANSI / RESNET / ACCA Std. 310 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO that the home is being certified under.
2. 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 Standard 301, or an equivalent designation as determined by an HCO; and, b) have attended and successfully completed an EPA-recognized training class. See www.energystar.gov/newhomestraining.
3. Raters are only required to document the partnership status of a builder once, for the first home that the Rater certifies for them.
4. All windows, doors and skylights shall meet or exceed the component U-factor and SHGC requirements specified in 2009 IECC Table 402.1.1. If no NFRC rating is noted on the window or in product literature (e.g., for site-built fenestration), select the U-factor and SHGC value from Tables 4 and 10, respectively, in 2013 ASHRAE Fundamentals, Chapter 15. Select the highest U-factor and SHGC value among the values listed for the known window characteristics (e.g., frame type, number of panes, glass color, and presence of low-e coating). Note that the U-factor requirement applies to all fenestration while the SHGC only applies to the glazed portion. The following exceptions apply:
   a. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
   b. An area-weighted average of fenestration products ≥ 50% glazed shall be permitted to satisfy the SHGC requirements;
   c. 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;
   d. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
   e. Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity > 20 btu / ft²x°F and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.

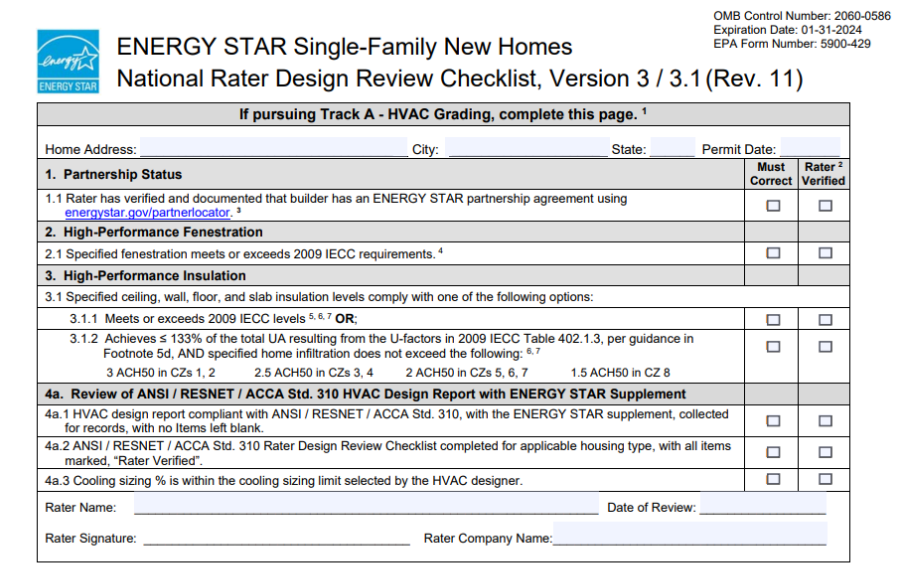
   In PHIUS+ or PHI certified homes, where triple-glazed window assemblies with thermal breaks / spacers between the panes are used, such windows meet the intent of Item 2.1 and shall be excluded when assessing compliance of a) through e), above.
5. Specified levels shall meet or exceed the component insulation levels in 2009 IECC Table 402.1.1. The following exceptions apply:
   a. Steel-frame ceilings, walls, and floors shall meet the insulation levels of 2009 IECC Table 402.2.5. In CZ 1 and 2, the continuous insulation requirements in this table shall be permitted to be reduced to R-3 for steel-frame wall assemblies with studs spaced at 24 in. on center. This exception shall not apply if the alternative calculations in d) are used;
   b. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38 and R-38 shall satisfy the requirement for R-49 wherever the full height of uncompressed insulation at the lower R-value extends over the wall top plate at the eaves. This exemption shall not apply if the alternative calculations in d) are used;
   c. For ceilings without attic spaces, R-30 shall satisfy the requirement for any required value above R-30 if the design of the roof / ceiling assembly does not provide sufficient space for the required insulation value. This exemption shall be limited to 500 sq. ft. or 20% of the total insulated ceiling area, whichever is less. This exemption shall not apply if the alternative calculations in d) are used;
   d. An alternative equivalent U-factor or total UA calculation may also be used to demonstrate compliance, as follows:

      An assembly with a U-factor equal or less than specified in 2009 IECC Table 402.1.3 complies.

      A total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in Table 402.1.3 also complies. The performance of all components (i.e., ceilings, walls, floors, slabs, and fenestration) can be traded off using the UA approach. Note that Items 3.1 through 3.3 of the National Rater Field Checklist shall be met regardless of the UA tradeoffs calculated. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method.
6. Consistent with the 2009 IECC, slab edge insulation is only required for slab-on-grade floors with a floor surface less than 12 inches below grade. Slab insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using ≥ R-3 rigid insulation on top of an existing slab (e.g., in a home undergoing a gut rehabilitation). In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
7. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the house, slab insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the home's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: energystar.gov/slabedge.
8. Raters' documentation of the HVAC contractor credential must be updated at least once every 12 months.
9. HVAC contractors must be credentialed by an EPA-recognized HVAC Quality Installation Training and Oversight Organization (H-QUITO) if a split air conditioner, unitary air conditioner, air-source heat pump, or water-source (i.e., geothermal) heat pump up to 65 kBtuh with a forced-air distribution system (i.e., ducts) or a furnace up to 225 kBtuh with a forced-air distribution system (i.e., ducts) will be installed in the home to be certified. For all other permutations of equipment (e.g., boilers, mini-split / multi-split systems) and distribution systems, a credential is not required. An explanation of this credentialing process and links to H-QUITOs, which maintain lists of credentialed contractors, can be found at energystar.gov/newhomeshvac.

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL RATER DESIGN REVIEW CHECKLIST

No change in how the form is filled out for a FAZS™ controlled home



OMB Control Number: 2060-0586
Expiration Date: 01-31-2024
EPA Form Number: 5900-429

ENERGY STAR Single-Family New Homes
National Rater Design Review Checklist, Version 3 / 3.1 (Rev. 11)

If pursuing Track A - HVAC Grading, complete this page. [1]

Home Address: _____ City: _____ State: _____ Permit Date: _____

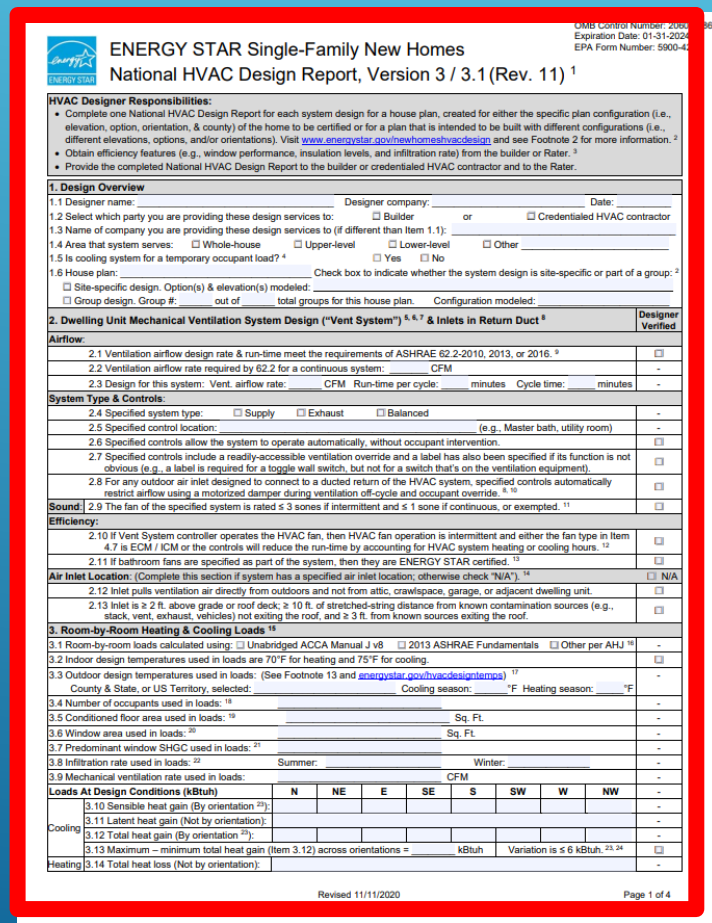
	Must Correct	Rater [2] Verified
1. Partnership Status		
1.1 Rater has verified and documented that builder has an ENERGY STAR partnership agreement using energystar.gov/partnerlocator. [3]	☐	☐
2. High-Performance Fenestration		
2.1 Specified fenestration meets or exceeds 2009 IECC requirements. [4]	☐	☐
3. High-Performance Insulation		
3.1 Specified ceiling, wall, floor, and slab insulation levels comply with one of the following options:		
3.1.1 Meets or exceeds 2009 IECC levels [5, 6, 7] **OR**;	☐	☐
3.1.2 Achieves ≤ 133% of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, per guidance in Footnote 5d, AND specified home infiltration does not exceed the following: [6, 7] 3 ACH50 in CZs 1, 2 2.5 ACH50 in CZs 3, 4 2 ACH50 in CZs 5, 6, 7 1.5 ACH50 in CZ 8	☐	☐
4a. Review of ANSI / RESNET / ACCA Std. 310 HVAC Design Report with ENERGY STAR Supplement		
4a.1 HVAC design report compliant with ANSI / RESNET / ACCA Std. 310, with the ENERGY STAR supplement, collected for records, with no Items left blank.	☐	☐
4a.2 ANSI / RESNET / ACCA Std. 310 Rater Design Review Checklist completed for applicable housing type, with all items marked, "Rater Verified".	☐	☐
4a.3 Cooling sizing % is within the cooling sizing limit selected by the HVAC designer.	☐	☐

Rater Name: _____ Date of Review: _____

Rater Signature: _____ Rater Company Name: _____

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL HVAC DESIGN REPORT PAGE 1 SECTIONS 1-3

No change in how the form is filled out for a FAZS™ controlled home.
Note: For section 3 use the same standard Manual J8 numbers.



OMB Control Number: 2060-0586
Expiration Date: 01-31-2024
EPA Form Number: 5900-424

ENERGY STAR Single-Family New Homes
National HVAC Design Report, Version 3 / 3.1 (Rev. 11) [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: [5]
☐ Site-specific design. Option(s) & elevation(s) modeled: _____
☐ Group design. Group #: _____ out of _____ total groups for this house plan. Configuration modeled: _____

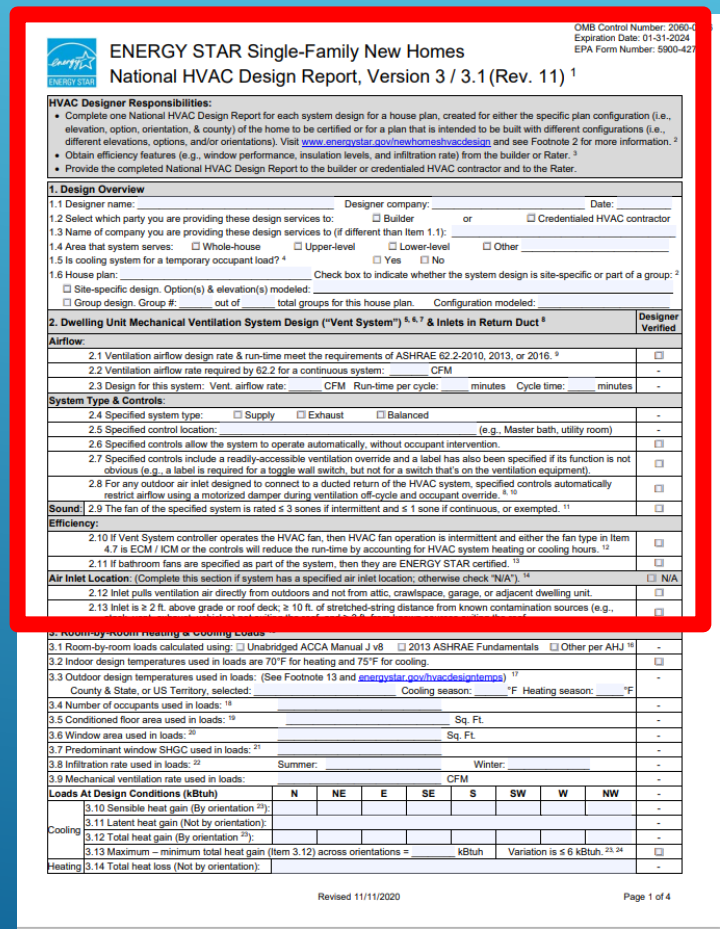
2. Dwelling Unit Mechanical Ventilation System Design ("Vent System") [6, 7] & Inlets in Return Duct [8]	Designer Verified
Airflow:	
2.1 Ventilation airflow design rate & run-time meet the requirements of ASHRAE 62.2-2010, 2013, or 2016. [9]	☐
2.2 Ventilation airflow rate required by 62.2 for a continuous 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.	☐

3. Room-by-Room Heating & Cooling Loads [15]									
3.1 Room-by-room loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013 ASHRAE Fundamentals ☐ Other per AHJ [16]									-
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 13 and energystar.gov/hvacdesigntemps) [17] County & State, or US Territory, selected: _____ Cooling season: _____°F Heating season: _____°F									-
3.4 Number of occupants used in loads: [18] _____									-
3.5 Conditioned floor area used in loads: [19] _____ Sq. Ft.									-
3.6 Window area used in loads: [20] _____ Sq. Ft.									-
3.7 Predominant window SHGC used in loads: [21] _____									-
3.8 Infiltration rate used in loads: [22] 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 [23]):									-
Cooling 3.11 Latent heat gain (Not by orientation):									-
Cooling 3.12 Total heat gain (By orientation [23]):									-
Cooling 3.13 Maximum – minimum total heat gain (Item 3.12) across orientations = _____ kBtuh Variation is ≤ 6 kBtuh. [23, 24]									☐
Heating 3.14 Total heat loss (Not by orientation):									-

Revised 11/11/2020 Page 1 of 4

ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL HVAC DESIGN REPORT PAGE 2 SECTION 4

No change for FAZS™ controlled HVAC



OMB Control Number: 2060-0
Expiration Date: 01-31-2024
EPA Form Number: 5900-427

ENERGY STAR Single-Family New Homes
National HVAC Design Report, Version 3 / 3.1 (Rev. 11) [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, 2013, or 2016. [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.,	☐

3. Room-by-Room Heating & Cooling Loads [15]

3.1 Room-by-room loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013 ASHRAE Fundamentals ☐ Other per AHJ [16] -
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 13 and energystar.gov/hvacdesigntemps) [17] -
County & State, or US Territory, selected: _____ Cooling season: _____°F Heating season: _____°F
3.4 Number of occupants used in loads: [18] _____ -
3.5 Conditioned floor area used in loads: [19] _____ Sq. Ft. -
3.6 Window area used in loads: [20] _____ Sq. Ft. -
3.7 Predominant window SHGC used in loads: [21] _____ -
3.8 Infiltration rate used in loads: [22] 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 [23]):									-
	3.11 Latent heat gain (Not by orientation):									-
	3.12 Total heat gain (By orientation [23]):									-
	3.13 Maximum – minimum total heat gain (Item 3.12) across orientations = _____ kBtuh Variation is ≤ 6 kBtuh. [23, 24]									☐
Heating	3.14 Total heat loss (Not by orientation):									-

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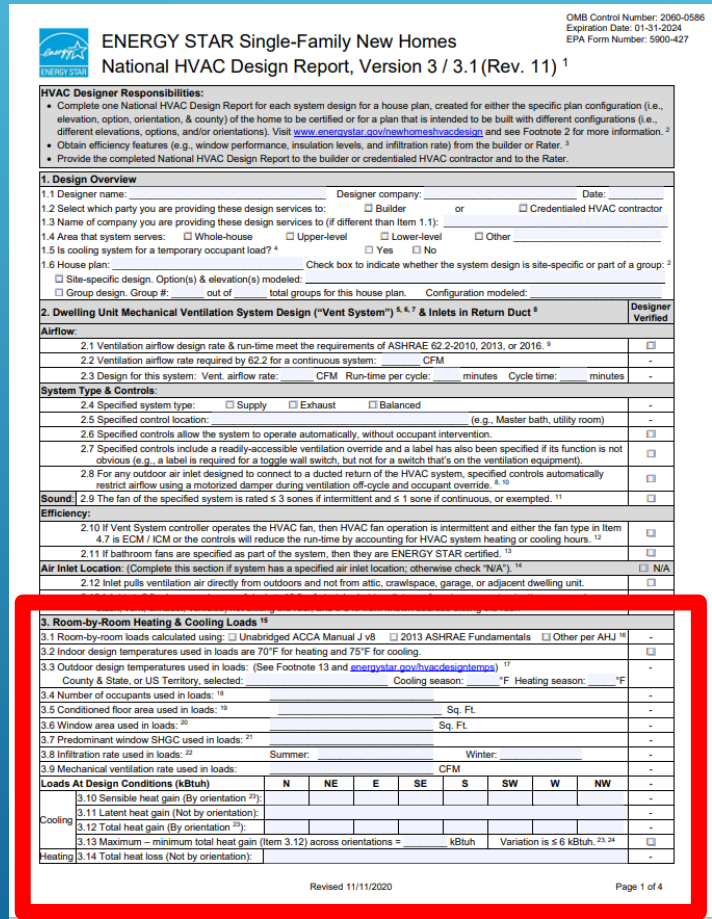
ENERGY STAR SINGLE-FAMILY NEW HOMES NATIONAL HVAC DESIGN REPORT PAGE 2

No change required for a FAZS™:

1) Fill in each of the three columns with one zone using the numbers generated using Manual D. OR
2) Fill in each of the three columns with one zone each using the proportional numbers generated for sizing the duct for the FAZS™ and note "as per zone OEM directions".



OMB Control Number: 2060-0586
Expiration Date: 01-31-2024
EPA Form Number: 5900-427

ENERGY STAR Single-Family New Homes
National HVAC Design Report, Version 3 / 3.1 (Rev. 11) [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, 2013, or 2016. [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.	☐

3. Room-by-Room Heating & Cooling Loads [15]

3.1 Room-by-room loads calculated using: ☐ Unabridged ACCA Manual J v8 ☐ 2013 ASHRAE Fundamentals ☐ Other per AHJ [16] -
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 13 and energystar.gov/hvacdesigntemps) [17] -
County & State, or US Territory, selected: _____ Cooling season: _____°F Heating season: _____°F
3.4 Number of occupants used in loads: [18] _____ -
3.5 Conditioned floor area used in loads: [19] _____ Sq. Ft. -
3.6 Window area used in loads: [20] _____ Sq. Ft. -
3.7 Predominant window SHGC used in loads: [21] _____ -
3.8 Infiltration rate used in loads: [22] 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 [23]):									-
	3.11 Latent heat gain (Not by orientation):									-
	3.12 Total heat gain (By orientation [23]):									-
	3.13 Maximum – minimum total heat gain (Item 3.12) across orientations = _____ kBtuh Variation is ≤ 6 kBtuh. [23, 24]									☐
Heating	3.14 Total heat loss (Not by orientation):									-

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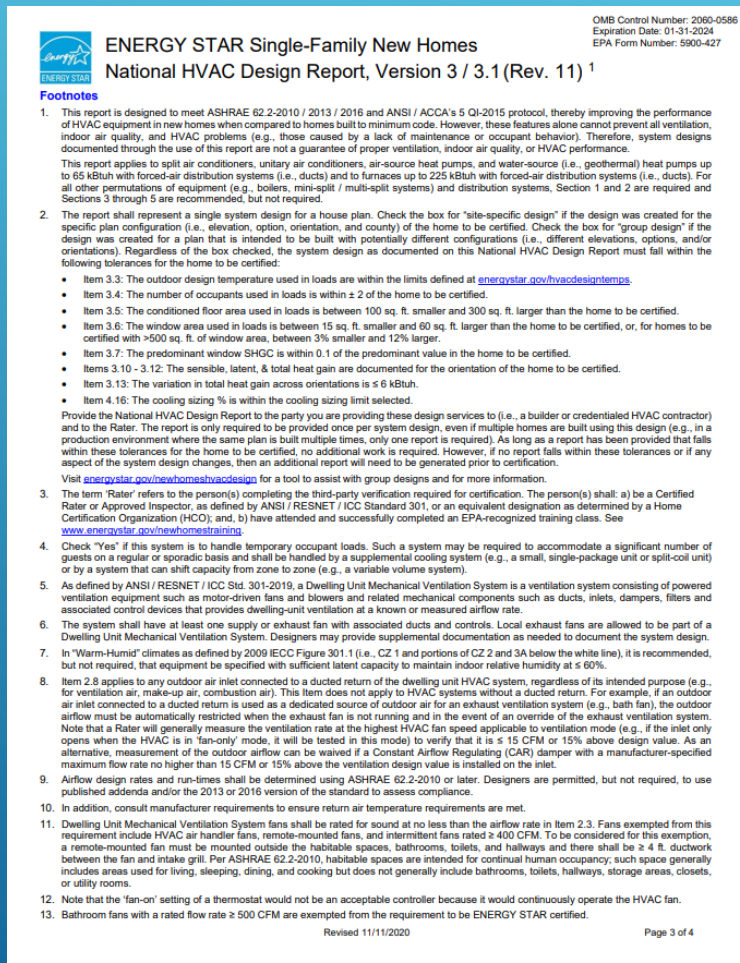
No Change for FAZS™

Design Report Section Completed



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ENERGY STAR Single-Family New Homes
National HVAC Design Report, Version 3 / 3.1 (Rev. 11) [1]

Footnotes

1. This report is designed to meet ASHRAE 62.2-2010 / 2013 / 2016 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 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.

   Visit 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 Standard 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 Std. 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.
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 the 2013 or 2016 version 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.

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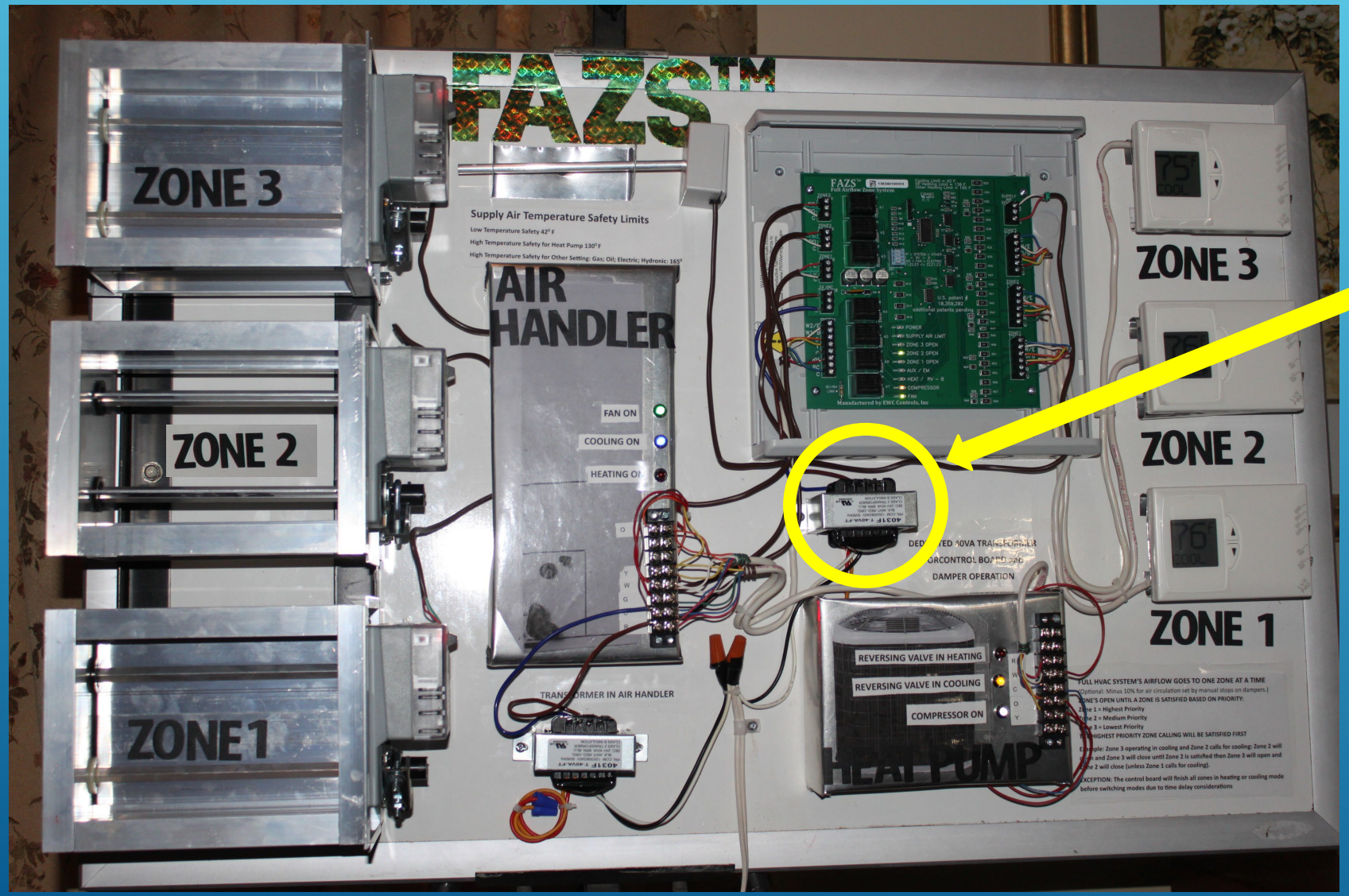
FINAL NOTE: A SEPARATE TRANSFORMER IS RECOMMENDED FOR THE FAZS™ CONTROL BOARD



Dedicated control Transformer

Recommend 40 VA 120 V

FULL AIRFLOW ZONE SYSTEM (FAZS™)

QUESTIONS?

Donald Prather

Full Airflow Zone System LLC

Owner

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