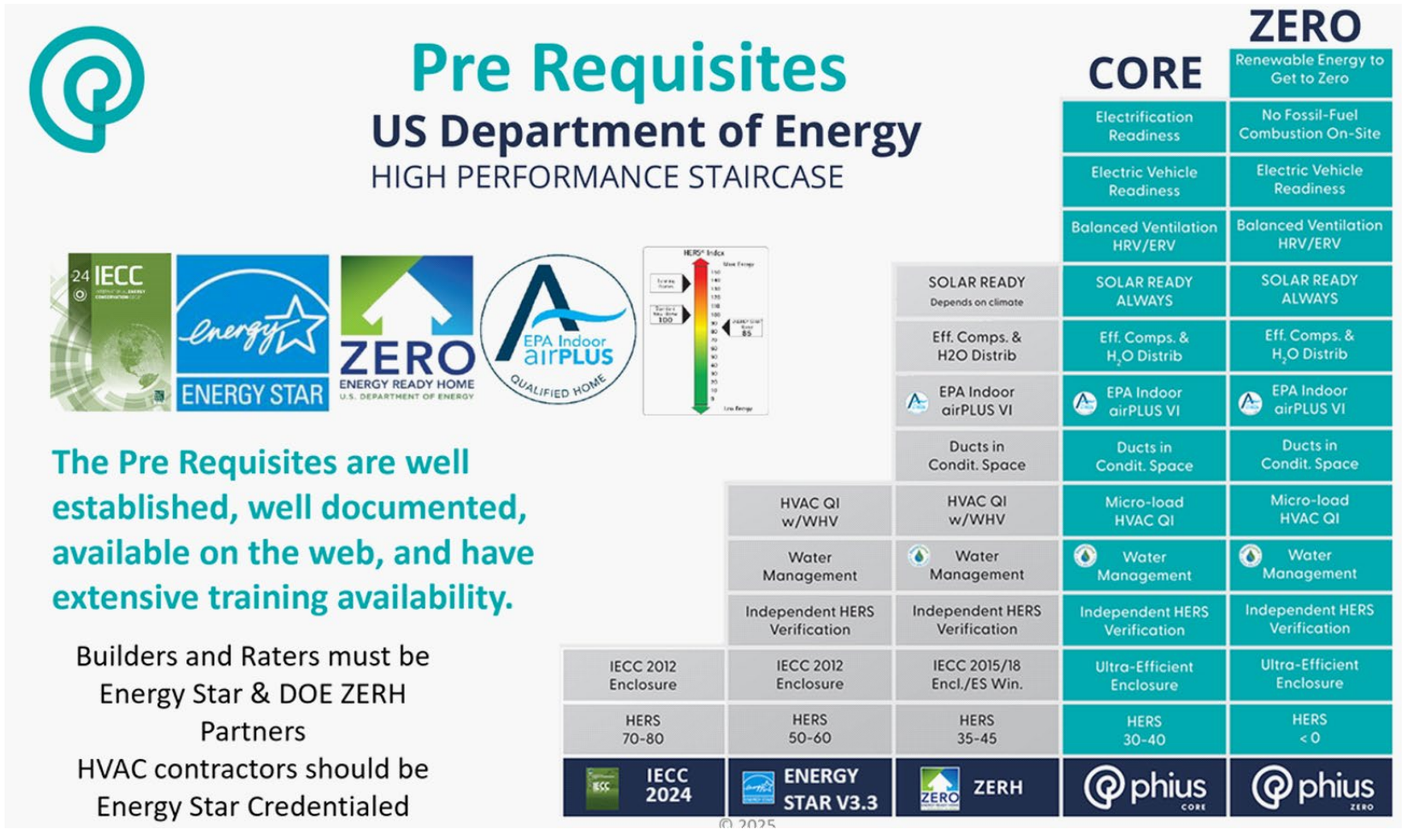
Pre-requisites for Passive Houses Certification



Location of Pre-requisite Program Requirements and Inspection Check Lists.

IECC 2024 Energy Code

https://codes.iccsafe.org/content/IECC2024P1

Energy Star Requirements - version 3.2

https://www.energystar.gov/partner-resources/residential-new/national-page

EPA Indoor airPlus version 2 effective Jan 1 2026

https://www.epa.gov/indoorairplus/indoor-airplus-program-documents

DOE Zero Energy Ready Requirements version 2

New name: DOE Efficient New Homes Single Family Version 2

https://www.energy.gov/eere/buildings/doe-efficient-new-homes-single-family-version-2

PHIUS QA Workbook, Field Checklist, Photo DON'Ts and DO's

https://www.phius.org/phius-single-family-quality-assurance-workbook

PHIUS GuideBook

https://www.phius.org/phius-certification-guidebook

Watersense

https://www.epa.gov/watersense

Watersense certification is not a requirement for PHIUS, however, there are Watersense requirements for Toilets, Bathroom Faucets, Showerheads in the DOE Zero Energy Ready Home Requirements.

Builder Registration and Partnership Registration (Mandatory)

Web site links:

DOE ZERH v2

Partnership sign up:

https://www.energy.gov/eere/buildings/partner-central

I need the ZERH builder number included on the HERS report for the final inspection rating.

The zip file attached has all ZERH forms for your reference.

National Requirements and Checklists:

https://www.energy.gov/eere/buildings/doe-efficient-new-homes-program-requirements

AirPlus v2

Partnership sign up:

https://www.epa.gov/indoorairplus

The form that we need to complete is attached: "IA3_indoor_airplus_fillable_verification_checklist (2).pdf"

There is a column for "builder verified" to check off and BUILDER SIGNATURE at the bottom.

The zip file attached has all airPlus forms for your reference.

National Requirements and Checklists:

https://www.epa.gov/indoorairplus/indoor-airplus-program-documents

Energy Star v3.2

Partnership sign up:

https://www.energystar.gov/partner-resources/join-energy-star

The form "ES6_National Water Management System Builder Requirements_Rev 12" is the exclusive responsibility of builders.

The zip file attached has all Energy Star forms for your reference.

National Requirements and Checklists:

https://www.energystar.gov/partner_resources/residential_new/homes_prog_reqs/national_page

For Reference: The Phius QA workbook combines all the check lists together into one spread-sheet.

https://www.phius.org/phius-single-family-quality-assurance-workbook

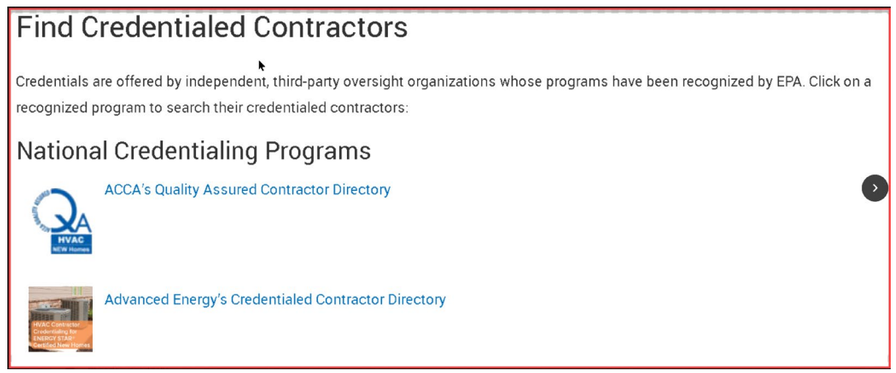
Click on: Download the Workbook v4.2

The PHIUS+ Rater will maintain the official copy of the PHIUS QA workbook and program checklists.

HVAC Contractor Credentials, Manual J & S, Energy Star HVAC Design Checklist

If the HVAC Contractor does not wish to be Credentialed by Energy Star, There is another Track that we can follow.
See the Document named "Energy Star HVAC Tracks A and B explained.pdf". This option will require some extra inspection steps, time, paperwork for the HVAC Contractor to fill out the Energy Star Design Supplemental Form.

This is the web site link to become a **HVAC Credentialed Energy Star Contractor.**
Find Energy Star credentialed contractor
https://www.energystar.gov/partner_resources/residential_new/working/hvac/find_hvac
There are two options you can choose from. All I need is to see
The HVAC contractor's company listed on either of these:



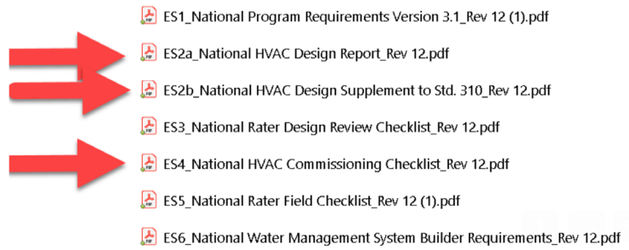
The mechanical engineer needs to submit a Manual J, Manual S, and Energy Star HVAC Design Report prior to starting construction. A prelimiary Manual J is needed for the permit application process.

The Rater will use these documents to complete the HVAC section of "Rater Design Review Checklist"

When HVAC contractor installs the HVAC system, the will complete the HVAC Commissioning Checklist and submit it to the Rater.

Energy Star checklist forms are available on the web site:

https://www.energystar.gov/partner-resources/residential-new/national-page



Inspection Summary

Builder Registration and Partnerships are Mandatory.

1. Design and Design Review documentation
2. Foundation before concrete pour, Site grading
3. Rough in - before exterior wall cavity insulation
4. Pre-drywall - after external cavity wall insulation is installed
5. Post Dry wall - HVAC grills sealed
6. Final

Note:
This can vary slightly depending on circumstances, construction materials, building design and re-testing requirements if a test fails.

Step 3 & 4 could be combined it desired, but most PHIUS Builders prefer to test the air barrier tightness before installing the cavity insulation so these can find air leaks and repair them easier.

Inspection	Construction Stage	Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
1	**Design and Design Review documentation (Mandatory), completed and submitted as pre-liminary to Roger Taylor: RTaylor@DGDallas.com**				
	Pre-construction	HVAC Contractor			**Credentials** are posted on the Energy Star web site
	Pre-construction	Builder			**Builders Partner Agreement posted on web sites:** Energy Star ZERH. Builder ID assigned, and sent to Roger Taylor EPA Indoor airPlus
	Pre-construction	HVAC design			**Energy Star HVAC design checklist** is complete and submitted by HVAC contractor or Mechanical Design Engineer. **HVAC Manual J, Manual D, Manual S** design and drawings are complete and submitted to Roger Taylor: RTaylor@DGDallas.com If HVAC contractor is not Energy Star Credentialed, also need Energy Star Supplemental Checklist and Stardard 310
	Pre-construction	PHIUS+ Rater HVAC design review			**Energy Star HVAC design Review checklist** is completed by the Rater.
	Pre-construction	PHIUS+ Rater Plans Review - Energy Star Design Review Checklist			**Energy Star Dwelling Unit design Review checklist** is completed by the Rater.
	Pre-construction	Data Sheets: Fixtures, Lighting, Appliances, Materials			**Collect Data Sheets** for each kitchen/bath fixture, lighting type, appliances. Water usage for faucets, toilets, showers. All items will probably not be selected at Pre-construction, however, please start collecting them and organizing them in the PHIUS drop box folders. Appliances need to be Energy Star rated. Faucets, Toilets, Showers need to be Watersense
	Pre-construction	EPA Indoor airPlus checklist			**EPA Indoor airPlus checklist** is completed based on materials listed in the plans.

Inspection	Construction Stage	PHIUS Guidebook Reference	Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
2	**Foundation before concrete pour, Site grading** *Photos taken by builder and sent to RTaylor@DGDallas.com. Prefer Geotagged photos with phone app.*					
	Foundation phase- prior to concrete pour		Foundation Inspection, before concrete	Builder, with tape measure showing insulation thickness	Vapor Barrier Underslab insulation Perimeter insulation Water drainage Radon piping	reference: **Indoor AirPlus version 2, Builder Responsibility Doc.** Builder tasks. Under slab insulation is clearly marked as "termite treated" Vapor Barrier in place between the insulation and the slab (to be poured) and lapped up over the side of forms. Taped securely to plumbing and electrical penetrations Radon piping, Footer Drainage Piping and Gravel, Rebar in place, Post tension cables in place, forms constructed to recess entry door thresholds Garage and Patio slabs are insulated from conditioned area slab. Perimeter insulation has depth of 2 feet. Note: depending on the climate zone and energy modeling,

Inspection	Construction Stage		Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
3	**Rough in - before exterior wall cavity insulation** *Photos by Builder, Fox Energy Specialists, or Roger Taylor. Prefer Geotagged photos with phone app.*					
	Framing, Exterior Continuous insulation, Sheathing **before cavity insulation, before Siding**		thermal bridge inspection	Schedule Fox Energy Specialists inspection, or Builder with geotagged photos (see Energy Star check list below)	Exterior continuous insulation with tape measure. Energy Star requires GeoTagged photos by the Fox Energy Rater of Insulation, Insulated ZIP sheathing, etc. DO NOT COVER ANYTHING UP WITHOUT A QUICK VISUAL INSPECTION. Wall and Roof Assemblies with tape measure showing cavity depth of fraiming Sill Sealing methods	Inspect all corners, soffits, connections that may cause a thermal bridge to ensure the connection construction matches the architects plans. All Walls are attached to the pressure treated Sill Plate. Sill Sealer in place under the sill plate. All SIP splices are I-beam splines with screws. Lag bolts hit the intended anchor point. All gaps and cracks are sealed. Sill plate to slab is air sealed on exterior with Prosoco.
			Energy Star "Advanced Framing" inspection	Builder	Advanced Framing Assemblies if applicable	Complete the Thermal Enclosure section of Energy Star checklist
	Rough-in Blower Door Test	(optional but recommended)	Rough-in Blower Door Test (1) Building (2) Compartmentalization (for duplex)	Schedule Fox Energy Specialists inspection	Photo of blower door set-up and manometer readings	Target specified by PHIUS
	Rough in, Duct leakage test: Indoor air handler, ERV, dehumidifier installed and sealed.		Mechanical and duct installs (1) "Total" duct leakage (2) "WRTO" duct leakage if required	Schedule Fox Energy Specialists inspection	Photo of test set-up and manometer readings ERV Exterior Duct R-value HVAC Duct R-value HVAC and ERV tag make/model 10 feet between ERV in-take and exhaust Kele flow sensors	All duct terminations are covered and securely taped prior to the grill install. All duct connections are sealed with Mastic. Equipment is covered to protect is from dust. HVAC duct test for WRTO and Total Leakage meet specifications. Photo of the Monometer reading and testing reports. PHIUS 2024 certification requires R8 Insulation for the ERV Ducts to the outside for External Fresh Air Intake and Exhaust. Internal ducts to the diffusers should be insulated, but may be less that R8. Record and take photo of make and model of all mechanical equipment. Make sure they match the WUFI model. For exhaust, record the exact CFM and SONES
	Rough in, Plumbing		Hot water Insulation	Roger Taylor	PIPE Insulation R-value	Inspect all hot water pipes for the insulation value documented in the WUFI energy model.
	rough in, Electrical		Electrical	Roger Taylor	Exterior boxes sealed	Outlet and Switch boxes are air sealed. Spray foam insulation behind the boxes on external walls.
	rough in framing		air sealing and hurricane bracing	Schedule Fox Energy Specialists inspection	Penetrations, window, door sealing	Inspect for air sealing and air barrier details. All penetrations Lags screws, bolts, nails, and covered with Prosoco. Hurricane tie downs are in place as specified by the Structural Engineer.

ENERGY STAR Single-Family New Homes
National Rater Field Checklist, Version 3.1 / 3.2 / 3.3 (Rev. 14)

Thermal Enclosure System **1.High-Performance Insulation & Fenestration**	**Must Correct**	**Builder Verified** [1]		**Rater Verified** [2,3]		**N/A** [4]
1.1 Insulation meets specifications in National Rater Design Review Checklist Item 2.1.		Pre-rock+50			📷	
1.2 All insulation achieves Grade I install. per ANSI / RESNET / ICC 301. Alternatives in Footnote 5 [5,6]		Pre-rock+50			📷	
1.3 Fenestration meets specifications in National Rater Design Review Checklist Items 2.1 & 2.2.						
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). [8,9]						
2.1 Dropped ceilings / soffits below unconditioned attics, and all other ceilings.		<= 50 sq ft			📷	
Walls: At exterior vertical surface of wall insulation in all climate zones; also at interior vertical surface of wall insulation in Climate Zones						
2.2 Walls behind showers, tubs, staircases, and fireplaces.		<= 50 sq ft			📷	
2.3 Attic knee walls and skylight shaft walls. [11]		<= 50 sq ft			📷	
2.4 Walls adjoining porch roofs or garages.		<= 50 sq ft			📷	
2.5 Double-walls and all other exterior walls.		<= 50 sq ft				
Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surfa						
2.6 Floors above garages, floors above unconditioned basements or crawlspaces, and cantilevered floors.		<= 50 sq ft			📷	
2.7 All other floors adjoining unconditioned space (e.g., rim / band joists at exterior wall or at porch roof).		<= 50 sq ft				

At the discretion of the Rater, the builder may verify up to five of the indicated Checklist Items. When this allowance is used for Items marked "Pre-rock + 50", up to 500 sq. ft. of wall areas that have drywall installed prior to general installation of drywall (i.e., "pre-rock" areas such as walls behind tubs or staircases), plus an additional 50 sq. ft., may be builder verified; when marked "50 sq. ft.", up to 50 sq. ft. of area may be verified by the builder; and when marked "5 penetrations", up to five penetrations may be builder verified. The remaining items and areas (i.e., all the applicable area other than what the builder verifies) must be visually verified on-site by the Rater or, for applicable minimum rated features, verified using an alternative on-site inspection protocol defined by ANSI / RESNET / ICC 301 (e.g., for slab insulation or continuous exterior wall insulation). 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.

Inspection	Construction Stage	Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
4	**Pre-drywall - after external wall insulation is installed** *Photos by Builder, Fox Energy Specialists, or Roger Taylor. Prefer Geotagged photos with phone app.*				
	Pre-drywall, **after external wall cavity insulation is installed**	insulation inspection	Schedule Fox Energy Specialists inspection	Depth of insulation with steel ruler or tape measure. Insulation Certificate	Insulation must be **"Grade 1"** in all wall and ceiling cavities. **Insulation Contractor's "Insulation Certificate"** posted on-site as per IECC2015/2021 R401.3 and sent to DwellGreen RTaylor@DGDallas.com
	Bathrooms	insulation inspection	Schedule Fox Energy Specialists inspection	Depth of insulation with steel ruler or tape measure.	Water proofing behind showers. Insulation in wall behind tubs and shower walls.
	Pre-drywall, windows QA	Window specification verification	Schedule Fox Energy Specialists inspection	NFRC window stickers or posted specs for custom built windows	Photos for each windows of **all NFRC labels or other evidence of U-value and SHGC value.**
	Pre-drywall doors QA	Doors specification verification	Schedule Fox Energy Specialists inspection	NFRC stickers or posted specs for custom built doors.	Photos for each exterior door of **all NFRC labels or other evidence of U-value and SHGC value.**
	Pre-drywall window, door install	Window and door install, prior to trim	Schedule Fox Energy Specialists inspection	Window and door over insulation and sealing	Window frame "over insulation" properly in place, Hanno product in place, Prosoco products properly applied, straps properly attached to the window and anchored to the buck properly with the correct reveal measurement. No wood shims. Door three point locks in place and latch bore is sealed (not a complete hole thru the door buck). Flashing correctly applied on exterior.
	Pre-drywall Blower Door Test	(optional but recommended)	Pre-drywall Blower Door Test with ERV,	Schedule Fox Energy Specialists inspection	Photo of blower door set-up and manometer readings	Record Blower Door CFM air leakage using computerized pressurization and de-pressurization. Photo of the Monometer reading and testing reports.
	Go/No Go		Pre-drywall Blower Door Test Go/No Go			Make a decision to stop and seal air leaks or proceed with construction. Repeat blower door test after repairing air leakage as many times as it takes to meet the air leakage requirement.

Inspection	Construction Stage	Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
5	**Pre-Final (Post Dry wall) - very quick inspection, primary for HVAC and ERV boots sealed to sheet rock** *Photos by Builder, Fox Energy Specialists, or Roger Taylor. Prefer Geotagged photos with phone app.*				
	House wrap/Dry wall, ceiling sheet rock.	House wrap/Dry wall	Schedule Fox Energy Specialists inspection	Insect screen	Inspect house wrap, furring strips, rainscreen flashing, insect screen at soffit and Sill Plate. Drywall, Electrical, ERV duct openings and backdraft dampers, plumbing stack openings. Floor insulation matches the spec by the architect.
	HVAC and ERV grills and diffusers are **NOT installed**	HVAC and ERV Boot inspection	Schedule Fox Energy Specialists inspection	HVAC and ERV boots sealed to sheet rock	Inspect each supply and return vent to make sure the boot is sealed with mastic to the sheet rock of the ceiling.
	airPlus prior to installing any fixtures or finishes	Fixture, Finish, WaterSense, airPlus	Builder or CPHC to supply datasheets to Roger Taylor		Inspect the specifications for all fixtures, finishes to ensure they pass the airPlus requirements. Inspect water fixtures to ensure they pass the WaterSense requirements.

Inspection	Construction Stage	Name of Inspection	Primary Photo responsibility	Photo documentation required?	Purpose if more explanation is needed
6	**Final** *Photos by Fox Energy Specialists, or Roger Taylor. Prefer Geotagged photos with phone app.*				
	post ceiling sheet rock after dust and dirt is vacuumed.	HVAC commissioning	Schedule Fox Energy Specialists inspection		HVAC commissioning per the Energy Star and PHIUS check list. Rater must confirm CFM measurements are within spec.
	post ceiling sheet rock after dust and dirt is vacuumed.	ERV commissioning	TAB Contractor	Balancing spread sheet showing conformance to the HVAC and ERV design.	ERV commissioning per the PHIUS check list. Rater must confirm CFM measurements are within spec.
	post ceiling sheet rock after dust and dirt is vacuumed.	HVAC and ERV balancing	TAB Contractor	Balancing spread sheet showing conformance to the HVAC and ERV design.	Install diffusers and test CFM output at each diffuser. Match it to the spec. Make sure jump ducts are in place.
	Hot water distribution testing	Hot water test	Roger Taylor	Testing set up and results	Hot Water Temperature Rise Test shall be conducted per the DOE ZERH Mandatory Requirements for Water Efficiency.
	After interior doors are installed	Bedroom pressure balancing	Schedule Fox Energy Specialists inspection	Manometer readings	Ducted heating and cooling systems: Bedrooms shall be pressure balanced to +/- 3 Pa with respect to (WRT) the main body of the house with all other bedroom doors closed and the system running Ventilation systems: Bedrooms shall be pressure balanced to +/- 1 Pa with respect to (WRT) the main body of the house with all other bedroom doors closed and the ventilation system running.
	Final Blower Door Test	Final Blower Door Test (1) Building (2) Compartmentalization	Schedule Fox Energy Specialists inspection	Photo of blower door set-up and manometer readings	Record Blower Door CFM air leakage using computerized pressurization and de-pressurization. Photo of the Monometer reading and testing reports.
	Final	Final visuals and all check lists	Schedule Fox Energy Specialists inspection		Review all IECC, Phius, ES, ZERH, airPlus check lists and that photos of visual checks. This would include distance between fresh air and exhaust vent, distance of ERV vent from cook top, number of solar panels installed, etc.
	Final	Infrared Scan of walls, ceilings, floors	Roger Taylor	IR photos	Rater will take infrared photos from the inside of building
	Final PHIUS QA Workbook	Appliances, all mechanical components	Roger Taylor	Tag with make/model	Pictures of all equipment and appliance tags containing the Make/Model/Serial Number. Match the list against the equipment kBTU/yr listed in the initial PHIUS pre-certification documentation. This is required.
	Final PHIUS QA Workbook	Home Owners Manual	Roger Taylor	Picture of Manuals	Home Owner Manual completed for all mechanical and appliances. This is required.
	Final PHIUS QA Workbook	All forms complete and signed	Roger Taylor		All forms and check lists submitted and approved to Local Code office, Energy Star, ZERH, airPlus, and PHIUS.

This document is intended to be a summary "schedule" for inspections that need to take place. Contact Roger Taylor for corrections or revisions, RTaylor@DGDallas.com

Lessons Learned

Energy Star and DOE have U-value and SHGC value minimum requirements that have gotten more strict.

Energy Star requires GeoTagged photos by the Fox Energy Rater of Insulation, Insulated ZIP sheathing, etc. DO NOT COVER ANYTHING UP WITHOUT A QUICK VISUAL INSPECTION.

Applicance need to be Energy Star Certifified.

PHIUS 2024 certification requires R8 Insulation for the ERV Ducts to the outside for External Fresh Air Intake and Exhaust. Internal ducts to the diffusers should be insulated, but may be less that R8.

All Insulation thicknesses need a photo with a tape measure.

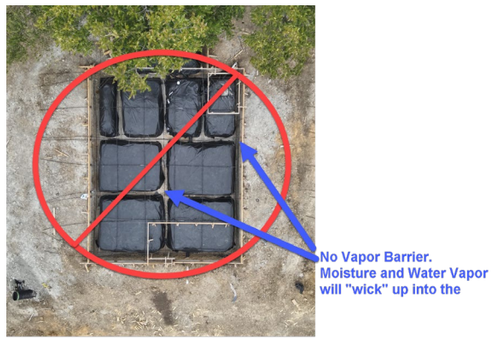
Make sure you post the "Insulation Certificates" on-site in the attic or mechanical room.

Version 2 of Indoor AirPlus is effective Jan 1, 2026. Please review it. Please keep track of sealants, paint, materials and verify compliance.

Start with a Charrette reference: https://www.wbdg.org/resources/planning-and-conducting-integrated-design-id-charrettes

It brings the team together and gives everyone a vision of the project. This is easily done on Zoom. It also allows all parties to contribute and correct issues.

Slab Vapor Barrier, Under slab insulation, Slab Perimeter insulation



The vapor retarder must be edge to edge, end to end, pulled up and over lapped on the concrete forms and secured.

The purpose of the vapor barrier is to protect the entire slab from water vapor. Most Passive House builders prefer Stego Tango Vapor Retarder because (1) it is thick and will not tear (2) it has been tested against Formosan termites in Hawaii. They are extremely destructive and are now in the United States, moving westward.

If the vapor barrier is not installed correctly and you put a wood floor over the slab, the wood will buckle in the spring. If you put a vinyl plank floor on it, moisture will collect in the concrete and find its way (wick) to the sill plates and dry wall eventually. At that point mold will grow. I can supply building science documentation from the Building Science Corp and from the US Dept of Energy if you are interested.

Sheets of the vapor retarder (edges) must be over lapped at least 6 inches and taped. Tamp down the vapor barrier so no air cavities will be formed between the vapor barrier and earth.

Vapor barrier should be in contact with the slab. If there is insulation under the slab, vapor barrier should be between the concrete and the insulation. The vapor barrier must be pulled up around plumbing and electrical penetrations and must be taped and sealed, preferably with mastic.

Leave enough lapped over onto the ground to pull up and cover the sill plate (about 1 foot or more). The best practice is to pull the vapor barrier up and tape it to the wall sheathing after the post-tension cables are tightened to protect the sill plate until the rainscreen siding assembly is installed. This will prevent the sill plate assembly from getting wet from rain and causing mold to grow when it is air sealed.

The vapor barrier that was lapped over the concrete forms is then trimmed (after rainscreen siding assembly is installed), and the exposed edge of the slab is painted with vapor permeable Latex Paint which will keep water out of the concrete and allow water vapor to escape.

DESIGN

Architect/Designers

Supply the Passive House Rater with the design drawing package (Architectural, Mechanical, Plumbing, Electrical, Electric Vehicle Charging Stations, Solar Panels) before quotes for the following reasons:
(1) The Rater must create (a) an Energy Model and design review using IEEC 2021 for PHIUS and (b) an Energy Model using the IEEC requirement for submission to the City for the Building Permit. This Energy Model must be updated continually as changes are made for final certification for all the programs (Energy Star, Indoor airPLUS, DOE ZERH, PHIUS).
(2) Mechanical is addressed below.
(3) The installation for the hot water pipes must be specified on the the design drawing. The water temperature is normally 120 degree F and acts like a heater in the summer if the pipes are not properly insulated. Hot water requirements must be met in the design and tested by the rater. The tolerances are contained in the DOE ZERH, WaterSense, and PHIUS requirements. For example: The design must pass WaterSense calculations. The Rater will need to know the length and diameter of the hot water runs to determine this. If there is a recirculation system to be installed, the specifications for it and pipe run lengths must be documented on the design drawings. The length of pipe runs must include horizontal and vertical lengths of pipe. The faucet with the longest pipe run must be identified for testing by the Rater. GPM and GPF (gallons per minute and gallons per flush) must be documented. Bathroom faucets and Shower heads have WaterSense requirements and are specified in the DOE ZERH requirements.

Builder
The builder must be an Energy Star Partner, an Indoor AirPlus Partner, and a DOE Zero Energy Ready Partner. The Rater will check the web sites to confirm and will need the builder's DOE ZERH partner number to complete the HERS rating and Building Permit plan review.

HVAC

Contractors

(1) The contractor that installs HVAC units in a Passive House must be Credentialed by Energy Star. The rater will check to make sure they are listed on the Energy Star web site. If not, the house will fail inspection.
(2) The contractor must either be given the Energy Star HVAC Design Check List or create it.
(3) The Passive House Rater (inspector) must be given the Energy Star HVAC Design Check List before construction begins. The Rater is required to complete the Energy Star HVAC Design QA Review. Preferably, this should be done before quotes are requested and budgets are set.

Design and Architecture

A mechanical room with a walk in door makes it much easier for installs and home owner maintenance.
(1) The walls must be insulated for sound because the units are noisy.
(2) The ERV system has an air-intake and exhaust duct length restriction. Therefore, the mechanical room should be located on an outside wall.
(3) The design of a Passive House requires a mandatory documented methods and access for home owner maintenance.
  (a) Filter changes: The systems needs to be accessible. They all have filters that need to be changed.
  (b) There are requiremetents to label breakers and switches for the HVAC and ERV equipment specified in the DOE ZERH and PHIUS requirements.

The mechanical engineer that designs the equipment and duct system must:
(1) Supply an ACCA Manual J, D, S reports and a duct schematic with CFM, duct sizes, balancing dampers. CAD is preferrable so it can be an over lay on the building design CAD drawings.
(2) Systems should be completely separate. Many designers try to combine them, but in the end the duct systems can not be balanced. It is preferrable to have separate duct systems for:
  (a) Heating and Cooling
  (b) Mechanical Ventilation, normally an ERV system in a Passive House.

(3) The Mechanical Ventilation system has many requirements, but some that should be known early are:

ERV:

(a) The ERV air-intake and exhaust CFM must be measured at the Final inspection by the Passive House Rater. This means that if the exterior vents are not easily reachable, the builder must supply some way to gain access (i.e. a lift if they are high on the wall, etc). The Rater will not climb tall ladders or crawl around on the roof.

(b) The ERV air-intake and exhaust must be separated by a minimum of 10 feet (stretched string measurement).

(c) The ERV air-intake must be separated from other contaminates (i.e. Plumbing stack) by the same criteria (10 feet stretched string).

(d) The ERV air-intake and exhaust vents must be 2 feet minimum above the ground or roof surface (or higher if in a heavy snow climate).

(e) The ERV exhaust vent in the kitchen must be a minimum of 6 feet from the cook top to avoid collecting grease in the filter.

(f) The ERV system will have a "boost switch" option to remove odors, kitchen contaminates, or bathroom moisture. The switches MUST be shown on the electrical design drawings so the wiring can be installed before the dry wall is installed.

Balancing Dampers

The Heating/Cooling and ERV ducts MUST have balancing dampers installed on branches of the duct system to allow balancing to be done at Final.

The location of dampers must be documented on the mechanical designers schematic.

The balancing dampers MUST BE ACCESSABLE (not covered with sheet rock),. The location should be identified and included in the architect's design.

The "branch" dampers are in addition to the register dampers that are mounted on the wall or ceiling. Some folks have used automated dampers in the design.

If an automated damper system is the option specified, this needs to be taken into account with the sensors internal to the HVAC air-handler.

Back Draft Dampers

The blower door test will include both pressurization and depressurization of the building. Therefore, this should be taken into account for the mechanical design. See blower door test section.

Back draft dampers should be high quality with gaskets or a cape method that will not leak when they are closed. Please do not allow the contractors to install cheap dampers.

Vents that require back draft dampers include:

(1) Kitchen Exhaust Hood

(2) Bathroom fans If bathroom fans are installed.

(3) Make up air vents.

(4) ERV vents for exhaust and supply.

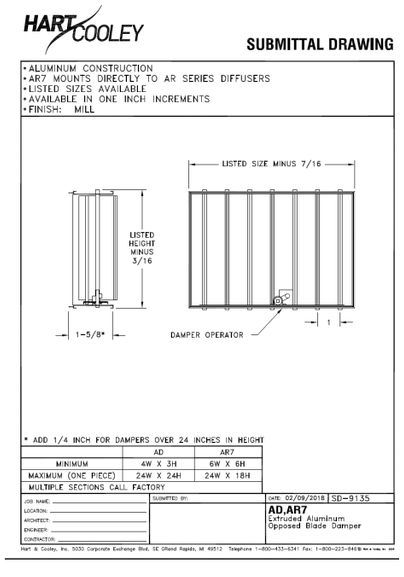
(5) Dehumidifer fresh air intake if installed.

(6) Clothes dryer exhaust, if an exhaust dryer is installed.

Ideally, place a balancing damper on each HVAC branch. It must be accessable at Final Inspection after dry wall and paint is installed. The Architect must be made aware that an access is required if a balancing damper will be covered by sheet rock so it will be included in the construction plans.

Opposed blade diffusers are recommended by the Houston Mitsubishi consultants.for the HVAC unit.

Zehnder adjustable diffusers work best for the ERV diffusers. Fan Tech also has adjustable ERV diffusers.



HART COOLEY

SUBMITTAL DRAWING

- ALUMINUM CONSTRUCTION
- AR7 MOUNTS DIRECTLY TO AR SERIES DIFFUSERS
- LISTED SIZES AVAILABLE
- AVAILABLE IN ONE INCH INCREMENTS
- FINISH: MILL

* ADD 1/4 INCH FOR DAMPERS OVER 24 INCHES IN HEIGHT

	AD	AR7
MINIMUM	4W X 3H	6W X 6H
MAXIMUM (ONE PIECE)	24W X 24H	24W X 18H
MULTIPLE SECTIONS CALL FACTORY		

JOB NAME:
LOCATION:
ARCHITECT:
ENGINEER:
CONTRACTOR:

SUBMITTED BY:

DATE: 02/09/2018 | SD-9135

AD,AR7
Extruded Aluminum
Opposed Blade Damper

Hart & Cooley, Inc. 5030 Corporate Exchange Blvd. SE Grand Rapids, MI 49512 Telephone 1-800-433-6241 Fax: 1-800-223-8408

Balancing

Tolerances:

The duct systems for the Heating/Cooling and ERV systems must be balanced to the CFM tolerances listed on the "duct design balancing specification". The tolerances are contained in the PHIUS QA workbook and in the EPA Energy Star requirements.

Documented Plan:

There are many competing pressure forces in the house that can make this difficult if you don't have a "Documented" planned method of preforming the balancing tasks. Some of the items to be considered are:
(1) HVAC Heating/Cooling air handlers have pressure sensors that will cause the blower fan to "back off" if you are changing the static pressure by adjusting dampers. Mitsubishi mini-split air-handlers are a good example. They need to be forced into a "test mode" with dip switches internal to the unit.
(2) Most modern cook top exhaust systems have a pressure sensor that will automatically (1) turn on the fan (2) energize a motor to open the make up air vent to the outdoors.
(3) ERVs have options for moisture and CO2 sensors that will automatically put the ERV into boost mode.
(4) Clothes dryers may be inter-locked with a make-up air vent motor to open the exterior vent.
(5) We normally recommend using an ERV rather than bathroom exhaust fans, however, if there are bathroom exhaust fans installed, they will interfer with the balancing task.
(6) The dehumidifier will turn on based on the relative humidity and will alter the static pressure in the house, and as a result, the CFM flow that you are trying to balance.

Contractors

(1) Both the ERV and Heating/Cooling duct systems must be balanced. Balancing can be preformed by anyone capable of doing it and that has the required equipment. I have come to realize that the majority of the HVAC contractors in Texas have never done this and do not have the necessary equipment. The measuring device must be the powered flow hood (RetroTEC FlowFinder MK2 - Powered Flow Hood) or equivalent as documented in the PHIUS and RESNET requirements.
(2) There are credentialed companies that will come in to balance duct systems that might be helpful.
(3) Some ERV vendors will balance and certify the ERV and duct system as part of the install. Zehnder is an example.
(4) The Rater is required to sample the results at the Final Inspection.

Duct Test

Some folks refer to this as a duct blaster test. It can be done at rough in after the air handler is installed, or at final The requirements are documented in the PHIUS QA workbook and Energy Star.
All duct connections must be sealed with mastic. The gap between the duct boot and the sheet rocki must be sealed air tight also. This is hidden by the register grill, so the registers need to be left off until the inspection is completed for this item. I am not aware of a current requirement to do a duct blaster test the ERV ducts as we do with the Heating/Cooling ducts, but the same air sealing with mastic applies to them also. There will be a visual inspection of all duct systems required before insulation and sheet rock cover them.

Noisy ducts

The air going through solid metal ducts is much more effecient., however, it does produce noise as well as conduct noise from the air handler, the ERV, and dehumdifier fans. Thus, it makes sense to use solid metal ducts for the main trunk lines, but use about 3 foot length of flex duct to connect from the main trunk to the duct register boot. This will reduce the noise. However, a word of caution. The flex duct must be pulled tight to reduce the air resistance. If you use too much flex, and/or do not pull it tight, it will cause several issues.

Zehnder duct systems

Zehnder has the best ERV duct system available. However, there is a cost trade-off to consider. (1) there is a manifold at the ERV (or near it) and every register is a "home run". This makes it easier to balance the system. (2) The ducts are small and will fit into a 2x4 interior wall. If more air is needed than one duct can supply, run multiple ducts. (3) the register diffusers have a "dial" on the inside to set the "CFM" that the mechanical engineer designed for that particular register. (3) You can buy the duct, manifold and diffuser products separately without the cost of the Zehnder ERV product.

Blower Door Test

This is the most feared test in the Passive House community. The maximum leakage for a Passive House being certified with the Prescriptive method 0.04 CFM per square foot of external envelope area. This means that every single tiny crack will contribute to a possible failure. The best construction method to avoid an end failure is to do a blower door test very early in the construction process, and repeat it as the project progresses. The local Rater will charge about $100 for each additional test, but that is a very low cost to avoid an expensive retro fit at the end of the project.

If someone were to ask "How much better is a Passive House", the elevator speech answer could be "10 times better".

LIGHTING REQUIREMENTS

PHIUS Guide Book:

3.5 Mandatory Design Requirements
Most of the following requirements come from prerequisite programs and are the responsibility of the builder but there are some items that concern the designer as well. Phius-specific requirements are listed individually, while prerequisite program requirements are provided as references to sections with hyperlinks to specific documents. The order of items and numbering conventions of specific line items are meant to align with the structure of the Phius Quality Assurance Workbooks but may differ slightly depending on the type of project (single-family, multifamily or non-residential). Please Contact Us for any broken hyperlinks.

3.5.4 Lights, Appliances, & Renewables
Lighting
● DOE ZERH National Program Requirements,
Appliances
● DOE ZERH National Program Requirements,

PHIUS QA workbook v 4.2.1 --- Lights, Appliances & Renewables

80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets

Note: The pre-requisite programs are more restrictive than PHIUS

LIGHTING DEFINITIONS:

Lighting - 2024 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019

Definition of "Qualifying Light Fixture Locations":
R404.1 Lighting equipment.
All **permanently** installed lighting fixtures, **(excluding** kitchen appliance lighting fixtures,) shall contain only **high-efficacy lighting sources**.

R105.2.5 Final inspection.
The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the **required number of high-efficacy lamps and fixtures.**

ANSI/RESNET/ICC 301-2014 Addendum G-2018, Solid State Lighting Approved Date February 28-2018

3.2 Definitions

Qualifying Light Fixture Locations – For the purposes of rating, those light fixtures located in kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole. This excludes plug-in lamps, closets, unfinished basements, and landscape lighting.

Qualifying Tier I Light Fixture – A light fixture located in a Qualifying Light Fixture Location that contains fluorescent lamps/light bulbs.

Qualifying Tier II Light Fixture – A light fixture located **in a Qualifying Light Fixture Location** that **contains LED lamps/light bulbs** with an average luminous efficacy equal to or greater than 50 lumens/watt; an i**ntegrated LED fixture**;or an **outdoor light fixture that is controlled by a photocell**; or an **indoor fixture controlled by a motion sensor.**

HIGH-EFFICACY LIGHT SOURCES:

Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

.

Decorative Light Strings

Be sure to look for the ENERGY STAR when shopping for decorative light strings
Current Specification Effective Date: January 2011

ENERGY STAR certified decorative light strings consume 75% less energy than conventional incandescent lights strands.

Products must meet stringent efficiency (no more than 0.2W per bulb) and quality (3-year warranty, protection against over-voltage, maintained light output) requirements.

In addition, certified light strings must meet product packaging requirements to ensure consumers have a clear understanding of products when they look to purchase light strings.

PLUMBING REQUIREMENTS

Whether we go Prescriptive or Performance path, we will need the same thought process for the hot water plumbing.

The hotwater delivery "timing" requirment is a requirement of the DOE ZERH program and is a pre-requisite of the PHIUS certification.
The size and length of pipe to each hot water fixture must be documented in the plans, ideally a labeled 3-D drawing.

See the PHIUS hot water calculator spread sheet.

If the PHIUS requirement can not be met with design only, a "demand" recirculation pump may be included to meet the requirement.

Concepts:

We do not want the hot water pipes to act as a "radiator" and heat up a house we are trying to cool. Nor, do we want the AirConditioning to cool down the hot water sitting in the pipes.
Therefore, ALL hotwater pipes must be insulated even though they are inside the conditioned area.

We want to minimize the amount of water running down the drain waiting for it to get hot. Therefore, we want to design a minimum length of pipe between the hot water heater and the point of use faucet.

There are restrictions on the gallons per minute flow for bathroom sink faucets and shower heads. (See Watersense.

Design Considerations:

Gallons per minute restrictions are enforced only in the bathroom sink and shower head. This is because of the human habit of letting the water run for long periods of time.
Watersense certification is not a requirement for PHIUS, however, there are Watersense requirements for Toilets, Bathroom Faucets, Showerheads in the DOE Zero Energy Ready Home Requirements.

If the pipe diameter is too large in relationship to length of the pipe, the "gallons per minute" restriction of the faucet will increase the time it takes to get hot water to the point of use.
This is because it takes more time to move the amount of water sitting in the over sized pipe. Pipe size needs to be optimum for the purpose.

On the other hand, some places you want large pipes delivering large amounts of water. Examples The bath tub, the clothes washer, and the dish washer. The flow is not restricted to these areas.

The kitchen sink is a little different. It does have to be included in the "hot water test" defined by DOE ZERH, but there is no requirement at this time for the kitchen faucet to restrict the flow.