Home Efficiency Program – Installation Standards: V8

Effective: 4/13/2014

General notes

- Fort Collins Efficiency Audit required as prerequisite for all measures
- To participate in the Home Efficiency Program, installation contractors must apply for inclusion, and pass the applicable training certification course.
- Do-It-Yourself installation will not qualify for incentives.
- The information in this matrix is subject to change. Utilities will provide thirty (30) days notice of any changes in installation standards
- Field Guide standards for building shell improvements generally follow the 2009 Saturn Building Shell Field Guide, with FCU addendums adding clarity or different standards.
- Field Guide standards for HVAC and Hydronic system installations generally follow the 2009 Saturn Mechanical Systems Field Guide, with FCU addendums adding clarity or different standards.
- All HVAC equipment must be installed per the manufacturer's installation instructions and current IRC Code.
- Customer education forms will be handed out and explained during the audit.
- Refer to the Home Efficiency Program Rebate Matrix for incentive details.
- All update revisions are highlighted

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Air Sealing	• Initial blower door test: ACH50 = 3.0 or greater • Each specific insulation efficiency measure must have the corresponding building shell component air sealed • Living space to garage connection > 200 cfm50, and/or visible openings in house/garage thermal boundary (garage ceiling, common walls house-to-garage, rim joist between garage and basement or crawl space)	**Garage to living space MANDATORY air sealing:** 1. When living space to garage connection has been determined to be >200 cfm50 using the Open-a-Door Zone Leakage measurement (recorded in HEP Audit Data Sheet), the interface must be air sealed to below 200 cfm50. 2. Air leakage paths between the living space and garage identified in the Health and Safety section of the audit report must be air sealed. **Attic to living space mandatory air sealing:** 1. Use approved high temp sealant around heat sources like B-vents, fireplaces and chimneys, and make sure they maintain the required clearance to combustibles, and take digital photos of air sealing materials used around the heat sources, and other concealed elements critical to Installation Standards. **Minimum 10% building envelope air leakage reduction is required:** 1. Unless the building envelope is already air sealed or significantly air tight. Call to discuss if 10% overall reduction cannot be reached. 2. Must be verified by a blower door test before and after air sealing, even if not going for air sealing rebate at 25% or greater reduction. **Minimum shell leakage (CFM50) reduction of:** 25% to be eligible for lower rebate; 33% reduction to qualify for mid level rebate; 50% reduction to qualify for highest rebate. **If the Combustion Safety Test fails under Worst Case Conditions**, the contractor is required to have the homeowner sign the Post-Improvement Carbon Monoxide Disclosure form, leave them a CO detector unless one is currently installed, and counsel about possible solutions. **If the Combustion Safety Test fails under Natural Conditions**, the contractor is required to have them sign the Post-Improvement Carbon Monoxide Disclosure form, leave them a CO detector unless one is currently installed, and refer them to the list of Participating HVAC Contractors for further diagnostics and solutions.	• **Combustion Safety Test required record results on Rebate Application form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).** • **Complete open-a-door living space to garage leakage test-out to verify leakage is below 200 cfm50.** • **Air sealing of interior space to garage air leakage paths identified in the audit will be verified during PIV inspection.**	• Need to fully educate customer on front end so they understand about house as a system, ventilation and combustion safety. • Options to mitigate a **failed Combustion Safety Test** will include: 1. Replace natural draft gas burning appliances with sealed combustion, direct vented, or power vented equipment. 2. Seal return air duct and filter slot in CAZ. 3. Re-line the old common B-vent. 4. Obtain further diagnostics and solutions from an HEP Participating HVAC contractor or a Plus Audit. Contractor to educate homeowner about these options. • Open-a-Door Zone-Leakage measurement methodology and the leakage conversion factor Table 2-4, can be found in The Saturn Building Shell Field Guide (see pg 49 – 51).

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Conditioned Crawl Space Insulation	• Contractor must inspect for proper grading, downspout leaders, moisture evidence on foundation walls, cracks in the foundation, and damp ground. **All moisture problems must be mitigated.** • **If any evidence of moisture intrusion having occurred** at any time is present, (efflorescence on the foundation wall) the crawl space must be treated as having moisture present. See #4 in the Installation Standards. • Provide digital pictures taken before and after any moisture mitigation repair which will not be visible. • Existing condition: un-insulated or poorly installed insulation being removed. • Call first to discuss field stone foundation air sealing and insulation method for approval.	• All three elements (rim joist, foundation wall, and moisture/soil gas barrier) of a conditioned crawl space must be completed in order to qualify for a rebate. If any one of the elements already exists, it must meet HEP Installation Standards AND the other elements must be completed to HEP Installation Standards for a conditioned crawl space rebate. • **Moisture/ soil gas barrier installation requirements:** 1. Barrier must meet ASTM specs listed in Field Manual Notes 2. Remove all debris and major ground surface irregularities 3. Cross laminated polyethylene barrier is required; the barrier must be sealed and mechanically fastened at least 6" up crawl space foundation wall or in cases involving moisture, the foundation plate (urethane caulk meets sealing and mechanical fastening requirements). Seams must be overlapped 6" minimum and be sealed w/ approved tape or sealant. 4. **If the foundation or soil in the crawl space is damp or shows evidence of moisture intrusion, the soil gas barrier could be extended up to and be sealed to the foundation plate to keep moisture out wall insulation**. A moisture collection system must be installed under the soil gas barrier connecting to a perforated pipe under all quadrants of the soil barrier, connected to solid pipe that is extended to the outside. Use a low watt ventilation fan (adequate fans available that draw 10-20 Watts). • **Field stone foundation wall will need to be air sealed. (see Field Manual)** • **Insulate and air seal rim joists and foundation plate:** 1. XPS foam board cut to fit, foamed-in place, R-10. 2. Closed or open cell 2-part spray foam, R-10. o Foam insulation does not require ignition barrier on rim joist (per IRC) • **Insulate Interior of Foundation walls;** 1. **Perforated vinyl faced fiberglass blanket, R-13.** ◦ **Vinyl faced insulation blanket is NOT allowed if foundation or ground shows evidence of past or present moisture-** Unless the moisture barrier extends up to and sealed to the foundation plate. ◦ Insulation blanket must be full height and be in substantial contact with the foundation wall along its entire width and not be pulled out by the footing. There must be minimal voids behind the blanket. ◦ Seal vinyl facing to top of wall and soil barrier so conditioned inside air cannot reach foundation wall and condense 2. **Foam board: Thermax, XPS or EPS, R-10.** ◦ Ignition barrier required over XPS or EPS unless no "utilities" are present in the crawl space; Thermax or R-Max 8850 are exempt. 3. **2-part closed or open cell spray foam** ◦ **Ignition barrier required,** unless no "utilities" are present and is listed and approved without covering (see Field Manual notes) ◦ **Open cell spray foam is only allowed** on the interior of foundation walls if there is **No Indication of Moisture**, unless the soil moisture barrier extends to the foundation plate with mechanical ventilation underneath • **Exterior foundation wall insulation, XPS, R-10** ◦ Foam board insulation must extend down to top of footing, and be protected above grade by a non-organic exterior finish. Provide flashing from under existing exterior finish, over top of foam exterior finish. • **Condition crawl space by any method listed in Field Manual Notes**.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• **Moisture/ soil gas barrier specifications**: 1. Cross laminated poly sheeting used as a moisture and soil gas barrier in crawl spaces must be performance tested to ASTM E-1745 and installed per ASTM E-1643 with a minimum of Class C rated. It must resist deterioration from contact with the soil and maintain a perm of 0.3 or less (per ASTM E-154 section 13). The moisture and soil gas barrier must have a minimum strength of 13.6 lbs/in (ASTM E-154 section 9) and puncture resistance of 475 grams (ASTM D-1709 method B). 2. Field stone and brick foundation details: moisture barrier must run up to fdn plate, and be fastened and caulked; or apply spray foam with an ignition barrier covering all field stone or brick foundation walls. • Crawl space must have adequate volume for combustion air and/ or provide outside combustion air per 2009 IRC Section G2407. • No vents may terminate in the crawl space. • No insulation needed on wall between crawl space and basement. • All foam must meet ASTM E-84 Class 1 standards for Flame Spread and Smoke Development. • Thermax and R-max 8850 are approved to be left exposed to the interior of buildings without a thermal barrier or ignition barrier. • **Ignition barriers are required over spray foam or foam board installed on the inside of crawl space foundation walls wherever there are "utilities" present in the crawl space:** 1. "Utilities" are defined as any mechanical, plumbing, or wiring components. 2. Ignition barriers include: intumescent coatings listed for this use, 1½" mineral fiber (includes fiberglass), and other materials listed in the 2009 IRC, Section 316.5.4. 3. Some open cell spray foam has come on the market that may be installed in a crawl space without an ignition barrier. They must have ICC approval for that application. Submit ES report to program administrator for approval. • **Rim joist and sill plate can have up to 3.5" of spray foam applied without a thermal or ignition barrier being required (IRC Sec R314.2.7).** • **Crawl space must be conditioned by one of the following methods:** 1. HVAC system: supply duct providing 50 cfm / 1000 sf of crawl space area, and return via (2)- 4x8 transfer grills or equivalent openings into living space. 2. Multiple intake whole house exhaust ventilation intake in crawl space, sized per ASHREA 62.2, w/ (2) 4x8 transfer grills or equivalent openings into living space. 3. Continuously operated balanced mechanical ventilation system, HRV or ERV (50cfm / 1000 sf of crawl space), with an intake in the crawl space and (2) 4x8 transfer grills or equivalent openings into the living space.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Cold Crawl Space	• Call first for approval • Water pipes must be above floor insulation • Mechanical ducts must be insulated. • Pre-improvement blower door test required.	• Finished floor must be the air barrier. • Air-seal floor penetrations. • Fill floor cavity with insulation installed RESNET Grade 1 • **Do not install vapor barrier on cold side of insulation.** • Ventilate crawl space per IRC Amendments, Sec R408.1.1.1 • Sealed moisture barrier required on ground in crawl space. (FC IRC Amendments Sec R408.1.1) • Water pipes in cold crawl space must have full floor depth insulation below (build floor down to install full depth of floor insulation below plumbing). • Mechanical equipment ducting must be insulated to R-8. • No exhaust venting may terminate in any crawl space.	• **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• Cold crawl space can be an alternative where the ground in the crawl space is wet due to high ground water, where the best mitigation is to install a sealed moisture soil gas barrier and ventilate under the barrier and the crawl space. See restrictions in Existing Conditions section. • Cold crawl space detail should be used where there is a shallow footing (< than 30" below grade), and a conditioned crawl space could create frost lenses under the footing, possibly heaving the foundation.
Basement Wall Insulation	• No existing insulation • Exterior grade must drain away from foundation, or be mitigated as part of the job scope. • Foundation cracks shall be completely sealed. • **If evidence of moisture exists, it must be or have been mitigated prior to insulating**	• Old brick or field stone foundations must have R-10 minimum closed cell spray foam over entire interior foundation wall and rim joist. • All insulation must be installed to Field Manual specifications. • Exterior foundation wall insulation: R-10 xps foam board 1. Exterior foam board insulation must be closed cell, R-10, and extend down 48" below grade. Must be protected above grade w/ non-organic exterior finish. Provide flashing from under existing exterior finish, over top of foam exterior finish flashed from under finish on walls. • Interior foundation wall insulation: 1" XPS or EPS foam board, R-5: 1. R-13 un-faced batt is installed in the finished frame wall so foundation can dry to the inside. (See Field Manual Notes). • Interior foundation wall insulation: XPS or EPS foam board or spray foam, R-10 1. Basement walls with foam insulation must be finished with drywall or equivalent thermal barrier. 2. Thermax or R-max 8850 is approved to be left exposed inside living space without ignition or thermal barrier. 3. Open cell spray foam is approved only if there is No Indication of Moisture on the foundation walls • Insulate and air-seal rim joist (see conditioned crawl space for rim options). 1. Spray foam or foam board on the rim can be left exposed without a thermal barrier (per IRC).	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).** • **For basement finishes, contractor must coordinate post-improvement verification at time of insulation inspection by Building Department.**	• Building code requires basement insulation be covered with a finish material like drywall, even if basement will not be finished at time of insulating. • "Best practice" recommendation is for basement foundations to dry to the interior. Perm rating of insulation ideally should be > 2. – Foam board insulation can be open cell or closed cell – Best practice is installing 1" foam board on interior of concrete foundation wall, with unfaced R-13 batt in framed wall adjacent on the interior – See Field Guide for sealing floating wall framing at bottom and top of framing. – If 2" R-10 foam board is used foundation wall must be dry. – tape all seams in foam board – Thermax or R-max 88500 can be left exposed without a thermal barrier. All other foam board or spray foam products must have a thermal barrier installed over them. • Cracks causing moisture intrusion into basement shall be sealed as part of the job scope; digital pictures taken before and after repair.
Cantilever Floor Insulation	• No restriction on existing condition of exterior cantilevers or cantilevers into garage	• Inside end of joist space must be blocked and air sealed (see Field Manual for options). • If interior blocking is not in place, and there is adequate room, remove soffits to block and air seal. • If soffits cannot be removed to block and air seal interior, other methods of interior blocking can be used (see Field Manual). • Final condition: intact sealed air barrier inside and outside. • Final condition: joist cavities totally filled with blown insulation.	None	• Other kinds of end blocking that will create the 6th side of insulation cavity: ◦ Change in direction of floor joists ◦ Rim joist on other side of a narrow room adjacent to cantilever ◦ House with insulation in interior floors (for sound) • Do not dense pack near panned or leaky return system • Advise homeowner to repair ductwork leaks that will compromise insulation, before insulating.

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Floor Over Garage Insulation	• Existing insulation does not fill floor cavity. • Drywall must be removed if water pipes are in the floor. •	• Joists must be end blocked and air sealed. – Not necessary to remove drywall to block joist ends. (see options in Field Manual) • To protect water lines from freezing, install net over bottom of pipes so insulation is only blown on the cold side of the pipe. – Provide photos of netted water pipes and/or sealed ducts prior to insulation installation. • Floor cavities used as a return air duct must have the header block or pan sealed prior to insulation installation. **Make sure insulation does not enter return air floor cavity.** • Disconnected ducts must be repaired prior to insulation installation. • Insulation must totally fill joist cavities, installed RESNET Grade 1. • Drywall on garage ceiling must be complete and sealed. • Garage ceiling with living space floor above is a Firewall. If removed, it must be restored to current code compliance	▪ **Combustion Safety Test required. Record results on Rebate Application Form.** ▪ **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• Other kinds of end blocking that will create the 6th side of insulation cavity when dense packing floor joist cavity: ◦ Change in direction of floor joists ◦ Rim joist on other side of a narrow room adjacent to cantilever ◦ House with insulation in interior floors (for sound) • Do not dense pack near panned or leaky return system without air sealing ducts.
Exterior Frame Wall Insulation	• Existing condition: R-9 or less • Do not dense pack walls if old cloth sheathed electrical wire or knob and tube wiring is present. • Measure includes garage/house fire walls.	• Use dense-pack cellulose or short fiber fiberglass in all wall cavities, installed with fill tube. • Air seal around windows, doors, and electrical boxes in wall assembly prior to insulating. • Must seal all penetrations into electrical panels, outlet and switch boxes to keep out insulation. • Plug, seal and refinish all drill holes used to fill exterior walls after insulating. • Cloth sheathed electrical wire must be evaluated or replaced with contemporary code complying 90 degree C temperature rated wiring prior to dense packing walls by a City of Fort Collins licensed electrical contractor. • Knob and tube wiring must be replaced with contemporary code complying 90 degree C temperature rated wiring prior to dense packing walls by a City of Fort Collins licensed electrical contractor.	▪ **Combustion Safety Test required. Record results on Rebate Application Form.** ▪ **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	
Masonry Exterior Wall Insulation	• Existing un-insulated masonry cinder block, double brick, field stone and other types. • Call first for approval	• Insulate masonry walls on either the interior or exterior: – Interior: foam board or 2 part spray foam inside finished frame wall; R-13 minimum. Blown insulation inside finished frame wall, R-13 minimum. Air seal interior wall. – Exterior closed cell foam board, with taped seams, covered with appropriate finish material; R-10 minimum. – Insulate and air seal rim joist if applicable (see crawl space rim options).	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• Exterior installation may be the best option. It's less destructive; moves thermal boundary to the exterior, with the mass wall on the interior to moderate temp swings. Recommend 2" foam board insulation.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Attic Insulation **(Flat Ceiling)**	• **Existing insulation must be < R-30 to qualify for attic insulation rebate.** • **Insulation areas compressed to < R-30 after air sealing can qualify for a rebate.** • Attic must be air sealed and have mechanical / duct issues corrected prior to blowing insulation (see installation standards). • Cloth sheathed electrical wire must be evaluated or replaced with code complying wiring prior to insulating • Knob and tube wiring must be abandoned or removed and new code complying wiring installed prior to insulating	• Install insulation baffles at all soffit vent locations (recommend adding passive ventilation to minimum code amounts). • Install an insulation stop on the outside edge of the top plates to maximize R-value at exterior edge of exterior wall top plates and minimize wind washing. This can consist of insulation batts or bags to blow insulation into. • Air seal all shell components interfacing with attic, including knee walls. • Extend any unvented bath or kitchen fan vent to exterior (vents not allowed to terminate in attic) • Repair and seal any disconnected HVAC prior to blowing attic insulation: – Un-insulated ducts must be insulated to minimum R-8. – Fix ducts that severely restrict airflow. • Insulation < R-30 must be improved to at least R-49 to qualify for a rebate: – If blowing cellulose on top of fiberglass, add an additional 2” of cellulose to the total to account for compressi9n of the fiberglass underneath. – Blown cellulose insulation shall contain at least 85% recycled material and be Borate treated in attics. – Blown fiberglass shall contain a minimum of 25% recycled material. • Seal thermal bypasses (total air seal not required): – Chases, plumbing vents, b-vents, chimneys, top plate penetrations, etc. (contractor discretion as to which minor thermal bypasses to seal. All significant thermal bypasses shall be sealed). – Provide digital photos of air sealing material installation around heat sources like b-vents, fireplaces and chimneys. Sealants used in contact with B-vents and chimneys must meet ASTM 136 (ie: 3M-FB136 or HT Silicone). • Insulate and air seal knee walls and skylight shafts and provide an air barrier. Separate knee wall and skylight requirements and incentives are listed below. • Whole house fan in ceiling must have a sealed insulated cover (as much R-value as possible between cover and fan), or install fan w/ motorized insulated cover (see whole house fan section below). • Recessed lighting must be air sealed with either can inserts or covers. Covers must maintain 3” clearance to can. If installing inserts also seal gap in drywall around can. • Attic hatch must be insulated with foam board to R-38 minimum, be air-sealed with a dense foam weather strip, and have full depth insulation curb blocking around the hatch. Seal all trim around hatch. • Insulation dams are required at all ceiling level transitions.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• All references to BTL and mechanical ventilation disclosure have been removed • Alternative details are allowed for installing adequate insulation at exterior wall top plates (while maintaining ventilation path at soffit vents) • Conditioned attic with spray foam on roof deck could create an asphalt shingle warranty issue, because roof is un-ventilated. Will need up to 10” of spray foam to meet R-Value requirement. • Recommend flagging electrical J boxes that will be buried under insulation. • Recommend adding attic ventilation to code minimum 1 sq ft of vent area per 300 sq ft of attic, with ½ of the vents is in the upper and ½ is in the lower part of the attic.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Attic Knee Wall and Skylight Shaft	• Un-insulated or insulated to R-11 or less	• If uninsulated, add a minimum R-19 spray foam, foam board or vinyl faced fiberglass blanket: 1. Seal all edges and seams of insulation 2. An ignition barrier is required over foam board or spray foam if "utilities" are present (they are almost always present. See crawl space Field Notes for definition of utilities). Unless Thermax or R-Max 8850 are used. • If already insulated, add a minimum R-11 spray foam, foam board or vinyl faced fiberglass blanket over existing insulation 1. Seal all edges and seams of insulation 2. An ignition barrier is required over foam board or spray foam if "utilities" are present (they are almost always present. See crawl space Field Notes for definition of utilities). Unless Thermax or R-Max 8850 are used.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• Attic knee walls and the separate installation instructions were added to the list of qualifying insulation improvements replacing just installing an air barrier. • The air barrier alone was not helping the thermal bridging problems especially in the summer when attic temps are over 130 degrees. The additional insulation and air barrier is required to help reduce conduction with this high delta T. • Un-insulated Solar tubes must be insulated to at least R-11 per the installation standards requirement.
Cathedral Ceiling Insulation	• Check roofing and ceiling for signs of leakage or excessive age. • No rebates if leaks or excessive age are present and roof is not replaced.	• Dense-pack with cellulose, or short fiber fiberglass insulation. • Replace or air seal any IC recessed lights in vaulted rafter space with Air Tight (AT) cans, or install an insert and air seal drywall cutout to can. • Wood ceiling finish must have plastic vapor/air barrier behind it, unless spray foamed cavity. • Seal all penetrations: i.e. light or ceiling fan boxes.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • **Blower door test required prior to air sealing and after insulating in order to measure house tightness improvement (see air sealing section).**	• Unvented roof assembly may void asphalt shingle's warranty. • If re-roofing is needed, look at installing foam insulation on top of roof deck before re-roofing to increase R-value of roof assembly.
Window Replacement (including sliding glass doors)	• Existing windows and/or sliding glass doors must have one of the following conditions: single pane; clear glass; metal frames; or leaky/poor sealing. • Walls must be insulated, or be insulated as part of this job scope to receive rebate.	• Window installations must be done by HEP certified window installers. • **Full frame replacement window installation must be done whenever possible.** • Replacement windows must meet Northern Climate Zone Energy Star requirements to qualify for our incentives – U-factor of < 0.31 w/ any SHGC – U-factor of 0.31 w/ SHGC of > 0.34 – U-factor of 0.32 w/ SHGC of > 0.39 • Windows/sliding glass door installation must meet AAMA standards, and must meet AAMA design standards for water and air infiltration. • Windows/sliding glass doors must have low maintenance exterior: clad, fiberglass, composite or vinyl. • When a replacement window is installed inside an existing window frame (Block Frame method), air sealing is required around the existing window frame (remove interior trim, insulate and air seal between framing and existing window frame). • Replacement windows must be properly insulated and air sealed in the opening with low expansive foams. • Dense pack old weight pockets with cellulose or short fiber fiberglass, or spray full with foam.	No test out required	• Variance procedure for alternative U-value and SHGC values with passive solar design. Must call for pre-approval, and submit design. • Replacement window types/ methods (Install per AAMA standards): – Block frame- replacement windows are installed inside frame of existing window frame. This is to be used only with wall construction types where full frame replacement window installation may be difficult to do, including historic homes, brick and stone veneer, or asbestos siding; more prone to leakage. Block frame installations must include air sealing around existing window frame, and insulating the weight pockets in old single/double hung windows. – Full frame - replacement windows are installed in existing framing after old window and trim is removed on the inside, and the mounting flange trim is removed on the outside and re-flashed. This method is less prone to leakage. • Must use window wrap approved by the manufacturer; typically urethane sealant. • Use AMMA or manufacturer approved Low expansive foams to air seal windows in the opening.

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Window film	• Only for unshaded E, W, and S windows • Clear Glass	• Rebates are for reducing solar heat gain only. • Professional installation required • Films must meet Energy Star qualifying guidelines. • Solar control films must follow manufacturer's thermal stress guidelines.	Manufacturers Certification Statement is required as a 'qualifying insulation system' to receive incentive.	
Replacement Air Handler Blower Motor	• Existing motor: Permanent Split Capacitor • TESP exceeding 0.8 iwc must be mitigated to qualify for rebate	• New motor must be brushless DC • Undertake minimal airflow mitigation measures such as replacing air filter, checking registers and ducts for problems first. Then measure airflow with flow grid, or use total external static pressure as proxy for airflow. • Match new airflow to old airflow, or match new external static pressure to old static pressure after replacing blower motor.	• Air flow or static pressure test required. • Total External Static Pressure (TESP) cannot exceed 0.8 iwc.	• $150 BPM Motor installation incentive payment is available to CheckMe qualified contractors. • Low airflow qualifies system for CheckMe Tune up incentive.
Replacement gas furnace	• Existing furnace must be below 83% rated AFUE • Contractor must provide existing furnace manufacturer, model #, BTUH Input, and age to qualify for a rebate.	• Equipment must be right sized using an approved Block Load heat loss calculation; installed and commissioned per ACCA Standard 5-2007. • All furnaces shall be sealed combustion, with both intake and exhaust piped to outdoors, and vented per OEM's installation instructions. • Tier 1 rebated furnaces shall be a minimum 90% AFUE. • Tier 2 rebated furnaces shall be a minimum 92% AFUE and have multi-stage gas valves and ECM motors. o Multi-stage thermostat required • Total External Static Pressure should not exceed manufacturer's spec without investigating cause and correcting if possible. • **Tier 2 Furnace replacements (with ECM blower motor) with a TESP exceeding 0.8 iwc will not qualify for a rebate.** • Follow HEP Post-Installation Combustion Safety Test Procedure.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • No CST required if all appliances in CAZ are sealed combustion. • Complete HEP Commissioning Form and return with rebate application.	▪ If orphaned water heater does not pass combustion safety test, the homeowner must sign Post-Improvement Carbon Monoxide Disclosure Form, and the contractor must present the homeowner with options to eliminate back drafting. Here are some options: o Replace the draft hooded water heater with a sealed combustion water heater that will qualify for our rebate. The old vent must be capped on both ends or removed and fire-stop the chase. o Re- line or resized the vent to avoid excess spillage from back drafting. Vent liner sized per liner manufacturer installation sizing tables for water heater BTU input and height. o Diagnose cause of negative pressure in the CAZ, and propose mitigation.
Replacement Gas Boiler	• **Call for pre-approval.** • **Hydronic system must be evaluated by an HEP Hydronic Specialty Contractor**	• Must be installed as sealed combustion: intake and exhaust piped to outdoors. • Outdoor reset and indoor temp feedback controls integrated into design. • Initial adjustment of the modulating gas valve must match incoming gas pressure with appropriate high and low fire outputs. • Program boiler computer to actual conditions, not default settings. • New boiler must be more than 10% more efficient than existing boiler. • Boiler over 85% efficient must have return water temps low enough to condense; thus receiving additional efficiency from condensation. • All existing circulator pumps must be replaced with DC ECM pumps. • Circulation pipes must be insulated when exposed in attics or crawl spaces.	• **Combustion Safety Test required. Record results on Rebate Application Form.** • No CST required if all appliances in CAZ are sealed combustion. ▪ Complete HEP Commissioning Form and return with rebate application.	• Return water temps may not be low enough with existing system design for new high efficiency boiler to condense. Thus eliminating efficiency gains. • Need to determine suitability of replacing the existing boiler: what type and size of boiler to replace it with, condensing high efficiency, or mid-efficiency. • Look at the type and the lineal footage of existing convectors for suitability with new high efficiency boiler system that operates at lower temps: may cause over and under heating of rooms. • Baseboard convectors may need replacement with a high-capacity model or increase the overall length.
New AC Installation or Replacing AC System	• Central AC split systems only • Existing AC must be SEER 10 or <, **OR** replacement AC system is at least 1 Ton smaller	• System must be right-sized using an ACCA approved Manual J block load calculations, installed per ACCA Standard 5, and commissioned with CheckMe. • AC systems > 115% of design cooling load: must provide equipment performance data sheets with equipment selection highlighted per Manual S. • AC system condenser, evaporator, and furnace must be AHRI matched. • HEP Participating Contractor technician must be CheckMe Certified. • 3 Tiers of rebates apply to either New or Replacement AC Installation: Tier 1 is SEER 14, EER 12; Tier 2 is SEER 15, EER 12.5; Tier 3 is SEER 16, EER 13 • Tier 3 must have 2 stage condensing unit and furnace with ECM motor	• Commission with CheckMe.	CheckMe commissioning protocol includes verifying that the A/C system airflow, sub-cooling, and refrigerant charge meet manufacturers specifications.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Heat Pump	• Call for pre-approval • Electric heat or heat pump only. • **Heat pump must be evaluated by an HEP Heat Pump Contractor**	• Must provide proposed system design for pre-approval • System must be right-sized using approved Block Load heat loss/gain calculations, installed per ACCA Standard 5, and commissioned with CheckMe. • Determine if existing forced air system duct size is large enough for heat pump. • Min SEER of 14.5 & HSPF of 9.0 Must be cold-climate air-source multi-stage heat pump (e.g. Hallowell), or ground source heat pump. • Contractors must be CheckMe Certified and be on the HEP Participating Contractor List.	• Commission with CheckMe. • Complete HEP Commissioning Form and return with rebate application.	CheckMe commissioning protocol includes verifying that the A/C system airflow, sub-cooling, and refrigerant charge meet manufacturers specifications.
Evaporative cooler	• Call for pre-approval • New evaporative cooler or replacing existing A/C w/ an evaporative cooler.	• Design system and ducts using approved block load heat gain calcs. Submit design and specs for pre-approval. • Evaporative Coolers must have: – Inorganic media, Thermostat control, Multi-speed settings w/ ECM fan, automated daily water dump, insulated cover for winter. • Direct evaporative coolers are permanently mounted on roof or ground. Indirect can be mounted on ground or in an attic. • Follow all manufacturer's installation instructions	• Verify that the indirect evaporative cooler system air flows are per design. • Submit airflow verification with rebate application.	
Replacement Gas Water Heater	• Replacing natural draft vented water heater, or electric water heater.	• Replacement gas water heater must be power vented, direct vented, or high efficiency sealed combustion. • High efficiency sealed combustion must have an EF of 0.80 or >. • Power vented and direct vented water heaters must have an EF of 0.62 or >. • Direct vent and high efficiency sealed combustion must have both intake and exhaust piped to exterior. • Cap or remove combustion air ducts if all appliances in CAZ are sealed combustion. • Do a combustion analysis test verifying the installation meets manufacturer's specifications.	• No Combustion Safety Test out if all CAZ appliances are sealed combustion • Must have Combustion Safety Test if furnace is natural draft vented	• Will solve back-drafting / combustion product spillage in houses with combustion safety problems. • Power vented tank helps with combustion safety; still requires combustion air ducts to CAZ; no efficiency gain over current standard efficiency tank. • Direct vent tank solves combustion safety problems; eliminates combustion air ducts; is cheaper than high efficiency; no efficiency gain over current standard efficiency tank • High efficiency sealed-combustion tank and tankless solves combustion safety problems; eliminates combustion air supply ducts.
Whole house fan	• New or replacing old non-motorized, non-insulated fan.	• Fans must have motorized, insulated doors, which shut and seal after every use. • Provide adequate attic venting per fan manufacturer, unless exhaust vent can be terminated outside the attic. • Insulation shall be prevented from being blown into soffits with baffles and/or insulation blocking. Soffits ventilation into attic shall be maintained. • Old non-qualifying whole house fans must be removed and the space insulated and air sealed to R-38.	• Document that attic ventilation is adequate for the fan air flow rate. Submit with rebate application.	• Quiet fans that seal move low CFM; multiple units may be required to provide comfort.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Duct Sealing and Insulating	• Duct leakage to outside thermal envelope must exceed 20% of system airflow. • Duct leakage must be verified in the Efficiency Audit Plus or by Participating HVAC Contractor with Duct Sealing Specialty. • **Call for pre-approval.**	• Duct Blaster with Blower door test is required before and after duct sealing to measure beginning leakage to outside, and the leakage to outside reduction. • Pressurize ducts to +25 Pa with duct blower, and pressurize house to 0 Pa WRT ducts. Measure duct leakage to outside: must exceed 20% of system airflow to qualify for an incentive. • Seal ducts with approved materials (foil tape can be used at parts that need to be removed for service). • Un-insulated duct must be insulated to R-8 (2009 IECC standard). • Follow HEP Post-Installation Combustion Safety Test Procedure.	• Must measure final leakage to outside: leakage cannot exceed 10% of system airflow (CFM25) • **Complete Post-Installation Combustion Safety Test procedures and record results on Rebate Application Form.**	• Sealing and insulating ducts located outside a home's thermal boundary are usually a cost effective measure. • Can help solve house depressurization issues.

Efficiency Measure	Existing Conditions	Installation Standards	Post-installation Tests	Field Manual, Notes
Mechanical Ventilation	• **Call for pre-approval** • Must provide proposed system design for pre-approval	• Balanced Heat Recovery Ventilators (HRV), and Energy Recovery Ventilators (ERV): Pollutant source point intake is preferred but not always possible – Exhaust ducted balanced systems: ° Furnace fan need not run continuously: intermittent operation/increased speed for on-demand fan operation ok ° Furnace fan should be interlocked w/ HRV/ERV for proper air distribution ° ECM motor required when furnace is used for ventilation, ° ECM motors required with HRV/ERV ventilation systems. ° Defrost must be with conditioned air, not electric resistance heat strips. ° Airflow commissioning required ⇒ Duct sealing critical in these systems • Exhaust-Only Ventilation Systems: Not appropriate for homes with fireplaces or open combustion appliances unless CAZ pressures are within BPI standards and Combustion Safety Test passes in worst-case. – Multi-port exhaust ventilator ° Includes remote attic mounted fans with multiple drops to bathrooms and other pollutant generating sources (except areas w/ gas or wood burning appliances) ° Can have continuous or intermittent run times ° If fan is in continuous operation, must have a DC motor. – Single port fans ° ENERGY STAR qualified bath or kitchen fans ° Quality insulated ducting ° Can have continuous or intermittent run times ° If fan is in continuous operation, must have a DC motor. – House to garage connection cannot exceed 1%. • Supply Ventilation o ECM motor required where furnace is used for ventilation, o Do not use in continuous operation: can over ventilate/pressurize house which may cause moisture condensation damage inside exterior assemblies. o Use FanCycler to control ventilation; a motorized damper on insulated outdoor air intake duct opens when the furnace/air-handler blower operates, and/or a specified amount of time per hour. o Outdoor air duct connects to the furnace return air far enough from furnace to temper cold air so air reaching the heat exchanger is not less than OEM minimum specification. Slope first 4’ of intake duct towards outside, use balancing damper	• **Complete Post-Installation Combustion Safety Test procedures and record results on Rebate Application Form.** • Commission HRV/ERV system. • Measure all system airflows to verify they meet ASHRAE 62.2 ventilation requirements. • Document balanced HRV/ERV intake and exhaust flow rates for rebate application submittal.	• Supply ventilation pros and cons: - Furnace fan used for ventilation uses a substantial amount of energy, even if the required ECM motor is used. - House becomes positively pressurized during operation of furnace-helps reduce spillage of natural draft combustion products and control garage to house pollutants. - Possible solution to air-sealing upgrades which cause failure of combustion safety test-out; especially worst case depressurization. - Can cause moisture penetration into tight building shell and possible damage • HRV & ERV: exhaust ducted balanced systems are good for retro-fit applications to address CAZ depressurization from exhaust fans, and meet ventilation requirements. • Exhaust-Only Ventilation: – Can potentially depressurize CAZ leading to back drafting. – As long as CAZ depressurization is within BPI standards and the Combustion Safety Test passes worst-case, then Exhaust-Only Ventilation is a viable solution. – Garage must be air sealed from home so that the garage does not become the source of makeup air.