



QUALITY ASSURANCE & VERIFICATION GUIDELINES BY MEASURE

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
Envelope	<ul style="list-style-type: none"> ○ Require contractor to do a mock-up of wall and window assembly, including all related trades i.e. sheet metal for review/approval prior to installing all windows ○ Field inspection by manufacturer representative ○ Photos ○ Visual Inspection ○ Blower door test-in and test-out ○ Conduct blower door and smoke pencil tests on sampling ○ Infrared camera imaging 	<p>Obtain product technical data including:</p> <ul style="list-style-type: none"> ● # of windows ● configuration by size and style ● Area orientation for each window configuration ● NFRC rating of each configuration ● Manufacturer name, window series and model # ● Contractor installation warranty (if applicable) ● <i>Other items to document:</i> Photos, infrared images, report on smoke pencil test results, manufacturer rep field report 	window manufacturer rep, Contractor/installer
Replace roofing and install R-38 insulation	<ul style="list-style-type: none"> ○ On-site inspection roofing manufacturer representative ○ HERS rater inspection for insulation installation 	<ul style="list-style-type: none"> ● Roofing manufacturer's on-site inspection report ● Insulation installer certificate ● HERS rater inspection/report 	roofing, insulation subcontractors
Window weatherstripping/control air leakage	<ul style="list-style-type: none"> ○ Visual inspection ○ Use infrared camera, smoke pencil to help identify direct or indirect (internal) air leakage <p><i>These test-outs to be performed on 15% of units including a mix of those located at upper/lower floors and all orientations. Per ASHRAE Standard 62-1989 air leakage or a combination of air leakage and mechanical ventilation must provide at least 15 CFM per person or 0.35 air changes per hour, whichever is greater.</i></p>	<ul style="list-style-type: none"> ● Photos, infrared camera photos and blower door test-in and test-out results. All documentation to show pre- and post-improvement conditions. 	

✓ Check when completed

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DHW Tune-up (E) gas fire DHW	<ul style="list-style-type: none"> ○ Record hot water temperature at sink and tub/shower in 10% of the units ○ Measure supply and return water temperature ○ Test combustion efficiency 	<ul style="list-style-type: none"> ● Log of recorded temperature at sampled fixtures and at DHW ● Results of combustion efficiency test 	
Insulate hot water piping	<ul style="list-style-type: none"> ○ Visual inspection ○ Photos 	<ul style="list-style-type: none"> ● Photos 	
Insulate hot water tanks	<ul style="list-style-type: none"> ○ Visual inspection ○ Photos 	<ul style="list-style-type: none"> ● Photos 	
Low-flow fixture replacement	<ul style="list-style-type: none"> ○ Visual inspection of installed fixture in all units ○ GPM Flow rate samplings to be conducted at all fixtures in 10% of the units 	<ul style="list-style-type: none"> ● Photo ● Product technical data sheets 	
Replace DHW Pumps (VFD)	<ul style="list-style-type: none"> ○ Visual inspection ○ Follow protocol in VFD Prefunctional Checklist referred to in Documentation ○ Conduct Functional VFD and Pump tests listed in Documentation 	<ul style="list-style-type: none"> ● Equipment manuals ● Photos ● (C.VFD 1)–VFD Pre-Functional Checklist completed ● (C.VFD 2)–Functional Test VFD Seattle City Light form filled in ● D. Heating Cooling Water Pumps ● Hot Water System Pump Functional Test documentation 	Testing performed by plumbing, boiler subcontractor/installer
Install Domestic Hot Water Heater	<ul style="list-style-type: none"> ○ Visual inspection ○ Obtain product technical data ○ Complete Pre-Functional Checklist described in Documentation ○ Conduct Functional Test listed in Documentation 	<ul style="list-style-type: none"> ● Obtain Product technical data including: <ul style="list-style-type: none"> ● Equipment, manufacturer and model number ● Equipment capacities and efficiency ratings ● Total quantity installed ● Installation location ● Date of installation ● Contact info of contractor/installer ● Equipment manual ● Photos ● (B. Boiler 1) Boiler Prefunctional checklist filled out ● (B. Boiler 2) Functional test Boilers form completed 	testing performed by plumbing, boiler subcontractor/installer

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DHW Install Solar Hot Water Heating	<ul style="list-style-type: none"> <input type="radio"/> Visual inspection <input type="radio"/> Conduct Inspection per the Checklist and Protocol listed in Documentation 	<ul style="list-style-type: none"> • Photos • Equipment manual • (E. Solar Thermal 1) CSI Solar Thermal Inspection Checklist completed 	testing performed by solar installer
HVAC Programmable thermostats	<ul style="list-style-type: none"> <input type="radio"/> Visual inspection <input type="radio"/> Obtain/review equipment manuals <input type="radio"/> Ensure thermostats are programmed per auditor recommendations in a sampling of the units 	<ul style="list-style-type: none"> • Log confirming programmed temperatures in a sampling of the units 	
Install outside Air (OA) Temp controls for boiler	<ul style="list-style-type: none"> <input type="radio"/> Monitor boiler activity in response to change in OA temperature <input type="radio"/> Conduct Functional Test listed in Documentation 	<ul style="list-style-type: none"> • Log of boiler response to change in OA t emperature • (B. Boiler 2) Functional Test Boiler System 	testing performed by plumbing, boiler subcontractor/installer & manufacturer rep
Install VFD on Heating/cooling	<ul style="list-style-type: none"> <input type="radio"/> Visual inspection <input type="radio"/> Follow protocol in VFD Prefunctional Test listed in documentation <input type="radio"/> Conduct VFD Functional Test in documentation 	<ul style="list-style-type: none"> • Photos • Equipment manual • (C. VFD 1) VFD Pre-functional Checklist form completed • (C. VFD 2) VFD Functional Test form completed 	testing performed by subcontractor/installer
Thermostatic Radiator Valve (TRV) & cleaning	<ul style="list-style-type: none"> <input type="radio"/> Visual inspection in a sampling of the units 	<ul style="list-style-type: none"> • Pre- and post-improvement photos • Product technical data 	subcontractor
Tune-up (E) space heating boiler	<ul style="list-style-type: none"> <input type="radio"/> Measure supply and return water temp <input type="radio"/> Test combustion efficiency 	<ul style="list-style-type: none"> • Log of recorded temperatures supply and return • Results of combustion efficiency test 	subcontractor and manufacturer rep
Replace exhaust fan motors with more efficient ones	<ul style="list-style-type: none"> <input type="radio"/> Visual inspection <input type="radio"/> Smoke test <input type="radio"/> Use flow hood to measure exhaust airflow <input type="radio"/> Test air quality in subject area moisture, CO content <input type="radio"/> May require testing and balancing if it's a balanced ventilation/exhaust system 	<ul style="list-style-type: none"> • Equipment manuals • Photos • Flow hood test results data • Documentation of air quality • TAB report if applicable 	

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HVAC Add timers to Laundry Rm exhaust fans	<input type="radio"/> Visual inspection <input type="radio"/> Check to see if timers operate correctly <input type="radio"/> Test air quality in subject area moisture, CO content	<ul style="list-style-type: none"> • Photos • Equipment manual • Documentation of air quality 	
Install VFDs, CO Sens, EMS and control all Parking Garage Exhaust Fan Motors	<input type="radio"/> Visual inspection <input type="radio"/> Follow protocol in VFD Prefunctional Checklist <input type="radio"/> Conduct VFD Functional Test <input type="radio"/> Test EMS controls <input type="radio"/> Test air quality, CO content	<ul style="list-style-type: none"> • EMS controls test results • Air quality, CO content test results • (C.VFD 1) VFD Functional Test form completed • (C.VFD 2) VFD Functional Test report form completed • Report on EMS Controls • Air testing results 	
Replace wall furnaces with heat pump system	<input type="radio"/> Conduct Prefunctional Checklist review listed in Documentation <input type="radio"/> Perform Functional Test listed in Documentation	<ul style="list-style-type: none"> • Photos • Equipment manual • (A. Heat Pump 1) Prefunctional Checklist completed • (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed 	subcontractor
Install High Efficiency Heat Pumps	<input type="radio"/> Conduct Prefunctional Checklist review listed in Documentation <input type="radio"/> Perform Functional Test listed in Documentation	<ul style="list-style-type: none"> • Photos • Equipment manual • (A. Heat Pump 1) Prefunctional Checklist completed • (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed 	subcontractor
Steam/Space htg Boiler Replacement	<input type="radio"/> Follow protocol listed Prefunctional Checklist referred to in Documentation <input type="radio"/> Conduct Boiler System Functional Tests referred to in Documentation	<ul style="list-style-type: none"> • Photos • Equipment manuals • (B. Boiler 1) Boiler Prefunctional Checklist form completed • (B. Boiler 2) Boiler Functional Test form completed • Water or room temperature tests in a sampling of units 	subcontractor, Manufacturer rep inspection

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HVAC Replace thru-wall AC/Elect heat with Energy Star heat pumps	<ul style="list-style-type: none"> ○ Conduct Prefunctional Checklist review listed in Documentation ○ Perform Functional Test listed in Documentation 	<ul style="list-style-type: none"> ● Photos ● Equipment manual ● (A. Heat Pump 1) Prefunctional Checklist completed ● (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed 	subcontractor
Replace window AC w/ Energy star	<ul style="list-style-type: none"> ○ Visual inspection ○ Verify that AC units work in all units 	<ul style="list-style-type: none"> ● Photos ● Equipment manual 	
Lighting/Exit Signs Lighting	<ul style="list-style-type: none"> ○ Visual inspection ○ Collect technical product data (see documentation) 	Obtain Product technical data including: <ul style="list-style-type: none"> ● Location, type, quantity of pre- and post- retrofit lighting fixtures ● Lamp manufacturer and model number ● Lamp wattage and quantity per fixture ● Ballast type, manufacturer, model number and quantity per fixture type ● Date of installation ● Name, address and contact info for installer/contractor 	subcontractor and manufacturer rep
Lighting controls	<ul style="list-style-type: none"> ○ Confirm all controls have been properly located, field calibrated and set for correct set points and threshold light levels ○ Obtain documentation of setpoints, settings and programming for each device from installer ○ Simulate daylight conditions to verify dimming of the controlled lights and simulate lack of daylight to verify energizing of the light fixtures 	<ul style="list-style-type: none"> ● Documentation of setpoints, settings and programming for each device from installer ● Report confirming controls perform as designed 	subcontractor and manufacturer rep

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Lighting/Exit Signs Replace Hi intensity Discharge Lamp with Induction lighting	<input type="radio"/> Visual inspection, collect technical product data (see documentation)	Obtain Product technical data including: <ul style="list-style-type: none"> • Location, type, quantity of pre- and post- retrofit lighting fixtures • Lamp manufacturer and model number • Lamp wattage and quantity per fixture • Date of installation • Name, address and contact info for installer/contractor 	subcontractor and manufacturer rep
Exit fixtures with LED fixtures	<input type="radio"/> Visual inspection <input type="radio"/> Collect technical product data (see documentation)	Obtain Product technical data including: <ul style="list-style-type: none"> • Location, type, quantity of pre- and post- retrofit lighting fixtures • Fixture manufacturer and model number • Fixture wattage and quantity per fixture • Date of installation • Name, address and contact info for installer/contractor 	subcontractor
Appliances Energy Star Appliance Replacement	<input type="radio"/> Verify installation of 15% of unit and 100% of common area appliances, and check invoices to confirm equipment purchase for entire building <input type="radio"/> Take photos <input type="radio"/> Obtain technical specs	<ul style="list-style-type: none"> • Photos • Equipment manuals 	
Energy Star washing machine replacement	<input type="radio"/> Verify installation of 15% of unit and 100% of common area appliances, and check invoices to confirm equipment purchase for entire building <input type="radio"/> Take photos <input type="radio"/> Obtain technical specs	<ul style="list-style-type: none"> • Photos • Equipment manuals 	
Add Vend Mizers to Vend mach, Cold water fountain	<input type="radio"/> Verify installation of all units <input type="radio"/> Take photos <input type="radio"/> Obtain technical specs	<ul style="list-style-type: none"> • Photos • Equipment manuals 	

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Elevator Replace elevator motors with efficient ones	<input type="radio"/> Obtain equipment manual, technical specs from vendor	<ul style="list-style-type: none"> • Photos • Equipment manuals • Results of test-out by elevator contractor 	subcontractor, manufacturer rep, City/County/State Elevator Inspector
Renewables Solar Photovoltaic	<input type="radio"/> Visual inspection <input type="radio"/> Conduct Inspection per the Checklist and Protocol listed in Documentation	<ul style="list-style-type: none"> • Photos • Equipment manual • (F. Solar PV 1) CSI Inspection Protocol completed and documented 	testing performed by installer

Notes:

1. Representative sampling unless otherwise noted shall include all of the subject fixtures/installations in 10% of the units but not less than 4 units. Selected units shall represent a mix of units from upper/lower floors and various orientations.
2. If sampling is not called out, assume all improvements must be inspected in all units.
3. Prefunctional checklists and Functional test document designations A-E and 1-2 refer back to the "QA&V List of Documents 6-1-11".
4. Prefunctional and Functional test forms can be found at the PECE (Portland Energy Conservatory Inc.) website at: <http://www.peci.org/ftguide/index.htm>