Retrofitting Washington

Standard Work Specifications
Field Guide for Multifamily Homes
created by
Washington Department of Commerce

Disclaimer

Weatherization (Wx) projects shall be weatherized in accordance with the State of Washington Weatherization Manual (Policies and Procedures and Supporting Documents) for the appropriate housing type (single-family, mobile, and multifamily). Policy defines allowable Wx Program work.

The Washington State Multifamily Field Guide Retrofitting Washington (Wx Field Guide) defines applicable work that meets the specifications, objectives, and desired outcomes outlined in the Standard Work Specifications for Home Energy Upgrades (SWS). The Guidelines for Home Energy Professionals Standard Work Specifications are the reference for any work the WA Field Guide does not address.

The technical specifications in the Field Guide take precedence over the Wx Manual Policy.

More specific requirements (e.g.: manufacturer's installation directions) take precedence over more general Field Guide or SWS rules. Where the referenced documents specify different requirements, materials, or methods of construction the most restrictive shall govern.

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3.0102.4 Sealing Firewalls

Section: Air Sealing
Topic: General Pressure Boundary
Sub-Topic: Specific Air Sealing

Desired Outcome

Restore firewall functionality with safe, durable, airtight sealing that remains in place and prevents air movement @ 50 Pascals of pressure

3.0102.4a Sealant selection

Specification

Select sealants that:

are compatible with their intended surfaces,

allow for differential expansion and contraction between dissimilar materials,

meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and

for use inside the pressure boundary select low volatile organic compound (VOC) sealants that meet independent testing and verification protocols

Objective

Select safe and effective sealants

3.0102.4b Material selection

Specification

Select materials that:

adequately support applied load and are permanent air barriers,

meet the requirements of the applicable fire safety code (e.g. thermal or ignition barriers), and

for use inside the pressure boundary select low volatile organic compound (VOC) materials that meet independent testing and verification protocols

Objective

Select safe and effective materials

3.0102.4c Backing and infill

Specification

Install backing or infill in any gap or crack greater than 1/4"

Install rigid backing or infill for gaps or cracks greater than 3" using mechanical fasteners

Once installed, backing or infill will not bend, sag, or move

Objective

Prevent excessive sealant movement

3.0102.4d Surface preparation

Specification

Remove any material from the sealing area that will prevent full adhesion of the selected sealant

Objective

Surface is clean and ready to accept sealant

3.0102.4e Sealant application

Specification

Apply a continuous seal at all seams, cracks, joints, edges, penetrations, and connections of the firewall while applying sufficient pressure to push sealant into any gaps or cracks and contact any backing or infill material required

If firewall assembly is not monolithic (e.g., balloon framing, CMU, open chase, attic bypass, or with similar penetration through the attic floor plane), attic floor plane penetrations within the firewall assembly will be accessed through the firewall, fully sealed, and firewall surface restored to prevent current or future breaches of the firewall below the attic floor plane from establishing an air flow path to the attic space

Objective

Fully adhered, airtight, and durable seal

4.0403.1 Raised and On-Grade Slab Edge Insulation

Section: Insulation
Topic: Conditioned Subspaces
Sub-Topic: Slabs

Desired Outcome

Durable, pest-resistant, thermal break between the slab edge and outdoors

4.0403.1a Pre-work qualifications

Specification

Verify all bulk sources of moisture have been directed away from the slab (i.e., gutters, flashing, grading, drainage)

Wall sill plate and slab edge penetration air sealing is completed

No active pest intrusions exist

Objective

Ensure space can be safely insulated

4.0403.1b Material selection

Specification

Select insulation that is rated for ground contact and is a class I vapor retarder

Objective

Durable insulation selected

4.0403.1c Sealant selection

Specification

Select sealants that:

- are compatible with their intended surfaces
- allow for differential expansion and contraction between dissimilar materials
- meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers)
- are low volatile organic compound (VOC) sealants for use inside the pressure boundary that meet independent testing and verification protocols

Objective

Select safe and effective sealants

4.0403.1d General preparation

Specification

Prepare slab edge to receive insulation and/or sealing materials per manufacturer specifications

Objective

Surface ready for insulation and sealant

4.0403.1e Excavation

Specification

Excavate slab edge to prescribed depth and width for installation while avoiding undermining slab footing or damaging underground utilities or drainage

- Protect excavation from weather until restored to original condition (e.g., density, drainage function)

Objective

Provide installation access and protect slab and utilities from damage

4.0403.1f Installation

Specification

Install insulation to prescribed R-value in contact with the slab edge, without voids, compressions, or misalignments and tight to any utilities penetrating the slab edge insulation

Objective

Continuous and contiguous thermal boundary

4.0403.1g Flashing

Specification

Install continuous and permanent flashing to direct water away from the foundation and slab edge insulation

Objective

Direct bulk moisture away from slab insulation

4.0403.1h Protective covering

Specification

Cover exposed insulation with a durable, rigid, and pest-resistant material

Objective

Protect insulation from weather and impact

4.0403.1i Sealing and pest protection

Specification

Seal all slab edge penetrations using a compatible sealant

Stuff any gaps 1/4" or greater with copper or stainless steel mesh prior to sealant application

Objective

Airtight and pest-resistant slab edge

4.0403.1j Termites

Specification

Preserve existing termite treatment and inspection gaps as required by applicable codes

Objective

Prevent pest entry and maintain applicable warranties

4.0403.1k Back fill

Specification

Restore excavated earth and grade to drain bulk moisture away from foundation

Objective

Preserve the drainage plane of the slab edge

4.0403.1l Insulation - onsite documentation

Specification

Post a dated receipt signed by the installer that minimally includes: Installed insulation type, coverage area, installed thickness, and installed R-value

Objective

Comply with 16 CFR 460.17 and document contract compliance

6.0101.4 Fan Controls

Section: Ventilation

Topic: Infrastructure
Sub-Topic: Components

Desired Outcome

Safe and effective fan control that supports the ventilation strategy

6.0101.4a Intermittent/continuous operation

Specification

Install controls that are either internal to the fan or external

For intermittent ventilation strategies: Install a controller that can operate the fan intermittently to produce the intended flow

For continuous ventilation strategies: Install an automatic controller that can operate the fan continuously to meet the intended flow rate

Only use continuous operation controls on fans containing ECM motors rated for continuous operation

Objective

Meet intended ventilation strategy

6.0101.4b Optional sensors

Specification

Install a manual override control to activate the fan as necessary

Occupancy sensors/humidistat:

Install an occupancy sensor and/or humidistat designed to function with the chosen fan and in accordance with manufacturer specifications

Carbon dioxide sensors (demand control):

Only use CO2 sensors with VFD or multispeed fans

Objective

Provide ventilation on an as-needed basis

6.0101.4c Manual override

Specification

Install a clearly labeled manual service disconnect for all ventilation fan controls

Objective

Service disconnect available

6.0101.4d Labeling, if applicable

Specification

Clearly label all whole-house ventilation system controls "Whole-House Ventilation Control"

Objective

Fan control operation made clear

6.0101.5 Airflow Control Devices

Section: Ventilation
Topic: Infrastructure
Sub-Topic: Components

Desired Outcome

Safe, balanced, and effective airflow control

6.0101.5a Pre-Work Qualifications

Specification

Verify:

air flow regulator specifications are appropriate to site conditions(e.g., duct size, type, shape, register type, duct static pressure)

presence and type of fire dampers and smoke control devices

Objective

Verify safety and appropriate regulator design

6.0101.5b Material selection

Specification

Select appropriate air flow regulator or orifice for the opening and desired airflow that will not interfere with the operation of smoke and fire dampers

Objective

Moderate air flow safely and efficiently

6.0101.5c Installation

Specification

Securely fasten transition or adapter according to manufacturer specifications

Install flow control device in the proper orientation for the desired flow direction

Set adjustable devices to preliminary balancing position per the design specifications

Objective

Secure and properly oriented device

6.0101.5d Sealing

Specification

Seal all connections with UL 181B or 181B-M listed materials (e.g., mastic, tape)

Objective

Airtight installation

6.0101.5e Fire Safety

Specification

Verify installed air flow device will not interfere with proper operation of smoke and fire dampers

Objective

Proper function of fire safety systems

6.0101.6 Variable Frequency Drives and Electrically Commutated Motors

Section: Ventilation
Topic: Infrastructure
Sub-Topic: Components

Desired Outcome

Improve fan efficiency and control systems

6.0101.6a Pre-work qualifications

Specification

Evaluate motors for compatibility with variable frequency drive (VFD)

Analyze load profile and source equipment for use of VFD to provide variable ventilation rates

Objective

Ensure existing system is compatible with VFD use

6.0101.6b Installation

Specification

Replace motor and/or starter per the manufacturer's specifications and in compliance with applicable codes

Objective

Ensure that VFD or ECM installed safely and effectively

6.0101.6c Feedback sensors

Specification

If using a sensor-controlled strategy, install feedback sensors in accordance with manufacturer specifications at locations that will optimize the chosen control strategy

Objective

Optimize VFD or ECM operation

6.0101.6d Manual controls

Specification

Install manual controls in accordance with manufacturer specifications at a location easy to access for continued operation

Objective

Safe and effective manual operation

6.0101.6e Initial setup

Specification

Set VFD and/or ECM parameters to accept feedback from sensors dependent upon chosen control strategy

Optimize system to meet design ventilation rates at the lowest possible speed setting.

Objective

Minimal fan speed for ventilation rate

6.0301.1 Fresh Air Intake In Forced Air System

Section: Ventilation
Topic: Whole-Building Ventilation
Sub-Topic: Supply Ventilation

Desired Outcome

Efficiently supply adequate, clean ventilation air

6.0301.1a Pre-work qualifications

Specification

Existing forced air system duct leakage to outside will be less than 10% of the air handler flow when measured at 25 pascals with reference to outside

Any portion of the return located inside a combustion appliance zone will be sealed

Objective

Prevent contamination through duct leakage

6.0301.1b Intake location

Specification

Install intake to pull air from the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

Install intake:

A minimum of 6" from grade;

A minimum of 10' from contaminant sources or exhaust outlets;

Above local snow or flood line;

A minimum of 18" above an asphalt based roof;

Never on a flat roof

Objective

Unrestricted entry of contaminant-free air

6.0301.1c Labeling

Specification

Intake fitting will be labeled "ventilation air intake"

Objective

Prevent fitting restriction

6.0301.1d Pest exclusion

Specification

Install corrosion resistant screen, louver, or grille material over exterior intake with a hole size of no less than 1/4" and no greater than 1/2" in any direction

Objective

Prevent pest entry while allowing proper air flow.

6.0301.1e Motorized damper

Specification

Install a motorized damper or equivalent between the intake fitting and the return side duct connection

Damper will be open only when the air handler fan is operating

Objective

Prevent unwanted air flow

6.0301.1f System control

Specification

Provide air flow by sequenced or scheduled operation of the damper or equivalent technology

Control system must operate both the air handler and the motorized damper or be interlocked to prevent damper operation when air handler is not on

Objective

Sufficient controlled ventilation rate

6.0301.1g Wiring

Specification

Install all electrical wiring according to manufacturer specifications and applicable code

Objective

Prevent an electrical hazard

6.0301.1h Fresh air filtration

Specification

All mechanically-supplied outdoor air must pass through a filter before combining with conditioned air

Filtration must meet a minimum efficiency of MERV 8

Filter or air cleaning systems that intentionally produce ozone are not allowed

Objective

Outdoor air filtered for particles

6.0301.1i Filter accessibility and fit

Specification

Install filtration in a readily accessible location for service

Filter opening must allow filter to be fully removed and inserted without bending or damaging the filter

Filter access panel must include gasket or comparable sealing mechanism and fit snugly against exposed edge of filter when closed

Filter plenum must be airtight and mechanically fastened to adjoining ductwork

Objective

Filter accessible for service and prevents air bypass

6.0301.1j Access

Specification

Ensure motorized dampers and service disconnect switches are accessible for maintenance according to NEC, or applicable building code

Objective

Serviceable parts are readily accessible

6.0301.1k Ducting

Specification

Install all ducting in accordance with SWS detail for "Ventilation Ducts"

Objective

Unrestricted ventilation air flow

6.0301.1l Fire dampers

Specification

If fire dampers are required in the fresh air supply duct, install them according to applicable building code

Fire dampers must be accessible for inspection and/or testing

Sealing activities must not interfere with the operation of fire dampers, balancing dampers, or backdraft dampers

Objective

Fire dampers function effectively and are accessible

6.0301.1m System balancing

Specification

Adjust fan speed, dampers, and registers until design specifications are met

Objective

Ensure complete dwelling ventilation

6.0301.2 Dedicated Air Handler for Multiple Dwellings

Section: Ventilation
Topic: Whole-Building Ventilation
Sub-Topic: Supply Ventilation

Desired Outcome

Efficiently supply adequate, clean ventilation air

6.0301.2a Fan selection

Specification

Select a fan that:

has an electrically commutated motor (ECM) and/or utilizes (VFD) controllers

is capable of maintaining a minimum operating static pressure of .25 inches of water column or greater

motors 1 horsepower or larger must meet NEMA premium efficiency standards

motors less than 1 HP must be rated by the Home Ventilation Institute to satisfy these requirements

Objective

Adequate and efficient fan motor

6.0301.2b Intake location

Specification

Install intake to pull air from the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

Install intake:

A minimum of 6" from grade;

A minimum of 10' from contaminant sources or exhaust outlets;

Above local snow or flood line;

A minimum of 18" above an asphalt based roof;

Never on a flat roof

Objective

Unrestricted entry of contaminant-free air

6.0301.2c Labeling

Specification

Label exterior intake fitting with the words "Ventilation Air Intake"

Objective

Prevent fitting restriction

6.0301.2d Pest exclusion

Specification

Install corrosion resistant screen, louver, or grille material over exterior intake with a hole size of no less than 1/4" and no greater than 1/2" in any direction

Objective

Prevent pest entry while allowing proper air flow.

6.0301.2e Motorized damper

Specification

Install a motorized damper or equivalent between the intake fitting and the return side duct connection

Damper will be open only when the air handler fan is operating

Objective

Prevent unwanted air flow

6.0301.2f Backdraft prevention

Specification

Design one or more supply fans located upstream of all the supply outlets to run continuously, or

install a system of one or more backdraft dampers to isolate each dwelling unit from the common duct when the fan is not running.

Objective

Prevent air movement between dwelling units

6.0301.2g Wiring

Specification

Install all electrical wiring according to manufacturer specifications and applicable code

Objective

Prevent an electrical hazard

6.0301.2h Fresh air filtration

Specification

All mechanically-supplied outdoor air must pass through a filter before combining with conditioned air

Filtration must meet a minimum efficiency of MERV 8

Filter or air cleaning systems that intentionally produce ozone are not allowed.

Objective

Outdoor air filtered for particles

6.0301.2i Filter accessibility and fit

Specification

Install filtration in a readily accessible location for service

Filter opening must allow filter to be fully removed and inserted without bending or damaging the filter

Filter access panel must include gasket or comparable sealing mechanism and fit snugly against exposed edge of filter when closed

Filter plenum must be airtight and mechanically fastened to adjoining ductwork

Objective

Filter accessible for service and prevents air bypass

6.0301.2j Air handler mounting

Specification

Mount fan using mechanical fasteners per manufacturer's specifications and applicable code (e.g., seismic restraints)

Isolate air handling unit from the building framing unless specifically designed to be directly attached

Objective

Secure, vibration-isolated air handler

6.0301.2k Air handler duct plenum connection

Specification

Attach ductwork to air handler via a flexible connection and that maintains the intended fan opening

Objective

Efficient, vibration-resistant plenum connections

6.0301.2l Sealing

Specification

Seal all air moving portions of the system using UL 181 products

Objective

Airtight ventilation system

6.0301.2m System control

Specification

Provide air flow by sequenced or scheduled operation of the damper or equivalent technology

Control system must operate both the air handler and the motorized damper or be interlocked to prevent damper operation when air handler is not on

Objective

Sufficient controlled ventilation rate

6.0301.2n Access

Specification

Ensure motorized damper, service disconnect switch, fan, filter, and conditioning coils are accessible for maintenance according to NEC and applicable building code

Objective

Serviceable parts are readily accessible

6.0301.2o Fire dampers

Specification

If fire dampers are required in the fresh air supply duct, install them according to applicable building code

Fire dampers must be accessible for inspection and/or testing

Sealing activities must not interfere with the operation of fire dampers, balancing dampers, or backdraft dampers

Objective

Fire dampers function effectively and are accessible

6.0301.2p System balancing

Specification

Adjust fan speed, dampers, and registers until design specifications are met

Objective

Ensure complete dwelling ventilation

6.0302.1 Individual Exhaust Fan Serving Entire Dwelling

Section: Ventilation
Topic: Whole-Building Ventilation
Sub-Topic: Exhaust Ventilation

Desired Outcome

Safe, efficient, and adequate whole dwelling exhaust ventilation

6.0302.1a Fan selection

Specification

Select a fan that:

uses an ECM motor designed for continuous operation

produces no more than 1.0 sones at maximum speed

has an efficacy of 2.8 cfm/watt or more

Objective

Select efficient and quiet equipment

6.0302.1b Sealant selection

Specification

Select sealants that:

are compatible with their intended surfaces,

allow for differential expansion and contraction between dissimilar materials,

meet the requirements of the applicable fire safety code (e.g., thermal or ignition barriers), and

for use inside the pressure boundary select low volatile organic compound (VOC) sealants that meet independent testing and verification protocols

Objective

Select safe and effective sealant

6.0302.1c Termination location

Specification

Terminate exhaust system to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

Install terminations: A minimum of 3' away from any property line; A minimum of 3' away from operable opening to houses; A minimum of 10' away from mechanical intake; Above the snow-line

If the termination is at the soffit, seal soffit vents within 6' of the termination

Objective

Prevent exhaust from reentering the structure

6.0302.1d Pest exclusion

Specification

Install corrosion resistant screen, louver, or grille material over exterior termination with a hole size of no less than 1/4" and no greater than 1/2" in any direction

Objective

Prevent pest entry while allowing proper air flow.

6.0302.1e Damper

Specification

If the fan does not contain an integrated damper, install a damper that:

opens in the direction of the desired flow

closes when the system is off

Objective

Prevent unwanted air movement while not restricting desired air flow

6.0302.1f Interior intake location

Specification

Install exhaust intake in a central location within the main body of the dwelling

Objective

Effective location for removal of contaminants

6.0302.1g Opening preparation

Specification

Cut hole for exhaust intake leaving no more than a 1/4" gap on each side of the fan assembly

Objective

Properly sized opening

6.0302.1h Fan orientation

Specification

Orient the fan outlet toward the final termination location and so the effective length of the duct run is as short as possible

Objective

Short, effective fan venting

6.0302.1i Fan mounting

Specification

Mount fan using mechanical fasteners and per manufacturer's specifications so that fan housing does not shake, rattle, or vibrate when operating

Objective

Securely mounted fan

6.0302.1j Wiring

Specification

Install all electrical wiring according to manufacturer specifications and applicable code

Objective

Prevent an electrical hazard

6.0302.1k Sealing

Specification

Seal gap between the fan housing and interior surface

Seal fan housing to be substantially airtight

Objective

Fan housing sealed to prevent air movement (except through the designed outlet) at 50PA of pressure

6.0302.1l Insulate housing

Specification

Insulate fan housing located outside the thermal boundary to a minimum of R-8 or cover with insulation of more than R-8

Objective

Prevent condensation

6.0302.1m Fan access

Specification

Ensure fan and service disconnect switch are accessible for maintenance according to NEC, or applicable building code

Objective

Accessible for service

6.0302.1n Venting

Specification

Duct and terminate fan to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors, in accordance with SWS detail for "Ventilation Ducts"

Objective

Exhausted to outdoors

6.0302.1o System balancing

Specification

Adjust fan speed, dampers, and registers until design specifications are met

Objective

Ensure complete dwelling ventilation

6.0302.1p Hot-humid climates

Specification

Exhaust ventilation will not rely on make-up air from common corridors

Objective

Ensure building durability and occupant health in humid conditions

6.0302.2 Multiport Exhaust Fan Serving Multiple Dwellings

Section: Ventilation
Topic: Whole-Building Ventilation
Sub-Topic: Exhaust Ventilation

Desired Outcome

Efficiently and safely exhaust adequate ventilation air

6.0302.2a Fan selection

Specification

Select a fan that:

has an electrically commutated motor (ECM) and/or utilizes (VFD) controllers

is capable of maintaining a minimum operating static pressure of .25 inches of water column or greater

motors 1 horsepower or larger must meet NEMA premium efficiency standards

motors less than 1 HP must be rated by the Home Ventilation Institute to satisfy these requirements

Objective

Adequate and efficient fan motor

6.0302.2b Termination location

Specification

Terminate exhaust system to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

Install terminations: A minimum of 3' away from any property line; A minimum of 3' away from operable opening to houses; A minimum of 10' away from mechanical intake; Above the snow-line.

If the termination is at the soffit, seal soffit vents within 6' of the termination

Objective

Prevent exhaust from reentering the structure

6.0302.2c Pest exclusion

Specification

Install corrosion resistant screen, louver, or grille material over exterior termination with a hole size of no less than 1/4" and no greater than 1/2" in any direction

Objective

Prevent pest entry while allowing proper air flow.

6.0302.2d Backdraft prevention

Specification

Design one or more exhaust fans located upstream of all the exhaust inlets to run continuously, or install a system of one or more backdraft dampers to isolate each dwelling unit from the common duct when the fan is not running

Objective

Prevent air movement between dwelling units

6.0302.2e Wiring

Specification

Install all electrical wiring according to manufacturer specifications and applicable code

Objective

Prevent an electrical hazard

6.0302.2f Fan mounting

Specification

Mount fan using mechanical fasteners per manufacturer's specifications and applicable code (e.g., seismic restraints)

Isolate unit from the building framing unless specifically designed to be directly attached

Objective

Secure, vibration-isolated air handler

6.0302.2g Combining air streams

Specification

If combining ducts, combine them on the upstream side of fan using "Y"-fittings or collection boxes

Do not combine dryer, kitchen, or garage exhausts streams with any other exhaust stream

Objective

Effective, safe exhaust of air from multiport systems

6.0302.2h Sealing

Specification

Seal all air moving portions of the system using UL 181 products without interfering with the function of dampers

Objective

Airtight ventilation system with freely operating dampers

6.0302.2i Access

Specification

Ensure fan and service disconnect switch are accessible for maintenance according to NEC, or applicable building code

Objective

Serviceable parts are readily accessible

6.0302.2j Fire dampers

Specification

If fire dampers are required in the fresh air supply duct, install them according to applicable building code

Fire dampers must be accessible for inspection and/or testing

Sealing activities must not interfere with the operation of fire dampers, balancing dampers, or backdraft dampers

Objective

Fire dampers function effectively and are accessible

6.0302.2k System balancing

Specification

Adjust fan speed, dampers, and registers until design specifications are met

Objective

Ensure complete dwelling ventilation

6.0303.1 HRV/ERV Installation

Section: Ventilation
Topic: Whole-Building Ventilation
Sub-Topic: Balanced Ventilation

Desired Outcome

Efficient, effective, safe, and adequate ventilation air

6.0303.1a Fan selection

Specification

Select Energy or Heat Recovery Ventilators (ERV/HRV) that are ENERGY STAR, equivalent, or better

Objective

Select efficient equipment

6.0303.1b Wiring

Specification

Install all electrical wiring according to manufacturer specifications and applicable code

Objective

Prevent an electrical hazard

6.0303.1c Exterior exhaust termination location

Specification

Terminate exhaust system to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors

Install terminations: A minimum of 3' away from any property line; A minimum of 3' away from operable opening to houses; A minimum of 10' away from mechanical intake; Above the snow-line

If the termination is at the soffit, seal soffit vents within 6' of the termination

Objective

Prevent exhaust from reentering the structure

6.0303.1d Exterior intake location

Specification

Install intake to pull air from the outdoors, which does not include unconditioned spaces such as attics

and crawl spaces that are ventilated with the outdoors

Install intake:

A minimum of 6" from grade;

A minimum of 10' from contaminant sources or exhaust outlets;

Above local snow or flood line;

A minimum of 18" above an asphalt based roof;

Never on a flat roof

Objective

Unrestricted entry of contaminant-free air

6.0303.1e Pest exclusion

Specification

Install corrosion resistant screen, louver, or grille material over exterior terminations with a hole size of no less than 1/4" and no greater than 1/2" in any direction

Objective

Prevent pest entry while allowing proper air flow.

6.0303.1f Interior intake location

Specification

Install interior intakes a minimum of 10' from interior fresh air supplies, cooking surfaces, or combustion appliances

Objective

Remove pollutants without damaging fan or interfering with fresh air supply

6.0303.1g Interior supply location

Specification

Install interior fresh air supply:

near high traffic areas and occupied spaces (e.g., living rooms, hallways, bedrooms)

not within 10' of interior exhaust intakes

Objective

Supply fresh air where needed

6.0303.1h Combining air streams

Specification

If combining ducts, combine them on the upstream side of fan using "Y"-fittings or collection boxes

Do not combine/connect dryer, kitchen, or garage exhaust streams with any other exhaust stream

Objective

Effective, safe exhaust of air from multiport systems

6.0303.1i Backdraft prevention

Specification

Ensure system contains a backdraft damper between the ventilator and all exterior terminations/intakes that only allows air flow in the desired direction

Equip outdoor air intakes and exhausts with automatic or gravity dampers that close when the ventilation system is not operating

Objective

Prevent unwanted air movement

6.0303.1i Backdraft prevention

Specification

Design one or more ventilation fans located upstream of all the exhaust inlets to run continuously, or install a system of one or more backdraft dampers to isolate each dwelling unit from the common duct when the fan is not running

Objective

Prevent unwanted air movement

6.0303.1j Fresh air filtration

Specification

All mechanically-supplied outdoor air must pass through a filter before combining with conditioned air

Filtration must meet a minimum efficiency of MERV 8

Filter or air cleaning systems that intentionally produce ozone are not allowed.

Objective

Outdoor air filtered for particles

6.0303.1k Fan mounting

Specification

Mount ventilator using mechanical fasteners per manufacturer's specifications and applicable code (e.g., seismic restraints)

Isolate unit from the building framing unless specifically designed to be directly attached

Objective

Secure, vibration-isolated ventilator

6.0303.1l Sealing

Specification

Seal all air moving portions of the system using UL 181 products without interfering with the function of dampers

Objective

Airtight ventilation system with freely operating dampers

6.0303.1m Condensate drain

Specification

If unit has a condensate drain, connect drain according to manufacturer specifications to a drain location approved by applicable code

Insulate all condensate lines outside the thermal boundary to a minimum of R-4

Objective

Safe and reliable condensate drainage

6.0303.1n Access

Specification

Ensure fan, service disconnect switch, filters, and drains are accessible for maintenance according to NEC, or applicable building code

Objective

Serviceable parts are readily accessible

6.0303.1o Fire dampers

Specification

If fire dampers are required in the fresh air supply duct, install them according to applicable building code

Fire dampers must be accessible for inspection and/or testing

Sealing activities must not interfere with the operation of fire dampers, balancing dampers, or backdraft dampers

Objective

Fire dampers function effectively and are accessible

6.0303.1p System balancing

Specification

Adjust fan speed, dampers, and registers until the incoming air volume is equal to the outgoing air volume

If the HRV/ERV is ducted to the air handler, balance it with the air handler running

Objective

Ensure complete dwelling ventilation

6.0303.1q Very cold climate considerations

Specification

In climate zones 6B, 7, and 8 (as defined by ASHRAE 62.2) do not install ERVs unless they are equipped with frost controls

Objective

Prevent freezing of ventilators and condensation

6.0303.1r Hot-humid climate considerations

Specification

In climate zones 0A, 1A, 2A (as defined by ASHRAE 62.2) it is preferential to install an ERV rather than an HRV

Do not terminate ventilation air intake at the roof

Determine whether net latent load from ventilation (both natural and mechanical) requires dehumidification; if so, install dehumidification

Objective

Prevent excessive heat and moisture from entering the ventilation air.

7.0103.1 Lighting Replacement

Section: Baseload
Topic: Plug Load
Sub-Topic: Lighting

Desired Outcome

Improved lighting efficacy without performance loss

7.0103.1a Selection

Specification

Select lighting that:

is appropriate for the intended application (e.g., enclosed, dimmable, potential for breakage, indoor, and outdoor)

provide lighting level quality required for the intended application (e.g., task lighting, hazards lighting, nightlights)

is the highest level of efficiency within a technology (e.g., LED bulbs)

are ENERGY STAR qualified, equivalent or better, and UL approved

facilitate upgrade to future lighting technologies

is rated no more than the rated wattage of fixture

Objective

Select efficient, reliable, and safe lighting improvements

7.0103.1b Installation

Specification

Install lighting in accordance with manufacturer specifications and applicable code (i.e., NFPA 70, NFPA 101, NECA/IESNA 500)

If applicable, clean lens and reflector before installing new bulb

Objective

Safe and proper installation

7.0103.1c Electrical installation

Specification

Install all electrical wiring according to applicable code (i.e., NFPA 70)

Objective

Safe electrical installation

7.0103.1d Disposal

Specification

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Objective

Old equipment is permanently removed from service, protect the environment, and comply with regulation

7.0103.1e Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant

7.0103.3 Ballast Replacement

Section: Baseload
Topic: Plug Load
Sub-Topic: Lighting

Desired Outcome

Improved lighting efficacy without performance loss

7.0103.3a Selection

Specification

Select pulse start, high-efficiency, electronic ballasts that meet the appropriate nationally recognized product standards (ANSI C82.1, ANSI C82.4, UL 924, UL 1029, NEMA) and have a ballast factor of 0.85 or greater

Select ballasts that match the input and output voltage of the existing fixture, that fit within the existing enclosure, and will support the necessary wattage of the bulbs

Objective

Select safe, efficient, and effective ballasts

7.0103.3b Removal and installation

Specification

De-energize circuit and lock out power before work begins

Install ballasts in accordance with manufacturer specifications

Clean the lens and reflector once installation is complete

Objective

Safe and effective installation

7.0103.3c Disposal

Specification

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Objective

Old equipment is permanently removed from service, protect the environment, and comply with regulation

7.0103.3d Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant

7.0103.6 Security Lighting

Section: Baseload
Topic: Plug Load
Sub-Topic: Lighting

Desired Outcome

Efficient, effective security lighting that minimizes disturbances of occupant and light pollution

7.0103.6a Selection

Specification

Select security light fixtures that:

are UL approved for location installed (i.e., indoor, outdoor, wet location)

provide the required lighting conditions with the lowest possible energy-use

are vandal-proof

are dark sky approved

are ENERGY STAR qualified, equivalent, or better

Objective

Select efficient, reliable, and safe lighting improvements

7.0103.6b Installation

Specification

De-energize circuit and lock out power before work begins

Install lighting in accordance with manufacturer specifications and applicable code (e.g., NFPA 70)

Aim light fixtures to minimize light emitted above the horizontal, beyond the perimeter of the property, and not directly into any window of a residence

Clean the lens and reflector once installation is complete

Objective

Safe, effective, and efficient installation that does not disturb occupants

7.0103.6c Controls

Specification

Install both photo and motion sensors and configure to only activate when sun is down and to switch off within 5 minutes if no motion is detected

Objective

Energy saving control strategy

7.0103.6d Disposal

Specification

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Objective

Old equipment is permanently removed from service, protect the environment, and comply with regulation

7.0103.6e Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant

7.0104.3 Motion Control Sensors

Section: Baseload
Topic: Plug Load
Sub-Topic: Lighting Controls

Desired Outcome

Reduce lighting run time without compromising required lighting levels, or safety

7.0104.3a Selection

Specification

Select sensor that:

is compatible with existing wiring and lighting

is UL approved and listed for the installed location

is location and climate appropriate (e.g., outdoor weatherproof fixture)

Objective

Safe, effective, and reliable sensor selection

7.0104.3b Location

Specification

Locate sensor where it will minimize false starts

Objective

Reduce unnecessary operation of lighting

7.0104.3c Installation

Specification

Install timer in accordance with NFPA 70 and manufacturer specifications, in a secure location, and protected from physical damage

Objective

Safe, secure, and proper installation

7.0104.3d Settings

Specification

Set controls of motion sensor based on anticipated occupant usage or security needs

Set control to turn off lighting if no motion is detected for a maximum of 15 minutes

Objective

Meet lighting needs for area

7.0104.3e Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant

7.0104.4 Outdoor Photo Sensors

Section: Baseload
Topic: Plug Load
Sub-Topic: Lighting Controls

Desired Outcome

Lights only on when needed without compromising required lighting levels, or safety

7.0104.4a Selection

Specification

Select sensor that:

is compatible with existing wiring and lighting

is UL approved for installation location (e.g., UL 60730-1)

is location and climate appropriate (e.g., outdoor weatherproof fixture)

Select fixture that allows for replacement of photo sensor independently

Objective

Safe, effective, serviceable, and reliable sensor selection

7.0104.4b Installation

Specification

Install timer in accordance with NFPA 70 and manufacturer specifications, in a secure location, and protected from physical damage

Position sensor to properly sense natural light, but shielded from artificial light sources (e.g., other outdoor lighting)

Objective

Safe and secure installation that operates lighting when needed without interruption

7.0104.4c Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant

7.0303.3 Pumps

Section: Baseload
Topic: Water Heating
Sub-Topic: Distribution Components

Desired Outcome

Safe, compliant, and efficient pump installation

7.0303.3a Pre-work qualifications

Specification

Verify current plumbing infrastructure is sufficient to support the installation(s) and is leak-free

Objective

Verify adequacy of plumbing

7.0303.3b Pump selection

Specification

Choose a pump built with materials suitable for potable water (i.e., bronze or stainless steel) and that is certified as lead-free

Objective

Select safe pump materials compatible with potable water source

7.0303.3c Installation

Specification

Install pumps according to manufacturer specifications and applicable code (e.g., IPC, IRC, NFPA 70)

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Objective

Safe, compliant, and effective pump installation

7.0303.3d Accessibility

Specification

Install and plumb pump to allow for inspection, maintenance, and replacement of the pump

Objective

Pump is accessible for service

7.0303.3e Laminar flow

Specification

Install pumps in accordance with manufacturer specifications with sufficient straight line piping before and after the pump

Objective

Minimize pump cavitation

7.0303.3f Isolation valves

Specification

Install a water cut-off valve on both sides of the pump

Objective

Allow isolation and service of mixing valve

7.0303.3g Drain/purge valve

Specification

Install a drain spigot in close proximity of the discharge end of the pump

Objective

Allow the piping to be purged of air

7.0303.3h Gauges

Specification

Install pressure gauges to measure suction, discharge, and pressure differential

Objective

Verify proper operation of the pump

7.0303.3i Dielectric unions

Specification

When connecting non-ferrous metal pump to existing ferrous piping, install a dielectric union or a plastic-lined steel nipple a minimum of 4" long to connect the two piping systems

Objective

Prevent corrosion between dissimilar metals

7.0303.3j Insulation

Specification

Do not insulate pumps

Objective

Prevent pump from overheating

7.0303.3k Controls and sensors

Specification

Install or reconnect controls and sensors in accordance with design specifications

When controls use low voltage, separate the low voltage and line voltage wiring

Objective

Proper operation of the water heating system

7.0303.3l Electrical wiring

Specification

Install all electrical wiring in compliance with NFPA 70 and manufacturer specifications

If conflict exists between code and manufacturer specifications, apply the more restrictive requirement

Objective

Safe and compliant pump installation

7.0303.3m Stray voltage protection

Specification

Install grounding and bonding for pump as required by NEC (NFPA 70)

Objective

Eliminate stray voltage from pump

7.0303.3n Disposal

Specification

Permanently remove equipment from job site and recycle or dispose of removed equipment and refrigerant in accordance with local and federal law (e.g., EPA Section 608 of Clean Air Act of 1990)

Permanently decommission old equipment

Objective

Old equipment is permanently removed from service, protect the environment, and comply with regulation

7.0303.3o Documentation

Specification

Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information

Objective

Manufacturer supplied information available to occupant