1. GENERAL
   1. SUMMARY
      1. Section includes:
         1. Summary of the Housing Development Consortium’s (HDC) Exemplary Buildings Program (EBP) Guidelines recommendations for:
            1. Early Integrative Design
            2. Balanced Ventilation with Heat Recovery
            3. Solar Integration
            4. Wall Assemblies
            5. Domestic Hot Water & Water Management Guidelines
            6. Healthy Materials
         2. Related sections:
            1. Section XXXXXX
            2. Section XXXXXX
            3. Section XXXXXX
   2. REFERENCES
      1. HDC Guidelines Series: The guideline documents listed below can be found on our webpage used to disseminate an ever-growing list of the practical, application-oriented products created by the EBP, <https://exemplarybuilding.housingconsortium.org/our-results-practical-tools/>
         1. HDC [Balanced](https://www.usgbc.org/resources/leed-v4-homes-and-multifamily-midrise-current-version) Ventilation with Heat Recovery Guidelines: <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2021/12/HDC-EBP-BVHR-Guidelines_-v.1.1-12.2021.pdf>
         2. HDC Early Integrative Design Guidelines:   
            <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2021/05/HDC-EBP-Guidelines-for-EID_-v.1.0-May-2021.pdf>
         3. HDC Solar Integration Guidelines:   
            <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2021/01/HDC-EBP-Guidelines-for-Solar-Integration_-v.1.0.3-January-2021.pdf>
         4. HDC Wall Assemblies Guidelines:
         5. <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2022/10/HDC-EBP_-Guidelines-for-Wall-Assemblies_-v.1.1-October-2022.pdf>
         6. HDC Domestic Hot Water & Water Management Guidelines: <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2022/09/EBP-Guidelines-for-Water_-v.1.0_-2022.09.26.pdf>
         7. HDC Healthy Materials Guidelines:   
            <https://exemplarybuilding.housingconsortium.org/wp-content/uploads/sites/2/2023/05/HDC_EBP-Healthy-Material_23-0129_v9.xlsx>
   3. EARLY INTEGRATIVE DESIGN
      1. Consult the EBP Early Integrative Design (EID) Guidelines, with specific attention paid to the following items:
         1. Early goal setting around building performance and sustainability
            1. Identify baseline energy code, as well as zoning or funding-related requirements for building performance or sustainability. Examples include municipal Green Building Standards for zoning bonus, or additional ESDS 5.02 points made as part of funding applications.
            2. Identify owner goals, ideally informed by facilities staff and case studies/data from comparable projects.
            3. Identify potential certification programs to pursue.
            4. Identify potential incentives from utility providers and associated costs and requirements.
         2. Financing & Budgeting
            1. Outline which financing programs will be pursued.
            2. Identify key financing milestones, and what level of design and specifications need to be developed to support funding efforts.
            3. Identify associated costs for early design efforts.
            4. Identify budget constraints.
         3. Project Team Formation
            1. Identify core team members and consultants to coordinate the early design and specification process.
            2. Identify key roles and responsibilities for design-making and project management.
            3. Owner/developer, or architect summarizes building performance, sustainability, financing, accessibility, etc. goals and requirements for team in a concise manner that can be distributed to the team.
            4. Confirm that team members and consultants have received the summary of owner/developer goals and requirements are accounted for in their scope of work.
         4. Integrated Scheduling
            1. Develop a schedule that includes design development, permitting, financing, and construction estimating to understand dependencies between those efforts and the timing for making decisions on what Exemplary Building options are included.
      2. Analyze approaches early in schematic design using an integrative design process beginning with the developer and architect and then expanding to the engineer, consultants, general contractor, and mechanical subcontractor.
      3. System Specific Considerations for EID
         1. Balanced Ventilation with Heat Recovery
            1. Consider code variances for additional building height for distribution systems, or roof area coverage/height for mechanical equipment.
            2. Consider the design and location of fenestration openings on building facades, with respect to intake and exhaust points.
            3. Research and confirm code requirements for centralized distribution systems, such as exceptions for fire/smoke dampers.
            4. Determine where distribution ducts will be located, with goal of locating all major ductwork located within the conditioned envelope.
            5. Consider duct distribution in corridor and units when determining floor-to-floor heights and building code height limits.
         2. Domestic Hot Water & Water Management
            1. Consider location of bathrooms and kitchens with respect to hot water distribution mains and fixture run-outs.
            2. Identify locations for heat pumps and storage tanks that facilitate both efficient operation and allow for access for maintenance and replacement.
            3. Evaluate low-flow plumbing fixtures, particularly showerheads and toilets, that have been used in past projects which were acceptable to both tenants and the property maintenance team.
         3. Solar
            1. Engage PV system designer/contractor early in building design process.
            2. Identify what roof areas are available for solar, and strategies for how area can be maximized.
            3. Identify if solar investment tax credit can be leveraged or if other incentives are available.
            4. Review financing and solar ownership strategies.
         4. Wall Assemblies
            1. Review wall type options, considering the following characteristics:

Achieving effective R22 wall assembly thermal efficiency

Standard vs. advanced framing strategies

Assembly airtightness

Water management

Vapor control

Cladding type and attachment, particularly if using advanced framing.

Material durability

* 1. BALANCED VENTILATION WITH HEAT RECOVERY
     1. In-Unit Ventilation Strategy
        1. Distributed System
           1. Design a “distributed” and “balanced” system, as defined by the Washington State Mechanical Code or as amended by local code. If using a recirculating range hood for studio and one-bedroom units (see “Residential Range Exhaust” below), a distributed system must be used. Total system airflow rates should be no greater than 120% of the code-required supply or exhaust air flow, whichever is larger.
        2. In-Unit Laundry
           1. If provided, locate the laundry equipment within a bathroom or kitchen area and utilize a ventless heat pump dryer that is specified as Tier 3 or higher per the Bonneville Power Administration’s (BPA) Clothes Dryer Qualified Products List (QPL), found here: https://www.bpa.gov/-/media/Aep/energy-efficiency/document-library/bpa-clothes-dryers-qpl.xlsx.
        3. Residential Range Exhaust
           1. Duct range hoods to the exterior. For buildings with very low air leakage, such as buildings that are at or below Passive House air leakage target, tenant education should suggest cracking a window may be needed to increase range hood flow performance. For studios and one-bedroom units with “distributed” ventilation, a recirculation range hood that meets local code or rating system requirements (i.e. ESDS) may be considered with owner approval.
     2. Filtration
        1. Use MERV-13 filters on outdoor air intake of central and unitized systems when the building is located in an area with a National Air Toxics Assessment (NATA) Respiratory Hazard Index (HI) and Traffic Proximity rating of 90% or higher, as determined using EPA’s EJScreen (<https://ejscreen.epa.gov/mapper/>) mapping tool. Otherwise, utilize minimum MERV-8 filters.
        2. For central ventilation systems, provide option to readily use MERV-15 or higher level of outdoor air intake filtration during wildfire smoke events and other periods of poor air quality.
        3. For central ventilation systems, equipment must have sensors that signal when filters need to be replaced, and triggers an auditory, visual, or digital message alert that is readily seen or heard by building operations staff.
     3. Equipment Specs
        1. Ventilator Type
           1. Use energy recovery ventilator (ERV) for unitized and centralized equipment with wheel type energy recovery. For central systems with plate heat exchangers, provide an option to use heat recovery ventilator (HRV) if lower cost.
        2. Ventilator Sizing
           1. Use a ventilator with a maximum flow capacity that is at least 25% greater than the design airflow rates to achieve greater heat recovery efficiency and lower fan power.
        3. Sensible Effectiveness
           1. Sensible effectiveness is ≥75% at design supply and exhaust airflow rates.
        4. System Power
           1. Total system fan power, in terms of Watts per CFM of supply ventilation air flow (Watts/CFM\_supply) shall be ≤0.8 with clean filters.
        5. Cross Leakage
           1. For centralized equipment, cross leakage as defined by AHRI-1060 ‘Exhaust Air Transfer Ratio’ (EATR) should be ≤3% (0.03) at the design airflow rates. Unitized equipment meets minimum code requirements for cross-leakage.
        6. Flow Control
           1. Ventilator shall have multi-speed or variable speed controls to facilitate balancing, or automatically adjust fan speed to maintain design flow setpoint regardless of system pressure drop.
        7. Heat Recovery Bypass
           1. For centralized equipment, provide a heat recovery bypass or wheel speed control that can stop energy recovery between 55°F (adj) and 75°F (adj) outdoor air temperature, or other control setpoint that minimizes energy recovery when the building is generally needs cooling.
     4. Distribution Design
        1. Choose a distribution strategy that minimizes the number of fire and/or smoke dampers and fire-rated shafts.
        2. Design and install all ducting systems to achieve design airflow rates at an average velocity below 600 feet per minute (fpm)
        3. Supply ventilation air to each bedroom and living area, and draw exhaust air from all bathrooms, kitchen area, and utility rooms.
        4. Locate supply diffusers to promote full mixing of supply air into rooms and full removal of contaminates via exhaust flow. Consider where tenants will typically be sitting or sleeping when locating supply air grilles and increase the distance between supply and exhaust points as much as possible. Coordinate supply and exhaust grille placement with architects and owners.
        5. Kitchen exhaust grilles should be located a minimum of 6’ horizontally from the primary cooking appliance and include a MERV-3 or washable mesh filter.
        6. Locate all ductwork within conditioned space to increase system efficiency and eliminate the need for installing supply duct insulation and/or maintaining ductwork exposed to outside elements.
        7. Wherever possible, locate ductwork below fire-rated floor/ceiling membrane. Coordinate with architect to identify where exposed ductwork is allowed, where drop ceilings or soffits are best provided, or method that will be used to allow ductwork to be located withing a fire-rated assembly.
        8. Locate all unitized H/ERVs inside the conditioned space and locate centralized equipment indoors whenever possible. The ducting between the ventilator and exterior wall or roof should be:
           1. As short as possible. A maximum length of 10 feet is recommended.
           2. Insulated with minimum R-16 and vapor barrier from exterior assembly to H/ERV with no gaps or voids.
        9. When centralized equipment is located outside, the ducting between the ventilator and the building should be:
           1. As short as possible. A maximum length of 10 feet is recommended.
           2. Insulated ductwork with to a minimum R-20.
        10. Seal all ductwork to SMACNA Seal Class A standards, with a target tested air leakage less than 10% of design flow rate.
     5. Optimized Equipment Placement
        1. Consider structural requirements, zoning requirements, impact on solar and tenant amenity real estate, and equipment replacement when locating equipment on roof.
        2. Locate outside air intakes for H/ERVs to minimize contamination from outdoor pollutants (smells, particulates) and consider temperature of air at intake location during summer and winter.
        3. Engage an acoustical consultant to evaluate requirements for equipment mounting and sound attenuation devices.
        4. Ensure H/ERVs are accessible for maintenance and future replacement. The expected useful life of this equipment is 10-20 years if properly maintained.
     6. Common-Area Ventilation Strategies
        1. Common Area Ventilation with Heat Recovery
           1. Serve corridors and other habitable common areas with systems that comply with WSEC C403.3.5 DOAS requirements and provide no more than 130% of the code-required ventilation.
        2. Common Area Laundry Rooms
           1. Use un-tempered outdoor air as make-up air for laundry rooms, supplied as close as possible to back of dryers.
     7. Related Building Attributes
        1. Confirm that the following items are accounted for in the architects/engineers/contractors scope:
           1. HVAC systems sizing calculations, as well as electrical service space heating loads account for reduced heating demand due to lower ventilation air loads and tighter envelope.
           2. Trickle vents in windows are no longer required and should be excluded from all cost estimates.
           3. Centralized systems may need “legally required standby power” to satisfy fire/smoke damper exceptions or approved code alternates.
           4. Centralized systems and layout of in-unit ducts often require additional coordination among design team and contractors.
     8. Construction & Commissioning
        1. Review plans to confirm equipment and duct access for test and balance (TAB) activities and maintenance.
        2. Mechanical plans or submittals clearly identify the design supply and exhaust flows for every H/ERV and every air inlet/outlet, as well as design total system fan power (Watts/CFM\_supply).
        3. Mechanical contractor and TAB contractor coordinate and produce a TAB plan for all major systems, and submit to design and commissioning team prior to completing ductwork rough-in.
        4. For centralized systems, test total duct system leakage prior to covering ducts.
           1. Scope of leakage testing includes connection to air handler, all major trunk ducts and branch ducts to dwelling units.
           2. Test conducted at the system design operating pressures.
           3. The tested total duct leakage does not exceed 10% of design flow rate. If this threshold is exceeded, leakage points to be identified and remediated until tested leakage meets the 10% limit.
        5. Properly protect distribution system and ventilation equipment from dust during construction and install new filters prior to balancing/commissioning.
        6. 100% TAB and commissioning of all ventilation systems, including:
           1. Measurement of supply/exhaust flow rates (CFM) at all inlets/outlets.
           2. For centralized systems, measurement of total system supply/exhaust flow at the main air handler or immediately downstream of air handler. Provide access panels as necessary to measure total system airflows using a duct traverse measurement or other acceptable method even after rest of ducts are covered.
           3. Verification that clean filters with correct MERV rating are installed.
           4. Measure total system input power (Watts) at final balanced airflow conditions with clean filters installed.

For centralized systems, measure system power for all H/ERVs.

For unitized systems, measure system power for at least 10% of apartments, including a representative selection of different unit types and ducting conditions.

* + - * 1. Calculate total system fan power (Watts/CFM\_supply) for each system. If any system power measurement does not meet the Watts/CFM\_supply power specification for the project, test all units to confirm how many systems do not meet the specification and investigate why.
    1. Operations
       1. Ensure supply and exhaust filters are readily accessible, are inspected every three to six months, and are replaced at minimum twice per year.
       2. Inspect filtration after seasonal smoke events.
       3. Consider washable/vacuumable pre-filters to extend life of primary filter.
  1. SOLAR INTEGRATION
     1. System Components for Exemplary Buildings
        1. Design for and install Teir-1 modules, listed on the Bloomberg, NEF Teir-1 PV module list, with a 25-year warranty.
        2. Design and install a minimum total solar resource fraction (TSRF) of 90% for each roof area.
        3. Install panels with a module efficiency minimum of 18%.
        4. Use string inverters that are listed in California Energy Commission Solar Equipment List.
        5. For monitoring, use a standard online portal available with the inverter, or an EGauge or other utility-grade add-on metering system.
        6. Racking
           1. For buildings under 6 stories with no wind concerns use a ballast system, with no attachments to roof if possible.
           2. For larger buildings use an anchored system, coordinating with roofing contractor.
  2. WALL ASSEMBLIES
     1. Wood-Framed 2x6 Walls with Exterior Insulation
        1. For cavity insulation, use R-24 blown-in fiberglass to a minimum density of 1.6 lb/cu.ft.
        2. Use 1.25” of continuous mineral wool (R-5) insulated sheathing board with a minimum density of 11 lb/ft3
        3. For sheathing use plywood or exterior gypsum as needed for structural and fire rating requirements.
        4. For framing use 2x6 intermediate framing. Assume 25% framing factor and thermal conductivity of Douglas Fir wood for building thermal analysis.
        5. Air and Water Barrier
           1. Option 1: Use fully adhered sheet air and water barrier. Sheet is vapor permeable with minimum wet cup 14 perm rating. Vertical 1x3 borate treated furring for ventilated rainscreen cavity.
           2. Option 2: Sealed sheathing air barrier with mechanically-attached sheet water barrier. Sheet is vapor permeable with minimum wet cup 28 perm rating. Vertical 1x3 borate treated furring for ventilated rainscreen cavity.
        6. For vapor control use a Class III vapor retarder, such as latex paint.
     2. Wood-Framed 2x8 Walls with Cavity Insulation
        1. For cavity insulation, use R-31 blown-in fiberglass to a minimum density of 1.6 lb/cu.ft.
        2. For sheathing use plywood or exterior gypsum as needed for structural and fire rating. OSB sheathing should be avoided.
        3. For framing use 2x8 advanced framing at 24” o.c. where structurally feasible and compatible with cladding systems. Assume 20% framing factor and thermal conductivity of Douglas Fir wood for building thermal analysis.
        4. Air and Water Barrier
           1. Option 1: Fully adhered sheet air and water barrier. Sheet is vapor permeable with minimum wet cup 14 perm rating. Vertical 1x3 borate-treated furring for ventilated rainscreen cavity.
           2. Option 2: Sealed sheathing air barrier with mechanically-attached sheet water barrier. Sheet is vapor permeable with minimum wet cup 28 perm rating. Vertical 1x3 borate treated furring for ventilated rainscreen cavity.
        5. For vapor control use a class II polyamide sheet smart vapor retarder.
     3. Steel-Framed 2x6 Walls with Exterior Insulation
        1. Use R-21 batt insulation installed to Grade 1.
        2. Continuous Insulation
           1. Option 1: 3” (R-12) mineral wool insulation combined with fiberglass clips or similar thermally broken clips for cladding attachment.
           2. Option 2: 3” (R-12) mineral wool insulated sheathing board with minimum density of 14 lb/ft3.
        3. For framing use 6” steel stud, minimum 20 gauge (33 mil) or greater as required for structure.
        4. Air and Water Barrier
           1. Option 1: Fully adhered sheet air and water resistive barrier. Vapor permeable with minimum wet cup 14 perm rating. 20-gauge G90 galvanized steel Z-furring for ventilated rainscreen cavity.
           2. Option 2: Sealed sheathing air barrier with mechanically-attached sheet water barrier. Sheet is vapor permeable with minimum wet cup 28 perm rating. 20-gauge steel Z-furring for ventilated rainscreen cavity.
        5. For vapor control use a class III vapor retarder such as latex paint.
     4. Cast-in-Place Concrete Walls with Exterior Insulation
        1. Use 6” minimum normal weight cast-in-place concrete.
        2. For exterior continuous insulation use 3” (R-12) mineral wool insulation combined with fiberglass clips or similar thermally broken clips for cladding attachment.
        3. For interior continuous insulation use 1.5” (R-9.8) non-halogenated (NH) polyiso insulation board with facer, joints and seams taped or sealed.
        4. For interior furring wall use 1.5” interior furring at 16” o.c. with a gypsum wall board thermal barrier required. No cavity insulation is required.
        5. For air and water control use fully adhered sheet water resistive barrier, vapor permeable with minimum 14 wet cup perm rating. 20 gauge steel Z-furring for ventilated rainscreen. Concrete acts as the air barrier.
        6. No vapor control required.
     5. Cast-in-Place Concrete Walls with Interior Insulation
        1. Use 6” minimum normal weight cast-in-place concrete.
        2. For interior continuous insulation use 3” (R-19.7) non-halogenated (NH) polyiso insulation board with facer, joints and seams taped or sealed.
        3. For interior furred wall use 1.5” interior furring at 24” o.c. with a gypsum wall board thermal barrier required. No cavity insulation required.
        4. For air and water control use silicone elastomeric paint, if exposed to weather. Below-grade waterproofing and drain mat if exposed to earth. Concrete acts as the air barrier.
        5. No vapor control required.
  3. DOMESTIC HOT WATER & WATER MANAGAMENT
     1. Water Heating Plant
        1. Use central air-source heat pump technology as the primary water heating equipment.
        2. Design domestic hot water heating equipment/system to meet the requirements of the most current version of NEEA’s commercial/multifamily Advanced Water Heating Specifications (AWHS)
        3. For any supplemental water heating equipment, such as back-up and temperature maintenance heating, use electric resistance or heat pump technology
        4. Prioritize use of heat pumps that use R-744 (CO2) or other safe, natural refrigerants, as they have low global warming potential (GWP) and limited other known environmental impacts.
        5. Provide plumbing engineer with the anticipated occupancy by unit type (people/unit) to facilitate in sizing the water heating system. Additionally, when available for a similar existing building, provide the following:
           1. Water demands for typical plumbing fixtures and appliances that use hot water.
           2. Average sub-metered daily hot water consumption (gallons/day, by unit type.
           3. Hourly or short interval hot water demand profile (gallons/hour), by unit or for central hot water plant.
     2. Water Heating Plant
        1. Pipe Sizing
           1. Size water main and building hot and cold-water piping using the most current version of the International Association of Plumbing & Mechanical Officials (IAPMO) Uniform Plumbing Code (UPC) Appendix M Peak Water Demand Calculator. This method should be used to size al piping, including:

Water main to building.

Make-up water supply to water heating plant.

The cold and hot water supply piping, including horizontal trunks and risers.

The branch piping to each apartment manifold or any other branches in the building.

* + - * 1. In plumbing plans or separate document, include a screenshot of WDC calculator for all unique piping sections listed above, for both hot and cold water.
        2. Where a manifold is being used to distribute water to the fixtures in the apartments, consider the use of 3/8" tubing to distribute water to the fixtures. Base decision on the residual pressure that will be available to operate each fixture. In general, it is not recommended to use 3/8” pipe for high-flow rate fixtures, such as toilets, tubs, or combination tub/shower valves.
      1. Central Hot Water Distribution Design and Controls
         1. Minimize the length of the hot water distribution system piping. Start with the layout of the hot water fixtures in the apartments relative to each other and to where hot water will enter each apartment:

Develop space plans that locate hot water fixtures close to where the hot water branch will enter the apartment.

Keep the volume in the branch and twigs from the circulation loop serving the showers to less than 0.25 gallons. Using a 1.5gpm shower, this results in a “first-use” delivery time of roughly 20 seconds.

Keep the length of the branch from the circulation loop or riser to the start of any fixture branch to less than 5 feet, including shut off valve, submeter, manifold and total vertical and horizontal pipe distances from the riser. Hot water should not be circulated all the way to dwelling unit manifolds.

* + - * 1. Wherever possible, mirror the wet rooms in apartments that share a common wall so that stacks of mirrored apartments can share one riser in vertical systems or branch in horizontal systems. Coordinate with structural design to locate the riser outside of shear walls and away from solid structural framing that cannot be penetrated between units by piping.
        2. Provide the following on the plumbing floor plans or other submittals:

The proposed pipe routing for each unique unit type.

Calculations of hot water pipe volume (in gallons) between the showerhead and the circulated hot water source (or water heater), including shut off valve, submeter, the manifold that distributes hot water, as well the total vertical and horizontal pipe distances from the riser to the showerhead.

Calculation of estimated shower hot water delivery time (in seconds). This is calculated by dividing the calculated hot water pipe volume by the rated gallons per minute flow rate of the showerhead, then multiplying by two. Multiplying by a factor of two accounts for both the time it takes to first clear the pipe, but also the thermal energy that is absorbed by room-temperature piping during first use after a prolonged period no hot water demand, i.e. representative of the first morning shower use.

* + - * 1. Use vertical risers for distribution to multiple floors, as opposed to horizontal (floor-by-floor) distribution unless a detailed calculation of system pipe length indicates horizontal distribution results in less total system pipe heat loss.
        2. Locate the primary water heating equipment centrally in the building and as close as possible to dwelling units.
        3. For large buildings, or buildings that are segmented, consider using more than one hot water plant/circulation loop for the building.
        4. Recirculation pumps should have electrically commutated motors (ECM) with variable speed/flow controls, and each riser should have a self-actuating thermostatic balancing valve. Valves should be readily accessible and serviceable (with isolation valves).
        5. Use a properly sized electronic thermostatic mixing valve (TMV) to control temperature of hot water supplied to the building, configure TMV to revert to full cold or maintain current valve position if the circulation pump is shut off (by controller or upon power failure). The TMV should be sized based on the peak hot water flow rate determined using Appendix M.
        6. Use thermally broken hangers and other pipe supports for all insulated pipe.
        7. Insulate hot water supply and recirculation (return) piping with 1” thicker than required by WSEC.
    1. Fixtures and Appliances
       1. Toilets
          1. MaP Premium-rated

WaterSense Certified

0.8-1.1 gallons per flush (GPF)

* + - * 1. MaP flush performance score >800 grams
        2. Avoid dual-flush and pressure/power-assisted toilets.
        3. Slope all drain lines ≥ ¼” per foot.
        4. Where possible, locate toilet downstream of other fixtures on a drain branch.
        5. Incorporate flapper replacement into maintenance schedules to preempt leaks (replace every 5 years).
        6. Provide education to tenants related on what to flush to avoid clogs and drain line issues.
      1. Showerheads
         1. WaterSense certified.
         2. 1.5 gallons per minute (gpm)
         3. Has a variable/adjustable spray pattern.
         4. Specify acceptable hand-held option for property management to provide if needed. Hand-held showers should have hoses with a minimum inside diameter of at least 0.3”.
      2. Bathroom Faucets
         1. WaterSense certified and submittal documentation that confirms the faucet’s aerator provides a flow rate close to the one specified over a wide range of actual operating pressures.
         2. 0.8 – 1.0 gpm, or as low as 0.5 gpm using a quality spray stream aerator.
         3. Consider using cold start faucets.
      3. Kitchen Faucet
         1. WaterSense certified and submittal documentation that confirms the faucet’s aerator provides a flow rate close to the one specified over a wide range of actual operating pressures.
         2. Minimum 1.5 gpm, maximum 1.75 gpm.
         3. Pause control and spray pattern options for dish washing recommended, especially if built-in dishwasher is not provided.
         4. Consider using cold start faucets.
      4. Dishwasher
         1. ENERGY STAR qualified.
         2. Provided for all 2+ bedroom units.
         3. Choose model with lowest gallons per cycle (gpc) performance and which have filters that can easily be cleaned.
      5. Clothes Washers
         1. ENERGY STAR qualified.
         2. In-unit laundry only provided in 3+ bedroom units.
         3. Choose model with lowest available integrated water factor (IWF) in price range.
         4. Consider only connecting washer to cold water or provide signage to inform tenants that cold water is acceptable for all applications.
    1. Metering and Monitoring
       1. Metering
          1. Install both hot and cold water meters for every dwelling unit, as well as all common laundry rooms and janitor closets (one meter for common riser(s) serving these rooms is acceptable).
          2. Utilize a remote metering system that does not require access to units for reading.
          3. Install meters that record consumption in 1-gallon increments.
          4. Install meters in a tamper-proof enclosure, with meter transmitters and on-board meter display accessible for maintenance.
          5. Ensure commissioning of metering system includes 100% testing that meters are assigned to the correct dwelling unit and hot or cold use, and accurately report consumption within the metering software platform.
       2. Monitoring
          1. At minimum, use a monitoring system that automatically records consumption either: a) every hour or, b) once 10 gallons of consumption is measured, and the consumption is reported to a local computer or cloud-based software platform.
          2. Install a monitoring system that has ability to automatically alert property management via email and/or SMS text of the following conditions:

On weekly or more frequent basis:

Continuous levels of consumption, such as that associated with a leaky toilet or faucet.

No consumption

On a daily or more frequent basis:

Equipment failure

High consumption

* + - * 1. Store historical meter data for a minimum of five years and can be exported for analysis outside the metering platform.
        2. Use a system that automatically sends a report on a weekly or shorter basis that identifies tenants with the highest water consumption.
  1. HEALTHY MATERIALS
     1. The following healthy materials recommendations for affordable housing are in consideration of the Evergreen Sustainable Development Standards (ESDS) and Enterprise Green Communities requirements. Submit cutsheets/documentation containing a compliance declaration demonstrating compliance with the following requirements outlined in this section and the summary table in 1.8.B
        1. Composites
           1. Composite Woods

For composite wood materials, use formaldehyde-free products.

* + - 1. Sheet & Waterproofing
         1. Thermoplastic Membrane Roofing

Use TPO or EPDM membrane roofing to reduce use of materials with phthalates.

* + - 1. Thermal Insulation
         1. Batt Insulation

Use formaldehyde-free products.

* + - * 1. Rigid Board Insulation

Use products with no halogenated flame retardants (HRFS).

* + - * 1. Acoustic Insulation

Use unfaced formaldehyde-free products.

* + - * 1. Blow-in Insulation (loose fill, dense pack, and spray-applied)

Use wood fiber, fiberglass, mineral wool, loose fill cellulose, or sheep wool.

* + - * 1. Foamed-in-place insulation

Do not use polyurethane spray foam.

* + - 1. Wall Panels
         1. Siding

Avoid crystalline silica products.

* + - 1. Vapor Permeable Barrier
         1. Use products with no halogenated flame retardants (HRFS) and low in volatile organic compounds (VOC)
      2. Adhesives & Sealants
         1. Sealants – Indoor Use

Use pre-compressed polyurethane joint sealants, and phthalate-free acrylic and/or latex sealants.

* + - 1. Openings
         1. For windows and doors made with polyvinyl chloride (PVC),

Use non-vinyl windows and doors.

* + - 1. Resilient Sheet Flooring and Tile Flooring

Use non-vinyl flooring.

* + - 1. Carpet

Use products that are free of per-and polyfluoroalkyl substances (PFAS) and do not use vinyl or polyurethane backing or fly ash. Specify no added antimicrobial agents.

* + - 1. Wall Coverings

Use vinyl free products and low in volatile organic compounds (VOC)

* + - 1. Paints, Sealers & Coatings
         1. Interior standard water-based paints

Use APE-Free paints.

Use paints with low VOC content and emissions: <50 g/L VOC content in the base paint and colorants (aligned with CARB and SCAQMD limits) and low VOC emission certified according to the CDPH standard. Further prefer paints with <10 g/L in the base paint and colorants that do not add to the VOC content.

Use paint with no PFAS.

Use paint without antibacterial health claims, i.e. products labeled microbicidal or that claim to kill disease-causing germs, like MRSA or coronavirus. Claims specifically related to mold or mildew are okay.

* + - * 1. Sealers – Outdoor Use

Do not use coal tar-based sealers.

* + - * 1. High-performance coatings

Use epoxy-free products.

Use isocyanates-free products.

* + - 1. Window Treatments
         1. Roller shades

Use phthalate-free products that are not PVC or vinyl.

* + - 1. Casework
         1. Doors and Cabinets

Use solid wood.

If not using solid wood, use composite wood with no added formaldehyde.

* + - 1. Countertop
         1. Use products with no formaldehyde and no sealers with PFAS.
    1. Summary Table

Abbreviations not defined in this table:

CARB: California Air Resources Board  
CDPH: California Department of Public Health  
PVC: Polyvinyl chloride  
SCAQMD: South Coast Air Quality Management District  
TSCA: Toxic Substances Control Act

| **Material** | **Cost Impact** | **Chemical(s) of Concern** | **Recommendation** | **ESDS v4.01 6.01a Mandatory** |
| --- | --- | --- | --- | --- |
| **ESDS v4.01 6.01b Optional** |
| Composite Wood | Low | **Formaldehyde** (causes cancer, eye, nose and throat irritation, and difficulty breathing) | Specify formaldehyde-free products | Formaldehyde - comply with CARB Phase 2 and/or TSCA Title VI |
| Only use No Added Formaldehyde (NAF) or Ultra-Low Emitting Formaldehyde (ULEF) |
| Thermoplastic Membrane Roofing | Medium | **PVC** production and disposal create known human carcinogens and PVC membranes may contain **Orthophthalates** (hormone-disrupting plasticizers) | Specify non-vinyl membrane roofing | Not addressed in ESDS 6.01a |
| Batt Insulation | Low | **Formaldehyde** | Specify formaldehyde-free products | Not addressed in ESDS 6.01b |
| Rigid Board Insulation | Low | **Halogenated flame retardants (HFRs)** (persistent, bioaccumulative, and toxic) | Specify products with no halogenated flame retardants (HRFS) and no Isocyanates | No HFRs |
| N/A |
| Acoustic Insulation | Low | **Formaldehyde** | Specify formaldehyde-free products | Not addressed in ESDS |
| Blow-in Insulation | Low | **Formaldehyde, HFRs,** and I**socyanates**(cause asthma) | Use blown-in fiberglass (loose fill, dense pack, and spray-applied) without carcinogenic dedusting oil | Not addressed in ESDS |
| Foamed-in-Place Insulation | Varies | **Isocyanates** and **Halogenated flame retardants (HFRs)** | Do not use polyurethane spray foam insulation | Comply with CDPH Standard  UL GreenGuard Gold  No HFC blowing agents |
| No spray foam insulation in large area and only for small area application  -or-  do not use |
| Wall Panels | Medium | **Crystalline Silica** generated during on-site cutting causes cancer. | Specify siding with no Crystalline Silica | Not addressed in ESDS |
| Vapor Permeable Barrier | Low | **VOCs** (have a variety of health effects including headache, nausea, eye, nose, and throat irritation, organ damage, and cancer) and **Halogenated flame retardants (HFRs)** | Specify products with no halogenated flame retardants (HFRs) and low VOC content and emissions (<50 g/L VOC content in the base paint and colorants, aligned with CARB and SCAQMD limits, and low VOC emission certified according to the CDPH standard) | VOC content less than or equal to the thresholds provided by the SCAQMD Rule 1168 |
| Comply with CDPH Standard |
| Sealants – Indoor Use | Low | **Cyclosiloxanes** (disrupt hormones), **VOCs** (variety of health effects including headache, nausea, eye, nose, and throat irritation, organ damage, and cancer), **Orthophthalates**, **Isocyanates** | Specify pre-compressed polyurethane joint seal, phthalate-free acrylic and latex sealants | VOC content less than or equal to the thresholds provided by the SCAQMD Rule 1168 |
| Comply with CDPH Standard  No orthophthalate plasticizers |
| Sealants – Outdoor Use | Low | **Polycyclic Aromatic Hydrocarbons (PAHs)** (cancer as well as heart defects, immune suppression, reduced growth, and reproductive effects) | Specify pre-compressed polyurethane joint seal, phthalate-free acrylic and latex sealants | Phthalate-free and no PVC/Vinyl |
| N/A |
| Windows made with PVC | Medium | **PVC** | Specify non-vinyl windows | Not addressed in ESDS |
| Doors made with PVC | Medium | **PVC** | Specify non-vinyl doors | Not addressed in ESDS |
| Flooring made with PVC (Resilient sheet and tile, and Linoleum) | Low | **PVC, Orthophthalates** | * + 1. Specify non-vinyl flooring | Comply with CDPH Standard  CRI-Green Label Plus |
| No vinyl flooring  All flooring assemblies are Red List-free |
| Carpet | Low | **Orthophthalates, PVC, PFAS** (“forever chemicals” with significant life cycle concerns and a range of health hazards), **Heavy metals** (can be found in fly ash) | * + 1. Specify products without vinyl or polyurethane backing | No carpet within 3 feet of building entrance  No carpet on slab-on-grade |
| No carpet |
| Wall Coverings | Low | **Orthophthalates,** **VOCs** | * + 1. Do not use vinyl and choose wall coverings low in VOC | Not addressed in ESDS |
| Paint | Low | **APEs** (alkylphenol ethoxylates) are hormone disruptors, **VOCs** | * + 1. Specify APE-free and zero VOC paints | Comply with CDPH Standard  UL GreenGuard Gold |
| APE-free |
| High-Performance Coatings | Low | **Bisphenols** (hormone disruptors), **Isocyanates** | Specify epoxy-free and isocyanates-free products | Not addressed in ESDS |
| Roller Shades | Medium | **Orthophthalates** | Specify phthalate-free and no PVC/Vinyl products | Not addressed in ESDS |
| Casework: Doors | Low | **Formaldehyde** | Specify solid wood or no-added formaldehyde composite, and opt for a plywood over other composite wood where possible | Formaldehyde - comply with CARB Phase 2 and/or TSCA Title VI |
| Only use No Added Formaldehyde (NAF) or Ultra-Low Emitting Formaldehyde (ULEF) |
| Casework: Cabinets | Low | **Formaldehyde** | Specify solid wood or no-added formaldehyde composite | Formaldehyde - comply with CARB Phase 2 and/or TSCA Title |
| Only use No Added Formaldehyde (NAF) or Ultra-Low Emitting Formaldehyde (ULEF) |
| Countertops |  | Laminate countertops may contain **formaldehyde**; stone countertops may be sealed with **PFAS** (can suppress the immune system, raise cholesterol, and cause cancer). | Specify mineral or stone-based countertops that do not need to be sealed after installation, such as porcelain slabs, quartz, or some natural stone. Avoid laminate and plastic countertops including cultured marble and solid surface | Formaldehyde - comply with CARB Phase 2 and/or TSCA Title VI |
| Only use No Added Formaldehyde (NAF) or Ultra-Low Emitting Formaldehyde (ULEF) |

**END OF SECTION**