# Retrofitting North Dakota


**Standard Work Specifications**

**for**

## Single-Family Homes

**created by**

## North Dakota Department of Commerce

# Single Family Standard Work Specifications

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| 2.0100.1 | Global Worker Safety |
| Topic | Safe Work Practices |
| Subtopic | Safe Work Practices |
| Desired Outcome | Work completed safely without injury or hazardous exposure |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0100.1a Prevention through design | Design will be incorporated to eliminate or minimize hazards (e.g., material selection, access to equipment for installation and maintenance, placement of equipment, ductwork and condensate lines) | Prevent worker injuries |
| | | Reduce risk exposure to toxic substances and physical hazards |
| 2.0100.1b Hand protection | Durable and wrist-protecting gloves will be worn that can withstand work activity | Minimize skin contact with contaminants |
| | | Protect hands from hazards |

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| 2.0100.1c Respiratory protection | If the risk of airborne contaminants cannot be prevented, proper respiratory protection will be provided and worn (e.g., N-95 or equivalent face mask)<br><br>When applying low pressure 2-component spray polyurethane foam, air purifying masks with an organic vapor cartridge and P-100 particulate filter will be used<br><br>When applying high-pressure SPF insulation, supplied air respirators (SARs) will be used<br><br>Consult SDSs for respiratory protection requirements | Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals) |
| 2.0100.1d Electrical safety | An electrical safety assessment will be performed<br><br>All electric tools will be protected by ground-fault circuit interrupters (GFCI)<br><br>Three-wire type extension cords will be used<br><br>Worn or frayed electrical cords will not be used<br><br>Water sources (e.g., condensate pans) and electrical sources will be kept separate<br><br>Metal ladders will be avoided<br><br>Special precautions will be taken if knob and tube wiring is present<br><br>Aluminum foil products will be kept away from live wires<br><br>For arc flash hazards, NFPA 70E will be consulted | Avoid electrical shock and arc flash hazards |
| 2.0100.1e Carbon monoxide (CO) | All homes will have a carbon monoxide alarm | Protect worker and occupant health |

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| | Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm) | |
| 2.0100.1f Protective clothing | SDSs and OSHA regulations will be consulted for protective clothing and equipment | Protect worker from skin contact with contaminants |
| | Eye protection will always be worn (e.g., safety glasses, goggles if not using full-face respirator) | Minimize spread of contaminants |
| 2.0100.1g Confined space safety | Access and egress points will be located before beginning work | Prevent build-up of toxic or flammable contaminants |
| | Inspection will be conducted for frayed electrical wires | Provide adequate access and egress points |
| | Adequate ventilation will be provided | Prevent electrical shock |
| | Use of toxic material will be reduced | |
| 2.0100.1h Power tool safety | Power tools will be inspected and used in accordance with manufacturer specifications and OSHA regulations to eliminate hazards such as those associated with missing ground prongs, ungrounded circuits, misuse of power tools, noise, and improper or defective cords or extension cords | Prevent power tool injuries |
| | All devices used will be verified as GFCI protected or double insulated | |
| | Exhaust gases from compressors and generators will be prevented from entering | |
| 2.0100.1i Chemical safety | Hazardous materials will be handled in accordance with manufacturer specifications or SDS standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers | Prevent worker exposure to toxic substances |
| | Appropriate personal protective equipment (PPE) will be provided | |

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| | Workers will be trained on how to use PPE | |
| | Workers will be expected to always use appropriate PPE during work | |
| 2.0100.1j Ergonomic safety | Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding) | Prevent injuries from awkward postures, repetitive motions, and improper lifting |
| | Proper equipment will be used for work | |
| | Proper lifting techniques will be used | |
| 2.0100.1k Hand tool safety | Hand tools will be used for intended purpose | Prevent hand tool injuries |
| 2.0100.1l Slips, trips, and falls | Caution will be used around power cords, hoses, tarps, and plastic sheeting | Prevent injuries due to slips, trips, and falls |
| | Precautions will be taken when ladders are used, when working at heights, or when balancing on joists | |
| | Walk boards will be used when practical | |
| | Appropriate footwear and clothing will be worn | |
| 2.0100.1m Heat and thermal stress | Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided | Prevent heat stroke, heat stress, and cold stress related injuries |
| | 911 will be dialed when necessary | |
| 2.0100.1n Fire safety | Ignition sources will be identified and eliminated (e.g., turn off pilot lights and fuel supply) | Prevent a fire hazard |
| | Use of flammable material will be reduced and fire-rated materials will be used | |
| 2.0100.1o Asbestos-containing materials (ACM) | Assess potential asbestos hazard; if unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material and to sample and test as needed | Protect workers and occupants from potential asbestos hazards |
| | If suspected ACM is in good condition, do not disturb | |

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| | If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)<br><br>For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair in accordance with federal, state, and local requirements; only a licensed or trained professional may abate, repair, or remove ACM<br><br>When working around ACM, do not:<br>Dust, sweep, or vacuum ACM debris<br>Saw, sand, scrape, or drill holes in the material<br>Use abrasive pads or brushes to strip materials<br><br>Asbestos abatement or repair work should be completed prior to blower door testing; exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos | |
| 2.0100.1p Lead paint assessment | Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise<br><br>The Environmental Protection Agency (EPA) Renovation, Repair, and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect workers and occupants from potential lead hazards |
| 2.0101.1<br>Topic<br>Subtopic | Air Sealing Worker Safety<br>Safe Work Practices<br>Air Sealing | |

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| Desired Outcome | Work completed safely without injury or hazardous exposure | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0101.1a Worker safety | All worker safety specifications in Global Worker Safety section will be followed | Prevent injury |
| | | Minimize exposure to health and safety hazards |
| 2.0102.1 | Insulation Worker Safety | |
| Topic | Safe Work Practices | |
| Subtopic | Insulation | |
| Desired Outcome | Work is completed safely without injury or hazardous exposure | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0102.1a Worker safety | Follow all worker safety specifications in Global Worker Safety section | Prevent injury |
| | | Minimize exposure to health and safety hazards |
| 2.0102.1b Vermiculite | When working around asbestos-containing material (ACM), the following will not be done:<br>Dust, sweep, or vacuum debris<br>Saw, sand, scrape, or drill holes in the material<br>Use abrasive pads or brushes to strip materials | Protect workers from toxic exposure |
| | Attic insulation that looks like vermiculite (as opposed to fiberglass, cellulose, or urethane foams) will not be removed or disturbed | |
| 2.0103.1 | Combustion Worker Safety | |
| Topic | Safe Work Practices | |
| Subtopic | Heating and Cooling Equipment | |
| Desired Outcome | Work completed safely without injury or hazardous exposure | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 2.0103.1a Worker safety | All worker safety specifications in Global Worker Safety section will be followed | Prevent injury<br><br>Minimize exposure to health and safety hazards |
| 2.0103.1b Carbon monoxide (CO) | Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm) | Protect worker and occupant health |
| 2.0103.1c Raw fuel | Raw fuel leaks will be monitored for before entering building spaces<br><br>If leaks are found, testing will be discontinued and condition reported to occupant immediately | Protect worker and occupant health |
| 2.0103.2 | Heating and Cooling Worker Safety | |
| Topic | Safe Work Practices | |
| Subtopic | Heating and Cooling Equipment | |
| Desired Outcome | Work completed safely without injury or hazardous exposure | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0103.2a Worker safety | Follow all worker safety specifications in Global Worker Safety section | Prevent injury<br><br>Minimize exposure to health and safety hazards |
| 2.0103.2b Mercury | When replacing existing thermostats, identify and dispose of any mercury containing thermostats in accordance with Environmental Protection Agency (EPA) guidance | Protect workers and occupants from mercury exposure |
| 2.0106.1 | Material Selection, Labeling, and Safety Data Sheets (SDSs) | |
| Topic | Safe Work Practices | |
| Subtopic | Material Safety | |
| Desired Outcome | Occupant and worker risk from hazardous materials minimized | |
| Single-Family Homes | | |

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0106.1a Material selection | Materials that do not create long-term health risks for occupants and workers will be used | Improve indoor air quality in the living space |
| 2.0106.1b Material labels | Manufacturer specifications will be followed | Reduce risk of exposure to harmful substances |
| | | Follow safety procedures |
| 2.0106.1c Safety Data Sheets (SDSs) | SDSs will be provided onsite and available during all work | Assess exposure risk |
| | | Prepare a response in case of emergency |
| 2.0107.2 | Crawl Spaces—Pre-Work Qualifications | |
| Topic | Safe Work Practices | |
| Subtopic | Basements and Crawl Spaces | |
| Desired Outcome | Site properly prepared for upgrade | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0107.2a Fuel leaks | Fuel leaks will be repaired and inspected in accordance with the ND State Building Code | Ensure site is safe and ready for upgrade |
| 2.0107.2b Electrical hazards | Electrical hazards will be eliminated and inspected in accordance with ND State Electrical Code | Ensure site is safe and ready for upgrade |
| 2.0107.2d Plumbing and water leaks | Plumbing leaks will be repaired before crawl space upgrade in accordance the local building code. | Prepare site for upgrade |
| 2.0107.2g Appliance and heating, ventilation, and air conditioning (HVAC) system repairs and change outs | Crawl space upgrades (e.g., sealing and insulation) are to be undertaken after appliance and HVAC system work has been completed and inspected | Prepare site for upgrade |
| 2.0107.2i Non-correctable standing water | Spaces with non-correctable standing water will not be considered for a closed crawl space | Prevent possible damage to house |
| 2.0107.3 | Crawl Spaces—Debris Removal | |
| Topic | Safe Work Practices | |
| Subtopic | Basements and Crawl Spaces | |

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| Desired Outcome | Clean, safe, and easily accessible crawl space created | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0107.3a Debris removal | Under floor grade will be cleared of all vegetation and organic material may puncture ground cover. Debris that can cause injury or puncture ground covers will be removed as needed from the crawl space. Care will be taken to prevent punctures during installation. | Minimize punctures in ground liner |
| | | Minimize habitat for pests (Integrated Pest Management—IPM) and contaminant sources |
| 2.0107.3b Debris disposalComment | Debris will be properly disposed of according to type and jurisdiction | Protect environment from damage |
| 2.0201.1 | Combustion Appliance Zone (CAZ) Testing | |
| Topic | Combustion Safety | |
| Subtopic | Combustion Safety Testing-General | |
| Desired Outcome | Accurate information about appliance safe operation is gathered | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0201.1a Assessment | Emergency problems (e.g., gas leak greater than 10% Lower Explosion Limit (LEL), ambient CO levels that exceed 70 ppm) will be communicated clearly and immediately to the customer the home shall be evacuated, and the appropriate emergency services shall be contacted | Ensure system does not have potentially fatal problems |
| | Significant problems (e.g., gas leak less than 10% LEL, ambient CO levels that exceed 35 ppm but less than 70 ppm) will be communicated clearly and immediately to the customer and appropriate solutions will be suggested | Ensure combustion appliance has adequate combustion and dilution air |
| | Examine appliance for signs of damage, misuse, improper repairs, and lack of maintenance | |

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| 2.0201.1b Fuel leak detection | Inspect and test for gas or oil leakage at connections of natural gas, propane piping, or oil systems | Detect fuel gas leaks |
| | If leaks are found, immediate action will be taken to notify occupant to help ensure leaks are repaired | Determine and report need for repair |
| | The report will specify repair for leaks and replacement for hazardous or damaged gas or oil connectors and pipes | |
| 2.0201.1c Venting | Combustion venting systems will be inspected for damage, leaks, disconnections, inadequate slope, and other safety hazards | Determine if a draft regulator is present and working and if vent system is in good condition and installed properly |
| | For oil systems, the presence and operability of a draft regulator will be verified and tested | |
| 2.0201.1d Base pressure test | Baseline pressure will be measured in Combustion Appliance Zone (CAZ) with reference to outdoors | Measure pressure difference between combustion zone and the outside under natural conditions |
| 2.0201.1e Depressurization test | CAZ depressurization testing will be administered for all equipment equipped with a draft hood. | Determine worst-case depressurization in combustion zone due to mechanical system fans |
| | Depressurization test will include exhaust fans, interior door closure, or duct leakage, or a combination thereof; the test will be done to determine the largest negative pressure per BPI Standard 1200. | |
| 2.0201.1i Combustion safety testing at completion of retrofitting home | At the conclusion of each work day in which envelope or duct sealing measures have been performed, depressurization and spillage testing will be performed | Ensure work completed in home has not adversely affected the operation of combustion appliances |
| 2.0201.2<br>Topic<br>Subtopic | Combustion Safety - Make-up Air<br>Combustion Safety<br>Combustion Safety General | |

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| Desired Outcome | Buildup of dangerous combustion byproducts in the living space prevented | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0201.2a Outside combustion make-up air | When combustion air is needed air will be provided from the exterior of the structure. | Prevent combustion byproducts from entering the house |
| 2.0201.2b New appliances | If replacing appliances, a sealed-combustion, direct-vent appliance will be installed if possible. New appliances will be installed in accordance with manufacturer specifications, the ND State Building Code and additional applicable codes. | Prevent combustion byproducts from entering the house |
| 2.0201.2c CO detection and warning equipment | CO detection or warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with ASHRAE 62.2 and authority having local jurisdiction<br><br>Installation will be accomplished by a licensed electrician when required by local code | Alert occupant to CO exposure |
| 2.0201.2d Gas ovens | Gas ovens will be tested for CO<br><br>A clean and tune will be conducted if measured CO in the undiluted flue gases of the oven vent at steady state exceeds 225 ppm as measured | Ensure clean burn of gas ovens |
| 2.0201.2e Gas range burners | Recommend a clean and tune to the client if the flame has any discoloration, flame impingement, or an irregular pattern or if burners are visibly dirty, corroded, or bent | Ensure clean burn and operation of gas range burners |
| 2.0201.2f Solid fuel burning appliances | If the solid fuel burning appliance is the primary heat source and has signs of structural failure replace solid fuel burning appliance with UL-listed and EPA - certified appliances | Ensure safe operations of solid fuel burning appliances |

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| 2.0201.3 | Vented Combustion Appliance Safety Testing | |
| Topic | Combustion Safety | |
| Subtopic | Combustion Safety Testing-General | |
| Desired Outcome | Buildup of dangerous combustion byproducts in the living space prevented | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0201.3a Spillage test | In conditions with largest negative pressure as determined from Detail 2.0201.1e:<br>If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate.<br><br>If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate. | Detect excessive spillage of combustion gases |
| 2.0201.3b Carbon monoxide (CO) test in appliance vent | CO will be tested for in undiluted flue gases of combustion appliances<br><br>In conditions with largest negative pressure as determined from Detail 2.0201.3e:<br><br>If CO levels exceed 400 ppm air-free measurement in furnaces, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications)<br><br>If CO levels exceed 200 ppm air-free measurement in water heaters or room heaters, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications) | Measure CO and report excessive levels |
| 2.0201.3c Final test out | Final combustion testing will be conducted at project completion to ensure compliance with the above specifications | Ensure safe operation of combustion appliance within the whole house system after any repair project |
| 2.0202.1 | Unvented Space Heaters: Propane, Natural Gas, and Kerosene Heaters | |
| Topic | Combustion Safety | |
| Subtopic | Unvented Space Heaters | |

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|---|---|---|
| Desired Outcome | Elimination of combustion byproducts | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0202.1a Removal | When un-vented combustion heaters exist they will be required to be removed before weatherization work can take place. | Eliminate sources of combustion byproduct within a living space |
| 2.0202.1b Occupant educationComment | Occupant will be educated on potential hazards of unvented combustion appliances (primary or secondary) within a living space | Inform occupant about possible hazards associated with combustion byproducts and moisture |
| 2.0203.1 | Combustion Air for Natural Draft Appliances | |
| Topic | Combustion Safety | |
| Subtopic | Vented Gas Appliances | |
| Desired Outcome | Sufficient air provided in the Combustion Appliance Zone (CAZ) | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0203.1a Required combustion air | Combustion air will be provided in accordance with ND State Building Code and authority having jurisdiction | Determine if existing conditions meet the combustion air calculation |
| 2.0203.1b Additional combustion air (if action is required) | Additional combustion air will be provided in accordance with ND State Building Code and authority having jurisdiction when necessary to solve spillage problems | Ensure adequate combustion air for operation of the appliance |
| 2.0203.1c Spillage testing | If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate.<br><br>If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate. | Detect excessive spillage of combustion gases. |
| 2.0203.2 | Combustion Flue Gas—Orphaned Water Heaters | |
| Topic | Combustion Safety | |
| Subtopic | Vented Gas Appliances | |
| Desired Outcome | Flue gasses successfully removed from the house | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0203.2a Spillage testing | If spillage in a combustion appliance with a warm vent exceeds two minutes during pressure testing, specify measures to mitigate | Detect excessive spillage of combustion gases |
| | If spillage in a combustion appliance with a cold vent exceeds five minutes during pressure testing, specify measures to mitigate | |
| 2.0203.2b Flue gas removal (chimney liner or approved methods) | A chimney liner will be installed in accordance with the ND State Building Code or applicable NFPA standard | Allow water heater to vent properly |
| | | Prevent damage to the chimney |
| 2.0203.2c Retesting spillage | If a combustion appliance spillage exceeds two minutes during pressure testing, specify measures to mitigate | Ensure appliance is not spilling longer than two minutes with a warm vent |
| 2.0203.2d Required combustion air | The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with the ND State Building Code and the authority having jurisdiction | Determine if existing conditions meet the combustion air calculation |
| 2.0203.2e Additional combustion air (if action is required) | Additional combustion air will be provided in accordance with ND State Building Code or other authority having jurisdiction | Ensure adequate combustion air for operation of the appliance |
| 2.0203.8<br>Topic<br>Subtopic<br>Desired Outcome | Occupant Education<br>Combustion Safety<br>Occupant Education<br>Ensure persistence of resident safety | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0203.8a Occupant health and safety | All homes will have a functioning CO alarm | Ensure occupant health and safety |

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| | If CO levels in interior living spaces exceed outdoor levels, potential sources will be investigated and appropriate action taken to reduce them (e.g., have a qualified professional tune, repair, or replace improperly operating combustion appliances; apply weather stripping or conduct air sealing between the garage or crawl space and the home) | Ensure indoor CO levels do not exceed outdoor CO levels |
| 2.0204.8b Occupant education | Occupants will be educated on the operation and maintenance of the CO alarm | Ensure occupant can operate and maintain installations |
| | Completed work on combustion appliances and recommended maintenance will be reviewed with occupant | Inform occupant regarding possible CO hazards |
| | Occupant will be provided information regarding the health effects and risk of high CO concentrations; EPA provides possible expanded actions and offers client education information in an appendix to the protocols | |
| 2.0301.1 | Smoke Alarm | |
| Topic | Safety Devices | |
| Subtopic | Combustion Safety Devices | |
| Desired Outcome | Properly installed smoke alarms | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0301.1b Smoke alarm (battery operated)Comment | Smoke detectors will be installed within 15 feet of all bedrooms and a minimum of one on each floor. They will either be mounted on the ceiling or within 12 inches of the ceiling if wall mounted. | Ensure proper installation |
| 2.0301.2 | Carbon Monoxide Alarm or Monitor | |
| Topic | Safety Devices | |
| Subtopic | Combustion Safety Devices | |
| Desired Outcome | Properly installed CO alarms or monitors | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0301.2b CO detection and warning equipment (battery operated) | Battery operated CO detection or warning equipment will be installed in accordance with ASHRAE 62.2 and manufacturer specifications as required by the authority having jurisdiction | Ensure proper installation |
| 2.0401.1<br>Topic<br>Subtopic<br>Desired Outcome | Air Sealing Moisture Precautions<br>Moisture<br>Air Sealing<br>Ensure durability of repairs and reduce potential for occupant exposure to mold and other moisture-related hazards | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0401.1a Moisture precautions for attics | Roof leaks will be repaired before performing attic air sealing or insulation | Ensure durability of repairs |
| | Moisture sources in the house that can generate moisture into the attic will be identified and removed or reduced | Reduce potential for occupant exposure to mold and other moisture-related hazards |
| | | Prevent moisture from communicating from within the conditioned space into unconditioned attic space when economically feasible |
| 2.0401.1b Moisture precautions for crawl spaces | Exposed earth will be covered with a continuous, durable, sealed Class 1 vapor retarder a minimum of 6 mils in thickness | Ensure durability of repairs |
| | Any vapor retarder shall not encapsulate wood building materials or spray foam | Reduce potential for occupant exposure to mold and other moisture-related hazards |
| | Holes between the crawl space and the living space will be sealed | |
| 2.0401.1c Moisture precautions for the living space | Moisture sources in the home will be identified and removed or reduced | Ensure durability of repairs |

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| | Local ventilation will be installed where appropriate (e.g., baths, kitchens) and vented to outside according to ASHRAE 62.2-2016 | Reduce potential for occupant exposure to mold and other moisture-related hazards |
| | Unvented combustion appliances that are not will be removed | |
| 2.0401.1d Moisture precautions for exterior water | Before air sealing basement or crawl space walls near wet areas, surface water pooling near the foundation will be addressed by: | Reduce potential for occupant exposure to mold and other moisture-related hazards |
| | Repairing, modifying or replacing gutters and downspouts | |
| | Grading and subsurface drainage at critical locations (e.g., localized drain and grading beneath valleys) in accordance with Environmental Protection Agency (EPA) Indoor airPLUS Construction Specifications Section 1.1 Possible mitigation by waterproofing or installing draining plane with construction adhesive | |
| 2.0401.2 | Vented Crawl Space—Venting | |
| Topic | Moisture | |
| Subtopic | Air Sealing | |
| Desired Outcome | Pollutants effectively vented | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0401.2a Venting | Venting will be performed in accordance with the ND State Building Code or the authority having jurisdiction | Provide ventilation for pollutant sources (e.g., moisture, radon, soil gases) |
| 2.0403.1 | Vented Crawl Spaces—Ground Moisture Barrier | |
| Topic | Moisture | |
| Subtopic | Vapor Barriers | |
| Desired Outcome | Durable, effective ground moisture barrier provides long-lasting access and minimizes ground vapor | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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|---|---|---|
| 2.0403.1a Material Integrity | Care will be taken to prevent punctures during installation | Protect ground moisture barrier from damage during other crawl space work |
| 2.0403.1b Coverage | A ground moisture barrier that covers 100% of the exposed crawl space floor will be installed where accessible. | Reduce ground moisture entering the crawl space |
| 2.0403.1c Material specification | A ground moisture barrier with a rating of no less than 6 mil will be used | Ensure crawl space is accessible for service and maintenance without damaging the integrity of the ground moisture barrier |
| | A minimum expected service life of 10 years will be ensured | |
| | A ground moisture barrier will be used that meets tear and puncture resistance of 6 mil or the current ASTM standard for puncture and tear resistance | |
| 2.0403.1d Overlap seams | When seams exist, they will be overlapped a minimum of 12" using reverse or upslope lapping technique | Keep water under the liner |
| | | Reduce the likelihood of damage at seams |
| 2.0403.1e Fastening | When ground moisture barrier is installed on sloping ground, may be exposed to wind, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s) | Prevent movement of the ground moisture barrier |
| | A minimum expected service life of 10 years will be ensured | |
| 2.0403.2 | Closed Crawl Spaces—Ground Moisture Barriers | |
| Topic | Moisture | |
| Subtopic | Vapor Barriers | |
| Desired Outcome | Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 2.0403.2a Material Integrity | Care will be taken to prevent punctures during installation | Protect ground moisture barrier from damage during other crawl space work |
| 2.0403.2b Coverage | An air barrier and ground moisture barrier, covering 100% of the exposed crawl space floor, where applicable and accessible, will be installed in accordance with ASTM E1643 and manufacturer's recommendations | Reduce ground moisture entering the crawl space |
| | A ground moisture barrier will be fastened if there is significant slope, wind acting on the ground cover, or if the crawl space is used regularly for storage or to access appliances. | Create a continuous and durable connection between the wall and ground air and moisture barriers |
| 2.0403.2c Material specification | A ground moisture barrier with a rating of no less than 6 mil will be used | Reduce ground vapor entering the crawl space |
| | A minimum expected service life of 10 years will be ensured | Ensure crawl space is accessible for service and maintenance without destroying the integrity of the moisture barrier |
| 2.0403.2d Overlap seams | When seams exist, they will be overlapped a minimum of 12" with reverse or upslope lapping technique | Keep water under the liner |
| | For wall to floor connection, the wall moisture barrier will be installed under the ground moisture barrier | |
| 2.0403.2e Fastening | When ground moisture barrier is installed on sloping ground, may be exposed to wind, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s) | Prevent movement and uplift of the air barrier and ground moisture barrier |
| | A minimum expected service life of 10 years will be ensured | |
| 2.0403.2f Sealing seams | A durable sealant compatible with the air barrier and ground moisture barrier will be used | Maintain continuous air barrier and ground moisture barrier |

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| | A minimum expected service life of 10 years will be ensured | |
| 2.0403.2g Air barrier, ground moisture barrier penetrations, including fastener penetrations | A durable sealant, compatible with the air barrier and ground moisture barrier, will be used | Maintain continuous air barrier and ground moisture barrier |
| | Physical attachments will be provided where practical (e.g., masonry columns, footings) | |
| | A minimum expected service life of 10 years will be ensured | |
| 2.0403.2h Drainage | The air barrier and ground moisture barrier will not interfere with the established drainage pattern | Ensure proper drainage |
| 2.0403.2i Drainage points | Interior drainage collection points will be accessible from above and below the air barrier and ground moisture barrier | Remove water above and below the air barrier and ground moisture barrier |
| 2.0601.1 | Knob and Tube Wiring | |
| Topic | Electrical | |
| Subtopic | Knob and Tube Wiring | |
| Desired Outcome | Live unsafe wiring identified and brought to local codes | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0601.1a Knob and tube identification | Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring | Ensure occupant safety |
| | | Preserve the integrity and safety of the house |
| 2.0601.1b Live wire testing | Non-contact testing method will be used to determine if wiring is live | Protect occupant safety |
| | | Preserve the integrity and safety of the house |

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| 2.0601.1c Isolation and protection | Proper clearance will be maintained aroung live knob and tube as required by the ND State Electrical Code | Ensure occupant safety |
| | When required, a dam that does not cover the top will be created to separate insulation from the wire path | Preserve the integrity and safety of the house |
| 2.0601.1d Replacement | Exposed wiring will be replaced with new appropriate wiring in accordance with the ND State Electrical Code | Ensure occupant safety |
| | Old wiring will be rendered inoperable by licensed electrician in accordance with the ND State Electrical Code | Preserve the integrity and safety of the house |
| 2.0701.1 | Crawl Spaces—Providing Access | |
| Topic | Occupant Education and Access | |
| Subtopic | Basements and Crawl Spaces | |
| Desired Outcome | Access to the closed crawl space is controlled and the ground moisture barrier is protected to maintain the integrity of the system | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 2.0701.1a Access | Crawl space will be accessible in accordance with the ND State Building Code | Provide crawl space access |
| | Access to mechanical equipment located in the crawl space will be in accordance with the ND State Building Code | Maintain integrity of the crawl space system |
| | Service and maintenance of the crawl space and equipment will be performed without risk of damage to the thermal barrier, air barrier, and ground moisture barrier in accordance with the ND State Building Code | |
| 2.0701.1b Lock | A lockable access will be provided if access is from the exterior | Control access and prevent intruders |
| 3.1001.1 | Penetrations and Chases | |
| Topic | Attics | |
| Subtopic | Penetrations and Chases | |

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| Desired Outcome | Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1001.1a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a chase | Repair moisture-related issues |
| | Repairs will be completed before work | |
| 3.1001.1b Backing and infill | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole | Minimize hole size to ensure successful use of sealant |
| | The infill or backing will not bend, sag, or move once installed | Ensure closure is permanent and supports any load (e.g., wind, insulation) |
| | | Ensure sealant does not fall out |
| 3.1001.1c Sealant selection | Sealants will be compatible with their intended surfaces | Select permanent sealant |
| | Sealants will allow for differential expansion and contraction between dissimilar materials | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |
| | Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | |
| 3.1001.1d High temperature application | Only non-combustible sealant will be used in contact with chimneys, vents, and flues | Prevent a fire hazard |
| | Local codes will be referenced | |
| 3.1001.2 | Chase Capping | |
| Topic | Attics | |
| Subtopic | Penetrations and Chases | |
| Desired Outcome | Chase capped to prevent air leakage and moisture movement between the attic and conditioned space | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1001.2a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a chase<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1001.2b Standard chase (interior walls covered with drywall or plaster) | Entire opening will be spanned with rigid material<br><br>Material will be cut to fit and fastened as required | Reduce opening to what can be sealed with sealant |
| 3.1001.2c Non-standard chase (interior walls covered with wood or paneling) | Material will be used that can be exposed to the interior of the house and meet the flame and smoke spread indexes as required in the ND State Building Code | Prevent a fire hazard |
| 3.1001.2d Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1001.2e Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1001.2f Adjacent framing | All remaining gaps at the top of the chase will be sealed | Ensure airtight seal from one finished side of the chase to the other |
| 3.1001.3 | Walls Open to Attic—Balloon Framing and Double Walls | |
| Topic | Attics | |
| Subtopic | Penetrations and Chases | |
| Desired Outcome | Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
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| 3.1001.3a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1001.3b Sealing methods | Entire opening will be spanned with rigid material in line with the ceiling level<br><br>Material will be cut to fit and fastened as required<br>OR<br>Wall below openings will be dense packed<br>OR<br>Wall below openings will be bridged and sealed with spray polyurethane foam (SPF)<br><br>Sealants will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | Prevent air leakage from wall cavity to attic |
| 3.1001.3c Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1001.3d Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1001.3e Adjacent framing | All remaining gaps at the top of the opening will be sealed<br><br>OR<br>All remaining gaps at the top of the chase will be sealed | Ensure airtight seal from one finished side of the wall assembly to the other |
| 3.1001.4 | Non-Insulation Contact (IC) Recessed Light | |
| Topic | Attics | |
| Subtopic | General Preparation | |
| Desired Outcome | Ensure safety from fire and prevent air leakage | |
| Single-Familiy Homes | | |
| Title | Specification(s) | |

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| 3.1001.4a Air barrier system | A fire-rated air barrier system (i.e., equivalent to 5/8 fire code gypsum wallboard) will be used to separate non-IC rated recessed lights from insulation, using one of the methods below: | Prevent a fire hazard |
| | A fire-rated airtight closure taller than surrounding attic insulation will beplaced over non-IC rated recessed lights<br>OR<br>The non-IC rated light fixture will be replaced with an airtight and IC- rated fixture<br>OR<br>The fixture(s) may be replaced with surface mounted fixture and opening sealed. | Prevent air leakage through fixture |
| 3.1001.4b Enclosure top | The top-fire rated enclosure material will have an R-value of 0.5 or less<br><br>The top of the enclosure will be left free of insulation | Prevent heat build up |
| 3.1001.4c Clearance | The entire closure will maintain a 3" clearance between the closure and fixture including wiring, box, and ballastthe | Keep an air space around the fixture |
| 3.1001.4d Sealants and weather stripping | Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only | To prevent air leakage, completely adhere the sealant to all surfaces to be sealed |
| 3.1002.1 | Interior with Sloped Ceiling | |
| Topic | Attics | |
| Subtopic | Open Stairwells | |
| Desired Outcome | Stairwells sealed to prevent air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1002.1a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell<br><br>Repairs will be completed before work begins | Repair moisture-related issues |

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| 3.1002.1b Standard void over stairwell (15-minute fire-rated material; e.g., gypsum lined) | Entire opening will be spanned with rigid material | Prevent air leakage from wall to attic |
| | Material will be cut to fit and fastened as required | Reduce opening to what can be sealed with sealant<br><br>Support load as required (e.g., wind, insulation) |
| 3.1002.1c Non-standard void over stairwell (surfaces around void are not 15-minute fire-rated (e.g., bookcases, chest of drawers), or lined with paneling | Material will be used that can be exposed to the interior of the house | Prevent a fire hazard |
| 3.1002.1d Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1002.1e Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1002.1f Perimeter sealing | Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier<br><br>Access will be gained as needed (e.g., pull flooring) | Create a continuous air barrier |

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| 3.1002.2 | Stairwell to Attic—Door at Bottom with No Ceiling Above |
| Topic | Attics |
| Subtopic | Open Stairwells |
| Desired Outcome | Stairwell sealed to prevent air leakage and moisture movement between the attic and the conditioned space |

| Single-Family Homes | | |
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| Title | Specification(s) | Objective(s) |

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| 3.1002.2a Pre-inspectionComment | An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1002.2b Option 1: bring stairwell inside | Materials will be installed in line with the ceiling level with an airtight and operable insulated panel weighing no more than 15 pounds, or a pre-fabricated kit may be used for repeated access<br>OR<br><br>Airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter<br><br>Access will be gained as needed (e.g., pull flooring) | Prevent air leakage through stairwell between conditioned space and attic<br><br>Ensure the insulated panel is lightweight and easy for the occupant to use on an ongoing basis<br>Support insulation<br><br>Bring the stairwell inside of the thermal boundary<br><br>Ensure the new closure ties into the existing air barrier on all sides |
| 3.1002.2c Option 2: keep stairwell outside | An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors<br>OR<br><br>All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)<br><br>Door will be weatherstripped and insulated<br>OR<br>A combination of the above methods can be used | Prevent air leakage<br><br>Provide continuous thermal boundary<br>Maximize thermal performance |
| 3.1002.2d Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |

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| 3.1002.2e Joint seal | Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1002.2 fPerimeter sealing | Air barrier will be extended on all four sides from finished ceiling or from existing framing to the new barrier<br><br>Access will be gained as needed (e.g., pull flooring) | Create a continuous air barrier |
| 3.1002.3 | Stairwell to Attic—Door at Top with Finished Ceiling Above | |
| Topic | Attics | |
| Subtopic | Open Stairwells | |
| Desired Outcome | Stairwell is sealed to prevent air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1002.3a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing an open stairwell<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1002.3b Option 1: bring stairwell inside | An airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter | Reduce air leakage |
| | Access will be gained as needed (e.g., pull flooring)<br>OR<br><br>An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors<br>OR<br>All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)<br>Door will be weatherstripped and insulated<br>OR | Provide continuous thermal boundary<br>Maximize thermal performance |

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| | A combination of the above methods can be used | |
| 3.1002.3c Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1002.3d Joint seal | Continuous, airtight seals will be provided around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1002.3e Perimeter sealing | Air barrier will be extended on all four sides from finished ceiling or existing framing to the new barrier<br><br>Access will be gained as needed (e.g., pull flooring) | Create a continuous air barrier |
| 3.1003.1 | New Ceiling Below Original—Old Ceiling Intact or Repairable | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1003.1a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1003.1b Sealing methods | Entire opening will be spanned with rigid material in line with the ceiling level<br><br>Material will be cut to fit and fastened as required<br>OR<br>Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate<br>OR<br>Wall below openings will be dense packed | Prevent air leakage from dropped ceiling to attic |

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| | OR<br>Wall below openings will be bridged and sealed with SPF<br><br>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | |
| 3.1003.1c SupportComment | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1003.1d Joint sealComment | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1003.1e Adjacent framingComment | All remaining gaps will be sealed at the top of the dropped ceiling<br><br>OR<br>All remaining gaps at the top of the chase will be sealed | Provide airtight framing from one finished side of the dropped ceiling to the other |
| 3.1003.2 | Ceiling Leaks Not Repairable—No Air Barrier Above | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1003.2a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit<br><br>Repairs will be completed before work begins | Repair moisture-related issues |
| 3.1003.2b Sealing methods | Ceiling or roof and wall air and thermal barriers will be connected with a rigid airtight connection around the perimeter<br>OR | Prevent air leakage from dropped ceiling to attic |

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| | If ceiling will support an air barrier and insulation, a rigid airtight barrier (e.g., gypsum) will be attached to current ceiling either above or below<br>OR<br>Intermediate framing will be used to support air and thermal barrier<br>OR<br>Rigid airtight thermal barrier will be installed at the roof sheathing<br><br>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | |
| 3.1003.2c Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1003.2d Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1003.2e Adjacent framing | All remaining gaps will be sealed at the top of the dropped ceiling<br><br>OR<br>All remaining gaps at the top of the chase will be sealed | Provide airtight framing from one finished side of the dropped ceiling to the other |
| 3.1003.3 | Above Closets and Tubs | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1003.3a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit<br><br>Repairs will be completed before work begins | Repair moisture-related issues |

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| 3.1003.3b Above closets and tubs | Entire opening will be spanned with rigid material in line with the ceiling level<br><br>Material will be cut to fit and fastened as required<br>OR<br>Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate<br>OR<br>Wall below openings will be dense packed<br>OR<br>Wall below openings will be bridged and sealed with SPF<br><br>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | Prevent air leakage from dropped ceiling to attic |
| 3.1003.3c Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1003.3d Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections | Provide airtight, durable seal that does not move, bend, or sag |
| 3.1003.3e Adjacent framing | All remaining gaps at the top of the dropped ceiling will be sealed | Provide airtight framing from one finished side of the dropped ceiling to the other |
| 3.1003.4 | Dropped Ceilings | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1003.4a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit<br><br>Repairs will be completed before work begins | Repair moisture-related issues |

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| 3.1003.4b Sealing methods | Entire opening will be spanned with rigid material installed in line with the ceiling level<br><br>Material will be cut to fit and fastened as required<br>OR<br>Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate<br>OR<br>Wall below openings will be dense packed<br>OR<br><br>Wall below openings will be bridged and sealed with SPF<br><br>Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | Prevent air leakage from dropped ceiling to attic |
| 3.1003.4c Support | Support material will be installed for spans wider than 24", except when air barrier material is rated to span greater distance under load (e.g., wind, insulation) | Ensure seal stays in place and does not sag |
| 3.1003.4d Joint seal | Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections<br><br>Pre-fabricated units may be used when meeting the desired outcome | Provide airtight, durable seal that does not move, bend or sag |
| 3.1003.4e Adjacent framing | All remaining gaps will be sealed at the top of the dropped ceiling<br><br>OR<br>All remaining gaps at the top of the chase will be sealed | Provide airtight framing from one finished side of the dropped ceiling to the other |
| 3.1003.5 | Dropped Ceiling with Light Boxes and Fixtures | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Sealed light boxes safely prevent air leakage and moisture movement between the attic and conditioned space | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1003.5a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit | Repair moisture-related issues |
| | Repairs will be completed before work begins | |
| 3.1003.5b Light boxes (e.g., fluorescent lights) | An airtight seal will be provided around perimeter between light box enclosure and interior ceiling | Prevent air leakage |
| | All seams and penetrations of the enclosure will be sealed | |
| | Access will be gained as needed (e.g., pull flooring) | |
| | Seals will be used that prevent visible air movement using chemical smoke at 50 pascals of pressure difference | |
| 3.1003.5c Non-insulation contact (IC) rated recessed lights | Insulation will be kept at least 3 inches away from the top and side of any fixtures | Prevent light fixture from overheating |
| | If dropped ceiling is to be filled with insulation, then a sealed rigid barrier enclosure will be installed to maintain a 3 inches clearance on all sides | Bring light fixture inside of the air barrier |
| | Top of rigid barrier enclosure will be sealed with non-insulating rigid material (e.g., gypsum or equivalent perm rating and R-value) | |
| 3.1003.6 | Dropped Soffits | |
| Topic | Attics | |
| Subtopic | Dropped Ceilings and Soffits | |
| Desired Outcome | Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
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| 3.1003.6a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a dropped ceiling or soffit | Repair moisture-related issues |
| | Repairs will be completed before work begins | |
| 3.1003.6b Soffit general | Air flow will be blocked at soffit in locations where access allows | Provide continuous air barrier across soffit openings |
| 3.1003.6c Option 1: bring soffit inside (seal at top) | Entire opening will be spanned with rigid material in line with the ceiling level | Prevent air leakage from wall to attic |
| | Material will be cut to fit and fastened as required | Reduce opening to what can be sealed with sealant |
| | | Ensure closure is permanent and supports any load (e.g., wind, insulation) |
| | | Bring soffit into thermal boundary |
| 3.1003.6d Option 2: leave soffit outside (seal at bottom or side) | Each stud bay will be spanned with rigid material will be cut to fit and fastened as required<br>OR | Prevent air leakage from wall to soffit<br>Reduce opening to what can be sealed with sealant |
| | Backing at each stud bay will be provided and will be sealed<br>OR<br>Side of stud bays will be sealed with rigid material from bottom of soffit to top-plate<br>OR<br>A sealed rigid barrier will be installed at all transitions | Ensure soffit is outside of the thermal boundary |
| 3.1003.6e Soffits containing non-IC rated recessed lightsComment | Insulation will be kept at least 3" away from the top and side of any fixtures | Prevent light fixture from overheating |
| | If dropped soffit is to be filled with insulation, then a sealed rigid barrier enclosure will be installed to maintain a 3" clearance around the entire fixture | Bring light fixture inside of the air barrier |
| | Top of rigid barrier enclosure will be sealed with non-insulating rigid material (e.g., gypsum or equivalent perm rating and R-value) | |

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| 3.1004.1 | Cathedralized Attic Air Sealing (Insulation Installed at Roof Deck) | |
| Topic | Attics | |
| Subtopic | Cathedralized Attic Ceilings | |
| Desired Outcome | Cathedralized attics sealed to prevent air leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1004.1a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a cathedralized ceiling | Repair moisture-related issues |
| | Repairs will be completed before work begins | |
| 3.1004.1b Backing and infill | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space | Minimize hole size to ensure successful use of sealant |
| | The infill or backing will not bend, sag, or move once installed | Ensure closure is permanent and supports any load (e.g., wind, insulation) |
| | | Ensure sealant does not fall out |
| 3.1004.1c Sealant selection | Sealants will be compatible with their intended surfaces | Select permanent sealant |
| | Sealants will allow for differential expansion and contraction between dissimilar materials | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |
| | Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | |
| 3.1005.1 | Tongue and Groove Ceilings | |
| Topic | Attics | |
| Subtopic | Other Ceiling Materials | |
| Desired Outcome | Tongue and groove ceilings sealed to prevent air leakage and moisture movement between the attic and conditioned space | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1005.1a Pre-inspection | An inspection will be conducted for mold, water leaks, and water damage before sealing a tongue and groove ceiling | Repair moisture-related issues |
| | Repairs will be completed before work | |
| 3.1005.1b Backing | Backing will be installed behind tongue and groove ceilings | Prevent air leakage and allow for sealants |
| 3.1005.1c Sealant selection | Sealants will be compatible with their intended surfaces | Select permanent sealant |
| | Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |
| | No sealant will be allowed to be visible in the living space | Ensure ceiling remains aesthetically pleasing |
| 3.1201.1 | Double-Hung Wood Windows | |
| Topic | Windows and Doors | |
| Subtopic | Maintenance, Repair, and Sealing | |
| Desired Outcome | Windows operable and weather tight; improved energy efficiency performance of fenestration | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1201.1a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |

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| 3.1201.1b Weather stripping | Existing weather stripping and sash sealant will be removed | Form a complete seal from the outer edge of the sash to the jamb |
| | Surface where the sill meets the sash will be cleaned | Maintain operability of the window |
| | Seal between the fixed components of the window (e.g., jambs, sill) will be continuous and complete while maintaining the operability of the window | |
| | Continuous and complete weather stripping will be installed on the bottom of the lower sash where it makes contact with the sill and at the top of the upper sash where it makes contact with the upper part of the window frame | |
| 3.1201.1c Sash locks | Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact | Form a secure connection between the two sashes |
| | No gaps will be visible between the two sashes | |
| | Locks will be installed to achieve compression of the two sashes | |
| 3.1201.1d Replacement sills | Beveled sill will be flush with interior wall and sloped to the exterior | Form a complete seal from the bottom of the lower sash to the sill |
| | Seams will be continuously and completely sealed with sealant to the jambs and to the frame | Maintain operability of the window |
| | Sill will be water-sealed and primed | Allow for drainage to the exterior |
| 3.1201.1e Sash replacement | Lower sash will have the same bevel on the bottom rail as the sill | Ensure sash remains in a fixed position when open or partially open |
| | Sash will be water-sealed and primed | Maintain operability of the window |

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| | | Form a complete seal from the bottom of the lower sash to the sill |
| 3.1201.1f Adjust stops | Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window | Form a complete seal between the jamb, sash, and stop |
| | | Maintain operability of the window |
| 3.1201.1g Replace stops | Stops will be installed to keep the window securely in place | Form a complete seal between the jamb, sash, and stop |
| | Stops will be adjusted to eliminate visible gaps between the stops and the jamb while maintaining operability of the window | Maintain operability of the window |
| 3.1201.2 | Single-Unit Window and Fixed Frame with Wood Sash | |
| Topic | Windows and Doors | |
| Subtopic | Maintenance, Repair, and Sealing | |
| Desired Outcome | Windows operable and weather tight; improved energy efficiency performance of fenestration | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1201.2a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |
| 3.1201.2b Operable windows | All egress windows will be operable as required by local codes | Maintain operability of egress windows |

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| 3.1201.2c Air infiltration | Details that reduce air infiltration will be repaired, replaced, sealed, or installed (e.g., new latch for meeting rail connection, pulley seals, rope caulking for other cracks, interior storm windows)<br><br>ND State Building Code or local code requirements for air leakage should be met (whichever is more stringent) | Reduce air infiltration |
| 3.1201.2d Water infiltration | Details that reduce water infiltration will be repaired, replaced, or installed (e.g., replace missing glazing compound on sash, exterior caulking, exterior storm windows) | Reduce water infiltration |
| 3.1201.2e Occupant education and maintenance | Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window | Ensure long-term weather tightness |
| 3.1201.3 | Exterior Doors | |
| Topic | Windows and Doors | |
| Subtopic | Maintenance, Repair, and Sealing | |
| Desired Outcome | Doors operable and weather tight | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1201.3a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise<br><br>EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | Protect worker and occupant from potential lead hazards |
| 3.1201.3b Door operation and fit | Door will be adjusted to properly fit the jamb and allow for ease of operation (e.g., hinge replacement, re-plane door, door strike adjustment) | Ensure proper operation of the door |

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| 3.1201.3c Air infiltration | Details that reduce air infiltration will be repaired, replaced, sealed, or installed in accordance with State Energy Conservation Code or local code—whichever is more stringent (e.g., weather stripping, door bottoms, trim replacement with foam) | Reduce air infiltration |
| 3.1201.3d Water infiltration | Details that reduce water infiltration will be repaired, replaced, sealed, or installed (e.g., adjust threshold, caulk jamb to threshold, caulk trim, flashing) | Reduce water infiltration |
| 3.1201.3e Occupant education and maintenance | Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain weather stripping and caulk around door and trim | Ensure long-term weather tightness |
| 3.1201.4 | Pocket Door | |
| Topic | Windows and Doors | |
| Subtopic | Maintenance, Repair, and Sealing | |
| Desired Outcome | Pocket door sealed top and back to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1201.4a Backing and infill | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole | Minimize hole size to ensure successful use of sealant |
| | The infill will not bend, sag, or move once installed | Ensure closure is permanent and supports any load (e.g., wind, insulation) |
| | | Ensure sealant does not fall out |
| 3.1201.4b Sealant selection | Sealants will be compatible with their intended surfaces | Select permanent sealant |
| | Sealants will allow for differential expansion and contraction between dissimilar materials | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |

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| | Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | |
| | Sealant will be used in accordance with OSHA/manufacturer safety protocol for worker and occupant safety | |
| | Manufacturer SDS sheet will be followed for worker safety | |
| 3.1202.1 | Fixed Frame with Wood Sash—Older House | |
| Topic | Windows and Doors | |
| Subtopic | Repairing/Replacing Cracked and Broken Glass | |
| Desired Outcome | Glass complete and intact; improved energy efficiency performance of fenestration | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1202.1a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |
| 3.1202.1b Broken glass removal | Putty and push points will be removed | Safely remove old glass |
| | Broken or cracked glass will be removed | |
| 3.1202.1c Sash preparation | Opening will be cleaned | Prepare opening for new glass |
| 3.1202.1d New glass installation | Glass will be sized 1/8" to 3/16'' smaller than opening to allow for movement of frame | Ensure glazing compound will adhere to sash |
| | Safety glass will be installed in accordance with local codes | Install, seal, and secure new glass in place |

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| | Push points will be provided on each side to secure glass in frame | Allow glazing compound to harden to ensure secure installation |
| | Glazing compound will be added in accordance with manufacturer specifications | |

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| 3.1202.2 | Single-Unit Window, Mounted on Rough Opening—Newer House |
| Topic | Windows and Doors |
| Subtopic | Repairing/Replacing Cracked and Broken Glass |
| Desired Outcome | Glass complete and intact; improved energy efficiency performance of fenestration |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 3.1202.2a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |
| 3.1202.2b Broken glass removal | Window stops and damaged glass will be removed | Safely remove old glass |
| 3.1202.2c Opening preparation | Opening will be cleaned | Prepare opening for new glass |
| | Glazing tape will be removed or replaced | |
| 3.1202.2d New glass installation | Replacement glass will be sized to original width, height, and depth | Install, seal, and secure new glass in place |
| | Stops will be replaced or installed | Allow glazing compound to harden to ensure secure installation |
| | Wood stops will be sealed to glass with appropriate sealant | |

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| | Glass will be selected with comparable tint and coating (color and look) | |
| | Tempered glass will be installed as required by local codes | |
| | Glazing compound will be added in accordance with manufacturer specifications | |
| 3.1203.1 | Replacement Window in Existing Window Frame | |
| Topic | Windows and Doors | |
| Subtopic | Replacement | |
| Desired Outcome | Replacement window provides weather tight fit; improved energy efficiency performance of fenestration | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1203.1a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |
| 3.1203.1b Opening preparation | Interior stops, sashes, parting strips, and pulleys will be removed | Provide a clean opening for replacement window unit |
| | Opening will be cleaned | |
| 3.1203.1c Replacement window installation | Replacement window will be installed in accordance with manufacturer specifications, ensuring that the exterior stops are caulked | Ensure replacement window operates properly |
| | | Ensure replacement window has a weather tight fit |
| 3.1203.1d Safety | Egress windows and safety glass will be installed in accordance with local codes | Meet all codes when replacing windows |

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| 3.1203.1e Occupant education and maintenance | Occupants will be notified of changes or repairs made and will be educated on how to operate and maintain window | Ensure long-term weather tightness |
| 3.1203.2 | Single-Unit Window, Mounted on Rough Opening—Newer House | |
| Topic | Windows and Doors | |
| Subtopic | Replacement | |
| Desired Outcome | Replacement window provides weather tight fit; improved energy efficiency performance of fenestration | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1203.2a Lead paint assessment | Presence of lead-based paint in pre-1978 homes will be assumed unless testing confirms otherwise | Protect worker and occupant from potential lead hazards |
| | EPA's RRP Program Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards | |
| 3.1203.2b Opening preparation | Replacement window will be laid out with trim | Provide a clean and properly flashed opening for replacement window unit |
| | Exterior trim will be removed or exterior siding will be cut back to fit new window with trim | |
| | Existing window will be removed | |
| | Window opening will be flashed in accordance with accepted industry standards | |
| 3.1203.2c Replacement unit preparation | Mounting detail will be determined based on depth of window and location of window liner | Allow for good fit and finish of replacement window |
| 3.1203.2d Replacement window installation | Replacement windows will be installed in accordance with manufacturer specifications and will be integrated with flashing | Ensure replacement window operates properly |
| | Gaps between the new window and existing frame will be sealed with low-expanding foam | Ensure replacement window is weather tight |

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| 3.1203.2e Safety | Egress windows and safety glass will be installed in accordance with local codes | Meet all codes when replacing windows |
| 3.1203.2f Occupant education and maintenance | Occupant will be notified of changes or repairs made and will be educated on how to operate and maintain window | Ensure long-term weather tightness |

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| 3.1401.1 | Basements Connected to Crawl Spaces—Sealing and Insulating |
| Topic | Basements and Crawl Spaces |
| Subtopic | Basements Connected to Crawl Spaces |
| Desired Outcome | Crawl spaces and basements separated using appropriate methods that define spaces and allow for treatment in accordance with specifications |

| Single-Family Homes Title | Specification(s) | Objective(s) |
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| 3.1401.1a Conditioned basements with vented crawl spaces | Crawl space will be separated from the conditioned basement with a continuous air barrier, ground moisture barrier, and thermal boundary | Create separation and define spaces<br><br>Enable treatment of crawl spaces and basements by referenced specifications<br><br>Increase house durability and energy efficiency |
| 3.1401.1b Conditioned basements with closed crawl spaces | Crawl space will be separated from the conditioned basement with a continuous air barrier and ground moisture barrier | Create separation and define spaces<br><br>Enable treatment of crawl spaces and basements by referenced specifications<br><br>Increase house durability and energy efficiency |

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| 3.1401.1c Unconditioned basements with vented crawl spaces | Vented crawl space will be separated from the unconditioned basement with a continuous air barrier and ground moisture barrier | Create separation and define spaces |
| | | Enable treatment of crawl spaces and basements by referenced specifications |
| | | Increase house durability and energy efficiency |
| 3.1401.1d Unconditioned basements with closed crawl spaces | Unconditioned basement will be treated as an extension of the closed crawl space | Create separation and define spaces |
| | | Enable treatment of crawl spaces and basements by referenced specifications |
| | | Increase house durability and energy efficiency |

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| 3.1402.1 | Crawl Spaces—Sealing Floor Penetrations |
| Topic | Basements and Crawl Spaces |
| Subtopic | Crawl Spaces |
| Desired Outcome | Air leakage prevented and indoor air quality protected |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1402.1a Backing and infill | Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration | Ensure resulting closure is permanent and supports any load (e.g., insulation) |
| | The backing or infill will not bend, sag, or move once installed | Ensure sealant does not fall out |
| 3.1402.1b Sealant selection | Sealants will be used to fill holes no larger than recommended by manufacturer specifications | Create a permanent seal |

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| | Sealants will be compatible with their intended surfaces | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |
| | Sealants will allow for differential expansion and contraction between dissimilar materials | |
| | Sealants will be continuous and meet fire barrier specifications, according to authority having jurisdiction | |
| 3.1402.1c High temperature application | Only non-combustible materials will be used in contact with chimneys, vents, and flues in accordance with authority having jurisdiction | Prevent a fire hazard |
| 3.1402.2 | Closed Crawl Spaces—Air Sealing Foundation Vents | |
| Topic | Basements and Crawl Spaces | |
| Subtopic | Crawl Spaces | |
| Desired Outcome | Air and moisture penetration through the existing vent into the crawl space blocked | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1402.2a Vent closure | Vent opening will be permanently closed and sealed | Prevent air and moisture penetration |
| 3.1402.3 | Closed Crawl Spaces—Air Sealing Exterior Wall | |
| Topic | Basements and Crawl Spaces | |
| Subtopic | Crawl Spaces | |
| Desired Outcome | Well-sealed exterior wall prevents leakage and pests | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1402.3a Seal penetrations | Penetrations will be sealed with a durable material | Prevent air and moisture penetration into crawl space |
| | A minimum expected service life of 10 years will be ensured | |

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| 3.1402.3b Pest exclusion | If penetration is greater than ¼ inches, caulking, steel wool, or other pest-proof material will be used to fill the penetration before sealing | Prevent pest entry |

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| 3.1402.4 | Closed Crawl Spaces—Air Sealing Brick Curtain Wall with Piers |
| Topic | Basements and Crawl Spaces |
| Subtopic | Crawl Spaces |
| Desired Outcome | Well-sealed exterior wall prevents leakage and pests |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1402.4a Seal penetrations | Penetrations will be sealed with a durable material, including the following: | Reduce moisture vapor and water from entering the crawl space through the rain screen |
| | Sealing rain screen to crawl space connection | |
| | Re-venting exterior weep holes with wicking rope | Decrease probability of rot |
| | A minimum expected service life of 10 years will be ensured | |
| 3.1402.4b Pest exclusionComment | If penetration is greater than ¼", a pest-proof material will be used to fill the penetration before sealing | Prevent pest entry |

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| 3.1402.5 | Closed Crawl Spaces—Attached Crawl Spaces Under Unconditioned Spaces |
| Topic | Basements and Crawl Spaces |
| Subtopic | Crawl Spaces |
| Desired Outcome | Closed, attached crawl spaces sealed but accessible |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1402.5a Separate crawl spaces | A continuous air and vapor barrier between the attached crawl space under unconditioned spaces and the closed crawl space will be maintained | Prevent air and moisture penetration |
| 3.1402.5b Entry point | When adding access to a crawl space: | Provide access to attached crawl space for inspections |

Access openings through the floor will be a minimum of 18 inches by 24 inches or as constrained by existing framing members

Openings through a perimeter wall will be not less than 16 inches by 24 inches or as constrained by existing framing members

When any portion of the through-wall access is below grade, an area way not less than 16 inches by 24 inches will be provided

Under-floor spaces containing appliances will be provided with an unobstructed access large enough to remove the largest appliance but not less than 30 inches high and 22 inches wide or more than 20 feet long measured along the center line of the passageway from the opening to the appliance

A level service space at least 30 inches deep and 30 inches wide will be present at the front or service side of the appliance

If the depth of the passageway or the service space exceeds 12 inches below the adjoining grade, the walls of the passageway will be lined with concrete or masonry extending 4 inches above the adjoining grade in accordance with the ND State Building Code

The rough-framed access opening dimensions will be a minimum of 22 inches by 30 inches and large enough to remove the largest appliance

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| 3.1488.1 | Skirting Post and Pier Foundations |
| Topic | Basements and Crawl Spaces |
| Subtopic | Special Considerations |
| Desired Outcome | Protective skirting effectively installed to retard damage from natural causes such as wind, water, and pests |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 3.1488.1a Skirting | Any materials making contact with the ground will be rated for ground contact | Minimize pests, wind, water, and freezing of pipes under house |
| | Skirting will be continuous around the perimeter and enclose the entire floor area below the conditioned living space | |
| 3.1488.1b Flashing | Skirting will be flashed to prevent the entrance of water | Prevent water from entering space under house |
| 3.1488.1c Fastening | Entire skirting will be mechanically fastened | Ensure lasting upgrade |
| 3.1501.1 | Penetrations, Cracks, and Doors Between Garage and House | |
| Topic | Attached Garages | |
| Subtopic | Garage Openings | |
| Desired Outcome | Openings from garage sealed to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1501.1a Penetrations | All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed | Prevent air leakage and pollutant entry |
| 3.1501.1b Ductwork | All joints and connections in ductwork will be fastened and sealed with UL 181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus-embedded-fabric systems | Prevent air leakage and pollutant entry |
| 3.1501.1c Cracks | All cracks in house and garage separation wall will be sealed, including cracks between mud sill, rim joists, subfloors, and bottom of gypsum board, ensuring the air sealing enhances the integrity of the fire resistance construction of that wall | Prevent air leakage and pollutant entry |
| | All cracks in ceiling surfaces will be sealed | |
| 3.1501.1d Garage to house door | Weather stripping, door sweep, and threshold will be installed to stop air leakage | Prevent air leakage and pollutant entry |
| 3.1501.1e Glass | Broken glass panes in doors will be replaced, pointed, and glazed where needed | Prevent air leakage and pollutant entry |

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| 3.1501.1f Carbon monoxide (CO) alarm | CO alarms will be installed in accordance with ASHRAE 62.2, applicable codes and manufacturer specifications | Warn occupants of CO exposure from attached garage |
| 3.1501.1g Occupant education | Occupant will be educated on need to keep door from garage to house closed and not to warm up vehicles or use any gas engine appliances or grills in the garage, even if the main door is left open | Reduce risk of CO poisoning inside of garage and adjacent rooms |
| 3.1601.1 | Preparation and Mechanical Fastening | |
| Topic | Ducts | |
| Subtopic | Duct Preparation | |
| Desired Outcome | Ducts and plenums properly fastened to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1601.1a Preparation | Type and R-value of existing duct insulation (e.g., fiberglass, stone wool, asbestos) will be identified as will the location of vapor retarders, if any | Gain access while maintaining insulation value |
| | If asbestos insulation was used, it will not be disturbed; consult with an asbestos abatement expert for removal | Achieve proper adhesion for airtight seal |
| | Surrounding insulation will be cleared to expose joints being sealed | |
| | Duct surface to accept sealant will be cleaned | |
| | Insulation will be returned or replaced with equivalent R-value | |
| 3.1601.1b Metal to metal | Round ducts will be mechanically fastened to maintain alignment | Ensure durable joints |
| | Other shaped ducts will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes | |
| 3.1601.1c Flex to metal | Joints will be fastened with tie bands using a tie band tensioning tool | Ensure durable joints |

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| 3.1601.1d Duct board to duct board | Joints will be fastened with clinch stapler | Ensure durable joints |
| 3.1601.1e Flexible duct to duct board | Metal take-off collar will be used and attached in accordance with 2012 IRC M1601.4.1 | Ensure durable joints |
| 3.1601.1f Metal plenum to air handler cabinet | Plenum will be mechanically fastened | Ensure durable joints |
| 3.1601.1g Duct board plenum to air handler cabinet | Termination bar or metal strip will be fastened with screws | Ensure durable joints |
| | Duct board will be installed between the screw and the termination bar | |
| 3.1601.1h Boot to wood | Screws or nails will be used to fasten boot to wood | Ensure durable joints |
| 3.1601.1i Boot to gypsum | Boot hanger will be fastened to adjacent framing with screws or nails | Ensure durable joints |
| | Boot will be connected to boot hanger with screws | |
| | Integral snap boots will be installed | |
| 3.1601.1j Flex to duct board | Take-offs will be in accordance with the ND State Building Code | Ensure durable joints |

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| 3.1601.3 | Support |
| Topic | Ducts |
| Subtopic | Duct Preparation |
| Desired Outcome | Ducts and plenums properly supported |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 3.1601.3a Support (applies to all duct types) | Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½" wide material | Eliminate falling and sagging |

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| | Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction | |
| | Metal ducts will be supported by 1/2 inch wide eighteen gauge metal straps or 12-gauge galvanized wire at intervals not exceeding 10 feet or other approved means | |
| 3.1602.1 | Air Sealing Duct System | |
| Topic | Ducts | |
| Subtopic | Duct Sealing | |
| Desired Outcome | Ducts and plenums sealed to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1602.1a New component to new component sealant selection | Any closure system used will be in accordance with the ND State Building Code | Ensure effectiveness of air sealing system |
| 3.1602.1b New component to existing component | Seams, cracks, joints, holes, and penetrations less than ¼" will be sealed using fiberglass mesh and mastic | Eliminate air leakage into or out of ducts and plenums |
| | Mastic alone will be acceptable for holes less than ¼" that are more than 10' from air handler | Ensure adhesion of primary seal (mastic and fiberglass mesh) to the duct |
| | Seams, cracks, joints, holes, and penetrations between ¼" and ¾" will be sealed in two stages: | Reinforce seal |
| | They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing | Support mastic and fiberglass mesh during curing |
| | They will be sealed using fiberglass mesh and mastic | |
| 3.1602.1c Existing component to existing component | Fiberglass mesh and mastic will overlap temporary tape by at least 1" on all sides | Eliminate air leakage into or out of ducts and plenums |

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| | Fiberglass mesh and mastic will become the primary seal | Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct |
| | Seams, cracks, joints, holes, and penetrations larger than ¾" will be repaired using rigid duct material | Reinforce seal |
| | Fiberglass mesh and mastic will overlap repair joint by at least 1" on all sides | Support fiberglass mesh and mastic during curing |
| | Fiberglass mesh and mastic will be the primary seal | |
| 3.1602.3 | Proprietary Spray Application | |
| Topic | Ducts | |
| Subtopic | Duct Sealing | |
| Desired Outcome | Ducts and plenums sealed to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1602.3a Internal or external application | Installation of sealant will be applied in accordance with manufacturer specifications as well as UL 181M, NFPA 90A, and NFPA 90B | Reduce duct leakage |
| 3.1602.4 | Air Sealing System Components | |
| Topic | Ducts | |
| Subtopic | Duct Sealing | |
| Desired Outcome | Ducts and plenums sealed to prevent leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1602.4a Duct boot to interior surface | All gaps between boot and interior surface that defines conditioned space will be air sealed | Prevent air leakage |
| | Gypsum edge will be wetted before applying water-based sealant | Prevent a fire hazard |
| | Sealants will be continuous and be in accordance with the ND State Building code | |
| 3.1602.4b Wooden plenums and building cavities | Accessible connections and joints will be made airtight using approved material | Ensure ducts and plenums will not leak |

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| 3.1602.4c Air handler cabinet | Joints will be closed and cracks and holes not needed for proper function of unit will be sealed using removable sealant (e.g., foil tape) or in accordance with the original equipment manufacturer directions (if available) | Reduce air leakage while maintaining accessibility |
| 3.1602.4d Filter slot | A pre-manufactured or site manufactured durable filter slot cover will be installed | Reduce air leakage while maintaining accessibility |
| 3.1602.5 | Return—Framed Platform | |
| Topic | Ducts | |
| Subtopic | Duct Sealing | |
| Desired Outcome | The return duct installed to prevent air leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1602.5a Preparation | Debris and dirt will be cleaned out of the return platform | Allow for the application of rigid materials and sealants |
| 3.1602.5b Infill and backing | Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the open space | Minimize hole size to ensure successful use of sealant |
| | Backing or infill will not bend, sag, or move once installed | Ensure closure is permanent and supports any load (e.g., return air pressure) |
| | Material will be rated for use in return duct systems | Ensure sealant does not fall out |
| 3.1602.5c Sealant selection | Sealants will be continuous and be in accordance with the ND State Building Code | Select permanent sealant |
| | | Ensure sealant meets or exceeds the performance characteristics of the surrounding materials |
| 3.1602.7 | Return and Supply Plenums in Basements and Crawl Spaces | |
| Topic | Ducts | |
| Subtopic | Duct Sealing | |

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| Desired Outcome | Connections between the crawl space/unconditioned basement and living space eliminated to improve indoor air quality ( IAQ ) and efficiency of the distribution system | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 3.1602.7a Supply plenums (includes conditioned crawl spaces) | Basements and crawl spaces that are used as heating and cooling supply plenums will not be allowed | Eliminate connection between the crawl space/unconditioned basement and living space |
| 3.1602.7b Return plenums | Basements and crawl spaces that are used as heating and cooling return plenums will not be allowed | Eliminate connection between the crawl space/unconditioned basement and living space |
| 4.1001.1 | Non-Insulation Contact (IC) Recessed Light | |
| Topic | Attics | |
| Subtopic | General Preparation | |
| Desired Outcome | Ensure safety from fire and prevent air leakage | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1001.1a Air barrier system | A fire-rated air barrier system (i.e., equivalent to 5/8 fire code gypsum wallboard) will be used to separate non-IC rated recessed lights from insulation, using one of the methods below: | Prevent a fire hazard |
| | A fire-rated airtight closure taller than surrounding attic insulation will be placed over non-IC rated recessed lights<br>OR<br>The non-IC rated light fixture will be replaced with an airtight and IC- rated fixture<br>OR<br>The fixture(s) may be replaced with surface mounted fixture and opening sealed<br>OR<br>Air sealing measures as approved by the authority having jurisdiction | Prevent air leakage through fixture |
| 4.1001.1b Enclosure topComment | The top-fire rated enclosure material will have an R-value of 0.56 or less | Prevent heat build up |

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| | The top of the enclosure will be left free of insulation | |
| 4.1001.1c Clearance | The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast | Keep an air space around the fixture |
| 4.1001.1d Sealants and weather stripping | Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only | To prevent air leakage, completely adhere the sealant to all surfaces to be sealed |
| 4.1001.2 | Knob and Tube Wiring | |
| Topic | Attics | |
| Subtopic | General Preparation | |
| Desired Outcome | Insulation kept away from contact with live wiring | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1001.2a Identifying knob and tube wiring | Contractor, assessor, auditor, or similar will inspect and assess the house to identify knob and tube wiring | Determine if knob and tube wiring exists |
| 4.1001.2b Testing to determine if live | Non-contact testing method will be used to identify live wiring | Ensure safety of occupants, workers, and house<br><br>Plan where remediation is needed |
| 4.1001.2c Isolate or replace | Live knob and tube will not be covered or surrounded; required by the ND State Electrical Code | Ensure work can be completed safely |
| | If all wiring is exposed a visual inspection must be done to verify no visual hazards exist(i. e. frayed wiring, broken knobs, signs of overheating, etc.). If visual inspection is acceptable the installer may proceed to install a dam that does not cover the top of the wiring to separate the insualtion from the wire path. Care must be taken not to disturb the wiring in any manner. | Protect occupant and house |

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| | OR | |
| | Knob and tube wiring will be replaced with new appropriate wiring by a licensed electrician in accordance with local codes | Prevent the overheating of the wiring |
| | Remaining knob and tube wiring will be rendered inoperable by licensed electrician in accordance with local codes | |
| 4.1001.3 | Fireplace Chimney and Combustion Flue Vents | |
| Topic | Attics | |
| Subtopic | General Preparation | |
| Desired Outcome | Combustible materials kept away from combustion sources | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1001.3a Verify attic prep | Holes, penetrations, and bypasses will be sealed | Prevent air leakage |
| | Dams will be fixed in places that maintain required clearance | Ensure insulation dams maintain clearance |
| 4.1001.3b Required clearance | A rigid dam having a height to ensure a 3" clearance area free of insulation or combustibles between combustion flue vent and dam, unless the flue vent is listed for a lesser clearance | Ensure dam material does not bend, move, or sag |
| | | Prevent a fire hazard |
| 4.1001.3c Safety | Insulation will not be allowed between a heat-generating appliance and a dam unless material is rated for contact with heat generating sources | Prevent a fire hazard |
| 4.1001.3d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1001.5 | Dense Pack Preparation | |
| Topic | Attics | |
| Subtopic | General Preparation | |
| Desired Outcome | Proper material density achieved safely and cleanly | |
| Single-Family Homes | | |

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1001.5a Preparation | Lead safety procedures will be followed | Prevent damage to house |
| | Cavities will be free of hazards, intact, and able to support dense pack pressures | Provide thorough access to allow 100% coverage |
| | All escape openings will be blocked for material | Use proper equipment and process to achieve consistent density, prevent settling, and retard air flow through cavities |
| | Access will be gained and each cavity will be probed, locating all attic floor joists and blockers | |
| | Interior will be masked and dust controlled during drilling when accessing from interior. Shrouds and containment devices are recommended | |
| | Electricity supply will be confirmed and will support blowing machine power demand | |
| | Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed | |
| | Hose outlet pressure will be at least 80" of water column ( IWC ) or 2.9 pounds per square inch ( psi ) for cellulose insulation; for other types of dense pack insulation, check manufacturer specifications for blowing machine set up | |
| 4.1002.1 | Above Roof Deck Insulation: Preparation | |
| Topic | Attics | |
| Subtopic | Above Roof Deck Insulation | |
| Desired Outcome | Roof covering removed and replaced to expose roof deck for installation of above roof deck insulation | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 4.1002.1a Roof covering removal | Existing roof covering will be removed | Expose existing roof deck to prepare for installation of above roof deck insulation |
| 4.1002.1b Roof covering replacement | New roof covering will be installed in accordance with manufacturer specifications and local building code requirements after installation of above roof deck insulation | Install roof covering correctly |
| | | Meet local code requirements |
| 4.1002.2 | Above Deck Roof Deck Insulation: Installation | |
| Topic | Attics | |
| Subtopic | Above Roof Deck Insulation | |
| Desired Outcome | Properly installed roof deck insulation | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1002.2a Sealing | Holes, gaps, and penetrations in existing roof deck will be sealed | Prevent air leaks |
| 4.1002.2b Installation | Insulation will be installed according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions | Install insulation properly |
| | Insulation will be installed to prescribed R-value | |
| 4.1002.2c Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1003.1 | Pitched/Vaulted/Cathedralized Ceilings—Loose Fill Over | |
| Topic | Attics | |
| Subtopic | Attic Ceilings | |
| Desired Outcome | Reduce the rate of heat transfer through cathedral or vaulted ceiling | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1003.1a Ventilation | Venting will be continuous, if applicable | Ensure capacity to increase R-value while not altering ventilation |

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| 4.1003.1b Lighting | Existence of rated insulation contact can lights, which allow for insulation encapsulation, will be verified | Prevent a fire hazard |
| | Non-insulation contact rated can lights will not be insulated | |
| 4.1003.1c Installation | When using cellulose, stabilized product is preferred when available | Ensure appropriate material and application |
| | On roof pitches less than 6/12, loose fill cellulose can be used; on roof pitches greater than 6/12, install non-woven polypropylene netting (webbing) baffles of the same height as the insulation every 6' across slope to prevent the loose fill insulation from sliding downward, or dense pack cellulose above webbing stapled to the bottom (underside) of the rafters | Insulate to prescribed R-value |
| | Loose fill fiberglass will only be used on a slope less than or equal to a 6/12 pitch or the slope application approved by the manufacturer, whichever is less (dense packed fiberglass at slopes greater than 6/12 may be used) | |
| | Roof cavities will be insulated with loose fill according to manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions | |
| | Insulation will be installed to prescribed R-value | |
| 4.1003.1d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1003.2 | Pitched/Vaulted/Cathedralized Ceilings—Dense Pack Over | |
| Topic | Attics | |
| Subtopic | Attic Ceilings | |
| Desired Outcome | Insulation reduces heat transfer through ceiling and closed attic sections as well as framing cavities inaccessible to other treatments | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 4.1003.2a Fill slant ceilings | Using fill tube, 100% of each cavity will be filled to a consistent density: | Ensure complete and consistent coverage throughout ceiling plane |
| | Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot | Eliminate voids and settling |
| | Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density of 2.2 pounds per cubic foot | Minimize framing cavity air flows |
| | The number of bags installed will be confirmed and will match the number required on the work order or documentation provided as to why not | |
| | Insulation will be verified to prevent visible air movement at 50 pascals of pressure difference using chemical smoke, IR scans, or other approved verification method. | |
| 4.1003.3 | Unvented Flat Roof with Existing Insulation | |
| Topic | Attics | |
| Subtopic | Attic Ceilings | |
| Desired Outcome | Insulation reduces heat flow through unvented roof | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1003.3a Ventilation | Code compliant ventilation will be installed before insulation | Reduce possibility of moisture issues |
| 4.1003.3b Installation | Roof cavities will be blown with loose fill insulation (or roof cavities will be dense packed with insulation) without gaps, voids, compressions, misalignments, or wind intrusions | Insulate to prescribed R-value |
| | Insulation will be installed to prescribed R-value | |
| 4.1003.3c Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |

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| 4.1003.4 | Cape Cod Side Attic Roof—Dense Pack Installation | |
| Topic | Attics | |
| Subtopic | Attic Ceilings | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1003.4a Vapor barrier removal | Vapor barriers will be removed from existing attic floor | Ensure the new conditioned space is coupled with the house |
| 4.1003.4b Netting, fabric, rigid sheathing | When using netting or fabric, staples will be placed in accordance with manufacturer specifications, whichever is more stringent | Secure insulation |
| | Netting or fabric will meet local fire codes | |
| | Rigid materials will close the cavity | |
| 4.1003.4c Installation | Roof cavities will be dense packed with loose fill insulation in accordance with manufacturer density specifications | Insulate to prescribed R-value |
| | Insulation will be installed to prescribed R-value | |
| 4.1003.4d Onsite documentationComment | Documentation will be posted as required by federal specification 16 CFR 460 | Post documentation onsite to allow verification |
| 4.1003.4e Occupant educationComment | Documentation of material and R-value will be provided to occupants | Provide occupant with documentation of installation |
| 4.1004.1 | Preparation for Dense Packing | |
| Topic | Attics | |
| Subtopic | Knee Walls | |
| Desired Outcome | Airtight cavity and insulated knee wall | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1004.1a Backing | All knee walls will have top and bottom plate or blockers installed using rigid materials | Eliminate bending, sagging, or movement that may result in air leakage |

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| | When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed | Prevent air leakage through the top or bottom of the knee wall |
| | If fabric is used before dense packing, it will be secured, according to manufacturers specifications or with furring strips every wall stud | Ensure material will not tear under stress from wind loads or insulation |
| | If rigid material is used, material will be installed to cover 100% of the surface of the accessible knee wall area | |
| | If foam sheathing is used, sheathing will be listed for uncovered use in an attic or covered with a fire barrier | |
| 4.1004.1b Installation | All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates | Eliminate misalignment of existing insulation |
| | Insulation that is blown behind fabric or air barrier material will be blown dense to a minimum specification of 3.5 pounds per cubic foot for cellulose | Prevent insulation from settling or moving |
| | Follow manufacturer's requirements for | |

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| 4.1004.2 | Preparation for Batt Insulation |
| Topic | Attics |
| Subtopic | Knee Walls |
| Desired Outcome | Airtight cavity and properly insulated knee wall |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1004.2a Knee wall prep for batts | All knee walls will have a top and bottom plate or blockers installed using a rigid material | Eliminate bending, sagging, or movement that may result in air leakage |
| | All joints, cracks, and penetrations will be sealed in finished material, including interior surface to framing connections | Prevent air leakage through the top or bottom of the knee wall |

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| | When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed. | Create an air barrier |
| 4.1004.2b Installation | Insulation will be installed using one of the following methods:<br><br>New batts will be installed in accordance with manufacture specifications<br>All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates | Eliminate misalignment of existing insulation |
| 4.1004.2c Backing knee wall | If rigid material is used, material will be installed to cover 100% of the surface of the knee wall<br><br>If foam sheathing is used, sheathing will be listed for uncovered use in attic, or covered with a fire barrier | Prevent insulation from settling or moving |
| 4.1004.3<br>Topic<br>Subtopic<br>Desired Outcome | Strapping for Existing Insulation<br>Attics<br>Knee Walls<br>Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 4.1004.3a Sealing | Holes and penetrations will be sealed<br><br>Bypasses will be blocked and sealed | Prevent air leakage |
| 4.1004.3b Installation | Insulation will be installed in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions | Insulate to prescribed R-value |
| 4.1004.3c Attachment | Strapping material will have a minimum expected service life of 20 years | Maintain alignment |
| 4.1004.3d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1004.4 | Knee Wall Without Framing | |

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| Topic | Attics |
| Subtopic | Knee Walls |
| Desired Outcome | Consistent uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1004.4a Sealing | Holes and penetrations will be sealed | Prevent air leakage |
| | Bypasses will be blocked and sealed | |
| 4.1004.4b Flat cavity present | Gap between framing and existing air barrier will be insulated | Create a flat insulated surface |
| 4.1004.4c Installation | A rigid insulated sheathing will be mechanically fastened to code required R-value | Insulate to prescribed R-value |
| | Seams will be sealed | |
| 4.1004.4d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |

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| 4.1005.1 | Accessible Floors—Batt Installation |
| Topic | Attics |
| Subtopic | Attic Floors |
| Desired Outcome | Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1005.1a Preparation | Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee-wall attic floor spaces | Access the workspace |
| | All electrical junctions will be flagged to be seen above the level of the insulation | Provide location of electrical junctions for future servicing |
| | Open electrical junction boxes will have covers installed | Prevent an electrical hazard |

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| 4.1005.1b Installation | Batt insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions | Insulate to prescribed R-value |
| | Insulation will be installed to the prescribed R-value | |
| 4.1005.1c Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1005.2 | Accessible Floors—Loose Fill Installation | |
| Topic | Attics | |
| Subtopic | Attic Floors | |
| Desired Outcome | Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1005.2a Preparation | Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee-wall attic floor spaces | Access the workspace |
| | Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier | Verify uniformity of insulation material |
| | All electrical boxes will be flagged to be seen above the level of the insulation | Provide location of electrical boxes for future servicing |
| | Open electrical junctions will have covers installed | Prevent an electrical hazard |
| | Insulation dams and enclosures will be installed as required | |
| 4.1005.2b Air barrier | Existence of air barrier material in line with the knee walls will be installed or verified when dense packing | Hold dense pack in place |
| | Air barrier material will not bend, sag, or move once dense packed | |

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| 4.1005.2c Installation | All insulation will be installed to the minimum unsettled depth and the maximum coverage per bag to reach a consistent depth for desired R-value indicated on the manufacturer's coverage chart. | Reduce heating and air conditioning costs |
| | | Improve comfort |
| | | Minimize noise |
| 4.1005.2d Onsite documentation | A signed and dated receipt signed by the installer will be provided that includes: | Document job completion to contract specifications |
| | Insulation type | Confirm amount of insulation installed |
| | Coverage area<br>R-value | Ensure ability to match bags required for total area completed |
| | Installed thickness and settled thickness<br>Number of bags installed in accordance with manufacturer specifications | |
| 4.1005.3 | Accessible Floors—Batt Insulation Over Existing Insulation | |
| Topic | Attics | |
| Subtopic | Attic Floors | |
| Desired Outcome | Insulation controls heat transfer through ceiling | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1005.3a Preparation | Existing insulation will be in contact with the air barrier prior to installing additional insulation on top | Ensure proper performance of insulation |
| 4.1005.3b Installation | If the top of the existing insulation is below the top of the framing, new batts will be installed parallel with framing members | Ensure uniform depth of insulation in continuous contact with existing insulation |
| | If the top of the existing insulation is above the top of the framing, new batts will be installed perpendicular to framing members | Eliminate voids and gaps |

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| 4.1005.3c Insulation | Batts will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions<br><br>Insulate to prescribed R-value | Insulation will be installed to prescribed R-value |
| 4.1005.3d Safety | Insulation will not be allowed on top of non-IC rated can light boxes or between a heat generating appliance and a dam, unless material is rated for contact with heat generating sources | Prevent a fire hazard |
| 4.1005.3e Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |

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| 4.1005.4 | Accessible Floors—Loose Fill Over Existing Insulation |
| Topic | Attics |
| Subtopic | Attic Floors |
| Desired Outcome | Insulation controls heat transfer through ceiling |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1005.4a Preparation | Existing insulation will be in contact with the air barrier prior to installing additional insulation on top | Ensure proper performance of insulation Verify uniformity of insulation material Provide location of electrical junctions for future servicing |
| | Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier<br><br>All electrical junction boxes will be flagged to be seen above the level of the insulation<br><br>Open electrical junction boxes will have covers installed<br><br>Insulation dams and enclosures will be installed as required | Prevent an electrical hazard |

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| 4.1005.4b Installation | The correct depth and number of bags will be blown in accordance with manufacturer specifications<br><br>Insulation will be installed to prescribed R-value | Insulate to prescribed R-value |
| 4.1005.4c Safety | Insulation will not be allowed on top of non-IC rated can light boxes or between a heat-generating appliance and a dam, unless material is rated for contact with heat generating sources | Prevent a fire hazard |
| 4.1005.4d Onsite documentation | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1005.5 | Enclosed Bonus Room Floor Over Unconditioned Space—Dense Pack Installation | |
| Topic | Attics | |
| Subtopic | Attic Floors | |
| Desired Outcome | A consistent thermal boundary between conditioned and unconditioned space controls the heat flow | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1005.5a Air barrier | Existence of air barrier material in line with the knee walls will be installed or verified when dense packing<br><br>Air barrier material will not bend, sag, or move once dense packed | Hold dense pack in place |
| 4.1005.5b Fill floors | Each cavity will be 100% filled to consistent density:<br><br>Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot or to a maximum density structurally allowable Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density per the manufacturer's recommendations | Eliminate voids and settling<br><br>Minimize framing cavity air flows |

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| | The number of bags installed will be confirmed and will match the number required on the coverage chart | |
| | Insulation will be verified to prevent visible air movement using chemical smoke at 50 pascals of pressure difference | |
| 4.1005.5c Safety | Insulation will not be allowed on top of non-IC rated can light boxes or between a heat-generating appliance and a dam, unless material is rated for contact with heat generating sources | Prevent a fire hazard |
| 4.1005.5d Onsite documentation | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1005.6 | Enclosed Attic Storage Platform Floor—Dense Pack Installation | |
| Topic | Attics | |
| Subtopic | Attic Floors | |
| Desired Outcome | Insulation reduces heat flow through floor and framing cavities inaccessible to other treatments | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1005.6a Fill floors | Each cavity will be 100% filled to consistent density: | Eliminate voids and settling |
| | Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot or to a maximum density per the manufacturer's recommendations | Minimize framing cavity air flows |
| | Loose fiberglass material will be installed and will be specifically approved for air flow resistance to a minimum density of 2.2 pounds per cubic foot | |
| | The number of bags installed will be confirmed and will match the number required on the coverage chart | |

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| 4.1005.6b Safety | Insulation will not be allowed on top of non-IC rated can light boxes or between a heat generating appliance and a dam, unless material is rated for contact with heat generating sources | Prevent a fire hazard |
| 4.1005.6c Onsite documentationComment | Documentation will be posted as required by federal specification 16 CFR 460 | Post documentation onsite to allow verification |
| 4.1006.1 | Pull-Down Stairs | |
| Topic | Attics | |
| Subtopic | Attic Openings | |
| Desired Outcome | Pull-down attic stair properly sealed and insulated | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1006.1a Installation | Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly | Achieve uniform R-value |
| | Pull-down stair rough opening will be surrounded with a durable dam that is higher than the level of the attic floor insulation | Prevent loose insulation from entering the living area |
| 4.1006.1b Sealing | Entire pull-down stair assembly will be covered with an airtight and removable/openable enclosure inside the attic space | Prevent air leakage |
| | Pull-down stair frame will be caulked, gasketed, weatherstripped, or otherwise sealed with an air barrier material, suitable film, or solid material that allows attic door operation | |
| 4.1006.1c DurabilityComment | Completed measure will meet a minimum expected service life of 20 years | Ensure a minimum expected service life |
| 4.1006.1d Onsite documentation | The purpose of the entire measure (insulation, air seal, protective barrier, proper attic stair operation) will be communicated to occupant | Educate occupant on how to use the hatch to ensure integrity of insulated and sealed assembly throughout service life |
| 4.1006.2 | Access Doors and Hatches | |
| Topic | Attics | |
| Subtopic | Attic Openings | |
| Desired Outcome | Attic access door properly sealed and insulated | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1006.2a Installation | Hatches will be insulated to the maximum R-value structurally allowable up to the R-value of the adjoining insulated assembly | Achieve uniform R-value on the attic door or hatch |
| | Attic hatches rough opening will be surrounded with a durable protective baffle that is higher than the level of the surrounding attic floor insulation | Achieve uniform R-value on the attic floor |
| | | Prevent loose attic floor insulation from entering the living area |
| 4.1006.2b Sealing | Access hatch frames will be sealed using caulk, gasket, weatherstrip, or otherwise sealed with an air barrier material, suitable film, or solid material | Prevent air leakage |
| | Options will include installing a latch or lock or frictionally engaged components that do not require a latch | |
| | The measure must include a protective baffle or insulation barrier | |
| 4.1006.2c Attachment | Insulation will be permanently attached and in complete contact with the air barrier | Insulate to prescribed R-value |
| 4.1006.2d Durability | Completed measure will meet a minimum expected service life of 20 years | Ensure a minimum expected service life |
| 4.1006.2e Occupant education | Purpose of insulation and proper hatch operation will be communicated to occupant | Educate occupant on how to use the hatch to ensure integrity of insulated and sealed assembly throughout service life |
| 4.1006.3 | Whole-House Fan | |
| Topic | Attics | |
| Subtopic | Attic Openings | |

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| Desired Outcome | Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value of an adjoining insulated assemb | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 4.1006.3a Installation | Sides of fan insulation box assembly will be insulated to the same R-value as adjoining insulated assembly | Insulate to prescribed R-value |
| 4.1006.3b Air sealing | Fan insulation box frame will be continuously weatherstripped to ensure a tight fit<br><br>Fan insulation box will be constructed at a depth to protect the fan housing and motor from insulation | Prevent air leakage |
| 4.1006.3c Attachment | Non-compressible insulation will be permanently attached in contact with fan insulation box<br><br>Appropriate adhesive or mechanical fastener will be used | Ensure continuous alignment with air barrier |
| 4.1006.3d Durability | Material integrity will meet a minimum expected service life of 20 years | Ensure a minimum expected service life |
| 4.1006.3e Occupant education | Purpose of insulation will be communicated to occupant | Educate occupant on how to use the whole-house fan to ensure integrity of the fan insulated assembly throughout service life |
| 4.1088.1<br>Topic<br>Subtopic<br>Desired Outcome | Attic Ventilation<br>Attics<br>Special Considerations<br>Properly restored vents minimize moisture and ice dams | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 4.1088.1a Air barrier and thermal boundary | Attic ventilation will be recommended or installed after: | Ensure presence of continuous air barrier and thermal boundary |

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| | The presence of an effective air barrier and thermal boundary between the attic and the living space must be verified and appropriate attic sealing and proper insulation is specified as part of the scope of work | |
| | Local code requires attic ventilation during weatherization or retrofits | |
| 4.1088.1b Vent type | Attic vent types will be made of corrosion-resistant material for their specific location (e.g., exterior soffit, gable end, roof ) and material and intended use (e.g., metal vent on metal roof ) | Ensure vent meets proper performance characteristics for location and roofing type |
| | Attic-powered ventilators will not be used | |
| 4.1088.1c Vent location | Placement of attic vents will be considered for proper air flow and prevention of entry of wind driven rain or snow | Encourage proper air flow |
| | | Minimize entry of wind driven rain or snow |
| 4.1088.1d Ventilation baffling | Baffling for attic soffit vents will be installed to: | Ensure vent allows proper air flow without compromising insulation performance |
| | Ensure proper air flow<br>Prevent wind washing of insulation<br>Allow maximum insulation coverage<br>Ensure baffle terminates above insulation | |
| 4.1088.1e Ventilation screens | All attic ventilation will have screens with non-corroding wire mesh with openings of 1/16" to 1/4" to prevent pest entry (e.g., birds, bats, bees) | Prevent pest entry |
| | Existing vents that are not screened will be covered with non-corroding wire mesh with openings of 1/16" to 1/4" | |
| | Ensure net free area requirements are met | |
| | Additional vents or larger vents can be added if screen size is smaller than designated | |

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| 4.1088.2 | Radiant Barrier | |
| Topic | Attics | |
| Subtopic | Special Considerations | |
| Desired Outcome | Radiant heat flow reduced | |
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| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1088.2aS tapling | An air space no less than ¾" will be maintained between the barrier and the bottom of the roof deck | Ensure performance of radiant barrier |
| 4.1088.2b Ventilation | A minimum of 3" clearance from soffit vents and ridge vents will be maintained | Allow for air flow behind barrier |
| 4.1088.2c Gable walls | Radiant barrier will apply to gable walls while maintaining a ¾" air space | Ensure performance of radiant barrier |
| | Radiant barrier will not block gable vents | |
| 4.1088.2d Porch and garage attic spaces | Radiant barrier will be installed to separate the attic above conditioned space from adjacent attics | Reduce radiant heat entry |
| | Radiant barrier will be installed to withstand local wind loads | Ensure durability |
| 4.1088.3 | Skylights | |
| Topic | Attics | |
| Subtopic | Special Considerations | |
| Desired Outcome | Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value | |
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| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1088.3a Sealing | Holes and penetrations will be sealed | Prevent air leakage |
| | Bypasses will be blocked and sealed | |
| 4.1088.3b Installation | Insulation will be installed in accordance with manufacturer specifications and will be in full contact with all sides of existing cavity without gaps, voids, compressions, misalignments, or wind intrusions | Insulate to prescribed R-value |

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| | Insulation will be installed to prescribed R-value | |
| 4.1088.4 | Parapet Walls—Dense Pack | |
| Topic | Attics | |
| Subtopic | Special Considerations | |
| Desired Outcome | Properly installed insulation reduces heat flow through parapet wall | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1088.4a Access | Proper access in wall exterior or interior containment area will be ensured | Protect worker and occupant health |
| | Lead safety procedures in houses built before 1978 will be followed in accordance with EPA Healthy Indoor Environment Protocols for Home Energy Upgrades | |
| 4.1088.4b Installation | Dense pack insulation will be installed in accordance with manufacturer specifications at void area | Seal wall |
| 4.1101.1 | Exterior Wall Dense Packing | |
| Topic | Walls | |
| Subtopic | Preparation | |
| Desired Outcome | Walls properly prepared to receive dense pack insulation | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1101.1a Preparation | Lead and asbestos safety procedures will be followed | Prevent damage to house |
| | Cavities will be free of hazards, intact, and able to support dense pack pressures | Provide a clean work space |
| | Drilling hazards (e.g., wiring, venting, fuel piping) will be located | Provide thorough access to allow 100% coverage |
| | Blocking will be installed around: | Ensure proper equipment and process results in consistent density |

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| | All openings to inside crawl space and basement for fibrous material<br>High temperature fire-rated materials<br>Wiring and electrical hazards<br><br>Heat sources<br><br>Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers<br><br>Interior will be masked and dust controlled during drilling when accessing from interior<br><br>Electricity supply will be confirmed and will support blowing machine power demand<br><br>Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed<br><br>Hose outlet pressure will be at least 80 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up | Prevent settling and retard air flow through cavities<br><br>Protect worker and occupant health |
| 4.1101.1b Exterior dense pack | Using fill tube, 100% of each cavity will be filled to a consistent density: | Eliminate voids and settling |
| | Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot<br>Loose fiber glass material will be installed and will be specifically approved for air flow resistance per manufacturer's specifications<br><br>The number of bags installed will be confirmed and will match the number required on the coverage chart<br><br>Insulation density will be verified by bag count, core sampling, or infrared camera with the blower door at 50 pascals to prevent visible air movement using chemical smoke at 50 pascals of pressure difference | Minimize framing cavity air flows |
| 4.1101.2<br>Topic | Exterior Wall Insulating Sheathing<br>Walls | |

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| Subtopic | Preparation | |
| Desired Outcome | Wall cladding removed and replaced to expose wall sheathing for installation of insulating wall sheathing | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1101.2a Wall cladding removal | Existing cladding will be removed | Expose existing wall sheathing to prepare for installation of insulating sheathing |
| | Lead and asbestos safety procedures will be followed | |
| 4.1101.2b Wall cladding replacement | New cladding will be installed in accordance with manufacturer specifications and local codes after exterior wall insulation is installed | Install wall cladding correctly |
| | | Meet local codes |
| 4.1101.3 | Exterior Wall Spray Polyurethane Foam (SPF)—Masking and Surface Preparation | |
| Topic | Walls | |
| Subtopic | Preparation | |
| Desired Outcome | Finished surfaces are protected and SPF has a suitable surface to adhere to | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1101.3a Surface protection | Finished surfaces that should not be covered with SPF (e.g., windows, doors) will be identified | Prevent overspray and potential damage to finished surfaces |
| | Surfaces will be covered or sealed with appropriate material (e.g., plastic film, masking tape) to protect from SPF overspray | |
| 4.1101.3b Substrate repair | Cracks, gaps, and holes in the substrate will be covered or sealed in accordance with manufacturer specifications with appropriate material | Prevent waste of SPF |
| | | Prevent overspray into adjacent areas |

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| 4.1101.3c Substrate cleaning | All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation | Ensure proper bonding of SPF to substrate surfaces |
| | Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt | |
| | Grease and oil will be removed using appropriate cleaners or solvents | |
| 4.1101.4 | Exterior Wall Spray Polyurethane Foam (SPF)—Electrical System Considerations | |
| Topic | Walls | |
| Subtopic | Preparation | |
| Desired Outcome | Outlet, junction, switch, and light fixture boxes and existing wiring are protected from SPF | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1101.4a Box protection | All front and back openings of all outlet, switch, and light fixture boxes will be covered with masking tape | Prevent SPF from covering any switches and outlets and from entering the inside of any electrical box |
| | All electrical junction boxes will be accessible after the installation of SPF | |
| | Open electrical junction boxes will have covers installed | |
| 4.1102.1 | Open-Cavity Wall Insulation—General | |
| Topic | Walls | |
| Subtopic | Accessible Walls | |
| Desired Outcome | Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R-value | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1102.1a Sealing | Holes and penetrations will be sealed | Prevent air leakage |
| | Bypasses will be blocked and sealed | |

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| 4.1102.1b Installation | Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions<br><br>Insulation will be installed to prescribed R-value | Insulate to prescribed R-value |
| 4.1102.1c Pre-drywall verification | Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided | Install insulation correctly |
| 4.1102.1d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |

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| 4.1102.2 | Open-Cavity Wall—Spray Polyurethane Foam (SPF) Installation |
| Topic | Walls |
| Subtopic | Accessible Walls |
| Desired Outcome | Exterior walls are insulated and sealed |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1102.2a Installation | Interior cladding or interior finish material will be removed on areas to be insulated<br><br>SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer<br><br>SPF will be applied onto exterior sheathing or interior finish materials between studs and top/bottom plates | Insulate and seal exterior walls |
| 4.1102.2b Vapor retarders | If vapor retarder is needed, it will be applied in proper location<br><br>In colder climates (IECC Zones 5-8), the SPF used will be installed to a thickness of at least Class II vapor retarder or have at least Class II vapor retarder coating or covering in direct contact with the inside surface of the SPF | Minimize water vapor condensation in walls |

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| 4.1102.2c Fire protection | SPF will be separated from the occupied interior spaces of the building with a thermal barrier (typically ½" or thicker gypsum wallboard or approved alternate assembly)<br><br>Check local codes for fire protection requirements | Provide necessary fire protection for combustible SPF insulation |
| 4.1103.1 | Dense Pack Exterior Walls | |
| Topic | Walls | |
| Subtopic | Enclosed Walls | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1103.1a Exterior dense pack | Using fill tube, 100% of each cavity will be filled to a consistent density: | Eliminate voids and settling |
| | Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density<br>Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit air flow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 pascals, as measured using BPI-102 "Standard for Air Resistance of Thermal Insulation Used in Retrofit Cavity Applications – Material Specification" or ASTM C 522, E 283, or E 2178; the number of bags installed will be confirmed and will match the number required on the coverage chart<br><br>All holes and penetrations will be plugged and/or sealed | Minimize framing cavity air flows |
| 4.1103.2 | Additional Exterior Wall Cavities | |
| Topic | Walls | |
| Subtopic | Enclosed Walls | |

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| Desired Outcome | Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 4.1103.2a Location of cavities | Details remaining in or between completed wall sections will be located and accessed | Ensure the last gaps and framing edges in the thermal boundary, roof-wall joints, floor-wall joints, etc., are found and finished |
| 4.1103.2b Sealing | Backing will be provided and all newly uncovered openings will be sealed with air barriers, foam, or mastic, maintaining all required clearances | Ensure the air barrier is connected across all accessible house elements |
| 4.1103.2c Dense packing | Using fill tube, 100% of each cavity will be filled to a consistent density: | Eliminate voids and settling |
| | Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density<br>Blown fiberglass, mineral fiber, or rock and slag wool used in an enclosed cavity will be installed at or above the manufacturer recommended density to limit airflow that corresponds to an air permeance value of 3.5 cfm/sq. ft. at 50 pascals, as measured using BPI-102 "Standard for Air Resistance of Thermal Insulation Used in Retrofit Cavity Applications—Material Specification" or ASTM C 522, E 283, or E 2178; the number of bags installed will be confirmed and will match the number required on the coverage chart | Minimize framing cavity air flows |
| 4.1103.2d Quality assurance | Completed wall sections will be viewed using infrared camera with blower door operating | Establish air barrier and thermal boundary |
| | Any voids or low density areas will be drilled and re-packed | Confirm no voids or hidden air flows remain |
| 4.1103.2e Close holes | Installation holes will be plugged as follows: | Ensure house is returned to watertight and clean condition |

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| | Exterior holes will be weather barrier patched<br>At a minimum interior holes will be patched and left ready for painting unless homeowner allows other methods i.e. plastic/wood plugs | |
| | All construction debris and dust will be collected and removed | |
| 4.1103.3 | Insulated Sheathing and Insulated Siding Installation | |
| Topic | Walls | |
| Subtopic | Enclosed Walls | |
| Desired Outcome | Properly installed insulated wall sheathing and insulated siding | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1103.3a Sealing | Holes, gaps, and penetrations in existing sheathing will be sealed | Prevent air leaks |
| 4.1103.3b Location of wall framing | Wall studs and other framing will be located and marked | Provide secure attachment of insulating sheathing |
| 4.1103.3c Installation | Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions | Install insulation properly |
| | Insulation will be installed to prescribed R-value | |
| 4.1103.3d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.1 | Standard Floor System—Batt Installation | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 4.1301.1a Sealing | Sealing the floor system will be completed before insulating | Ensure airtight envelope<br><br>Prevent leakage |
| 4.1301.1b Installation | Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions<br><br>If kraft-faced batts are used, they will be installed with kraft facing to subfloor<br><br>Insulation will be installed to prescribed R-value | Insulate to prescribed R-value |
| 4.1301.1c Securing batts | Batts will be secured with physical fasteners | Ensure insulation remains in contact with subfloor |
| 4.1301.1d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.2 | Standard Floor System—Loose Fill with Netting | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.2a Sealing | Sealing the floor system will be completed before insulating | Ensure airtight envelope<br><br>Prevent leakage |
| 4.1301.2b Netting, fabric | When using netting or fabric, staples will be placed according to manufacturer specifications<br><br>Netting or fabric will meet local fire codes | Secure insulation |
| 4.1301.2c Installation | Insulation in netted or fabric cavities will be dense packed with loose fill insulation in accordance with manufacturer specifications | Insulate to prescribed R-value |

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| | Insulation will be installed to prescribed R-value | Ensure a continuous thermal boundary between conditioned and unconditioned space |
| | Insulation will be in continuous contact with air barrier | |
| 4.1301.2d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.3 | Standard Floor System—Loose Fill with Rigid Barrier | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.3a Sealing | Sealing the floor system will be completed before insulating | Ensure airtight envelope |
| | | Prevent leakage |
| 4.1301.3b Rigid air barrier | A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly | Relocate air barrier |
| | Seams and penetrations will be sealed | |
| 4.1301.3c Installation | Loose fill insulation will be installed between air barrier and subfloor according to manufacturer specifications | Insulate to prescribed R-value |
| | Insulation will be installed to prescribed R-value | |
| 4.1301.3d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.4 | Dense Pack Floor System with Rigid Barrier | |
| Topic | Floors | |

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| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.4a Sealing | Sealing the floor system will be completed before insulating | Ensure airtight envelope |
| | | Prevent leakage |
| 4.1301.4b Rigid air barrier | A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly | Relocate air barrier |
| | Seams and penetrations will be sealed | |
| 4.1301.4c Installation | Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications | Insulate to prescribed R-value |
| | Insulation will be installed to prescribed R-value | |
| 4.1301.4d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.5 | Cantilevered Floor—Batt Installation | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.5a Air barrier | Air barrier will be installed between joists and sealed | Separate cantilevered floor from conditioned floor space |
| | Air barrier will be placed to the most interior edge of the top plate of the wall below | Allow for insulation |

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| 4.1301.5b Installation | Air barrier will be insulated between joist from top plate of the wall below to subfloor above<br><br>Cantilevered subfloor will be insulated in complete contact with the floor without gaps, voids, compressions, misalignments, or wind intrusions<br><br>If kraft-faced batts are used, they will be installed with kraft facing to the air barrier<br><br>Insulation will be installed to prescribed R-value | Insulate to prescribed R-value |
| 4.1301.5c Attachment | Batts will be secured with physical fasteners | Ensure insulation remains in contact with subfloor and air barrier |
| 4.1301.5d Exterior soffit | Exterior soffit material will be installed and sealed | Cover and protect insulation |
| 4.1301.5e Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.6 | Pier Construction Subfloor Insulation—Batt Installation with Rigid Barrier | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal barrier between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.6a Subfloor preparation | Sealing between house and crawl space will be completed before insulating | Ensure airtight envelope<br><br>Prevent leakage |
| 4.1301.6b Installation | Insulation will be installed in contact with subfloor without gaps, voids, compressions, misalignments, or wind intrusions<br><br>If kraft-faced batts are used, they will be installed with kraft facing to subfloor | Insulate to prescribed R-value |

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| | Insulation will be installed to prescribed R-value | |
| 4.1301.6c Secure batts | Batts will be secured with physical fasteners | Ensure insulation remains in contact with subfloor |
| 4.1301.6d Rigid air barrier | A rigid air barrier will be mechanically fastened to underside of floor assembly | Protect insulation |
| | Seams and penetrations will be sealed | |
| 4.1301.6e Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1301.7 | Pier Construction Subfloor Insulation—Loose Fill with Rigid Barrier | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal barrier between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.7a Subfloor preparation | Sealing between house and crawl space will be completed before insulating | Prevent air leakage |
| 4.1301.7b Rigid air barrier | A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly | Relocate air barrier |
| | Seams and penetrations will be sealed | |
| 4.1301.7c Installation | Loose fill insulation will be installed between air barrier and subfloor according to manufacturer specifications | Insulate to prescribed R-value |
| | Insulation will be installed to prescribed R-value | |
| 4.1301.7d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |

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| 4.1301.8 | Pier Construction Subfloor Installation—Dense Pack with Rigid Barrier | |
| Topic | Floors | |
| Subtopic | Accessible Floors | |
| Desired Outcome | Consistent, uniform thermal barrier between conditioned and unconditioned space to prescribed R-value of an adjoining insulated assembly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1301.8a Subfloor preparation | Sealing between house and crawl space will be completed before insulating | Prevent air leakage |
| 4.1301.8b Rigid air barrier | A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly<br><br>Seams and penetrations will be sealed | Relocate air barrier |
| 4.1301.8c Installation | Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications<br><br>Insulation will be installed to prescribed R-value | Insulate to prescribed R-value |
| 4.1301.8d Occupant education | Documentation of material and R-value will be provided to occupant | Provide occupant with documentation of installation |
| 4.1401.1 | Band/Rim Joists—Spray Polyurethane Foam (SPF) Installation | |
| Topic | Basements and Crawl Spaces | |
| Subtopic | Band/Rim Joists | |
| Desired Outcome | Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1401.1a Preparation | All band/rim joist areas will be open and accessible for SPF application<br><br>All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation | Prepare all substrate surfaces for the application of SPF |

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| | Substrate surfaces will be wiped, blown, or vacuumed to be free of excessive dust and dirt<br><br>Grease and oil will be removed using appropriate cleaners or solvents | |
| 4.1401.1b Installation | SPF will be applied to desired thickness, using pass thickness maximum in accordance with manufacturer specifications, onto subfloor between floor joists and all rim/band joists<br><br>When applied to first floor, SPF will be continuous from subfloor surface, over band/rim joist and sill plate, and in contact with foundation below except as stipulated by classification 4.1402.1c<br><br>When applied to second story floor or above, SPF will be continuous from subfloor surface, over band/rim joist, and in contact with top plate below | Insulate and seal floors |
| 4.1401.1c Fire protection | If SPF exceeds a thickness of 3", all SPF will be separated from the occupied interior space of the building with an approved thermal barrier material (typically ½" or thicker gypsum wallboard or an approved thermal barrier coating)<br><br>Application to rim/band joist up to 3" can be left exposed if the foam is Class I<br><br>Local codes will be confirmed and followed for fire protection requirements | Provide necessary fire protection for combustible SPF insulation |
| 4.1402.1 | Closed Crawl Spaces—Wall Insulation | |
| Topic | Basements and Crawl Spaces | |
| Subtopic | Basements and Crawl Space Walls | |
| Desired Outcome | Closed crawl spaces insulated to achieve best thermal performance possible | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 4.1402.1a Insulation selection | Where the crawl space is dry, fiberglass insulation may be used. A fire-rated insulation with a minimum life expectancy of 10 years may be used in other situations. | Improve thermal performance |
| 4.1402.1b R-value | The ND Field Standard Section 5325 Foundation Insulation will be followed for required R-values | Improve thermal performance |
| 4.1402.1c Termite inspection gap | Where termite pressure exists, a 3" inspection gap will be maintained from the top of the insulation to the bottom of any wood | Allow for termite detection |
| 4.1402.1d Attachment | Insulation will be attached with a durable connection better than or equal to manufacturer specifications | Maintain insulation performance without compromising the air or vapor barrier |
| | A minimum expected service life of 10 years will be ensured | |
| 4.1402.1e Band joist and wood foundation walls | A vapor-diffuse insulation will be installed | Improve thermal performance |
| | Where termite pressure exists, removable band joist insulation will be installed | Allow for termite inspection and drying of wood materials |
| 4.1402.2 | Basement Wall Insulation—No Groundwater Leakage | |
| Topic | Basements and Crawl Spaces | |
| Subtopic | Basements and Crawl Space Walls | |
| Desired Outcome | Basement insulation improves thermal performance and ensures sufficient drying potential | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1402.2a R-value | The ND Field Standard Section 5325 Foundation Insulation will be followed for required R-values | Improve thermal performance of the basement and living space |
| 4.1402.2b Air barrier | A continuous air barrier will be installed on the warm side of the insulation | Prevent condensation on the basement wall |

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| 4.1402.2c Vapor permeability | When absorbent insulation materials are installed, assembly will remain vapor semi-impermeable to the interior in all climate zones except Zone 7 | Provide drying potential to the basement |
| 4.1601.1 | Insulating Flex Ducts | |
| Topic | Ducts | |
| Subtopic | Insulating Ducts | |
| Desired Outcome | Lower conductive heat transfer by ducts and decreased condensation on duct vapor barrier | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.1601.1a Removal of existing flexible ducting | All accessible low R-value flexible ducting will be removed from premises | Ensure installation of proper R-value ducts |
| 4.1601.1b Selection of new flexible ducting | All flexible ducting will have a minimum of R-8 | Minimize thermal conductance of the duct system |
| 4.1601.1c Sizing of new flex | Duct sizing procedures will be conducted when replacing flex duct | Improve comfort in rooms<br><br>Improve fan performance |
| 4.1601.1d Installation of flex | Flexible ducts will be supported in accordance with flex duct manufacturer's directions or local codes | Prevent sags, drops, or other bends that may interfere with correct air flow |
| 4.1601.1e Interior liner attachment | Interior liner of the flex-to-metal connection will be fastened with tie bands using a tie band tensioning tool or a mechanical band | Create a strong, secure attachment |
| 4.1601.1f Sealing of interior liner | Systems used to seal flexible air ducts and flexible air connectors will comply with UL 181B and will be marked "181 B-FX" for pressure-sensitive tape or "181 B-M" for mastic | Create an airtight connection |
| 4.1601.1g Attachment of exterior liner | Liner will be pulled up onto the metal duct as far as possible before securing<br><br>The exterior liner of the flex duct will be fastened with tie bands using a tie band tensioning tool | Create a strong, durable attachment |

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| 4.1601.1h Sealing of all accessible ducts | All accessible joints, seams, and connections in ductwork will be securely fastened and sealed with UL "181 B-M" compliant mastic (adhesives) or mastic-plus-embedded-fabric systems | Minimize duct leakage |
| 4.1601.1i Insulation of all fittings | All metal fittings including boots, elbows, and take-offs will be insulated separately using an R-11 duct wrap with vapor retarder | Minimize thermal conductance of the duct system |
| 4.1601.1j Completeness of vapor barrier | Vapor retarder of all duct insulation will be taped to the flex duct using tape that complies with UL 181B and will be marked "181 B-FX" for pressure-sensitive tape or "181 B-M" for mastic | Ensure a complete vapor barrier |

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| 4.1601.2 | Insulating Metal Ducts |
| Topic | Ducts |
| Subtopic | Insulating Ducts |
| Desired Outcome | Lowered thermal conductance of duct system and minimized condensation on the duct system |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 4.1601.2a Selection of duct insulation material | Duct insulation on all ducts located in unconditioned spaces will be a minimum of R-8, in accordance with local code, or buried under attic insulation, whichever is greater, and have an attached vapor retarder<br><br>Hot humid and warm coastal regions will not bury ducts | Decrease heat loss and condensation problems |
| 4.1601.2b Duct sealing | All joints, seams, and connections in ductwork shall be securely fastened and sealed with UL 181 B-M mastics (adhesives) or mastic- plus-embedded-fabric systems installed in accordance with the manufacturer's instructions before insulation is applied | Minimize duct leakage |
| 4.1601.2c Attachment of duct insulation | Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine | Ensure a secure connection between the duct system and the duct insulation |

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| | Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct | |
| 4.1601.2d Taping of the duct insulation | Using a tape approved by the manufacturer, all seams and connection of the duct insulation will be taped<br><br>No gaps will exist between pieces of duct insulation | Prevent gaps in the vapor barrier of the insulation |
| 4.9901.1 | General Information on Spray Polyurethane Foam (SPF) | |
| Topic | Insulation—Additional Resources | |
| Subtopic | Materials | |
| Desired Outcome | To provide general Information on spray polyurethane foam | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 4.9901.1a Low-Pressure SPF | Low-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in pressurized canisters (~250 psi), dispensed through unheated hoses through a disposable mixing nozzle system, and applied as a froth-like material to substrate. This type of SPF product is typically used for large sealing and small-scale insulation products. | To provide general Information on spray polyurethane foam |
| 4.9901.1b High-Pressure SPF | High-pressure SPF systems are two-component polyurethane foam products. They are typically delivered to the job site in unpressurized drums or totes, and dispensed by a proportioner pump where heat and pressure are added. These chemicals travel through heated hoses to a spray gun where the material is aerosolized during application. This type of SPF product is typically used for larger insulation applications.<br><br>Once installed, there is essentially no difference in product performance between low- and high-pressure foams. It should be noted that the main differences between the delivery methods are in capital equipment investment, application rate, and PPE requirements. | To provide general Information on spray polyurethane foam |

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| | Applicators should obtain training from the suppliers of SPF to help assure installation quality and use of all equipment as well as safe handling, use, and disposal of all chemicals used in the process. Spray Polyurethane Foam Alliance (SPFA) also offers additional training and accreditation for high-pressure SPF applicators. | |
| 4.9901.1c Manufacturer Installation Instructions | In addition to the guidelines above, SPF applicators should follow all manufacturer installation instructions for the product being used. These instructions include product-specific documents, such as application instructions, SDSs, and evaluation reports. | To provide general Information on spray polyurethane foam |
| 5.3001.1 | Load Calculation and Equipment Selection | |
| Topic | Forced Air | |
| Subtopic | Design | |
| Desired Outcome | Equipment sized properly and operates efficiently | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3001.1a Load calculation | Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications | Properly size equipment for load |
| 5.3001.1b Equipment selection | Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications | Ensure equipment is able to heat, cool, and dehumidify the house |
| 5.3001.1c Air filtration | New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters | Particle removal to protect equipment and help maintain indoor air quality |
| 5.3001.2 | Ductwork and Termination Design | |
| Topic | Forced Air | |
| Subtopic | Design | |
| Desired Outcome | Efficient air flow to all rooms ensured by proper ductwork | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 5.3001.2a Duct design | Duct design will be performed in accordance with ANSI/ACCA Manual D and manufacturer specifications | Maximize air flow |
| 5.3001.2b Termination design | Termination design will be performed in accordance with ANSI/ACCA Manual T and manufacturer specifications | Maximize air flow |
| | | Ensure occupant comfort |
| 5.3001.2c Air filtration | New central forced air HVAC systems will have minimum MERV 6 filtration with no air bypass around the filters | Particle removal to protect equipment and help maintain indoor air quality |
| 5.3002.1 | Preparation for New Equipment | |
| Topic | Forced Air | |
| Subtopic | Site Preparation | |
| Desired Outcome | Existing equipment removed safely and lawfully | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3002.1a Access | A code compliant walkway and service platform will be installed in attics, if not present | Ensure new equipment can be installed and serviced |
| | Walkway and platform will be above the level of insulation (if practical) | Maintain adequate insulation level |
| 5.3002.1b Utility disconnect | Electricity and fuel will be turned off prior to starting removal of old appliance | Protect workers and occupants from injury |
| 5.3002.1c Refrigerant recovery | Refrigerant will be recovered in accordance with 40 CFR 608 (EPA) by a licensed contractor | Comply with Safe Handling of Refrigerant Law |
| | | Protect workers and occupants from injury |
| 5.3002.1d Equipment disconnection | Refrigerant lines, plumbing, ducts, electric, control wires, vents, and fuel supply will be disconnected | Ensure equipment can be removed |

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| 5.3002.1e Removal | Equipment will be removed (e.g., furnace, air handler, evaporator, condensing unit) | Provide room to install new equipment and work safely |
| | Equipment will be removed from space without damaging property and disturbing or compressing the insulation | Comply with applicable disposal laws |
| | Equipment will be disposed of in accordance with local laws and regulations, recycling materials when feasible | |
| 5.3003.1 | Data Plate Verification | |
| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Data for commissioning and future service work is recorded | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3003.1a Data plate verification | Equipment will be visually inspected | Ensure technician has equipment data necessary for commissioning and future service work |
| | Information will be recorded from the equipment data plates indoors and outdoors | |
| 5.3003.2 | Combustion Analysis of Oil-Fired Appliances | |
| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Analysis on critical components and operations completed in accordance with industry and manufacturer specifications to ensure equipment operates as designed, safely, efficiently and is durable. | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3003.2a Oil System: filter | Filter will be present, clean, and leak free | |

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| 5.3003.2b Nozzle size | Nozzle size, angle, and spray pattern will be correct for design input and within equipment firing rate of the heating system manufacturer. Position of nozzle and electrodes will be in accordance with manufacturer specifications | Ensure equipment is outfitted with the correct nozzle per manufacturer guidelines. |
| 5.3003.2c Fuel pressure | Measurement will be verified in accordance with manufacturer specifications | Ensure correct oil pump pressure for nozzle installed and at OEM's specified values per ACCA. |
| 5.3003.2d Place appliance in operation | Heating equipment will be placed in operation in accordance with applicable standards and manufacturer specifications when available | Prepare equipment for combustion analysis tests |
| 5.3003.2e Oil system: smoke test (This test must be conducted before any combustion testing is completed) | Smoke test will be conducted before any combustion testing is completed | Determine whether equipment is operating within acceptable range according to smoke test and call for action if needed. |
| | Smoke spot reading will be in accordance with burner manufacturer specifications<br><br>If smoke test is more than actionable levels, specify a clean and tune | |
| 5.3003.2f Steady state efficiency (SSE) | Measurement will be verified in accordance with manufacturer specifications | Determine whether steady state efficiency is within manufacturer range |
| 5.3003.2g Net stack temperature | Net stack temperature will be measured and verified in accordance with manufacturer specifications | Determine whether net stack temperature is within manufacturer's recommended range. |
| 5.3003.2h Carbon dioxide and oxygen | Measurement will be verified in accordance with manufacturer specifications | Verify combustion performance of equipment is within manufacturer recommended range based on CO2 and O2 readings. |

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| 5.3003.2i Excess combustion air | Excess combustion air will be calculated and shown to be in accordance with manufacturer specifications | Verify combustion performance of equipment is within manufacturer recommended range based on excess combustion air readings |
| 5.3003.2j CO in flue gas | Measure CO and recommend actions to ensure that CO in the undiluted flue gas will be less than 400 ppm air-free | Ensure CO in undiluted flue gas is less than 400 ppm air-free. |
| 5.3003.2k Testing/inspection holes | All testing and inspection holes will be sealed with approved materials | Ensure equipment:<br>- Operates as designed<br>- Operates safely<br>- Operates efficiently<br>- Is durable |
| 5.3003.3 | Evaluating Air Flow | |
| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Air flow is properly tested | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3003.3a Total air flow | Total system air flow will be measured by one of the following methods: | Ensure equipment operates as designed |
| | Temperature rise | Ensure equipment operates efficiently |
| | Flow plate<br>Fan depressurization device (e.g., Duct Blaster, DucTester) | Ensure equipment provides comfort |
| | | Ensure equipment operates safely |
| | | Ensure equipment is durable |
| 5.3003.6 | Evaluating Sequence of Operation | |
| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Sequence of operation of the system verified | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
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| 5.3003.6a Verification | The sequence of operation of the system will be verified in accordance with the manufacturer installation, operation, and maintenance manual | Ensure system components function and operate in the correct sequence |
| 5.3003.7<br>Topic<br>Subtopic<br>Desired Outcome | Occupant Education<br>Forced Air<br>System Assessment and Maintenance<br>Occupants understand their role and responsibility in the safe, effective, and efficient operation of the equipment | |

| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
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| 5.3003.7a Basic operation | Basic operation of the equipment will be explained to the occupant (e.g., design conditions, efficiency measures, differences from previous system or situation) | Ensure occupant has a reasonable expectation of the equipment's capability |
| 5.3003.7b System controls (e.g., thermostat, humidistat) | Proper operation and programming of system controls to achieve temperature and humidity control will be explained to the occupant | Ensure occupant can operate system controls |
| 5.3003.7c System disconnects | Indoor and outdoor electrical disconnects and fuel shut-offs will be demonstrated to occupant | Ensure occupant can shut off equipment in emergencies |
| 5.3003.7d Combustion air inlets | Location of combustion air inlets will be identified for occupant in accordance with NFPA 31, 54, and 58<br><br>Importance of not blocking inlets will be explained to occupant | Ensure occupant does not block combustion air inlets |
| 5.3003.7e Blocking air flow | Importance of cleaning dust and debris from return grilles will be explained to occupant<br><br>Proper placement of interior furnishings with respect to registers will be explained to occupant<br><br>Negative consequences of closing registers will be explained to occupant | Ensure occupant does not prevent equipment from operating as designed |

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| | Importance of leaving interior doors open as much as possible will be explained to occupant | |
| 5.3003.7f Routine maintenance | Proper filter selection and how to change the filter will be explained to occupant | Ensure equipment operates as designed |
| | Importance of keeping outside unit clear of debris, vegetation, decks, and other blockage will be explained to occupant | |
| | Importance and timing of routine professional maintenance will be explained to occupant | |
| | There will be no air bypass around the filters and new central forced air HVAC systems will have minimum MERV 6 filtration | |
| 5.3003.7g Calling heating, ventilation, and air conditioning (HVAC) contractor | Situations when the occupant should contact the HVAC contractor will be explained, including:<br><br>Fuel odors<br>Water draining from secondary drainline<br>Emergency heat indicator always on for a heat pump system<br>System blowing cold air during heating season and vice versa<br>Icing of the evaporator coil during cooling mode<br>Outside unit never defrosts<br>Unusual noises<br>Unusual odors | Notify occupant to contact installer when system is not operating as designed |
| 5.3003.7h Carbon monoxide (CO) | A carbon monoxide (CO) alarm will be installed | Occupant will be made aware of operation of CO alarm |
| 5.3003.7i Warranty and service | Occupant will be provided with relevant manuals and warranties | Provide manuals and warranties for future servicing |
| | The labor warranty will be explained and the occupant will be given a phone number to call for warranty service | |
| 5.3003.9 | Heating and Cooling Controls | |

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| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Heating and cooling controls installed and set properly | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3003.9a Removal of mercury- based thermostats | Mercury based thermostat will be removed safely and disposed of in accordance with EPA regulations | Protect workers and occupants from injury |
| | | Protect environment from damage |
| 5.3003.9b Removal of existing controls | Existing controls will be removed in accordance with EPA lead-safe work rules | Protect workers and occupants from injury |
| | | Protect environment from damage |
| 5.3003.9c Penetrations | Penetrations for control wiring will be sealed with a durable sealant (e.g., caulk, silicone, foam) | Ensure controls operate as designed |
| | | Minimize infiltration and exfiltration from house |
| 5.3003.9d Thermostat location | Thermostats will be installed to reflect the temperature of the zone in which they are installed | Ensure controls operate as designed |
| | Thermostats will not be exposed to extreme temperatures, radiant heat sources, and drafts | |
| 5.3003.9e Blower speed | Blower speed will be set for equipment in accordance with manufacturer specifications | Ensure equipment has correct air flow |
| 5.3003.9f Thermostat selection: heat pump | A thermostat with equipment supplementary heat lockout that can interface with an outside temperature sensor will be selected | Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load |

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| 5.3003.9g Heat pump: supplementary heat | Supplementary heat will be used on air-to-air heat pumps with conditions that allow for a balance point of less than 30°F | Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load |
| | Supplementary heat lockout will be installed and set to manufacturer specifications | |
| 5.3003.9h Heat pump: low ambient compressor lockout | For air-to-air heat pumps, low ambient compressor lockout will be set to 0°F outdoor temperature or to manufacturer specifications | Ensure supplementary heater operation is prevented when the heat pump is capable of meeting the load |
| 5.3003.9i Heat pump: outside temperature sensor | An outdoor temperature sensor will be installed in accordance with manufacturer specifications | Ensure equipment operates as designed |
| 5.3003.9j Heat pump: supplementary heat wiring | Supplementary heat will be wired onto second-stage heating terminal in accordance with manufacturer specifications | Do not operate supplementary heat in stage one heating |
| 5.3003.9k Thermostat: installer programming | The installer options will be set to match the thermostat to the equipment and control board settings | Ensure equipment operates as designed |
| 5.3003.9l Time delay settings | Time delay for equipment will be set in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates) | Maximize transfer of heat without adversely affecting indoor humidity levels |
| 5.3003.9m Humidistat: location | Humidistat will be installed to reflect humidity of the zone in which it is installed | Ensure controls operate as designed |
| | Humidistat will be installed in a dry location | |
| 5.3003.9n Occupant education | Occupants will be educated on proper use of thermostat including: | Ensure equipment and controls operate as designed |
| | Proper use of setbacks for air conditioners and heat pumps<br>Allowing occupant comfort to determine setback for combustion heating appliances<br>Using emergency heat appropriately | Provide comfort throughout house |
| 5.3003.10 | Condensate Drainage of Heating and Air Conditioning Equipment | |
| Topic | Forced Air | |

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| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Equipment and condensate drain operate as designed | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3003.10a Connection | Connections in condensate drain system will be watertight | Ensure condensate drain connections do not leak |
| 5.3003.10b Insulation | Condensate drainlines will be insulated with a minimum 1" of insulation with a vapor retarder when there is potential for condensation or freezing on the drainline | Ensure condensate drain connections do not leak |
| 5.3003.10c Overflow protection: upflow | Secondary drain pan and float switch will be installed when overflow could damage finished surfaces<br>OR<br>Float switch in the primary condensate drain for upflow systems will be installed when overflow could damage finished surfaces | Ensure condensate drain connections do not leak |
| 5.3003.10d Pumps | Condensate drain pumps will be installed when condensate cannot be drained by gravity | Ensure condensate drain connections do not leak |
| | Power source for pump will be installed | |
| | Operation and drainage of pump will be verified | |
| 5.3003.10e Vents and traps | Vents and traps will be installed on condensate drainlines | Ensure condensate drain operates as designed |
| | Trap supplied with the equipment will be used and manufacturer specifications will be followed | Ensure condensate drain does not leak air |
| 5.3003.10f Drain pan | Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal | Prevent water damage from drain system malfunction |

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| | Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than 1/8 unit vertical in 12 units horizontal (1% slope)<br><br>Condensate shall not discharge into a street, alley, or other areas where it would cause a nuisance | |
| 5.3003.10g Float switchComment | All secondary drain pans will have a float switch and be drained away through a drainline | Prevent water overflowing the pan and draining onto the ceiling below |
| 5.3003.10h TerminationComment | Condensate drain will be terminated in accordance with local codes | Ensure condensate does not leak to the house<br><br>Ensure condensate drain does not freeze |
| 5.3003.14 | Combustion Analysis of Gas-Fired Appliances (LP and Natural Gas) | |
| Topic | Forced Air | |
| Subtopic | System Assessment and Maintenance | |
| Desired Outcome | Analysis of critical components and operations completed in accordance with industry and manufacturer specifications | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 5.3003.14a Place appliance in operation | Heating equipment will be placed in operation in accordance with applicable NFPA standards and manufacturer specifications when available | Ensure equipment: Operates as designed, Operates safely, Operates safely, Is durable |
| 5.3003.14c Carbon dioxide (CO2)and oxygen (O2) | Measurement will be verified in accordance with industry manuals (e.g., Testo, Bacharach) | Ensure equipment: Operates as designed, Operates safely, Operates safely, Is durable |
| 5.3003.14e Carbon monoxide (CO) in flue gas | CO in the undiluted flue gas will be less than 400 ppm air-free | Ensure equipment: Operates as designed, Operates safely, Operates safely, Is durable |
| 5.3003.14f Gas pressure | If fault has been determined in the preceding steps, then measurement will be verified by a certified professional in accordance with fuel type and manufacturer specifications | Ensure equipment: Operates as designed, Operates safely, Operates safely, Is durable |

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| 5.3003.14g<br>Testing/inspection holes | All testing and inspection holes will be sealed with manufacturer approved materials | Ensure equipment: Operates as designed, Operates safely, Operates safely, Is durable |
| 5.3101.1<br>Topic<br>Subtopic<br>Desired Outcome | Heat Load Calculation—Whole House<br>Hydronic Heating (Hot Water and Steam)<br>Design<br>A properly sized heating appliance selected | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 5.3101.1a Heating load calculation | Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications | Enable proper sizing of the heating appliance |
| 5.3101.1b Equipment selection | Equipment selection will be performed in accordance with ANSI/ACCA Manual S and manufacturer specifications | Ensure equipment is able to heat the house |
| 5.3101.2<br>Topic<br>Subtopic<br>Desired Outcome | Space Load Calculation—Heat Emitter Sizing<br>Hydronic Heating (Hot Water and Steam)<br>Design<br>Heat emitter selected provides adequate heat output | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 5.3101.2a Space load calculation | Load calculation will be performed in accordance with ANSI/ACCA 2 Manual J-2011 (Residential Load Calculation) and manufacturer specifications | Enable proper sizing of the heating appliance |
| 5.3104.1<br>Topic<br>Subtopic<br>Desired Outcome | Controls—Thermostat Replacement<br>Hydronic Heating (Hot Water and Steam)<br>Equipment Maintenance, Testing, and Repair<br>Thermostat replaced when appropriate | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 5.3104.1a Visual inspection | Thermostats will be visually located | Determine if existing thermostats need to be replaced |

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| | Verify anticipator setting, if appropriate for thermostat model | |
| | Replacement will be recommended if a digital, double setback thermostat is not present | |
| 5.3104.1b Mercury assessment | Thermostats containing mercury will be identified and disposed of in accordance with EPA guidance | Protect workers and occupants from mercury exposure |
| 5.3104.1c Removal (if removal is recommended) | Heating system will be de-energized before removal | Proper removal of thermostat |
| | Thermostat will be removed | |
| | Compatibility will be verified (e.g., voltage, wiring condition, location) and documented | |
| | Location of existing thermostat will be assessed for appropriateness (e.g., central to the house, out of direct sunlight, away from supply air, protected from abnormal radiant surface temperatures) | |
| 5.3104.1d Installation | Location for new thermostat will be determined | Achieve comfort and energy savings for the occupant |
| | Compatibility with new thermostat will be verified (e.g., voltage, wiring, condition, location) | |
| | Replacement will be recommended if a digital, double setback thermostat is not present | |
| | Heating system will be re-energized and cycled | |
| | Thermostat will be programmed to occupant lifestyle choices | |
| 5.3104.1e Disposal | Thermostats will be disposed of in accordance with EPA guidelines and local regulations | Prevent mercury from entering the environment |
| 5.3104.1f Occupant education | Occupant will be involved in the initial programming of thermostat and educated on common settings and programming | Educate occupant on best use |

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| | On new installs, occupants will be encouraged to save the manual and keep it accessible | |
| 5.3104.2 | Maintenance: Gas Boiler Service Inspection | |
| Topic | Hydronic Heating (Hot Water and Steam) | |
| Subtopic | Equipment Maintenance, Testing, and Repair | |
| Desired Outcome | Boiler service improves safety, efficiency, and performance | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 5.3104.2a Visual inspection | The following conditions will be assessed by a licensed contractor:<br><br>Water, steam, and fuel leaks<br>Damaged or missing pipe insulation<br>Venting issues—draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)<br>Corrosion (e.g., rust, mineral deposits)<br>General condition of components | Observe general conditions to determine needed repairs or maintenance |
| 5.3104.2b Appliance gas valve | When replacement is necessary, gas valve will be removed and replaced according to manufacturer specifications | Provide gas to burner when there is a call for heat<br><br>Control volume of gas for burner<br><br>Ensure the safe shut off of gas at the end of a call for heat |
| 5.3104.2c Ignition system | Components of ignition system will be repaired or replaced in accordance with manufacturer specifications | Do not allow flow of main burner gas without proof of ignition |
| 5.3104.2d Main gas burners | Problems that may interfere with flame (e.g., dust, debris, misalignment) will be cleaned, vacuumed, and adjusted | Produce combustion in a safe, clean, and efficient manner |

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| 5.3104.2e Venting | Flue gases will be removed from the venting system in accordance with the ND State Building Code or per manufacturer specifications | Ensure the safety and durability of the venting system |
| 5.3104.2f Flue gas testing | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI 1200 or other approved standard | Confirm that combustion occurs safely with maximum efficiency |
| | If combustion is not in compliance with the referenced standard, diagnostics and adjustments will be referred to a qualified technician to meet manufacturer specifications or local codes | |
| 5.3104.2g Combustion efficiency checks | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with accepted protocol to determine if acceptable boiler efficiency is being maintained | Increase the operational efficiency of the system |
| | If boilers are found to be out of compliance, a combustion analysis will be administered and minimum stack temperature will be in accordance with manufacturer specifications | Improve occupant comfort |
| 5.3104.2h Occupant health | All homes will have a carbon monoxide (CO) alarm | Ensure ambient CO does not exceed acceptable levels after completion of work |
| 5.3104.2i Occupant education | Occupants will be educated on the operation and maintenance of the carbon monoxide (CO) alarm | Ensure occupant is informed of the safe and efficient operation and maintenance of the work performed |
| | Completed work and recommended maintenance will be reviewed | |
| 5.3104.3 | Maintenance: Checklist | |
| Topic | Hydronic Heating (Hot Water and Steam) | |
| Subtopic | Equipment Maintenance, Testing, and Repair | |
| Desired Outcome | Thorough maintenance improves safety, efficiency, and performance | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |

| Title | Specification(s) | Objective(s) |
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| 5.3104.3a Health and safety | Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the (Standard Work Specifications for Single Family Housing) or other equivalent practice | Identify potential health and safety issues |
| 5.3104.3b Visual inspection | The following conditions will be inspected:<br><br>Water, steam, and fuel leaks<br>Damaged or missing pipe insulation<br>Venting issues—draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)<br>Corrosion (e.g., rust, mineral deposits)<br>General condition of components | Observe general conditions to determine needed repairs or maintenance |
| 5.3104.3c Pipe insulation inspection | Pipe insulation will be inspected, including:<br><br>Integrity—complete coverage, no holes or tears<br><br>Damage—holes or tears<br>Complete coverage—insulation missing<br><br>If asbestos is suspected, occupants will be notified and asbestos will not be disturbed<br><br>Required repair or replacement will be performed in accordance with the following conditions:<br><br>Materials will be approved for steam heating pipes<br>Materials will be approved for hot water heating pipes<br>Insulation will completely cover pipe<br><br>Pipe insulation will be installed in accordance with manufacturer specifications | Minimize heat loss<br><br>Improve performance of the system |
| 5.3104.3d Check system pressure | Check system pressure will be verified | Keep system operating within pressure parameters |

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| | Check system pressure will be 1 pound per square inch gauge (psig) per 28" of system height | |
| 5.3104.3e Purge system | Devices that are under performing or have need of purging will be purged as needed | Remove air from the system to maximize performance |
| 5.3104.3f Automatic fill | Automatic fill valve will be inspected to ensure it maintains system pressure | Maintain optimal system pressure to maximize performance |
| | If pressure is not maintained, replacement will be made in accordance with the following criteria:<br>Valve will be replaced and include backflow prevention; existing backflow protection shall be tested to verify operation<br>Components will be installed in accordance with manufacturer specifications<br>Correct system pressure will be verified | |
| 5.3104.3g Gauge glass | Gauge glass will be inspected for erosion, cracks, or drying | Ensure gauge glass is in safe operating condition to allow observation of water level in boiler |
| | Damaged gauge glass on boiler will be replaced in accordance with manufacturer specifications | |
| | Gauge glass that is coated with dirt or sediment, making it difficult to observe the water level of the boiler, will be removed, cleaned, and replaced | |
| 5.3104.3h Low water cut-off: float type | Operation of low-water cutoff on steam boilers will be observed by opening blow-off valve | Ensure safe minimum water level of the boiler |
| | If combustion is not extinguished, remediation will be accomplished by the following procedure: | Maintain safe operation of the low water cut-off on ongoing basis |
| | Electricity will be disconnected from boiler<br>Problem will be diagnosed<br>Low-water cutoff will be repaired, serviced, or replaced in accordance with manufacturer specifications | |

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| | A blow-down valve will be added, if not already present<br>Boiler will be retested for proper operation | |
| | Operation of low-water cutoff on hot water boilers is applicable only if proper test setup is available on-site, to avoid draining the system | |
| | Occupants will be educated on the correct method to drain the low water cutoff weekly (must drain once per week to remove sediment from float chamber of low-water cutoff) | |
| 5.3104.3i Low water cut-off: immersion | An immersion low-water cutoff will be installed and operable | Ensure safe minimum water level of the boiler |
| 5.3104.3j Expansion tank: non-bladder and bladder | An expansion tank will be installed and operable | Absorb water expansion of the system |
| | Tanks that leak or have excessive corrosion will be replaced, and non- bladder tanks will include an expansion tank drain | |
| | Tank will be installed in accordance with manufacturer specifications | |
| | Expansion tanks will be properly supported with strapping | |
| | Tanks that are full of water will be drained; after expansion tank is drained, re-establish the correct water level in relation to system pressure | |
| | Expansion tanks with bladders will have air charged to the manufacturer pressure specifications while water is not present in the tank | |
| | Bladder tanks that have water inside of the air bladder will be replaced in accordance with manufacturer specifications | |
| 5.3104.3k Flush or skim steam boiler | Manufacturer specifications for flushing or skimming steam boiler will be followed | Ensure boiler produces dry steam |

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| 5.3104.3l System temperature or pressure gauge | The temperature or pressure gauge will be inspected for erosion, cracks, or dirt | Allow for accurate observation of system temperature and pressure |
| | Damaged temperature or pressure gauges will be replaced in accordance with manufacturer specifications | |
| 5.3104.3m Circulators | Non-working motors that cannot be serviced will be replaced with a new motor | Ensure circulation of water at designated velocity in system without leaks in the circulators |
| | New motors will be installed in accordance with manufacturer specifications | |
| | Oil-lubricated circulators will be installed in proper alignment with the pump coupler and will be supported so they do not sag | |
| | Bearings will have free movement without binding | |
| | Shaft seals will not leak | |
| | Bearings in inoperable, water-lubricated circulators will be freed, if possible, before replacement with a new circulation pump | |
| 5.3104.3n Zone valves | Zone valves will be inspected for the following conditions: | Ensure proper zonal control of the system for comfort and efficiency |
| | Leaking water<br>Not responding to a call for heat | |
| | New equipment will be replaced in accordance with manufacturer specifications | |
| 5.3104.3o Condensate | If boiler is 90% efficient or more, condensate discharge will be an acceptable pH level, in accordance with local code, and will be drained to the exterior of the house, away from the foundation | Bring the condensate to an acceptable pH and discharge to appropriate location |
| | Condensate pumps will be installed, if needed, to ensure proper drainage | |

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| 5.3104.3p Temperature, pressure valves, and air vents | Occupant will be informed that air vents have potential to cause moisture problems if not operating properly | Maintain efficient operation of the system |
| | Occupant will be reminded to call for maintenance if vents discharge steam or have moisture issues | |
| 5.3104.3q Maintenance records | Keeping records of all maintenance will be recommended to occupants | Provide a history of system installation and maintenance to improve future maintenance or repair |
| | Copies or access to installation and operation manuals will be provided | |
| 5.3104.3r Occupant health and safety | All homes will have a carbon monoxide (CO) alarm | Ensure occupant health and safety |
| 5.3104.3s Occupant education | Completed work will be reviewed | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |
| | Occupants will be educated on the safe and efficient operation and maintenance of the system | |
| 6.6002.1 | Ducts | |
| Topic | Exhaust | |
| Subtopic | Components | |
| Desired Outcome | Installed ducts effectively move the required volume of air and prevent condensation | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6002.1a Duct design and configuration | Ventilation ducts will be as short, straight, and smooth as possible | Effectively move the required volume of air |
| | Ventilation ducts will not be smaller than the connections to which they are attached | |
| 6.6002.1 bDuct insulation | Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes | Prevent condensation from forming or collecting inside of the ductwork |

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| 6.6002.1c Duct support | Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½" wide material | Effectively move the required volume of air |
| | Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction | Preserve the integrity of the duct system |
| | Metal ducts will be supported by 1/2" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart | Eliminate falling and sagging |
| 6.6002.1d Duct connections | Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws | Effectively move the required volume of air |
| | Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic- plus-embedded-fabric systems, or tapes | Preserve the integrity of the duct system |
| | Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool | |
| | PVC-to-PVC materials will be fastened with approved PVC cement | |
| | Other specialized duct fittings will be fastened in accordance with manufacturer specifications | |
| | In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | |
| 6.6002.1e Duct materials | Flexible materials will be UL 181 listed or Air Diffusion Council approved | Effectively move the required volume of air |
| | Rigid, kitchen fans gauges shall meet code requirements or authority having jurisdiction | Preserve the integrity of the duct system |
| 6.6002.2<br>Topic | Terminations<br>Exhaust | |

| Subtopic | Components | |
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| Desired Outcome | Securely installed termination fittings with unrestricted air flow | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6002.2a Hole in building shell | A hole no greater than a 1/4" greater than the fitting will be cut to accommodate termination fitting | Allow for ease of weatherproofing |
| 6.6002.2b Termination fitting | A termination fitting with an integrated collar will be used | Effectively move the required volume of air to the outside |
| | Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used | Preserve integrity of the building envelope |
| | Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable | Ensure durable installation |
| 6.6002.2c Duct to termination connection | Duct will be connected and sealed to termination fitting as follows: | Effectively move the required volume of air to the outside |
| | Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws<br>Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes | Preserve integrity of the building envelope |
| | Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | Ensure durable installation |
| | Fasteners will not inhibit damper operation | |

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| 6.6002.2d Weatherproof installation | Exterior termination fitting will be flashed or weather sealed | Preserve integrity of the building envelope |
| | Water will be directed away from penetration | Ensure a weather tight and durable termination installation |
| | Installation will not inhibit damper operation | Ensure unrestricted air flow |
| | Manufacturer specifications will be followed | |
| 6.6002.2e Pest exclusion | Screen material with no less than ¼" and no greater than ½" hole size in any direction will be used | Prevent pest entry |
| | Installation will not inhibit damper operation or restrict air flow | Ensure proper air flow |
| 6.6002.2f Termination location | Terminations will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors. | Prevent exhaust from reentering house |
| | Terminations will be installed:<br>A minimum of 3' away from any property line<br>A minimum of 3' away from operable opening to houses<br>A minimum of 10' away from mechanical intake | |
| | As required by authority having jurisdiction | |
| 6.6002.2g Kitchen exhaust | Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust | Prevent a fire hazard |
| 6.6002.3 | Exhaust-Only Ventilation—Fan Intake Grille Location | |
| Topic | Exhaust | |
| Subtopic | Components | |
| Desired Outcome | Exhaust grille location optimizes either primary or local ventilation | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 6.6002.3a Primary whole house ventilation | Fan intake grille will be installed in a central location within the main body of the house | Provide whole house air exchange |
| | Ensure it is accessible for filter change and cleaning | |
| 6.6002.3b Local ventilation | Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated | Remove contaminated air at the source |
| 6.6003.1 | Surface-Mounted Ducted | |
| Topic | Exhaust | |
| Subtopic | Fans | |
| Desired Outcome | Surface-mounted ducted fans installed to specification | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6003.1a Hole through interior surface | A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly | Minimize repair work |
| | | Ensure a secure installation |
| 6.6003.1b Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6003.1c Fan mounting | Fan outlet will be oriented toward the final termination location | Ensure short duct run to achieve optimum air flow |
| | Fan will be oriented so the equivalent length of the duct run is as short as possible | Ensure a secure installation |
| | Fan will be mounted securely in accordance with manufacturer specifications | Ensure fan housing does not shake, rattle, or hum when operating |
| 6.6003.1d Backdraft damper | A backdraft damper will be installed between the outlet side of the fan and the exterior | Prevent reverse air flow when the fan is off |

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| 6.6003.1e Duct to fan connection | Duct-to-fan outlet will be connected and sealed as follows:<br><br>Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws<br>Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes<br>Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened according to manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | Exhaust to outside |
| 6.6003.1f Fan housing seal | Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations | Prevent air leakage through fan housing |
| | Sealants will be compatible with their intended surfaces | Ensure a permanent seal |
| | Sealants will be continuous and meet fire barrier specifications | Prevent a fire hazard |
| 6.6003.1g Fan to interior surface seal | Sealants will be compatible with their intended surfaces | Prevent air leakage between house and fan |
| | Sealants will be continuous and meet fire barrier specifications | |
| 6.6003.1h Air flow | Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements | Exhaust sufficient air from desired locations to outside |
| 6.6003.1i Preventing air leakage caused by exhaust fans | Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics) | Ensure occupant health and safety |

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| 6.6003.1j Combustion safety | Pressure effects will be assessed and corrected on all combustion appliances | Ensure safe operation of combustion appliances |
| 6.6003.2 | Inline | |
| Topic | Exhaust | |
| Subtopic | Fans | |
| Desired Outcome | Inline fans installed to specification | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6003.2a Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6003.2b Access | Fan and service switch will be accessible for maintenance according to the ND State Electrical Code | Fan and service switch will be accessible for maintenance |
| 6.6003.2c Fan mounting | Fan outlet will be oriented toward the final termination location | Ensure short duct run to achieve optimum air flow |
| | Fan will be oriented so the equivalent length of the duct run is as short as possible | Ensure fan is installed securely |
| | Fan will be mounted securely in accordance with manufacturer specifications | Ensure fan housing or building framing does not shake, rattle, or hum when operating |
| | Fan will be isolated from the building framing unless specifically designed to be directly attached | Minimize noise |
| | Fan will be installed remotely by installing ducting from intake grille | |
| 6.6003.2d Backdraft damper | A backdraft damper will be installed between the outlet side of the fan and the exterior | Prevent reverse air flow when the fan is off |
| 6.6003.2e Duct connections | Ducts will be connected and sealed to the intake fan and termination fitting as follows: | Exhaust from desired location to outside |

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| | Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws<br>Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes<br>Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | Preserve integrity of the duct system and building envelope |
| 6.6003.2f Boot to interior surface seal | Sealants will be compatible with their intended surfaces | Prevent air leakage around intake housing |
| | Sealants will be continuous and meet fire barrier specifications | Prevent a fire hazard |
| 6.6003.2g Air flow | Air flows in CFM will be measured and adjusted to meet the design requirements | Exhaust sufficient air from desired locations to outside |
| 6.6003.2h Preventing air leakage caused by exhaust fans | Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics) | Ensure occupant health and safety |
| 6.6003.2i Combustion safety | Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards | Ensure safe operation of combustion appliances |
| | Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief | |
| 6.6003.3 | Through the Wall | |
| Topic | Exhaust | |
| Subtopic | Fans | |
| Desired Outcome | Through the wall fans installed to specification | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 6.6003.3a Hole in building shell | A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly | Allow for ease of weatherproofing |
| 6.6003.3b Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6003.3c Fan mounting | Fan outlet will be oriented toward the final termination location | Install mounting fan securely |
| | Fan will be oriented so the equivalent length of the duct run is as short as possible | Ensure fan housing does not shake, rattle, or hum when operating |
| | Fan will be mounted securely according to manufacturer specifications | |
| 6.6003.3d Weatherproof installation | Exterior termination fitting will be flashed or weather sealed | Preserve integrity of the building envelope |
| | Water will be directed away from penetration | Ensure a weather tight and durable installation |
| | Termination fitting installation will not inhibit damper operation | Ensure unrestricted air flow |
| | Manufacturer specifications will be followed | |
| 6.6003.3e Backdraft damper | A backdraft damper will be installed between the outlet side of the fan and the exterior | Prevent reverse air flow when the fan is off |
| 6.6003.3f Fan housing seal | Sealants will be compatible with their intended surfaces | Prevent air leakage through fan housing |
| | Sealants will be continuous and meet fire barrier specifications | Ensure a permanent seal to the building air barrier |
| 6.6003.3g Fan to interior surface seal | Sealants will be compatible with their intended surfaces | Prevent air leakage around intake housing |

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| | Sealants will be continuous and meet fire barrier specifications | Prevent a fire hazard |
| 6.6003.3h Insulation | All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code<br><br>Exception: If system operates continuously, fan housing need not be insulated | Preserve integrity of the duct system |
| 6.6003.3i Air flow | Air flows in CFM will be measured and adjusted to meet the design requirements | Exhaust sufficient air from desired locations to outside |
| 6.6003.3j Preventing air leakage caused by exhaust fans | Leakage to the house from other spaces will be prevented (e.g., garages, unconditioned crawl spaces, unconditioned attics) | Ensure occupant health and safety |
| 6.6003.3k Combustion safety | Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards<br><br>Make-up air will be provided in accordance with the current version of ASHRAE 62.2 and in compliance with the authority having jurisdiction. | Ensure safe operation of combustion appliances |
| 6.6003.5 | Garage Exhaust Fan | |
| Topic | Exhaust | |
| Subtopic | Fans | |
| Desired Outcome | Contaminants properly removed from house | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6003.5a System selection | Ventilation for garage will be exhaust only and provide a minimum installed capacity of 100 CFM of ventilation per vehicle bay and will vent directly outdoors | Remove contaminants from garage |
| | Garage exhaust fan will be wired for continuous operation or installed with automatic controls that activate the fan whenever the garage is occupied and for at least 15 minutes after the garage has been vacated | Reduce contaminant migration from garage to house |

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| | If a ducted fan (not through-the-wall) is used, measure and verify the minimum air flow and adjust as necessary | Ensure occupant health and safety |
| 6.6003.5b Air leakage | Air leakage between the house and garages will be prevented by sealing and weather stripping | Ensure occupant health and safety |
| | | Reduce conditioned air being drawn from the house |
| | | Reduce contaminant migration from garage to house |
| 6.6003.5c Combustion safety | Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards | Ensure safe operation of combustion appliances |
| | Exhaust fans and other exhausting systems shall be provided with makeup air or other pressure relief | Ensure occupant health and safety |
| 6.6005.1 | Clothes Dryer | |
| Topic | Exhaust | |
| Subtopic | Appliance Exhaust Vents | |
| Desired Outcome | Dryer air exhausted efficiently and safely | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6005.1a Clothes dryer ducting | Clothes dryers will be ducted to the outdoors, which does not include unconditioned spaces such as attics and crawl spaces that are ventilated with the outdoors | Preserve integrity of building envelope |
| | As short a run as practical of rigid sheet metal or semi-rigid sheet metal venting material will be used in accordance with manufacturer specifications | Effectively move air from clothes dryer to outside |
| | Dryer ducts exceeding 35' in duct equivalent length will have a dryer booster fan installed | |
| | Plastic venting material will not be used | |

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| | Uninsulated clothes dryer duct will not pass through unconditioned spaces such as attics and crawl spaces | |
| | Ducts will be connected and sealed as follows:<br><br>UL listed foil type or semi-rigid sheet metal to rigid metal will be fastened with clamp<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material<br><br>In addition:<br>Sheet metal screws or other fasteners that will obstruct the exhaust flow will not be used<br>Condensing dryers will be plumbed to a drain | |
| 6.6005.1b Termination fitting | Termination fitting manufactured for use with dryers will be installed | Preserve integrity of building envelope |
| | A backdraft damper will be included, as described in termination fitting detail | Effectively move air from clothes dryer to outside |
| | | Effectively move air from clothes dryer to outside |
| 6.6005.1d Combustion safety | Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards | Ensure safe operation of combustion appliances |
| | | Ensure occupant health and safety |
| 6.6005.1e Occupant education | Occupant will be instructed to keep lint filter and termination fitting clean | Effectively move air from clothes dryer to outside |
| | Occupant will be instructed to keep dryer booster fan clean, if present | |

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| | Occupant will be instructed on clothes dryer operation safety including information on items that must not be placed in the clothes dryer (items with any oil or other flammable liquid on it, foam, rubber, plastic or other heat-sensitive fabric, glass fiber materials) | |
| 6.6005.2 | Kitchen Range | |
| Topic | Exhaust | |
| Subtopic | Appliance Exhaust Vents | |
| Desired Outcome | Kitchen range fan installed to specification | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6005.2a Wiring | Wiring will be installed in accordance with local regulations or the ND State Electrical Code in the absence of such regulations or where those regulations are not as stringent as the the ND State Electrical Code | Prevent an electrical hazard |
| | Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes | |
| 6.6005.2b Fan venting | Kitchen range fans will be vented to the outdoors | Remove cooking contaminants from the house |
| | Recirculating fans will not be used as a ventilating device | Preserve integrity of building envelope |
| 6.6005.2c Fan ducting | Kitchen range fans will be ducted to the outdoors | Preserve integrity of building envelope |
| | As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications | Effectively move air from range to outside |
| | Ducting will be connected and sealed as follows: | |
| | Metal-to-metal will be fastened with a minimum of three equally spaced screws | |

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| | Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes<br>For down-draft exhaust systems, PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | |
| 6.6005.2d Termination fitting | Termination fitting will be installed including a backdraft damper, as described in termination fitting detail | Ensure safe operation of combustion appliances<br><br>Ensure occupant health and safety |
| 6.6005.2f Combustion safety | Pressure effects caused by fans will be assessed and corrected when found outside of combustion safety standards | Ensure safe operation of combustion appliances<br><br>Ensure occupant health and safety |
| 6.6005.2g Occupant education | Occupant will be instructed to keep grease filters and termination fitting clean | Effectively move air from kitchen range to outdoors |
| 6.6102.1<br>Topic<br>Subtopic<br>Desired Outcome | Outside Air Ventilation Supply Ducts<br>Supply<br>Components<br>Ventilation supply ducts effectively move the required amount of air and prevent condensation | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 6.6102.1a Duct design and configuration | Ventilation ducts will be as short, straight, and smooth as possible<br><br>Ventilation ducts will not be smaller than the connections to which they are attached | Effectively move the required volume of air |

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| 6.6102.1b Duct insulation | Ventilation supply ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes | Prevent moisture condensation |
| 6.6102.1c Duct support | Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½" wide material | Effectively move the required volume of air |
| | Support materials will be applied in a way that does not crimp ductwork or cause the interior dimensions of the ductwork to be less than specified (e.g., ceiling, framing, strapping); duct support must be installed in accordance with authority having jurisdiction | Preserve integrity of the ventilation supply duct system |
| | Metal ducts will be supported by 1/2" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart | Eliminate falling and sagging |
| 6.6102.1d Duct connections | All connections will have a contact overlap of at least 1" | Effectively move the required volume of air |
| | Ducts will be connected and sealed as follows:<br><br>Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws<br>Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded- fabric systems, or tapes<br>Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>Flexible duct between the cable tie and end of metal or PVC duct will be screwed<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications | Preserve integrity of the ventilation supply duct system and building envelope |
| | Outdoor air ventilation supply ducts attached to the return side of forced air systems will be: | |

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| | Attached as close to the heating, ventilation, and air conditioning (HVAC) systems fan as possible while remaining in compliance with manufacturer specifications<br>Set up to provide filtration of outdoor ventilation air before reaching the HVAC system (for minimum MERV 6 filter)<br>Attached via a mechanically fastened takeoff collar<br><br>All joints and connections in ductwork will be fastened and sealed with UL181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus-embedded-fabric systems | |
| 6.6102.1e Duct materials | Flexible air duct material will meet the ND State Building Code | Effectively move the required volume of air<br><br>Preserve integrity of the duct system and building envelope |
| 6.6102.1f Outdoor air intake location | Outdoor air intake will be installed in accordance with the following:<br>A minimum of 6" from grade<br>A minimum of 10' from contaminant sources or exhaust outlets<br>Above local snow or flood line<br>A minimum of 18" above an asphalt based roof<br>Never on a flat roof<br>As required by authority having jurisdiction | Prevent contaminants from entering house<br>Ensure unrestricted air flow |
| 6.6102.2 | Intakes | |
| Topic | Supply | |
| Subtopic | Components | |
| Desired Outcome | Intake optimizes air flow while limiting the entry of insects, debris, and contaminants | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6102.2a Hole in building shell | A hole no greater than a 1/4" greater than the fitting will be cut to accommodate intake fitting | Ensure a weather tight installation |
| 6.6102.2b Intake fitting | Collar will be at least the same diameter as the duct; if collar is larger than duct, a rigid metal transition will be used | Effectively draw the required volume of air from the outdoors |

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| | Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable | Preserve integrity of the building envelope |
| | | Ensure durable installation |
| 6.6102.2c Occupant education | Intake fitting will be labeled "ventilation air intake" | Ensure unrestricted air flow |
| | Occupant will be instructed to keep yard debris and other contaminants clear of the intake | |
| 6.6102.2d Damper (if applicable) | The damper will be installed to open in the direction of the desired flow | Ensure unrestricted air flow |
| | Damper will close when system is off | |
| 6.6102.2e Connection to intake fitting | Duct to intake fitting will be connected and sealed as follows:<br>Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws<br>Other metal-to-metal or metal-to-PVC connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes<br>Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>Flexible duct between tie band and end of metal or PVC duct will be screwed into place<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material<br><br>Ensure fasteners do not inhibit intake damper operation | Preserve integrity of the building envelope<br>Ensure a weather tight and durable intake installation<br><br>Ensure unrestricted air flow |
| 6.6102.2f Weatherproofing | Exterior termination fitting will be flashed or weather sealed | Preserve integrity of the building envelope |

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| | Water will be directed away from penetration<br>Installation will not inhibit damper operation | Ensure a weather tight and durable intake installation |
| | Manufacturer specifications will be followed | Ensure unrestricted air flow |
| 6.6102.2g Pest exclusion | Corrosion resistant screen, louver, or grille material no less than ¼" and no greater than ½" hole size in any direction will be used, or as specified by authority having jurisdiction | Prevent pest entry |
| | Screen will be installed so it does not inhibit intake damper operation | Ensure unrestricted air flow |
| 6.6102.2h Intake location | Intake will be installed according to the following:<br>A minimum of 6" from grade<br>A minimum of 10' from contaminant sources or exhaust outlets<br>Above local snow or flood line<br>A minimum of 18" above an asphalt based roof<br>Never on a flat roof<br>As required by authority having jurisdiction | Prevent contaminants from entering house<br>Ensure unrestricted air flow |
| 6.6102.3 | Intake for Ventilation Air to Forced Air System Used for Heating or Cooling | |
| Topic | Supply | |
| Subtopic | Components | |
| Desired Outcome | Intake reduces pollutant entry, is easily maintained, has proper flow, and enhances house durability | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6102.3a Forced air system requirements | Existing forced air system leakage to outside will be less than 10% of the air handler flow when measured at 25 pascals with reference to outside | Reduce migration of pollutants |
| See redline change(s) | Any portion of the return located inside the combustion appliance zone will be air sealed | |

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| 6.6102.3b Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6102.3c Access | Motorized damper and service switch will be accessible for maintenance in accordance with required code or authority having jurisdiction | Ensure accessibility for maintenance |
| 6.6102.3d Mounting intake duct | Ventilation duct will be attached as close to the HVAC system's fan as possible while remaining in compliance with HVAC manufacturer specifications | Ensure short duct run to achieve optimum air flow |
| | Filtration of ventilation air will be provided before passing through the thermal conditioning components | Preserve integrity of the duct system and building envelope |
| | Duct will be connected to intake fitting | |
| | Connection and seal will be performed according to supply duct detail | |
| 6.6102.3e Motorized damper | A motorized damper or equivalent technology will be installed between the intake fitting and the return side of the air handler | Prevent air flow when none is desired |
| | Air flow will be provided by sequenced operation of the damper or equivalent technology | |
| 6.6102.3f Intake filter | An accessible filter will be installed | Ensure occupant health and safety |
| | Filter will be able to remove contaminants consistent with at least minimum efficiency reporting value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE 52.2-2007 | Preserve integrity of the building envelope |
| | Filter or air cleaning systems that intentionally produce ozone will not be allowed | |
| 6.6102.3g Occupant education | Occupant will be educated on how and when to change filter | Protect occupant health and safety |
| | | Preserve integrity of the building envelope |

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| 6.6103.1 | Inline or Multi-Port |
| Topic | Supply |
| Subtopic | Fans |
| Desired Outcome | Inline or multi-port fan installed in accordance with specifications |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
|---|---|---|
| 6.6103.1a Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6103.1b Access | Fan and service switch will be accessible for maintenance, service, and replacement in accordance with applicable code or authority having jurisdiction | Ensure accessibility for maintenance |
| 6.6103.1c Fan mounting | Fan will be oriented with inlet toward the fan intake fitting | Ensure short duct run to achieve optimum air flow |
| | Fan will be oriented so the equivalent length of the duct run is as short as possible | Ensure fan is mounted securely |
| | Fan will be securely mounted in accordance with manufacturer specifications | Ensure fan housing or building framing does not shake, rattle, or hum when operating |
| | Fan will be isolated from the building framing unless specifically designed to be directly attached | Minimize noise |
| | Fan will be installed remotely by ducting from supply register or grilles | |
| 6.6103.1d Damper (required for intermittent operation) | Damper will be installed to open in the direction of the desired flow | Ensure unrestricted air flow |
| | Damper will close when system is off | |

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| 6.6103.1e Duct connections | Ducts will be connected and sealed to the intake fitting, fan, and register or grilles as follows: | Provide desired air flow |
| | Metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws | Preserve integrity of the duct system and building envelope |
| | Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool | |
| | Flexible duct between the cable tie and end of metal or PVC duct will be screwed | |
| | PVC-to-PVC materials will be fastened with approved PVC cement | |
| | Other specialized duct fittings will be fastened in accordance with manufacturer specifications | |
| | All joints and connections in ductwork will be fastened and sealed with UL 181B or 181B-M welds, gaskets, adhesive mastics, or mastic-plus-embedded-fabric systems | |
| 6.6103.1f Filter | An accessible filter will be installed between the intake fitting and the fan | Ensure occupant health and safety |
| | Contaminant removal will be consistent with at least minimum efficiency reporting value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE 52.2 | Preserve integrity of the building envelope |
| | Filter or air cleaning systems that intentionally produce ozone will not be allowed | |
| 6.6103.1g Occupant education | Occupant will be educated on how and when to change filter | Ensure occupant health and safety |
| 6.6103.1h Boot to interior surface seal | All gaps between boot and interior surface will be air sealed | Prevent air leakage around intake housing |
| | Gypsum edge will be wetted before applying water-based sealant | Ensure a permanent seal to the building air barrier |
| | Sealants will be continuous and be in accordance with 2012 IRC R302.9 | Prevent a fire hazard |
| 6.6188.1 | Removing Supply Vents from Garages | |
| Topic | Supply | |
| Subtopic | Special Considerations | |

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| Desired Outcome | Safe removal of supply garage vents | |
| Single-Family Homes<br>Title | Specification(s) | Objective(s) |
| 6.6188.1a Removal of supply/return in garage | Supply run feeding the register will be truncated as near to the supply plenum as possible<br><br>If directly connected to the plenum, it will be truncated at the plenum<br><br>If connected to a Y or T branch system, it will be truncated at the Y or T<br><br>Return grille located in garage will be removed in the same manner as supply | Minimize surface area of duct |
| 6.6188.1b Patching of the hole in the duct system created by removal | All holes in sheet metal ducts will be patched with sheet metal and secured with sufficient screws to hold the patch flat without gaps<br><br>Holes left in any Y or T will be capped with sheet metal caps and fastened with at least three screws | Ensure a secure and strong patch |
| 6.6188.1c Sealing of the patch | All patches will be sealed with mastic meeting UL 181M and in accordance with manufacturer specifications | Ensure an airtight patch |
| 6.6188.1d Removal of discarded ducts | All abandoned ductwork will be removed from work area | Provide a clean work site |
| 6.6188.1e Patching of the register hole in garage | Hole created by the removal of the register and boot will be patched and taped using material meeting local codes | Prevent a fire hazard |
| 6.6188.1f External static pressure testing | Units will be tested for external static pressure (ESP) before and after work<br><br>If there is a significant rise in ESP, air flow testing will be required | Ensure correct fan performance |
| 6.6201.2<br>Topic<br>Subtopic | Primary Ventilation Air Flow between Rooms<br>Whole Building Ventilation<br>Air Flow Requirements | |

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| Desired Outcome | Air circulates freely between rooms | |
| Single-Family Homes Title | Specification(s) | Objective(s) |
| 6.6201.2a Balancing pressure | An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns) | Ensure free flow of air between rooms |
| | No room will exceed +/- 3 pascals with reference to the outdoors with all interior doors closed and ventilation systems running | Preserve integrity of the building envelope |
| 6.6202.1<br>Topic<br>Subtopic<br>Desired Outcome<br>Note | Controls<br>Whole Building Ventilation<br>Components<br>Fan controls support ventilation strategy<br>The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes Title | Specification(s) | Objective(s) |
| 6.6202.1a Primary ventilation fan (whole-house volume) | Controls will be used that can meet the following conditions: | Deliver intended air exchange |
| | Run fan continuously or intermittently depending upon the intended schedule of operation<br>Operate fan to produce the intended flow for each intended flow setting | Ensure fan controls meet intended ventilation strategy |
| 6.6202.1b Local exhaust—local fan | Controls will be used that meet the following conditions: | Deliver intended air exchange |
| | Run fan continuously or intermittently depending on the intended schedule of operation<br>Run fan for intended time for timed operation<br>Operate fan to produce the intended flow for each intended flow setting | Ensure fan controls meet intended ventilation strategy |

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| 6.6202.1c Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| | | Ensure fan controls meet intended ventilation strategy |
| 6.6202.1d Manual override | A labeled switch for manual override will be included for the ventilation system | Ensure fan controls meet intended ventilation strategy |
| 6.6202.1e Occupant education | A system operation guide designed for occupants (non-professionals) will be provided to explain how and why to operate system | Educate occupants about system operation and importance |
| | A label indicating the presence and purpose of the ventilation system will be included or a copy of the system operation guide will be posted at the electrical panel | Deliver intended air exchange |

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| 6.6202.2 | Heat Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) Installation |
| Topic | Whole Building Ventilation |
| Subtopic | Components |
| Desired Outcome | HRV and ERV systems installed to specifications |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. |

Single-Family Homes

| Title | Specification(s) | Objective(s) |
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| 6.6202.2a Wiring | Wiring will be installed in accordance with original equipment manufacturer specifications, and local and national electrical and mechanical codes | Prevent an electrical hazard |
| 6.6202.2b Access | Fans, service switch, filters, drain, and drain pan will be accessible for maintenance in accordance with authority having jurisdiction | Maintain designed air flows and system performance |
| | | Ensure occupant health and safety |

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| 6.6202.2c Fan mounting | Fan will be securely mounted in accordance with manufacturer specifications | Ensure short duct runs achieve optimum air flows |
| | Fan will be oriented so the equivalent length of the duct run is as short as possible; calculate "equivalent length" in accordance with ANSI/ACCA Manual D – 2009 (Residential Duct Systems) | Ensure fan is mounted securely |
| | Fan will be isolated from the building framing unless specifically designed to be directly attached | Ensure fan housing or building framing does not shake, rattle, or hum when operating |
| | | Minimize noise |
| 6.6202.2d Backdraft dampers (required for intermittent operation) | A backdraft damper will be installed between the heat recovery ventilator (HRV) or energy recovery ventilator (ERV) and the exterior, unless the system operates continuously | Prevent reverse air flow when the system is off |
| | Outdoor air intakes and exhausts will be equipped with automatic or gravity dampers that close when the ventilation system is not operating | |
| 6.6202.2e Installation of fittings | Collar will be at least the same diameter as the exhaust fan outlet; if collar is larger than exhaust fan outlet, a rigid metal transition will be used | Achieve the desired air flows to and from the designated locations |
| | Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable | Ensure unrestricted air flow |
| | | Preserve integrity of the building envelope |
| 6.6202.2f Duct connections | Ducts will be connected to applicable registers or grilles, collector box, HRV or ERV, intake fitting, and termination fitting | Achieve the desired air flows to and from the desired locations |
| | Ducts will be connected and sealed as follows: | Preserve integrity of the duct system and building envelope |
| | Metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws | |

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| | Flexible duct-to-metal or flexible duct-to-PVC will be fastened with tie bands using a tie band tensioning tool<br>Flexible duct between tie band and end of metal or PVC duct will be screwed into place<br>PVC-to-PVC materials will be fastened with approved PVC cement<br>Other specialized duct fittings will be fastened in accordance with manufacturer specifications<br>In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material | |
| 6.6202.2g Duct layout | Air to be exhausted to the outdoors will not be taken directly from the forced air system | Achieve the desired air flows to and from the desired locations |
| | Supply ducts attached to the return side of forced air systems will be:<br>Attached as close to the HVAC system's fan as possible while remaining in compliance with manufacturer specifications<br>Set up to provide filtration of outdoor ventilation air before reaching the HVAC system with minimum MERV 6 filter<br>Connected to the intake fitting<br>Connected and sealed in accordance with the supply duct detail | Preserve integrity of duct system and house<br>Ensure occupant health and safety |
| 6.6202.2h Insulation | Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes | Preserve integrity of the duct system by eliminating condensation |
| 6.6202.2i Sealant selection | Gap between registers or grilles and interior surface will be sealed | Prevent air leakage around registers or grilles |
| | Sealants will be compatible with their intended surfaces | Ensure a permanent seal |
| | Sealants will be continuous and meet fire barrier specifications | Prevent a fire hazard |
| 6.6202.2j Balance and flow | Air flows will be measured and adjusted to match to the system's intent | Achieve the desired air flows to and from the desired locations |

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| 6.6202.2k Occupant education | Occupant will be educated on how and when to change filter and clean drain pan, if applicable, according to manufacturer specifications | Ensure occupant health and safety |
| | | Preserve integrity of system |
| 6.6202.9 | Filtration for Fan-Powered (Active) Systems | |
| Topic | Whole Building Ventilation | |
| Subtopic | Components | |
| Desired Outcome | Indoor air quality (IAQ) improved and equipment efficiency maintained | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6202.9a Pre-inspection | Specifications will be field verified as appropriate to site conditions by installer | Specifications will be field verified as appropriate to site conditions by installer |
| 6.6202.9b Selection | All mechanically supplied outdoor air will pass through filter before conditioning | Ensure outdoor air is filtered before entering occupied space |
| | Filters and filter racks/holders will have a rating of minimum efficiency rating value 6 or higher when tested in accordance with ASHRAE 52.2- | Ensure occupant health and safety |
| | Pressure drop across filter will match equipment capabilities | |
| | Filter systems that produce ozone will not be allowed | |
| 6.6202.9c Installation | Filter will be located and installed to facilitate access and regular service by occupant/maintenance staff | Prevent air bypass of filter |
| | Filter will be located on the inlet side of the equipment fan | Allow for proper maintenance and replacement |
| | Filter access panel will include gasket or comparable sealing mechanism and fit snugly against exposed edge of filter when closed to prevent air bypass | |

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| | Filter plenum construction will be airtight and sealed to adjoining ductwork | |
| 6.6202.9d Occupant/property manager education | Occupant/property manager will be instructed on proper maintenance procedures and replacement schedule | Ensure continued performance of equipment efficiency and IAQ |
| 6.6204.1 | Commissioning Ventilation Systems | |
| Topic | Whole Building Ventilation | |
| Subtopic | System Evaluation | |
| Desired Outcome | Verify proper operation of existing system installed system air flow meets required standard and provides continuous ventilation for background pollutant sources | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6204.1a Identification | Identify whole building ventilation strategy that was installed in the home, based on options described in current version of ASHRAE 62.2, e.g., exhaust only, supply only, balanced, combining local and whole home ventilation delivery, incorporating infiltration credit, etc. | Ensure suitable whole building ventilation strategy is installed. Identify testing requirements to determine installed system air flow. |
| 6.6204.1b Equipment inspection | Visually inspect and document status of:<br><br>Electrical connections<br>Name plate (rated sone and flow)<br>Motor cleanliness | Evaluate equipment |
| 6.6204.1c Pathway inspection | Visually inspect and document status of ducting or other airflow pathways to ensure proper:<br><br>Connections (proper materials, sealed and connected)<br>Insulation<br>Support<br>Sizing<br>Termination locations and fittings.<br>Verify proper damper operation | Preserve integrity of building envelope. Effectively move air along selected pathways. |

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| 6.6204.1d Measurement and AdjustmentVerify | Using a calibrated device, measure air flow of all necessary components, including building air leakage when relevant.<br>Adjust ventilation equipment air flows as necessary to meet the ventilation rates required by the current version of ASHRAE 62.2 | Provide sufficient air flows per current ventilation standards. Verify suitable performance of installed ventilation strategy. |
| 6.6204. 1e Work order | Develop work order as necessary to correct deficiencies identified during inspections and measurement | Correct deficiencies |
| 6.6204.1f Occupant education | Instruct occupant on purpose, use and maintenance of ventilation, and typical signs that ventilation is needed, e.g., condensation on windows | Occupant understands benefits of good indoor air quality and can operate ventilation equipment as needed. |
| 6.6288.1 | Sound-Rating Limits | |
| Topic | Whole Building Ventilation | |
| Subtopic | Special Considerations | |
| Desired Outcome | Systems operate as quietly as possible | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 6.6288.1a Primary ventilation system or any continuously operating fan | System shall be rated for sound in accordance with current ASHRAE 62.2 standard | Minimize noise |
| 6.6288.1b Intermittent local ventilation system | Local ventilation will be rated for sound at a maximum of 3 sone, unless their maximum rated airflow exceeds 400 cfm, in accordance with the current ASHRAE 62.2 standard | Minimize noise |
| 6.9901.1 | Supplemental Ventilation Information—ASHRAE 62.2 | |
| Topic | Additional Resources | |
| Subtopic | Codes and Standards Resources | |
| Desired Outcome | To provide supplemental ventilation information—ASHRAE 62.2 | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |

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| 6.9901.1a Ventilation fan flow rate | ASHRAE Standard 62.2-2013 and the calculation of the infiltration credit allow adjustments to primary ventilation fan flow rates for existing houses using a single fan. | To provide supplemental ventilation information--ASHRAE 62.2 |
| 7.8001.1 | Refrigerator and Freezer Replacement | |
| Topic | Plug Load | |
| Subtopic | Refrigerators/Freezers | |
| Desired Outcome | A more energy efficient appliance installed | |
| Single-Family Homes Title | Specification(s) | Objective(s) |
| 7.8001.1a Selection | Appliance shall be ENERGY STAR® rated | Energy efficient appliance installed |
| | Appliance will fit in the available space without blocking access to light switches, cabinets, etc. | |
| | Appliance will carry a minimum one-year warranty that will provide a replacement appliance if repeated issues relating to health, safety, or performance occur | |
| 7.8001.1b Installation | Appliance will be installed in accordance with manufacturer specifications and local codes | Achieve intended appliance function |
| | Any penetrations to the exterior of the home created by the installation of the appliance will be sealed | Preserve food at low energy use |
| | Energy-related appliance controls will be demonstrated to the occupant | Educate occupant on how to operate and maintain the appliance |
| | Specific information on the proper maintenance of the equipment will be provided to the occupant | |
| | Warranty information, operation manuals, and installer contact information will be provided to the occupant | |
| 7.8001.1c Decommissioning | Appliances replaced by new units will be recycled or disposed of in accordance with federal, state, or local regulations | Prevent reuse of inefficient equipment and components |

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| | Appliances infested with pests will be enclosed before moving | Protect the environment |
| | | Protect worker safety |
| 7.8003.1 | Lighting Upgrade | |
| Topic | Plug Load | |
| Subtopic | Lighting | |
| Desired Outcome | Energy used for lighting reduced while maintaining adequate and safe lighting levels | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8003.1b Selection | All bulbs, fixtures, and controls will be appropriate for the intended application (e.g., enclosed, orientation, dimmable, potential for breakage, indoor, and outdoor) | Provide improved lighting quality at lower energy use |
| | All bulbs, fixtures, and controls will be selected to provide the brightness and light quality required in that application (e.g., task lighting, trip-and- fall hazards, nightlights) | Select equipment that will not be an unnecessary barrier to future technologies |
| | Selected equipment should have the highest level of efficiency within a technology [e.g., compact fluorescent lamp (CFL), LED] | Avoid inferior products and unsatisfied occupants |
| | All bulbs, fixtures, and controls will be ENERGY STAR® rated where applicable | |
| | When possible, bulbs, fixtures, and controls will be selected that will facilitate the use of future lighting technologies (e.g., LEDs) | |
| | Light/lamp wattage should not exceed rated wattage of fixture | |
| | Bulb replacements will be chosen based on expected durability, light quality, and lifetime energy use of the bulb | |
| | All bulbs, fixtures, and controls will be UL-approved and installed in accordance with the ND State Electrical Code | |

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| | Fluorescent light ballasts containing polychlorinated biphenyls (PCBs) will be replaced in accordance with the EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades | |
| 7.8102.1 | Water Heater Selection | |
| Topic | Water Heating | |
| Subtopic | Installation and Replacement | |
| Desired Outcome | Safe, reliable, and efficient hot water source selected that meets occupant needs at lowest possible cost of ownership and operation | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8102.1a Selection parameters | Equipment will provide sufficient, affordable, safe, and healthy hot water for the occupant in accordance with the ND State Building Code | Save energy and water |
| | Potential for health and safety hazards (e.g., backdrafting, flame rollout, obstructions) will be assessed in selecting equipment and the cost of remedying such problems will be included in any cost and benefit calculations | Identify appliance options based on the needs and wants of the occupant |
| | Equipment will be functional at high efficiency under all load conditions | |
| | Standby losses will be reduced to maximum potential | |
| | Fuel type will be selected based on affordability to occupant | |
| | Equipment will be freeze resistant or installed in a conditioned space | |
| | Efficiency of equipment will be maintained throughout life of system | |
| | Occupant control of hot water temperature will be provided on the equipment | |
| | The following will be determined from the occupant:<br>Lifestyle<br>Current and future needs | |

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| | Space considerations<br>Fuel options<br>Health and safety considerations<br>Appliance options<br>Maintenance and operation costs<br>Return on investment concerns | |
| 7.8102.1b Product selection | Water heater will be selected based on performance requirements of the occupant, available fuel sources, energy efficiency, and total life cycle cost<br><br>In very cold climates, on-demand water heaters will be sized to meet the demand of water flow at very low water intake temperatures | Ensure equipment meets the occupant's expectations while providing efficient energy and water use |
| 7.8102.2 | Storage-Type Appliance | |
| Topic | Water Heating | |
| Subtopic | Installation and Replacement | |
| Desired Outcome | Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8102.2a Hazardous material removal | Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified<br><br>Occupant will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation) | Remediate health hazards using EPA-certified contractors |
| 7.8102.2b Equipment removal | Accepted industry procedures and practices will be followed to:<br>Remove old water heater and associated components in accordance with the ND State Building Code or authority having jurisdiction<br>Seal any unused chimney openings and penetrations in accordance with the ND State Building Code or authority having jurisdiction | Ensure the safety of the workers and occupants<br>Preserve integrity of the building |

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| | Remove unused oil tank, lines, valves, and associated equipment in accordance with the ND State Building Code or authority having jurisdiction | Remove old equipment in a timely and efficient manner |
| | All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards | |
| 7.8102.2c New equipment installation | New water heater and associated components will be installed to accepted industry standards, in accordance with the ND State Building Code and manufacturer specifications | Ensure the safety of the workers and occupants |
| | The system will be installed to be freeze resistant | Preserve integrity of the building |
| | Any existing water leaks will be repaired before installation begins | Remove old equipment in a timely and efficient manner |
| | Any penetrations to the exterior of the home created by the installation of the equipment will be sealed | |
| 7.8102.2d Emergency drain pan | An emergency drain pan will be installed with sides that extend a minimum of 4" above floor if leakage would cause damage to the home and in accordance with the ND State Building Code | Collect and safely dispose of water escaping from the storage tank |
| | A ¾" drainline or larger will be connected to tapping on pan and terminated in accordance with the ND State Building Code | |
| 7.8102.2e Expansion tank | A potable water expansion tank will be installed on the cold water side where required by the ND State Plumbing Code | Protect the storage tank from expansion |
| | A direct connection with no valves between the storage tank and expansion tank will be installed in accordance with the ND StatePlumbing Code, authority having jurisdiction, and according to manufacturer specifications | |

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| 7.8102.2f Temperature and pressure relief valve | Correct temperature and pressure relief valve will be installed in compliance with the ND State Building Code and according to manufacturer specifications | Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| | Temperature and pressure relief valve discharge tube will be installed in accordance with P2803.6.1 of the 2012 IRC | |
| 7.8102.2g Dielectric unions | Dielectric unions will be installed in accordance with the ND State Building Code, authority having jurisdiction, and according to manufacturer specifications | Break the stray voltage electrical circuit through the storage tank |
| 7.8102.2h Backflow prevention | Backflow prevention will be installed in accordance with manufacturer specifications and all applicable codes | Protect water supply from contamination |
| 7.8102.2i Thermal efficiency | If additional tank insulation is installed, it will be rated a minimum of R-11 will be installed to manufacturer specificationsand | Reduce standby loss from near tank piping and storage tank |
| | If additional insulation is installed, it will be installed based on fuel type, making sure not to obstruct draft diverter, pressure relief valve, thermostats, hi-limit switch, plumbing pipes or elements, and thermostat access plates | Ensure insulation does not make contact with flue gas venting |
| | The first 6' of inlet and outlet piping will be insulated in accordance with manufacturer specifications | |
| | Combustible pipe insulation must remain maintain a minimum clearance of 6'' from gas water heater draft hood and/or single wall metal pipe. Clearance from vent such as "B" vent should be maintained per vent manufacturer's specifications. | |
| | Heat traps will be installed on the inlet and outlet piping where not provided by manufacturer | |

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| 7.8102.2j Fuel supply | Electric or fossil fuel supply components will be installed to accepted industry standards as per NFPA 31 and 54, or The ND State Electrical Code) for electric components, or authority having jurisdiction | Provide sufficient fuel to the water heater, burner, or element |
| 7.8102.2k Discharge temperature | Discharge temperature will be set not to exceed 120° or as prescribed by local code | Ensure safe hot water supply temperature to fixtures |
| 7.8102.2l Commissioning of system | The following will be checked once the system has been filled and purged:<br>Safety controls<br>Combustion safety and efficiency<br><br>Operational controls<br>Fuel and water leaks<br>Local code requirements<br><br>Commissioning will be in compliance with manufacturer specifications and relevant industry standards | Ensure safe system function<br><br>Keep cost of ownership as low as possible |
| 7.8102.2m Occupant safety | Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction<br><br>Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels | Ensure occupant life safety; CO alarms are designed to detect levels at which occupants might become unable to evacuate |
| 7.8102.2n Occupant education | Completed work will be reviewed<br><br>Occupants will be educated on the safe and efficient operation and maintenance of the system, including:<br>Adjustment of water temperature and target temperature in accordance with local code<br>Periodic drain and flush<br>Expansion tank and backflow preventer (no occupant maintenance required) | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |

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| | Periodic inspection, maintenance, or replacement | |
| 7.8102.3 | On-Demand Appliance | |
| Topic | Water Heating | |
| Subtopic | Installation and Replacement | |
| Desired Outcome | Safe and reliable hot water source provided that meets occupant needs at lowest possible cost of ownership | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8102.3a Hazardous material removal | Health concerns in the removal and replacement of equipment (e.g., asbestos, other hazardous materials) will be identified | Remediate health hazards using EPA-certified contractors |
| | Written notification will be provided to occupants of the discovery of hazardous material, including contact information for regional EPA asbestos coordinator | |
| | Occupants will be asked to contract with an EPA-certified asbestos contractor to conduct abatement before equipment removal and replacement (occupant is responsible for abatement or remediation) | |
| 7.8102.3b Equipment removal | Accepted industry procedures and practices will be followed to: | Ensure the safety of the workers and occupants |
| | Remove old water heater and associated components in accordance with the ND State Building Code | Preserve integrity of the building |
| | Seal any unused chimney openings and penetrations in accordance with the ND State Building Code | |
| | Remove unused oil tank, lines, valves, and associated equipment in accordance with the ND State Building Code | Remove old equipment in a timely and efficient manner |

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| | All work shall be completed by a licensed plumbing professional where required by the authority having jurisdiction and installed to industry-accepted standards | |
| 7.8102.3c New equipment installation | A new water heater and associated components will be installed to accepted industry standards, in accordance with the ND State Building Code, authority having jurisdiction and manufacturer specifications | Ensure the safety of the workers and occupants |
| | | Preserve integrity of the building |
| | | Remove old equipment in a timely and efficient manner |
| 7.8102.3d Emergency drain pan | An emergency drain pan will be installed with sides that extend a minimum of 4" above floor if leakage would cause damage to the home and in accordance with the ND State Building Code | Collect and safely dispose of water escaping from the storage tank |
| | A ¾" drainline or larger will be connected to tapping on pan and terminated in accordance with the ND State Building Code | |
| 7.8102.3e Temperature and pressure relief valve | Correct temperature and pressure relief valve will be installed in compliance with the ND State Building Code and according to manufacturer specifications | Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| | Temperature and pressure relief valve discharge tube will be installed in accordance with the ND State Building Code | |
| 7.8102.3f Dielectric unions | Dielectric unions will be installed to accepted industry standards, in accordance with the ND State Building Code and according to manufacturer specifications | Break the stray voltage electrical circuit through the storage tank |
| 7.8102.3g Backflow prevention and pressure regulator | Backflow prevention will be installed in accordance with manufacturer specifications | Protect the water supply from contamination |
| | House water pressure and volume will be verified as sufficient to be in accordance with manufacturer specifications | Provide for sufficient volume and pressure |

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| | All applicable codes will be followed | |
| 7.8102.3h Thermal efficiency | Any accessible hot water lines at the appliance will be insulated to meet the ND State Building Code or local requirements, whichever is greater. | Reduce line losses |
| 7.8102.3i Required combustion air | Recommendations will be made to install all on-demand appliances as sealed combustion<br><br>If not possible:<br>Combustion and ventilation (excess air) requirements of gas-fired appliances, including provision of outside and inside air to account for building tightness, will be provided<br><br>The minimum required volume shall be 50 cubic feet per 1,000 Btu/h in accordance with the ND State Building Code<br><br>If needed, additional combustion air will be provided in accordance with the ND State Building Code | Ensure adequate combustion air for operation of the appliance |
| 7.8102.3j Venting of flue gases | Combustion byproducts will be removed in accordance with the ND State Building Code, authority having jurisdiction, and manufacturer specifications | Ensure the safety and durability of the venting system |
| 7.8102.3k Flue gas testing | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012<br><br>If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes | Confirm that combustion is occurring safely with maximum efficiency |
| 7.8102.3l Electric and fossil fuel supply | Electric or fossil fuel supply components will be installed to accepted industry standards as per the ND State Building Code, NFGC and NFPA 31 and 54 for gas and oil, or the ND State Electrical Code for electric | Provide sufficient fuel to the water heater burner or element |

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| | Energy input required by the appliance will be in accordance with manufacturer specifications | |
| 7.8102.3m Cold water supply | The volume and pressure of the water supplied to the appliance will be in accordance with manufacturer specifications | Provide sufficient volume and pressure of water to the appliance |
| 7.8102.3n Discharge temperature | Discharge temperature will be set in accordance with manufacturer instructions and in compliance with local codes<br><br>Use extreme caution when temperature setting is above 120°F | Ensure safe hot water supply temperature to fixtures |
| 7.8102.3o Commissioning of system | The following will be checked once the system has been connected and filled:<br><br>Safety controls<br>Combustion safety and efficiency<br>Operational controls<br>Fuel and water leaks<br>Cycle unit<br>Local code requirements<br><br>Manufacturer specifications and all relevant industry standards will be met in commissioning | Ensure system functions safely with lowest possible cost of ownership |
| 7.8102.3p Ambient carbon monoxide (CO) | All homes will have a CO alarm | Ensure occupant health and safety |
| 7.8102.3q Occupant education | Completed work will be reviewed<br><br>Occupants will be educated on the safe and efficient operation and maintenance of the system, including:<br>Adjustment of water temperature and target temperature in accordance with local code<br>Operation of backflow preventer and pressure regulator (no occupant maintenance required)<br>Importance of keeping operating manuals accessible | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |
| 7.8103.1 | Storage-Type Appliance | |

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| Topic | Water Heating | |
| Subtopic | Maintenance/Inspection | |
| Desired Outcome | Safe, reliable, and efficient operation of the appliance maintained | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8103.1a Health and safety | Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice<br><br>Electrical components will be verified to comply with the ND State Electrical Code (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire) | Identify potential health and safety issues |
| 7.8103.1b Visual inspection | Inspection will be conducted to show compliance with the the ND State Building Code, including but not limited to:<br>Water or fuel leaks<br>Damaged wiring<br>Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)<br>Corrosion (e.g., rust, mineral deposits)<br>General condition of components | Determine needed repairs or maintenance |
| 7.8103.1e Temperature and pressure relief valve | Correct temperature and pressure relief valve will be installed in compliance with the ND State Building Code and according to manufacturer specifications<br><br>Temperature and pressure relief valve discharge tube will be installed in accordance with the ND State Building Code | Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| 7.8103.1fMaintenance records | Occupants will be advised to keep records of all maintenance done to their system | Provide a history of system installation and maintenance to improve chance of successful future maintenance or repair |

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| | Copies of or access to installation and operation manuals will be provided | |
| 7.8103.1g Occupant safety | Carbon monoxide (CO) alarms will be installed in each dwelling in accordance with ASHRAE 62.2 and authority having local jurisdiction | Ensure occupant life safety |
| | Occupant will be provided information regarding the health effects and risk of high CO concentrations as well as a list of monitors that can provide more detail regarding CO levels | Inform occupant regarding possible CO hazards |
| 7.8103.1h Occupant education | Completed work will be reviewed | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |
| | Occupants will be educated on the safe and efficient operation and maintenance of the system, including:<br>Adjustment of water temperature and target temperature in accordance with local code<br>Periodic drain and flush<br>Periodic inspection, maintenance, or replacement of anode rod | |
| 7.8103.2 | On-Demand Appliance | |
| Topic | Water Heating | |
| Subtopic | Maintenance/Inspection | |
| Desired Outcome | Safe, reliable, and efficient operation of the appliance maintained | |
| Note | The authority having jurisdiction may require that a licensed professional perform certain tasks outlined in this detail. | |
| Single-Family Homes | | |
| Title | Specification(s) | Objective(s) |
| 7.8103.2a Health and safety | Combustion safety testing will be performed in accordance with the Health and Safety Chapter of the Standard Work Specifications for Single Family Housing or other equivalent practice | Identify potential health and safety issues |

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| | Electrical components will be verified to comply with the ND State Electrical Code (e.g., no electrical box connector, no disconnect, improperly sized breaker and wire) | |
| 7.8103.2b Visual inspection | Inspection will be conducted to show compliance with the 2012 IRC, including but not limited to:<br>Water or fuel leaks<br>Damaged or missing pipe insulation and tank insulation, where applicable<br>Damaged wiring<br>Venting issues with draft and condensation (e.g., soot, rusting of flue pipe, burned paint or wires, efflorescence)<br>Corrosion (e.g., rust, mineral deposits)<br>General condition of components | Determine needed repairs or maintenance |
| 7.8103.2c Temperature and pressure relief valve | Correct temperature and pressure relief valve will be installed in compliance with the ND State Building Code and according to manufacturer specifications<br><br>Temperature and pressure relief valve discharge tube will be installed in accordance with the ND State Building Code | Discharge excessive energy (pressure or temperature) from storage tank to safe location |
| 7.8103.2d Flue gas testing | Undiluted flue gases will be checked with a calibrated combustion analyzer in accordance with BPI-1100-T-2012<br><br>If combustion is not in compliance with BPI-1100-T-2012, diagnostics and adjustments will be done to manufacturer specifications or local codes | Perform combustion testing |
| 7.8103.2e Required combustion air | If sealed combustion has not been installed:<br><br>Combustion and ventilation (excess air) requirements of gas-fired appliances, including provision of outside and inside air to account for building tightness, will be provided | Ensure adequate combustion air for operation of the appliance |

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| | The minimum required volume will be 50 cubic feet per 1,000 Btu/h in accordance with the ND State Building Code<br><br>If needed, additional combustion air will be provided in accordance with the ND State Building Code | |
| 7.8103.2f Venting of flue gases | Condition of venting will be inspected in accordance with the ND State Building Code for gas water heaters or NFPA 31 for oil water heaters | Verify proper venting of flue gases |
| 7.8103.2g Fuel supply | Condition of fuel supply components will be checked in accordance with NFPA 31 for oil, NFPA 54 for gas, NFPA 58 for propane, or the ND Electrical Code for electric, and authority having jurisdiction | Verify sufficient fuel to the water heater burner and element |
| 7.8103.2h Cold water supply | Water supplied to the appliance will be of sufficient volume and pressure to be in accordance with manufacturer specifications | Verify sufficient volume and pressure of water to the appliance |
| 7.8103.2i Discharge temperature | Discharge temperature will be set not to exceed 120°F or in accordance with local code, whichever is lower | Ensure safe hot water supply temperature to fixtures |
| 7.8103.2j Test the system safety and operation | The following will be tested:<br><br>Safety controls (e.g., water, air pressure switches)<br>Combustion safety and efficiency<br>Operational controls<br>Fuel and water leaks<br>Unit runs through complete cycle<br>Local code requirements<br><br>Manufacturer specifications and all relevant industry standards will be met | Ensure system functions safely with lowest possible cost of ownership |
| 7.8103.2k Maintenance records | Occupants will be advised to keep records of all maintenance done to their system<br><br>Copies of or access to installation and operation manuals will be provided | Improve chance of successful future maintenance or repair |

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| 7.8103.2l Occupant health and safety | All homes will have a carbon monoxide (CO) alarm | Ensure occupant health and safety |
| 7.8103.2m Occupant education | Completed work will be reviewed | Ensure occupant is informed of the safe, efficient operation and maintenance of the system |
| | Occupants will be educated on the safe and efficient operation and maintenance of the system, including:<br><br>Adjustment of water temperature<br>Target temperature in accordance with local code | |

**2312 Required Subgrantee Deferral of Services Policy**

There are some situations in which a subgrantee should not or may choose not to weatherize an otherwise eligible unit. In order to deal with these situations each subgrantee must develop an approved policy which, when implemented, allows weatherization staff to defer services because of conditions and/or circumstances that may be hazardous to their health or safety or that of the client's.

The following is a model deferral of services policy intended to list the more common conditions and situations a subgrantee may encounter while delivering weatherization services. This list is not intended to be all inclusive of those instances in which a subgrantee may choose not to weatherize a unit. In some instances, corrective measures by the client/owner may allow program services to proceed. At a minimum, the subgrantee deferral of services policy should contain the following:

1. *Procedure:* If a subgrantee cannot or chooses not to weatherize a dwelling unit it must notify the client and owner/authorized agent in writing and include the following items:
    a. The nature and extent of the problem(s) and how the problem(s) relate to the determination to not weatherize the unit;
    b. Any corrective action required before weatherization services can be initiated;
    c. A time limit for correcting problems so that weatherization services may be rescheduled;
    d. The right of appeal; and
    e. All correspondence justifying the decision to "defer services" must be kept in the client file.

*2. Withholding of Weatherization Services: A subgrantee may withhold weatherization services under the following conditions:*

    a. A dwelling unit is vacant.
    b. A dwelling unit is for sale.
    c. A dwelling unit is scheduled for demolition.
    d. A dwelling unit is found to have serious structural problems that would make weatherization impossible or impractical.
    e. A dwelling unit is deemed by the auditor or foreman to pose a threat to the health or safety of the crew or subcontractor.
    f. The Health and Safety assessment done at the time of the initial audit shows that meeting the requirements will be too costly or that the requirements cannot be met.
    g. A mobile home is improperly installed (for example, inadequate supports).
    h. A dwelling unit is uninhabitable (for example, such as a burned out apartment).
    i. When there are minor children in the dwelling but no adult client or adult agent of the client at the time of the estimate or at any other time subgrantee personnel must enter the dwelling.
        i. An adult client or adult agent of the client need not be present if the estimator or crew foreman feel satisfied with a signed note from an adult client or adult agent of the client stating their permission to enter the dwelling occupied by the minor children.
    j. The client is uncooperative with the weatherization subgrantee, either in demanding that certain work be done and refusing higher priority work which is needed, or by being abusive to the work crew or subcontractor, or by being unreasonable in allowing access to the unit, every attempt should be made to

explain the program and the benefits of the work. If this fails, work should be suspended and the State Weatherization Office consulted.

k. Obvious discrepancies are found between the information supplied by the client on the application and observed conditions at the time of weatherization. The subgrantee must resolve these discrepancies before weatherization work can continue.

l. If , at any time prior to the beginning or work (materials installed in a unit), the subgrantee determines that the client is no longer eligible or subgrantee personnel believe that circumstances may have changed, the unit shall not be weatherized until updated information can be obtained from the client.

m. There are rats, bats, roaches, reptiles, insects, animals or other vermin that are inappropriately or not properly contained on the premises.

n. There are health and safety hazards that must be corrected before weatherization services may begin including, but not limited to:

i. The presence of animal feces and/or other excrement,

ii. Disconnected waste water pipes,

iii. Hazardous electrical wiring, or

iv. Unvented combustion appliances.

o. There are illegal drugs or illegal activities occurring on the premises.

p. The client or owner is physically or verbally abusive to subgrantee personnel.

q. The dwelling unit or parts thereof are being remodeled and weatherization work is not coordinated with a housing rehabilitation program.

r. The eligible household moves from the dwelling unit where weatherization activities and services are in progress. In such a case, the subgrantee must determine whether to complete the work and the circumstances must be documented in the client file.

s. There are unusual situations, which in the judgment of the subgrantee staff, must be corrected before proceeding with weatherization.

i. No utility hookups (It is apparent that utilities have been shut off).

ii. Lack of cooperation from client.

iii. Dwelling units undergoing remodeling, or which have untreated areas that directly affect the weatherization process, shall not be weatherized.

t. If for any reason a worst-case draft test cannot be done in a dwelling requiring a worst-case draft.

**4320 Domestic Hot Water Pipes**

1. Insulate the first 9 feet of hot water pipe and the first 3 feet of cold water pipe with ¾ inch pipe insulation except on gas water heaters.

2. Closed cell foam, high temperature rated insulation or elastomeric pipe insulation should be used that has a flame spread rating no greater than 25.

3. Maintain a minimum of 6 inches between pipe insulation and all heat sources.

4. Domestic hot water pipes running through unconditioned spaces must be insulated if accessible.

**4330 Water Heater Blankets**

The installation of water heater blankets on electric water heaters in conditioned spaces is recommended unless this will void the warranty. Gas water heaters should not be insulated.

Water heaters located in unconditioned areas should be moved to a conditioned area, if possible. If the water heater cannot be moved, the heater and distribution pipes, both hot and cold, must be insulated.

***4331 Water Heater Blanket Materials***

1. The water heater blanket must be fiberglass batt insulation with a protective covering.

2. An R-11 water heater blanket is preferred on all tanks not labeled with a prohibition to installing additional insulation to that already installed by the manufacturer.

3. A water heater blanket must be secured to the water heater with at least two (2) straps with buckles. The installed straps must not excessively compress the water heater blanket.

***4332 Installation***

1. The water heater tank must be inspected to determine the type of water heater (gas, electric, other), and whenever possible, the amount of existing insulation.

2. If there are signs that the water heater is leaking, this problem must be solved before insulation is added.

3. Electric water heaters outside the living space, including mobile home water heaters in exterior closets, must be insulated if the total existing tank insulation is less than R-11.

4. A water heater blanket must not be installed when a temperature and pressure relief valve does not exist or when the existing temperature and pressure relief valve is leaking

5. A water heater blanket must not cover the following:

    a. The temperature and pressure relief valve on an electric unit.

    b. The drain valve on an electric unit.

    c. The electrical line attaches to an electric unit. Insulation must be kept at least three inches away from where this electrical line attaches to the water heater.

**5121 Insulation Coverage and Density For Attics**

1. Insulate uninsulated open-joist attics to R-50 in all dwelling heated with any fuel but electric resistance and to R-60 for electric resistance heat. Add insulation to other areas as necessary or as directed by the approved audit software program.
2. Using the WxPro Audit Software to calculate the number of bags is the preferred method for determining the proper amount of material to be installed into an attic area at a given R-value.
3. Where the combined material and labor costs can be reduced, it is preferred that dropped soffits and similar construction details be filled with cellulose insulation.
4. When a vapor barrier is installed with the insulation, the barrier should be installed on the warm side of the insulation and never more than 1/3 of the R-value away from the warm-side surface.
5. Add necessary insulation to eliminate voids and areas of incomplete coverage. Cut or pull back existing fiberglass batts two feet from the soffit and blow and dense pack the perimeter. Prepare floored areas or other restricted zones with existing insulation for high-density application.
6. Cellulose must be blown in site built attics unless circumstances warrant blown fiberglass. This use of fiberglass must be documented in the file

**5122 GHW-Wall Dense Packing**

1. Lead and asbestos safety procedures will be followed
2. Cavities will be free of hazards, intact, and able to support dense pack pressures
3. Drilling hazards (e.g., wiring, venting, fuel piping) will be located
4. Blocking will be installed around:
    a. All openings to inside crawl space and basement for fibrous material
    b. High temperature fire-rated materials
    c. Wiring and electrical hazards
    d. Heat sources
5. Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers
6. Interior will be masked and dust controlled during drilling when accessing from interior
7. Electricity supply will be confirmed and will support blowing machine power demand
8. Blowing machine pressure test will be performed with air on full, feed off, agitator running, and gate closed
    a. Hose outlet pressure will be at least 80 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up
9. Using fill tube, 100% of each cavity will be filled to a consistent density:
    a. Using the WxPro Audit Software to calculate the number of bags is the preferred method for determining the proper amount of material to be installed into an attic area at a given R-value.
    b. Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot
    c. Loose fiber glass material will be installed and will be specifically approved for air flow resistance to a minimum density of 1.5 to 2 pounds per cubic foot
10. Insulation density will be verified by bag count, core sampling, or infrared camera with the blower door at 50 pascals to prevent visible air movement using chemical smoke at 50 pascals of pressure difference

**5324 Rim Joist Insulation**

1. Rim Joist insulation must be a minimum of R-10.
2. Fiberglass, rigid, or foam insulation may be used for this application. Whichever is used must result in a Savings-to-Investment Ration equal to or greather than the current State-approved value.
3. If there is significant air leakage, the band or rim joist area must be properly sealed before the insulation is installed.
4. The insulation must be secured in a permanent manner.

**5325 Foundation Insulation**

1. Route any exhaust fans to the outside using damperd vents, smooth-bore rigid pipe, and an appropriate termination fixture.

2. If necessary, repair or replace exterior doors or door components to reduce air leakage. If necessary, replace all missing glass and repair or replace window components to reduce air leakage.

3. Foundation walls should be insulated so that no portion above grade is left uninsulated.

4. Fiberglass insulation must be covered with ½" drywall living areas.

5 .Mechanical fasteners must be used to secure perimeter insulation in a permanent manner.

6. Basement wall insulation must be a minimum of R-7.5 and exterior basement wall insulation must be a minimum of R-5

a. Where moisture is a problem in basements and an approved moisture mitigation technique is used to insulate the interior walls, an R-Value of 5 is acceptable.

7. Interior-wall installation

a. Stud out wall and insulate with fiberglass or use rigid insulation glued and fastened.

b .An alternative method for installing perimeter insulation is to attach metal-building insulation at the floor above the rim, so that the blanket extends from the floor above four feet down the foundation wall. It should be run horizontally in a continuous manner to eliminate as many seams as possible. The blanket may be slit at each floor joist to allow installation in a manner that minimizes gaps around the joist. The bottom of this fiberglass batt insulation should be air sealed to the wall with a strip of wood nailed to the foundation or by sealing the vinyl facing to the wall with adhesive caulk.

c. Other insulation types and methods may be used with the approval of the DCS.

8. Exterior-wall installation

a. Foundation insulation may be installed on the exterior, but this requires digging a one-foot deep trench around the foundation. If this method is used, the rigid insulation must be extruded polystyrene at least one-inch thick with an R-5 and it must be protected from sunlight and exterior mechanical damage by an appropriate rigid material.

## 6210 Storm Windows

1. Interior storm windows shall be installed whenever feasible in mobile homes.

2. Exterior storm windows shall be installed whenever feasible in site-built homes.

3 .A one half-inch to two-inch air space between the prime window and the installed storm window is preferred.

4. Storm windows shall be installed over single-pane windows, and according to cost-effectiveness as determined by the approved North Dakota energy audit software.

5. Allowable storm windows include:

   a. Rigid framed single- and double-strength glass.

   b. Rigid and flexible framed Plexiglas.

   c. Framed and unframed plastic "kits" with a minimum thickness of six mils.

6. Repairs to prime windows must be done to keep moisture out before an interior storm window may be installed over the prime window.

7. Storm windows must be securely fastened in place; installed straight, plumb, and level, and without distortion.

8. Storm windows may be installed as a replacement for non-repairable existing storm windows when determined to be cost-effective by the approved North Dakota energy audit program.

9. Metal storm windows should not come in contact with frames or fasteners constructed of dissimilar metals.

10. Subgrantee installed storm windows in kitchens; baths and other high moisture areas must be operable if they provide the only source of ventilation into the space.

1. Operable storm windows shall move freely.

## 6340 Door Replacements

1. Individual replacement doors may only be installed if the cost of the repair is justified by the approved audit software.
2. Pre-hung replacement doors may be installed if determined to be more cost-effective than the repair of the existing door and frame, or the installation of a door that is not pre-hung.
3. The cost of the purchase and installation of all hardware and the material associated with the replacement of a door must be included in the calculation of the SIR used to justify the door replacement.
4. Replacement doors may include one light (pane of glass) if the replaced door had one or more lights. The cost any other extra features must be borne by the client.