2. Health and Safety ......................................................... 1

2.01 Safe Work Practices ...................................................... 1

2.0100 Safe Work Practices ...................................................... 1

2.0100.1 Global Worker Safety ........................................... 1
  2.0100.1b – Hand Protection .............................................. 1
  2.0100.1c – Respiratory Protection ....................................... 2
  2.0100.1d – Electrical Safety ............................................... 5
  2.0100.1e – Carbon Monoxide ............................................... 8
  2.0100.1f – Protective Clothing ............................................ 9
  2.0100.1g – Confined Space Safety ...................................... 10
  2.0100.1h – Power Tool Safety ............................................. 12
  2.0100.1i – Chemical Safety ............................................... 13
  2.0100.1j – Ergonomic Safety ............................................. 14
  2.0100.1k – Slips, trips and falls ......................................... 15
  2.0100.1m – Heat and Thermal Stress .................................. 16
  2.0100.1o – Asbestos containing materials ................................ 17

2.0102 Insulation ..................................................................... 19

2.0102.1 Insulation Worker Safety ..................................... 19
  2.0102.1b – Asbestos containing materials .......................... 19

2.0106 Material Safety .............................................................. 21

2.0106.1 Material Selection, Labeling and Material Safety Data Sheets ............................................. 21
  2.0106.1c – Material Safety Data Sheets (SDSs) ........................ 21

2.0107 Basements and Crawl Spaces ...................................... 22

2.0107.3 Crawl Spaces – Debris Removal .............................. 22
  2.0107.3a – Debris Removal .................................................. 22
  2.0107.3b – Debris Disposal ............................................... 23

2.02 Combustion Safety .......................................................... 24

2.0201 Combustion Safety – General ...................................... 24

2.0201.2 Combustion Safety ................................................ 24
  2.0201.2c – CO Detection and Warning Equipment ................ 24

2.03 Safety Devices ............................................................... 26

2.0301 Combustion Safety Devices ...................................... 26

2.0301.1 Smoke Alarm ......................................................... 26
  2.0301.1b – Smoke Alarm (Battery Operated) ...................... 26

2.0301.2 Carbon Monoxide Alarm or Monitor ...................... 28
  2.0301.2b – CO Detection and Warning Equipment (Battery Operated) .......................... 28
# Table of Contents

2.04 Moisture.............................................................................................................. 29
  2.0403 Vapor Barriers .............................................................................................. 29

2.0403.2 Closed Crawl Spaces – Ground Moisture Barriers .................................. 29
  2.0403.2a – Material Integrity ................................................................................ 29
  2.0403.2b – Coverage ............................................................................................. 30
  2.0403.2c – Material Specification ......................................................................... 31
  2.0403.2d – Overlap Seams .................................................................................. 32
  2.0403.2e – Fastening ............................................................................................. 34
  2.0403.2f – Sealing Seams ..................................................................................... 36
  2.0403.2g – Air Barrier, Ground Moisture Barrier Penetrations (including fastener penetrations) ......................................................... 38

3 Air Sealing .................................................................................................................. 39

3.10 Attics .................................................................................................................... 39
  3.1001 Penetrations and Chases .............................................................................. 39

3.1001.1 Penetrations and Chases .............................................................................. 39
  3.1001.1b – Backing and Infill ............................................................................... 39
  3.1001.1c – Sealant Selection ............................................................................... 40
  3.1001.1d – High Temperature Application ............................................................. 42

3.1001.2 Chase Capping .............................................................................................. 44
  3.1001.2a – Pre-inspection ..................................................................................... 44
  3.1001.2b – Standard Chase (interior walls covered with drywall or plaster) ........ 46
  3.1001.2c – Non-Standard Chase (Interior Walls Covered With Wood or Paneling) ...................................................................................... 48
  3.1001.2d – Support ............................................................................................... 50
  3.1001.2e – Joint Seal ............................................................................................. 52
  3.1001.2f – Adjacent Framing ............................................................................... 54

3.1001.3 Walls Open to Attic .................................................................................... 56
  3.1001.3b – Sealing Methods ............................................................................... 56

3.1002 Open Stairwells ............................................................................................... 58
  3.1002.2 Stairwell to Attic – Door at Bottom with No Ceiling Above .................... 58
    3.1002.2b – Option 1: Bring Stairwell Inside .......................................................... 58
    3.1002.2c – Option 2: Keep Stairwell Outside ....................................................... 59

3.1002.3 Stairwell to Attic – Door at Top with Finished Ceiling Above .................... 60
    3.1002.3b – Bring Stairwell Inside ...................................................................... 60

3.1003 Dropped Ceilings and Soffits ........................................................................ 61
  3.1003.1 New Ceiling Below Original (Old Ceiling Intact or Repairable) ................. 61
    3.1003.1b – Sealing Methods ............................................................................... 61
    3.1003.1c – Support ............................................................................................. 64
3.1003.1d – Joint Seal ........................................................... 66
3.1003.1e – Adjacent Framing .............................................. 68

3.1003.2 Ceiling Leaks Not Repairable  
(No Air Barrier Above) ............................................... 70
3.1003.2c – Support .............................................................. 70
3.1003.2d – Joint Seal ........................................................... 72
3.1003.2e – Adjacent Framing ............................................... 74

3.1003.6 Dropped Soffits ................................................... 76
3.1003.6b – Soffit General ..................................................... 76
3.1003.6c – Option 1: Bring Soffit Inside (seal at top) .......... 77
3.1003.6d – Option 2: Leave Soffit Outside  
(seal at bottom or side) .............................................. 79
3.1003.6e – Soffits Containing non-IC Rated Recessed  
Lights ................................................................. 82

3.12 Windows and Doors ................................................... 83
3.1201 Maintenance, Repair and Sealing ................................ 83
3.1201.1 Double-Hung Wood Windows ........................... 83
3.1201.1b – Weather Stripping .............................................. 83
3.1201.1c – Sash Locks ......................................................... 84
3.1201.1d – Replacement Sills .............................................. 85
3.1201.3 Exterior Doors ..................................................... 87
3.1201.3b – Door Operation and Fit ...................................... 87
3.1201.3c – Air Infiltration ...................................................... 89
3.1201.3d – Water Infiltration ............................................... 93

3.1202 Repairing/Replacing Cracked and Broken Glass .......... 95
3.1202.1 Fixed Frame with Wood Sash (Older House) ..... 95
3.1202.1b – Broken Glass Removal ...................................... 95
3.1202.1c – Sash Preparation ............................................... 98
3.1202.1d – New Glass Installation ..................................... 100

3.14 Basements and Crawl Spaces ....................................... 103
3.1402 Crawl Spaces ............................................................... 103
3.1402.1 Crawl Spaces: Sealing Floor Penetrations ... 103
3.1402.1a – Backing and Infill .............................................. 103
3.1402.1b – Sealant Selection .............................................. 105
3.1402.1c – High Temperature Application ......................... 107
3.1402.2 Closed Crawl Spaces  
(Air Sealing Foundation Vents) ............................ 109
3.1402.2a – Vent Closure ................................................... 109
3.1402.3 Closed Crawl Spaces  
(Air Sealing Exterior Wall) ......................................... 110
3.1402.3a – Seal Penetrations .............................................. 110
3.1402.3b – Pest Exclusion ................................................... 112
# Table of Contents

3.1402.5 Closed Crawl Spaces – Attached Under Unconditional Spaces .......................................................... 114

3.1402.5b Entry Point .......................................................................................................................... 114

3.15 Attached Garages ...................................................................................................................... 115

3.1501 Garage Openings .................................................................................................................... 115

3.1501.1 Penetrations, Cracks and Doors Between Garage and House ........................................... 115

3.1501.1a – Penetrations .................................................................................................................... 115
3.1501.1b – Ductwork .......................................................................................................................... 116
3.1501.1c – Cracks .............................................................................................................................. 118
3.1501.1d – Garage to House Door .................................................................................................... 120
3.1501.1e – Glass ................................................................................................................................. 123
3.1501.1f – Carbon Monoxide (CO) Alarm ....................................................................................... 126
3.1501.1g – Occupant Education ....................................................................................................... 127

3.16 Ducts .......................................................................................................................................... 129

3.1601 Duct Preparation .................................................................................................................... 129

3.1601.3 Support ............................................................................................................................... 129

3.1602 Duct Sealing ............................................................................................................................ 132

3.1602.1 Air Sealing System Components ....................................................................................... 132

3.1602.4 Air Sealing System to Components .................................................................................. 134

3.1602.4a – Duct Boot to Interior Surface ....................................................................................... 134

4 Insulation ........................................................................................................................................ 136

4.10 Attics .......................................................................................................................................... 136

4.1001 General Preparation .................................................................................................................. 136

4.1001.1 Non-Insulation Contact (IC) Recessed Light ........................................................................ 136

4.1001.1a – Air Barrier System ........................................................................................................... 136
4.1001.1b – Enclosure Top .................................................................................................................... 138
4.1001.1c – Clearance ............................................................................................................................ 139
4.1001.1d – Sealants and Weather Stripping ....................................................................................... 140

4.1001.3 Fireplace Chimney and Combustion Flue Vents ................................................................ 141

4.1001.3a – Verify Attic Prep ............................................................................................................... 141
4.1001.3b – Required Clearance .......................................................................................................... 143
4.1001.3c – Safety .................................................................................................................................. 144
4.1001.3d – Occupant Education ........................................................................................................ 145

4.1001.4 Vented Eave or Soffit Baffles ............................................................................................. 146

4.1001.4a – Installation ......................................................................................................................... 146

4.1001.5 Dense Pack Preparation ...................................................................................................... 148

4.1001.5a – Preparation ......................................................................................................................... 148
4.1003 Attic Ceilings ................................................................. 149
  4.1003.1 Pitched / Vaulted / Cathedralized Ceilings –
    Loose Fill Over ............................................................. 149
    4.1003.1a – Ventilation .................................................... 149
    4.1003.1b – Lighting ............................................................ 149
    4.1003.1c – Installation ..................................................... 150
  4.1003.2 Pitched/Vaulted/Cathedralized Ceilings (Dense
    Pack Over) ................................................................ 151
    4.1003.2a – Fill Slant Ceilings .......................................... 151
  4.1003.4 Cape Code Side Attic Roof (Dense Pack
    Installation) ...................................................................... 152
    4.1003.4a – Vapor Barrier Removal .................................... 152
    4.1003.4b – Netting, Fabric, Rigid Sheathing ..................... 152
    4.1003.4c – Installation ..................................................... 153
  4.1003.5 Unvented Roof Deck (SPF Installation) .......... 154
    4.1003.5a – Installation ..................................................... 154
  4.1003.6 Vented Roof Deck (SPF Installation) ............. 155
    4.1003.6a – Installation ..................................................... 155

4.1004 Knee Walls ..................................................................... 156
  4.1004.1 Preparation for Dense Packing ................. 156
    4.1004.1a – Backing ............................................................ 156
    4.1004.1b – Installation ..................................................... 159
  4.1004.5 Knee Walls and Gable End Walls (Preparation
    for Installation of Spray Polyurethane Foam
    (SPF)) ........................................................................ 161
    4.1004.5a – Installation of Backing .................................. 161
    4.1004.5b – Installation ..................................................... 162

4.1005 Attic Floors ..................................................................... 163
  4.1005.2 Accessible Floors (Loose Fill Installation) .... 163
    4.1005.2a – Preparation ..................................................... 163
    4.1005.2b – Air Barrier ....................................................... 166
    4.1005.2c – Installation ..................................................... 168
    4.1005.2d – Onsite Documentation .................................. 170
  4.1005.4 Accessible Floors (Loose Fill Over Existing
    Insulation) .................................................................... 171
    4.1005.4a – Preparation ..................................................... 171
    4.1005.4b – Installation ..................................................... 172
    4.1005.4d – Onsite Documentation .................................. 173
  4.1005 Enclosed Bonus Room Floor Over
    Unconditioned Space (Dense Pack
    Insulation) .................................................................... 174
    4.1005.5a – Air Barrier ....................................................... 174
    4.1005.5b – Fill Floors ......................................................... 177
    4.1005.5c – Safety ............................................................... 179
    4.1005.5d – Onsite Documentation .................................. 180
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
</table>
| 4.1005.6 | Enclosed Attic Storage Platform Floor  
*(Dense Pack Insulation)* | 181 |
| 4.1005.6a | Fill Floors | 181 |
| 4.1005.6b | Safety | 181 |
| 4.1005.7 | Attic Floor (Preparation and Installation of SPF) | 182 |
| 4.1005.7a | Preparation | 182 |
| 4.1005.7b | Installation | 182 |
| 4.1005.7c | Safety | 183 |
| 4.1006 | Attic Openings | 184 |
| 4.1006.1 | Pull-Down Stairs | 184 |
| 4.1006.1a | Installation | 184 |
| 4.1006.1b | Sealing | 185 |
| 4.1006.2 | Access Doors and Hatches | 187 |
| 4.1006.2a | Installation | 187 |
| 4.1006.2b | Sealing | 189 |
| 4.1006.2c | Attachment | 191 |
| 4.1088 | Special Circumstances | 193 |
| 4.1088.1 | Attic Ventilation | 194 |
| 4.1088.1a | Air Barrier and Thermal Boundary | 194 |
| 4.1088.1b | Vent Type | 194 |
| 4.1088.1c | Vent Location | 195 |
| 4.1088.1d | Ventilation Baffling | 196 |
| 4.1088.1e | Ventilation Screens | 197 |
| 4.11 | Walls | 198 |
| 4.1101 | Preparation | 198 |
| 4.1101.1 | Exterior Wall Dense Packing | 198 |
| 4.1101.1a | Preparation | 198 |
| 4.1101.1b | Exterior Dense Pack | 199 |
| 4.1101.3 | Exterior Wall SPF (Masking and Surface Preparation) | 200 |
| 4.1101.3a | Surface Protection | 200 |
| 4.1101.3b | Substrate Repair | 200 |
| 4.1101.3c | Substrate Cleaning | 201 |
| 4.1101.4 | Exterior Wall SPF (Electrical System Considerations) | 202 |
| 4.1101.4a | Box Protection | 202 |
| 4.1102 | Accessible Walls | 203 |
| 4.1102.1 | Open Cavity Wall Insulation (General) | 203 |
| 4.1102.1a | Sealing | 203 |
| 4.1102.1b | Installation | 205 |
| 4.1102.1c | Pre-Drywall Verification | 207 |
| 4.1102.1d | Occupant Education | 208 |
# Table of Contents

4.1102.2 Open Cavity Wall SPF Installation .......................... 209  
4.1102.2a – Installation ........................................................ 209  
4.1102.2b – Vapor Retarders ............................................... 209  
4.1102.2c – Fire Protection .................................................. 210  

4.1103 Enclosed Walls .................................................................. 211  

4.1103 Dense Pack Exterior Walls ............................................. 211  
4.1103.1a – Exterior Dense Pack ........................................ 211  
4.1103.1b – Onsite Documentation ..................................... 214  

4.1103.2 Additional Exterior Wall Cavities ............................... 215  
4.1103.2e – Close Holes ...................................................... 215  

4.13 Floors ........................................................................ 218  

4.1301 Accessible Floors .......................................................... 218  

4.1301.2 Standard Floor System .............................................. 218  
4.1301.2a – Sealing ............................................................. 218  
4.1301.2b – Netting, Fabric ................................................... 220  
4.1301.2c – Installation ........................................................ 222  
4.1301.2d – Occupant Education .......................................... 224  

4.1301.4 Dense Pack Floor System with Rigid Barrier 225  
4.1301.4a – Sealing ............................................................. 225  
4.1301.4b – Rigid Air Barrier ................................................ 226  
4.1301.4c – Installation ........................................................ 229  
4.1301.4d – Occupant Education .......................................... 232  

4.1301.9 Open Floors Over Unconditioned Space and  
Cantilevered Floors, Floors Over Garages,  
Floors Over Unconditioned Crawl Spaces  
(Spray Polyurethane) ....................................... 233  
4.1301.9a – Preparation ...................................................... 233  
4.1301.9b – Installation ........................................................ 234  
4.1301.9c – Fire Protection .................................................. 235  
4.1301.9d – Onsite Documentation ..................................... 235  

4.14 Basements and Crawl Spaces ........................................... 236  

4.1401 Band/Rim Joists .......................................................... 236  

4.1401.1 Band/Rim Joists (SPF Installation) ......................... 236  
4.1401.1a – Preparation ...................................................... 236  
4.1401.1b – Installation ........................................................ 237  
4.1401.1c – Fire Protection .................................................. 238  

4.1401.2 Band/Rim Joists (Insulation Other Than  
SPF) ............................................................................ 239  
4.1401.2a – Preparation ...................................................... 239  
4.1401.2b – Insulation Installation ..................................... 239  

4.1402 Basements and Crawl Space Walls .............................. 238  

4.1402.1 Closed Crawl Spaces (Wall Insulation) .............. 240  
4.1402.1a – Insulation Selection ........................................ 240
Table of Contents

4.1402.1b – R-Value ............................................................ 240
4.1402.1d – Attachment ....................................................... 242

4.1402.2 Basement Wall Insulation
(No Groundwater Leakage) ........................................ 243

4.1402.2a – R-Value ............................................................ 243

4.16 Ducts .......................................................................... 245

4.1601 Insulating Ducts ............................................................ 245

4.1601.2 Insulating Metal Ducts ........................................ 245

4.1601.2a – Selection of Duct Insulation Material .......... 245
4.1601.2b – Duct Sealing ..................................................... 247
4.1601.2c – Attachment of Duct Insulation ..................... 249
4.1601.2d – Taping Of the Duct Insulation ....................... 250

4.99 Insulation – Additional Resources ......................... 251

4.9901 Materials ................................................................... 251

4.9901.1 General Information on SPF ............................... 251

4.9901.1a – Low Pressure SPF ........................................... 251
4.9901.1b – High Pressure SPF .......................................... 252
4.9901.1c – Manufacturer Installation Instructions .......... 253

6 Ventilation ...................................................................... 254

6.60 Exhaust ...................................................................... 254

6.6002 Components ................................................................. 254

6.6002.1 Ducts ................................................................. 254

6.6002.1a – Duct Design and Configuration ................. 254
6.6002.1b – Duct Insulation .............................................. 255
6.6002.1c – Duct Support .................................................... 256
6.6002.1d – Duct Connections ........................................... 259
6.6002.1e – Duct Materials .................................................. 262

6.6002.2 Terminations ..................................................... 264

6.6002.2a – Hole in Building Shell ................................. 264
6.6002.2b – Termination Fitting ....................................... 266
6.6002.2c – Duct to Termination Connection .................. 268
6.6002.2d – Weatherproof Installation ......................... 271
6.6002.2e – Pest Exclusion ................................................ 272
6.6002.2f – Termination Location .................................... 273
6.6002.2g – Kitchen Exhaust ........................................... 274
### Table of Contents

#### 6.6002.3 Exhaust Only Ventilation (Fan Intake Grille Location)
- 6.6002.3a – Primary Whole House Ventilation
- 6.6002.3b – Local Ventilation

#### 6.6003 Fans

#### 6.6003.1 Surface Mounted Ducted
- 6.6003.1a – Hole Through Interior Surface
- 6.6003.1c – Fan Mounting
- 6.6003.1d – Backdraft Damper
- 6.6003.1e – Duct to Fan Connection
- 6.6003.1f – Fan Housing Seal
- 6.6003.1g – Fan to Interior Surface Seal
- 6.6003.1h – Air Flow

#### 6.6003.2 Inline
- 6.6003.2a – Wiring
- 6.6003.2b – Access
- 6.6003.2c – Fan Mounting
- 6.6003.2d – Backdraft Damper
- 6.6003.2e – Duct Connections
- 6.6003.2f – Boot to Interior Surface
- 6.6003.2g – Air Flow

#### 6.6003.3 Through the Wall
- 6.6003.3a – Hole in Building Shell
- 6.6003.3c – Fan Mounting
- 6.6003.3d – Weatherproof Installation
- 6.6003.3e – Backdraft Damper
- 6.6003.3f – Fan Housing Seal
- 6.6003.3g – Fan to Interior Surface Seal
- 6.6003.3h – Insulation
- 6.6003.3i – Air Flow

#### 6.6005 Appliance Exhaust Vents

#### 6.6005.1 Clothes Dryer
- 6.6005.1a – Clothes Dryer Ducting
- 6.6005.1b – Termination Fitting

#### 6.6005.2 Kitchen Range
- 6.6005.2b – Fan Venting
- 6.6005.2c – Fan Ducting
- 6.6005.2d – Termination Fitting

#### 6.62 Air Flow

#### 6.6201 Air Flow Requirements

#### 6.6201.2 Primary Ventilation Air Flow Between Rooms
2. Health and Safety

2.01 Safe Work Practices

2.0100 Safe Work Practices

2.0100.1 Global Worker Safety

2.0100.1b – Hand Protection

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

Durable and wrist-protecting gloves will be worn that can withstand work activity

Objective(s):

Minimize skin contact with contaminants  Protect hands from hazards

Inspect gloves for holes and damage to minimize risk

GOOD: Wear nitrile gloves when handling mastic

Wear appropriate hand protection

Satisfies SWS
2.0100.1c – Respiratory Protection

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
- 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)
- 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
- When applying high-pressure SPF insulation, supplied air respirators (SARs) will be used
- Consult SDS for respiratory protection requirements
- OSHA 1910.134 shall be followed for the implementation of a respiratory protection program

Objective(s):
Minimize exposure to airborne contaminants (e.g., insulation materials, mold spores, feces, bacteria, chemicals)

Workers need to properly protect their airways when retrofitting

Retrofits can have multiple different respiratory protection requirements

Satisfies SWS
2.0100.1c – Respiratory Protection

Whenever airborne contaminants are a possibility, wear an N-95 mask

All P-100s should be fitted to the individual worker

When unsure what level of protection is necessary, check the SDS
2. Health and Safety

2.0100.1c – Respiratory Protection

When working with high-pressure spray foam, use a Supplied Air Respirator

For two-component spray insulation, P-100 respirators should be used
2. Health and Safety

2.0100.1d – Electrical Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- An electrical safety assessment will be performed
- All electric tools will be protected by ground-fault circuit interrupters (GFCI)
- Three-wire type extension cords will be used with portable electric tools
- Worn or frayed electrical cords will not be used
- Water sources (e.g., condensate pans) and electrical sources will be kept separate
- Metal ladders will be avoided
- Special precautions will be taken if knob and tube wiring is present
- Aluminum foil products will be kept away from live wires
- For arc flash hazards, NFPA 70E will be consulted

Objective(s):

Avoid electrical shock and arc flash hazards
2.0100.1d – Electrical Safety

Any fixture, ballast, line voltage control, receptacle, or circuit modification will be performed by a licensed electrical professional in accordance with ANSI American National Standards Institute, www.ansi.org NFPA National Fire Protection Association, www.nfpa.org

All workers will comply with ANSI American National Standards Institute, NFPA National Fire Protection Association, www.nfpa.org

All OSHA U.S. Occupational Safety and Health Administration, www.osha.gov standard practices will be followed.

Unsafe

Inspect house for unsafe electrical situations

Safe

Attics and crawl spaces should be inspected closely for electrical safety before work begins
2. Health and Safety

2.0100.1d – Electrical Safety

- Use fiberglass ladders in place of metal
- Electrical wiring should not be located near a water source
- Recognize if knob and tube wiring is present and take special precautions
- Use GFCIs and three-wire extension cords for all power tools
- Follow NFPA 70E 2012 guidelines for arc flash hazards
2. Health and Safety

2.0100.1e – Carbon Monoxide

Desired Outcome:
Work completed safely without injury or hazardous exposure

Specification(s):
- All homes will have a carbon monoxide alarm
- 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)

Objective(s):
Protect worker and occupant health

Tools:
- CO meter

Unsafe
STOP WORK if CO levels are higher than 35ppm!!

Best Practice
Install carbon monoxide alarms
2. Health and Safety

2.0100.1f – Protective Clothing

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- SDSs and OSHA regulations will be consulted for protective clothing and equipment and protective clothing would be worn if contaminants are present (e.g., insulation materials)
- Eye protection will always be worn (e.g., safety glasses, goggles if not using full-face respirator)

Objective(s):

Protect worker from skin contact with contaminants Minimize spread of contaminants. Provide eye protection

Bad Practice

Workers should be aware of work required and dress appropriately

After

Ensure workers have proper protective equipment for work environment
2. Health and Safety

2.0100.1g – Confined Space Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- Spaces with limited ingress and egress and restricted work area will be considered confined space
- Access and egress points will be located before beginning work
- Inspection will be conducted for hazards, such as damaged or exposed electrical conductors, mold, sewage effluent, friable asbestos or fiberglass, pests, and other potential hazards
- Adequate ventilation will be provided
- Use of toxic material will be reduced

Objective(s):

- Prevent build-up of toxic or flammable contaminants
- Reduce risk to the workers in the confined space
- Provide adequate access and egress points
- Prevent electrical shock

Perform visual inspection of confined spaces before beginning work
2.0100.1g – Confined Space Safety

Locate all access and egress points of confined spaces before entering

Check for frayed or worn electrical wires

In confined spaces, use a ventilator

Check GHS labels and Safety Data Sheets for all materials to minimize hazards
2. Health and Safety

2.0100.1h – Power Tool Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- 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. All tools must be maintained in proper operating condition with all guards securely in place.
- All devices used will be verified as GFCI protected or double insulated.
- Exhaust gases from compressors and generators will be prevented from entering interior space.

Objective(s):

- Prevent power tool injuries
- Prevent buildup of toxic or flammable contaminants

Unsafe
This saw blade must be covered with a guard to prevent injury from the cutting blade and flying particles.

Safe
Manufacturer's safety features are in place; blade guard, dust bag, grounded plug.
2.0100.1i – Chemical Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- Hazardous materials will be handled in accordance with manufacturer specifications, SDS and OSHA standards to eliminate hazards associated with volatile organic compounds (VOCs), sealants, insulation, contaminated drywall, dust, foams, asbestos, lead, mercury, and fibers
- Appropriate personal protective equipment (PPE) will be provided
- Workers will be trained on how to use PPE
- Workers will be expected to always use appropriate PPE during work

Objective(s):

Prevent worker exposure to toxic substances

Best Practice

Keep SDS on site for reference
Always employ appropriate PPE
2. Health and Safety

2.0100.1j – Ergonomic Safety

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- Appropriate PPE will be used (e.g., knee pads, bump caps, additional padding)
- Proper equipment will be used for work
- Proper lifting techniques will be used

Objective(s):

Prevent injuries from awkward postures, repetitive motions, and improper lifting

Unsafe

Workers will take precautions to protect themselves on the job site

Best Practice

Hard hats, knee pads, bump caps, and team lifts help to prevent injury
2. Health and Safety

2.0100.1l – Slips, trips and falls

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

• Caution will be used around power cords, hoses, tarps, and plastic sheeting
• Precautions will be taken when ladders are used, when working at heights, or when balancing on joists
• Walk boards will be used when practical
• When scaffolding is used, manufacturer set-up procedures will be followed
• Appropriate footwear and clothing will be worn

Objective(s):

Prevent injuries due to slips, trips, and falls

You can prevent injuries; be aware of and correct slip, trip and fall hazards
2. Health and Safety

2.0100.1m – Heat and Thermal Stress

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- Ensure staff is aware of risks during extreme weather including the symptoms of heat stroke, heat exhaustion, and hypothermia
- Appropriate ventilation, hydration, rest breaks, and cooling equipment will be provided
- 911 will be dialed when necessary

Objective(s):

Prevent heat stroke, heat stress, and cold stress related injuries

*Attics and crawl spaces can be dangerous work places in the heat*

*Keep workers comfortable with hydration and cool vests*
2. Health and Safety

2.0100.1o – Asbestos containing materials

Desired Outcome:

Work completed safely without injury or hazardous exposure

Specification(s):

- 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
- If suspected ACM is in good condition, do not disturb
- If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)
- 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
- When working around ACM, do not:
  - Dust, sweep, or vacuum ACM debris
  - Saw, sand, scrape, or drill holes in the material
  - Use abrasive pads or brushes to strip materials
- 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

Objective(s):

Protect workers and occupants from potential asbestos hazards
2. Health and Safety

2.0100.1o – Asbestos containing materials

*Do not dust, sweep or vacuum suspected ACM debris*

*Do not saw, sand, scrape, or drill holes in suspected ACM*
2. Health and Safety

2.0102 Insulation
2.0102.1 Insulation Worker Safety

2.0101.1b – Asbestos containing materials

Desired Outcome:

Work is completed safely without injury or hazardous exposure

Specification(s):

- OSHA asbestos abatement protocol 29 CFR 1926.1101 will be followed if vermiculite insulation is present
- 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
- If suspected ACM is in good condition, do not disturb
- If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s)
- 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
- When working around ACM, do not:
  - Dust, sweep, or vacuum ACM debris
  - Saw, sand, scrape, or drill holes in the material
  - Use abrasive pads or brushes to strip materials
- 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

Objective(s):

Protect workers and occupants from potential asbestos hazards
2.0101.1b – Asbestos containing materials

If asbestos is suspected, call an EPA-accredited professional

Material identified as vermiculite may contain asbestos

Do not disturb vermiculite by vacuuming, dusting, or sweeping
2. Health and Safety

2.0106 Material Safety
2.0106.1 Material Selection, Labeling and Material Safety Data Sheets

2.0106.1c – Material Safety Data Sheets (SDSs)

Desired Outcome:
Occupant and worker risk from hazardous materials minimized

Specification(s):
SDSs will be provided onsite and available during all work

Objective(s):
- Assess exposure risk
- Prepare a response in case of emergency

Best Practice

*Keep SDS on site and easily accessible.*
2. Health and Safety

2.0107 Basements and Crawl Spaces
2.0107.3 Crawl Spaces – Debris Removal

2.0107.3a – Debris Removal

Desired Outcome:
Clean, safe, and easily accessible crawl space created

Specification(s):

- Under-floor grade will be removed of all vegetation and organic material
- Debris that can cause injury or puncture ground covers (e.g., nails, glass, sheet metal screws, etc.) will be removed from the crawl space

Objective(s):

- Minimize punctures in ground liner
- Minimize habitat for pests (Integrated Pest Management—IPM) and contaminant sources

Tools:

- Tools needed to remove debris that could damage ground cover.
- PPE

Clear crawl spaces of trash and overgrowth for safety and ground cover longevity
2. Health and Safety

2.0107.3b – Debris Disposal

Desired Outcome:
Clean, safe, and easily accessible crawl space created

Specification(s):
Debris will be properly disposed of according to type and jurisdiction

Objective(s):
Protect environment from damage

Best Practice

*The Weatherization Technician is properly bagging the damaged fiberglass for removal from the job site*
2.02 Combustion Safety

2.0201 Combustion Safety – General

2.0201.2 Combustion Safety

2.0201.2c – CO Detection and Warning Equipment

Desired Outcome:

Buildup of dangerous combustion byproducts in the living space prevented

Specification(s):

- 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
- Installation will be accomplished by a licensed electrician when required by local code

Objective(s):

Alert occupant to CO exposure

Materials:

- CO alarm
- Fasteners

Tools:

- Drill
2.0201.2c – CO Detection and Warning Equipment

CO alarms are required in all homes where none currently exist, or existing alarms do not function. Per WPN 17-07, full compliance with ASHRAE 62.2.2016 and NFPA 720 is required.

**Best Practice**

*Carbon Monoxide alarms should be installed according to local codes*

*Alarms should be mounted near sleeping areas—such as the one marked in red*
2. Health and Safety

2.03 Safety Devices

2.0301 Combustion Safety Devices

2.0301.1 Smoke Alarm

2.0301.1b – Smoke Alarm (Battery Operated)

Desired Outcome:
Properly installed smoke alarms

Specification(s):
When installing battery operated smoke alarms, it will be installed in accordance with manufacturer specifications

Objective(s):
Ensure proper installation

Materials:
Install UL/ANSI/NFPA approved smoke alarms.

Best Practice
All homes should have UL-217 rated smoke alarms
2. Health and Safety

2.0301.1b – Smoke Alarm (Battery Operated)

Install smoke alarms per NFPA 72 National Fire Alarm and Signaling Code and per Manufacturer's specifications.

Smoke alarms Paraphrased from 2015 IRC R314: Smoke alarms will be permitted to be battery operated when installed in buildings without commercial power or when alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure to provide access for hard-wiring, unless there is an attic, crawl space, or basement available which could provide access.

Ceiling mounted smoke alarms can be battery-operated

Wall mounted smoke alarms must be mounted within 12
2. Health and Safety

2.0301.2 Carbon Monoxide Alarm or Monitor

2.0301.2b – CO Detection and Warning Equipment (Battery Operated)

Desired Outcome:

Properly installed CO alarms or monitors

Specification(s):

Battery operated CO detection or warning equipment will be installed in accordance with ASHRAE and manufacturer specifications as required by the authority having jurisdiction

Objective(s):

Ensure proper installation

Before

Houses should have carbon monoxide monitors installed near sleeping areas

After

Battery operated CO alarms should be UL-2075 or UL-2034 compliant

CO alarms are required in all homes where none currently exist, or existing alarms do not function. Compliance with ASHRAE 62.2.2016 and NFPA 720 is required.
2. Health and Safety

2.04 Moisture

2.0403 Vapor Barriers

2.0403.2 Closed Crawl Spaces – Ground Moisture Barriers

2.0403.2a – Material Integrity

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

Care will be taken to prevent punctures during installation

Objective(s):

Protect ground moisture barrier from damage during other crawl space work
2. Health and Safety

2.0403.2b – Coverage

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

- An air barrier and ground moisture barrier, covering the exposed crawl space floor, will be installed and sealed to the wall's air and moisture barrier in accordance with ASTM E1643 and manufacturer's recommendations
- Ground moisture barrier will be fastened to ground in accordance with manufacturer's recommendations and extend a minimum of 6 inches up the foundation wall

Objective(s):

- Reduce ground moisture entering the crawl space
- Create a continuous and durable connection between the wall and ground air and moisture barriers

Materials:

- Plastic sheeting (at least 6 mil)
- Fasteners
- Furring strips

Uncovered crawl space floors can lead to moisture issues

Ground moisture barrier should cover 100% of floor and at least 6" of
2. Health and Safety

2.0403.2c – Material Specification

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

- A ground moisture barrier with a rating of no more than 0.1 perm will be used
- A ground moisture barrier will be used that meets tear and puncture resistance standard ASTM E1745
- Homeowner will be advised that all plastic is biodegradable and will have a life span much shorter than the home, and it will need replacing to remain effective

Objective(s):

- Reduce ground vapor entering the crawl space
- Ensure crawl space is accessible for service and maintenance without destroying the integrity of the moisture barrier

Materials:

- Plastic sheeting (at least 6 mil)
- Furring strip
- Fasteners

The higher a material's perm rating, the more vapor can pass through said material. Drywall typically has a perm rating of approximately 50. For vapor retarders in basements and crawl spaces, SWS calls for materials with a perm rating of <0.5 (which translates to 4mil or thicker). From 2007 IRC

Definition of vapor retarders: Class I: ≤ 0.1 perm (called impermeable), Class II: 0.1 to 1.0 perm (called semi-impermeable), Class III: 1.0 perm to 10 perms (called semi-permeable).
2. Health and Safety

2.0403.2d – Overlap Seams

Desired Outcome:

Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):

- When seams exist, they will be overlapped a minimum of 12" with reverse or upslope lapping technique
- For wall to floor connection, the wall moisture barrier will be installed under the ground moisture barrier

Objective(s):

Keep water under the liner

Tools:

- Stapler
- Utility knife
- Drill

Materials:

- Ballast
- Plastic sheeting (at least 6 mil)
- Furring strips
- Moisture-resistant adhesive tape

Before

Ground moisture barriers help keep moisture from permeating floor

After

Ground moisture barrier overlaps at least 12 in and is securely fastened
2. Health and Safety

2.0403.2d – Overlap Seams

1. Securely fasten moisture barrier to wall at least 6 inches from ground

2. Overlap seams at least 12 inches, using a shingle method to keep water out
2.0403.2e – Fastening

Desired Outcome:
Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):
When ground moisture barrier is installed on sloping ground, or accessed for routine maintenance or storage it will be fastened to ground with durable fasteners or ballast(s)

Objective(s):
Prevent movement and uplift of the air barrier and ground moisture barrier

Tools:
- Drill
- Stapler

Materials:
- Plastic sheeting (at least 6 mil)
- Furring strips
- Fasteners

When using SPF, bring vapor barrier up and seal behind
2.0403.2e – Fastening

Moisture barrier needs to be held in place with more permanent fasteners

Ballast or fasteners should be used to hold barrier in place securely
2.0403.2f – Sealing Seams

Desired Outcome:
Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):
A durable sealant compatible with the air barrier and ground moisture barrier will be used

Objective(s):
Maintain continuous air barrier and ground moisture barrier

Materials:
Moisture-resistant adhesive tape

Tools:
- Utility knife

Before
Crawl spaces lacking moisture barrier risk moisture penetration of floor

After
Ground moisture barriers in unvented spaces should be sealed
2. Health and Safety

2.0403.2f – Sealing Seams

Tape wall seams and press to ensure airtight bonding of adhesive

Tape (overlapped) floor seams to prevent movement and water leakage
2. Health and Safety

2.0403.2g – Air Barrier, Ground Moisture Barrier Penetrations (including fastener penetrations)

Desired Outcome:
Durable, effective air barrier and ground moisture barrier provide ongoing access and minimize ground vapor

Specification(s):
- A durable sealant, compatible with the air barrier and ground moisture barrier, will be used. Physical attachments will be provided where practical (e.g., masonry columns, footings).
- Remove debris to allow vapor retarder to lay as flat as practical. Overlap seams of adjacent sheets 6" and extend 6" up walls/piers to achieve a continuous layer. Care will be taken to prevent punctures during installation.

Objective(s):
Maintain continuous air barrier and ground moisture barrier

Materials:
- Plastic sheeting (at least 6 mil) or 45 mil EPDM
- Material compatible sealant or tape
- Necessary fasteners

Before After
3. Air Sealing

3.10 Attics

3.1001 Penetrations and Chases

3.1001.1 Penetrations and Chases

3.1001.1b – Backing and Infill

Desired Outcome:
Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space.

Specification(s):
- Backing or infill will be provided as needed to meet the specific characteristics of the selected material and the characteristics of the hole.
- The infill or backing will not bend, sag, or move once installed.

Objective(s):
- Minimize hole size to ensure successful use of sealant.
- Ensure closure is permanent and supports any load (e.g., wind, insulation). Ensure sealant does not fall out.

Refer to Maine Task Specifications, Joint Sealers, Caulking and Sealants: Caulking, Acrylic Latex Based, Silicone Based, High Temperature, Caulking Foam Can and Sprayed Foam, Closed Cell.
3. Air Sealing

3.1001.1c – Sealant Selection

Desired Outcome:

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):

- Sealants will be compatible with their intended surfaces
- 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

Objective(s):

- Select permanent sealant
- Ensure sealant meets or exceeds the performance characteristics of the surrounding materials

Spray foam can be used to span gaps up to 3 inches

Caulking can be used to span gaps up to 1/4 inch
3.1001.1c – Sealant Selection

Refer to Maine Task Specifications, Joint Sealers, Caulking and Sealants: Caulking, Acrylic Latex Based, Silicone Based, High Temperature, Caulking Foam Can and Sprayed Foam, Closed Cell.

Also check manufacturer specs for incompatibility with intended surfaces.

Check manufacturer specifications to verify spanning capabilities.

Attic air sealing caulk and foam.
3. Air Sealing

3.1001.1d – High Temperature Application

Desired Outcome:

Penetrations and chases sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):

Only non-combustible sealant will be used in contact with chimneys, vents, and flues. Local codes will be referenced.

Objective(s):

Prevent a fire hazard

Tools:

- Drill/screwdriver
- Caulk gun
- Metal snips

Materials:

- High-temperature caulking
- 26-gauge steel sheeting

Installation must comply with applicable code for Maine: IRC R302.11

Fire blocking. In combustible construction, fire blocking shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space. 4. At openings around vents, pipes, ducts, cables and wires at ceiling and floor level, with an approved material to resist the free passage of flame and products of combustion.
3. Air Sealing

3.1001.1d – High temperature application

1. Prepare work area by removing any insulation and debris

2. Use high-temperature caulking (600°F min)

3. Apply first ring of caulking to match shape of opening

4. Apply second ring of caulking to size and shape of rigid material

5. Fasten rigid material (26-gauge steel) and apply additional caulking

6. Fasten rigid material to cover penetration and seal against flue with caulk
3. Air Sealing

3.1001.2 Chase Capping

3.1001.2a – Pre-inspection

**Desired Outcome:**

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**

An inspection will be conducted for mold, water leaks, and water damage before sealing a chase. Repairs will be completed before work begins.

**Objective(s):**

Repair moisture-related issues

**Tools:**

- Flashlight
- Headlamp
- Bammer
- Prybar
- Circular saw
- Reciprocating saw
- Borescope
- Mirror

Removing the batt over this chimney chase provided access to see a large hole and water damage in the chimney wall.
3. Air Sealing

3.1001.2a – Pre-inspection

1. Locate and expose chases to prepare for inspection and capping/sealing

2. Clear away insulation and debris to allow inspection

3. Carefully investigate areas with high potential for water leaks
3. Air Sealing

3.1001.2b – Standard Chase (interior walls covered with drywall or plaster)

Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):

- Entire opening will be spanned with rigid material
- Material will be cut to fit and fastened as required

Objective(s):

Reduce opening to what can be sealed with sealant

Tools:

- Drill/screwdriver
- Caulk gun

Materials:

- XPS
- Drywall
- Caulk
- Sheet metal
- OSB or plywood

Applicable to all walls open to attic, balloon framing and double walls
3. Air Sealing

3.1001.2b – Standard chase (interior walls covered with drywall or plaster)

1. Clear area of debris and insulation in preparation for work
2. Apply sealant all the way around opening
3. Trim rigid material, such as drywall or XPS, to size and place over sealant
4. Fasten rigid material appropriately, such as with screws
3. Air Sealing

3.1001.2c – Non-Standard Chase (Interior Walls Covered With Wood or Paneling)

**Desired Outcome:**
Chase capped to prevent air leakage and moisture movement between the attic and conditioned space.

**Specification(s):**
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 2012 IRC R302.9.

**Objective(s):**
Prevent a fire hazard.

**Materials:**
- Drywall
- "Thermax" fire-rated rigid insulation
- Fire-block sealant
- Fasteners

**Tools:**
- Drywall saw
- Tape measure
- Caulk gun
- Drill

Sealing with drywall or Thermax reduces overall combustibility of paneled chases.
3. Air Sealing

3.1001.2c – Non-Standard Chase (Interior Walls Covered With Wood or Paneling)

Applicable to all walls open to attic, balloon framing and double walls.

Paneled drop soffits typically are more combustible than plain drywall

When sealing on attic side, drywall and Thermax are viable material
3. Air Sealing

3.1001.2d – Support

**Desired Outcome:**
Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**
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)

**Objective(s):**
Ensure seal stays in place and does not sag

**Tools:**
- Drill
- Saw
- Tape measure

**Materials:**
- Lumber
- Drywall or other approved rigid material
- Fasteners
- Caulking or other appropriate sealants

Applicable to all walls open to attic, balloon framing and double walls.
3. Air Sealing

3.1001.2d – Support

1. Create bracing to support spans larger than 24”, either from above or below.

2. When supporting from above, apply adhesive between drywall and bracing.

3. Bracing can be screwed to drywall before capping chase.

4. Ensure new bracing is secure by using screws to fasten to joist.

5. Once chase is capped, it is now ready to be sealed along framing.
3. Air Sealing

3.1001.2e – Joint Seal

**Desired Outcome:**
Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

**Objective(s):**
Provide airtight, durable seal that does not move, bend, or sag

**Tools:**
- Spray foam gun
- Caulk gun

**Materials:**
- Spray foam
- Caulk

*Before*
Chases need to be capped and sealed to prevent leakage

*After*
Chase is sealed along all cracks, gaps, and penetrations
3.1001.2e – Joint Seal

Applicable to all walls open to attic, balloon framing and double walls. Always wear protective gloves when working with sealants.

1. Chase has been capped but needs to be sealed
2. Sealant is used to fill in all cracks and gaps along edges of chase cap
3. Cap is sealed
3. Air Sealing

3.1001.2f – Adjacent Framing

Desired Outcome:

Chase capped to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):

All remaining gaps at the top of the chase will be sealed

Objective(s):

Ensure airtight seal from one finished side of the chase to the other

Tools:

- Spray foam gun
- Caulk gun

Materials:

- Spray foam
- Caulk

Before

Chases need to be capped and sealed to prevent leakage

After

Chase is sealed along all cracks, gaps, and penetrations
3.1001.2f – Adjacent Framing

Applicable to all walls open to attic, balloon framing and double walls.

1. Sealant is used to fill in all cracks and gaps along edges of chase cap

2. Extend seal along adjacent framing
3. Air Sealing

3.1001.3 Walls Open to Attic

3.1001.3b – Sealing Methods

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
- Entire opening will be spanned with rigid material in line with the ceiling level. Material will be cut to fit and fastened as required OR
- Wall below openings will be dense packed OR
- Wall below openings will be bridged and sealed with spray polyurethane foam (SPF)
- Sealants will be used that prevent air movement and verified using IR scans at 50 pascals of pressure difference when Delta T is within the range of the specific thermal imager being used. If IR is not feasible, use blower door testing at 50pascal with reference to an air sealing target to evaluate effectiveness.

Objective(s):
Prevent air leakage from wall cavity to attic

Materials:
- Drywall
- XPS
- Caulk
- Fasteners
- Dense packable insulation
- Lumber

Tools:
- Utility knife
- Saw
- Insulation machine
- Caulk gun
- Spray foam gun

Wall cavities are open to attic
3. Air Sealing

3.1001.3b – Sealing Methods

Spray polyurethane is not an approved duct sealant and should not be used.

Option 1: Dense pack cavities through wood cap fastened in place

Option 2: Bridge cavities with spray foam

Option 3, Step 1: Apply sealant around opening and on surrounding framing

Option 3, Step 2, Option A: Cap with XPS and seal exposed joints

Option 3, Step 2, Option B: Cap with drywall and seal exposed joints
3. Air Sealing

3.1002 Open Stairwells

3.1002.2 Stairwell to Attic – Door at Bottom with No Ceiling Above

3.1002.2b – Option 1: Bring Stairwell Inside

Desired Outcome:

Stairwell sealed to prevent air leakage and moisture movement between the attic and the conditioned space

Specification(s):

- 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 OR
- Airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter
- Access will be gained as needed (e.g., pull flooring)

Objective(s):

- Prevent air leakage through stairwell between conditioned space and attic
- Ensure the insulated panel is lightweight and easy for the occupant to use on an ongoing basis
- Support insulation
- Bring the stairwell inside of the thermal boundary
- Ensure the new closure ties into the existing air barrier on all sides
3. Air Sealing

3.1002.2c – Option 2: Keep Stairwell Outside

Desired Outcome:
Stairwell sealed to prevent air leakage and moisture movement between the attic and the conditioned space

Specification(s):
- An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors OR
- All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)
- Door will be weatherstripped and insulated OR
- A combination of the above methods can be used

Objective(s):
- Prevent air leakage
- Provide continuous thermal boundary Maximize thermal performance
3. Air Sealing

3.1002.3 Stairwell to Attic – Door at Top with Finished Ceiling Above

3.1002.3b – Bring Stairwell Inside

Desired Outcome:

Stairwell is sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):

- An airtight seal will be provided between level of new closure or cap and interior ceiling around perimeter
- Access will be gained as needed (e.g., pull flooring) OR
- An air barrier will be created and insulation material will be continuously installed across all surfaces of stairwell, including weather-stripped and insulated doors OR
- All cavities between stairs and conditioned space will be insulated and tested to resist air flow (e.g., walls, floors, landings, under stairs)
- Door will be weatherstripped and insulated OR
- A combination of the above methods can be used

Objective(s):

- Reduce air leakage
- Provide continuous thermal boundary Maximize thermal performance
3. Air Sealing

3.1003 Dropped Ceilings and Soffits
3.1003.1 New Ceiling Below Original – Old Ceiling Intact or Repairable

3.1003.1b – Sealing Methods

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
- Entire opening will be spanned with rigid material in line with the ceiling level. Material will be cut to fit and fastened as required OR
- Side of stud bays will be sealed with rigid material from bottom of dropped ceiling to top-plate OR
- Wall below openings will be dense packed OR
- Wall below openings will be bridged and sealed with SPF
- Sealing will prevent air movement and will be verified using IR camera scan with blower door at 50pa when Delta T is within the range of the specific thermal imager being used. If Delta T is not sufficient, blower door test result at 50pa will be compared to an air sealing target to evaluate effective air sealing.

Objective(s):
Prevent air leakage from dropped ceiling to attic

Materials:
- Caulk sealant
- Rigid material -- XPS or Drywall
- Spray foam
- Fasteners
- Dense packable insulation
- Wrapped fiberglass batts

Tools:
- Utility knife
- Saw
- Drill
- Insulation machine
- Caulk gun and spray foam gun
- Tape measure
3. Air Sealing

3.1003.1b – Sealing Methods

Damage to an older ceiling reveals the new ceiling below

Rigid material sealed in place creates an air barrier
3. Air Sealing

3.1003.1b – Sealing Methods

Option 1, Step 1: Run a bead of sealant around damage in old ceiling

Prepare work area by removing existing insulation and debris

Option 1, Step 2: Cover openings with rigid material, either XPS or drywall

Option 2: Seal with rigid material along face of stud cavities

Option 3: Dense pack cavities through fastened wood plate

Option 4: Bridge cavities at new ceiling level with wrapped batts and SPF
3. Air Sealing

3.1003.1c – Support

**Desired Outcome:**

Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

**Specification(s):**

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)

**Objective(s):**

Ensure seal stays in place and does not sag

**Tools:**

- Saw
- Drill
- Tape measure

**Materials:**

- Lumber
- Drywall
- Fasteners

---

**Before**

Spans greater than 24 inches require additional bracing before capping

**After**

Support should prevent cap from sagging or moving
3. Air Sealing

3.1003.1c – Support

Create bracing to support spans larger than 24", either from above or below.

Ensure new bracing is secure by using screws to fasten to joist.

Bracing can be screwed to drywall before capping chase.

When supporting from above, apply adhesive between drywall and bracing.

Once chase is capped, it is now ready to be sealed along framing.
3. Air Sealing

3.1003.1d – Joint Seal

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Tools:
- Spray foam gun
- Caulk gun

Materials:
- Caulk
- Spray foam

Before
Damage to an old ceiling reveals a newer ceiling below

After
No gaps should remain after sealant is applied
3. Air Sealing

3.1003.1d – Joint Seal

Apply sealant to surrounding surfaces before setting cap in place

Sealant should extend along joists and into seams at top plates
3. Air Sealing

3.1003.1e – Adjacent Framing

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
- All remaining gaps will be sealed at the top of the dropped ceiling
  OR
- All remaining gaps at the top of the chase will be sealed

Objective(s):
Provide airtight framing from one finished side of the dropped ceiling to the other

Materials:
- Spray foam
- Caulk sealant
- Sheetrock
- Drywall tape
- Joint compound

Tools:
- Caulk gun
- Spray foam gun
- Sheetrock knife
- Mudding tools

Before
Damage to an old ceiling reveals a newer ceiling below

After
No gaps should remain after sealant is applied
3. Air Sealing

3.1003.1e – Adjacent Framing

1. Caulk along all joists before setting cap

2. Use sealant to fill all remaining gaps

Satisfies SWS
3. Air Sealing

3.1003.2 Ceiling Leaks Not Repairable – No Air Barrier Above

3.1003.2c – Support

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
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)

Objective(s):
Ensure seal stays in place and does not sag

Tools:
• Drill
• Saw
• Tape measure

Materials:
• Lumber
• Drywall
• Fasteners

Spans greater than 24 inches require additional bracing before capping

Support should prevent cap from sagging or moving
3. Air Sealing

3.1003.2c – Support

Create bracing to support spans larger than 24”, either from above or below.

Ensure new bracing is secure by using screws to fasten to joist.

Bracing can be screwed to drywall before capping chase.

When supporting from above, apply adhesive between drywall and bracing.

Once chase is capped, it is now ready to be sealed along framing.
3. Air Sealing

3.1003.2d – Joint Seal

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
Continuous seal will be installed around seams, cracks, joints, edges, penetrations, and connections

Objective(s):
Provide airtight, durable seal that does not move, bend, or sag

Materials:
- Spray foam
- Caulk

Tools:
- Caulk gun
- Spray foam gun

Dropped soffits need to be capped and sealed to prevent leakage

No gaps should remain after sealant is applied
3.1003.2d – Joint Seal

Apply sealant to surrounding surfaces before setting cap in place

Sealant should extend along surround joist and into seams at top plates
3. Air Sealing

3.1003.2e – Adjacent Framing

Desired Outcome:
Continuous air barrier prevents air leakage and moisture movement between the attic and conditioned space

Specification(s):
- All remaining gaps will be sealed at the top of the dropped ceiling
  OR
- All remaining gaps at the top of the chase will be sealed

Objective(s):
Provide airtight framing from one finished side of the dropped ceiling to the other

Materials:
- Spray foam
- Caulk sealant

Tools:
- Caulk gun
- Spray foam gun

Before
Dropped soffits need to be capped and sealed to prevent leakage

After
No gaps should remain after sealant is applied along adjacent framing
3. Air Sealing

3.1003.2e – Adjacent Framing

Sealant should have been along all joists and adjacent framing before cap was set

Additional sealant should fill in all remaining gaps after cap has been set
3. Air Sealing

3.1003.6 Dropped Soffits

3.1003.6b – Soffit General

Desired Outcome:
Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):
Air flow will be blocked at soffit in locations where access allows

Objective(s):
Provide continuous air barrier across soffit openings

Tools:
- Measuring tape
- Utility knife
- Caulk gun
- Spray foam gun
- Saw
- Drill

Materials:
- Caulk
- Spray foam
- Lumber
- XPS
- Fasteners

There is a variety of ways to seal soffits. Please examine 3.1003.6c and 3.1003.6d for more information.

Before
Accessible drop soffits should be sealed to prevent heat gain/loss

After
Completely sealed drop soffits and chases minimize heat transfer
3. Air Sealing

3.1003.6c – Option 1: Bring Soffit Inside (seal at top)

Desired Outcome:
Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):
Entire opening will be spanned with rigid material in line with the ceiling level. Material will be cut to fit and fastened as required

Objective(s):

- Prevent air leakage from wall to attic
- 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

Tools:

- Drill/screwdriver
- Caulk gun

Materials:

- Drywall
- Sealant

Before
Standard soffits are often open to the attic and uninsulated

After
Rigid material encloses the soffit into the conditioned living space
3. Air Sealing

3.1003.6c – Option 1: bring soffit inside (seal at top)

1. Soffits open to the attic need to be sealed to maintain air barrier

2. Apply sealant along top plates

3. Cap soffit with rigid material, such as drywall, cut to size

4. Fasten cap with screws to set sealant and create air barrier

5. Insulate over now-capped soffit
3. Air Sealing

3.1003.6d – Option 2: Leave Soffit Outside (seal at bottom or side)

**Desired Outcome:**
Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

**Specification(s):**
- Each stud bay will be spanned with rigid material will be cut to fit and fastened as required OR
- Backing at each stud bay will be provided and will be sealed OR
- Side of stud bays will be sealed with rigid material from bottom of soffit to top-plate OR
- A sealed rigid barrier will be installed at all transitions

**Objective(s):**
- Prevent air leakage from wall to soffit
- Reduce opening to what can be sealed with sealant Ensure soffit is outside of the thermal boundary

**Materials:**
- XPS
- Drywall
- Plywood
- Lumber
- Fasteners
- Caulk
- Spray foam
- Dense packable insulation
- Poly-wrapped insulation

**Tools:**
- Tape measure
- Utility knife
- Saw
- Insulation machine
- Drill
- Caulk gun
- Spray foam gun
3.1003.6d – Option 2: Leave Soffit Outside (seal at bottom or side)

**Before**

Wall cavities are open to attic and heat transfer due to dropped soffit

**After**

Wall cavities capped and air-sealed in one of a variety of options
3. Air Sealing

3.1003.6d – Option 2: Leave Soffit Outside (seal at bottom or side)

Option 1: Span each stud bay with rigid material at level of soffit

Clear work area of insulation and debris

Option 2: Backing used to fill bays and sealed with spray foam

Option 3: Stud bay will faced with rigid material, fastened and sealed
3. Air Sealing

3.1003.6e – Soffits Containing non-IC Rated Recessed Lights

Desired Outcome:
Dropped soffits sealed to prevent air leakage and moisture movement between the attic and conditioned space

Specification(s):
- Insulation will be kept at least 3" away from the top and side of any fixtures
- 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
- Top of rigid barrier enclosure will be sealed with non-insulating rigid material (e.g., gypsum or equivalent perm rating and R value)

Objective(s):
Prevent light fixture from overheating Bring light fixture inside of the air barrier
3.12 Windows and Doors

3.1201 Maintenance, Repair and Sealing

3.1201.1 Double-Hung Wood Windows

3.1201.1b – Weather Stripping

Desired Outcome:

Windows operable and weather tight; improved energy efficiency performance of fenestration

Specification(s):

- Existing weather stripping and sash sealant will be removed
  Surface where the sill meets the sash will be cleaned
- 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

Objective(s):

Form a complete seal from the outer edge of the sash to the jamb
Maintain operability of the window
3. Air Sealing

3.1201.1c – Sash Locks

Desired Outcome:

Windows operable and weather tight; improved energy efficiency performance of fenestration

Specification(s):

- Locks will be installed so that the rails of the upper and lower sashes are flush and in full contact. No gaps will be visible between the two sashes.
- Locks will be installed to achieve compression of the two sashes.

Objective(s):

Form a secure connection between the two sashes.

Tools:

- Drill
- Appropriate drill bit
- Screw driver

Materials:

- Sash lock and screws
- Shim if needed
3. Air Sealing

3.1201.1d – Replacement Sills

Desired Outcome:

Windows operable and weather tight; improved energy efficiency performance of fenestration

Specification(s):

- Beveled sill will be flush with interior wall and sloped to the exterior
- Seams will be continuously and completely sealed with sealant to the jambs and to the frame Sill will be water-sealed and primed

Objective(s):

- Form a complete seal from the bottom of the lower sash to the sill Maintain operability of the window
- Allow for drainage to the exterior

Tools:

- Saw
- Drill
- Pry bar
- Sander
- Caulk gun

Materials:

- Lumber or metal sill
- Caulk
- Fasteners
- Flashing

After

Once repaired, this window is less leaky and better supported

Before

Rot in and under a window sill is often a sign of a bigger problem
3. Air Sealing

3.1201.1d – Replacement sills

Remove sill to determine full extent of rot and necessary repairs

Cut new materials flush to surrounding surfaces and pitch toward exterior

Once rotted materials are cut away, determine sizing of new materials

For exterior repairs, replace flashing

Set new sill, then replace and prime
3. Air Sealing

3.1201.3 Exterior Doors

3.1201.3b – Door Operation and Fit

Desired Outcome:

Doors operable and weather tight

Specification(s):

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)

Objective(s):

Ensure proper operation of the door

Tools:

- Screwdriver
- Planer

Materials:

- Shims

Before

Daylight visible around door can indicate it does not hang true and leaks

After

With proper adjustment, doors should hang true and minimize leakage
3. Air Sealing

3.1201.3b – Door Operation and Fit

1. After examining how door hangs, remove door from hinges

2. Adjust hinge plates to bring door back into true alignment

3. Adjust strike plate to allow for secure and smooth operation

4. Rehang door to verify adjustments worked and door operates smoothly
3.1201.3c – Air Infiltration

Desired Outcome:

Doors operable and weather tight

Specification(s):

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)

Objective(s):

Reduce air infiltration

Tools:

- Screwdriver
- Saw
- Utility knife
- Caulk gun
- Drill
- Tape measure

Materials:

- Weatherstripping (Q-lan)
- Door bottom
- Door frame weather strip kit
- Fasteners
- Caulk
3. Air Sealing

3.1201.3c – Air Infiltration

After

Weatherstripping and a door bottom minimize air infiltration around doors

Door sweep

Before

Daylight visible around an exterior door indicates air infiltration

Weather strip corners should be mitred and tight
3. Air Sealing

3.1201.3c – Air Infiltration

Measure and trim door, if necessary, to allow for door bottom

Trimming to allow for door bottom

Remove leaky door in order to affix door bottom

Cut door bottom to width of door
3. Air Sealing

3.1201.3c – Air Infiltration

Ensure door bottom fits snugly around

Measure doorway for weather stripping

Notch upper ends of side weather stripping to allow for top piece

Weatherstripping should fit snugly into rabbit and against other pieces

Rehang door and verify fit, operation, and lack of air infiltration
3. Air Sealing

3.1201.3d – Water Infiltration

Desired Outcome:
Doors operable and weather tight

Specification(s):
Details that reduce water infiltration will be repaired, replaced, sealed, or installed (e.g., adjust threshold, caulk jamb to threshold, caulk trim, flashing)

Objective(s):
Reduce water infiltration

Tools:
- Caulk gun
- Screwdriver
- Pry bar

Materials:
- Caulk sealant

Before
Daylight visible under exterior doors indicate water can leak in

After
By adjusting the threshold and sealing along it, water should be kept out
3.1201.3d – Water Infiltration

Caulk along threshold from inside and outside to prevent

Adjust threshold to minimize gap and keep water out
3. Air Sealing

3.1202 Repairing / Replacing Cracked and Broken Glass

3.1202.1 Fixed Frame with Wood Sash (Older House)

3.1202.1b – Broken Glass Removal

Desired Outcome:
Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):
Putty and push points will be removed. Broken or cracked glass will be removed.

Objective(s):
Safely remove old glass

Tools:
- Putty knife
- Chisel
- Utility knife
- Shop vacuum
- Tape measure

Materials:
- Tape
3. Air Sealing

3.1202.1b – Broken Glass Removal

Always wear heavy work gloves when working with glass. See also 2.0100.1b for Hand Protection.

*Broken glass with failed repairs needs to be replaced*

*Large pieces of glass have been removed but sash still needs preparation*
3. Air Sealing

3.1202.1b – Broken Glass Removal

1. Always wear heavy work gloves when working with glass.

2. Cut through caulk bead and glazing to ease removal.

3. Remove old putty and glazing to expose metal points holding glass in place.

4. With points and glass removed, measure opening for replacement pane.

5. Cut replacement glass 1/8" smaller than measured opening.
3. Air Sealing

3.1202.1c – Sash Preparation

**Desired Outcome:**

Glass complete and intact; improved energy efficiency performance of fenestration

**Specification(s):**

Opening will be cleaned

**Objective(s):**

Prepare opening for new glass

**Tools:**

- Chisel
- Utility knife

**Materials:**

- Sand paper
- Cleaning solution
- Rags

Remove all debris from sash either by sand paper, knife, or chisel

Mount new glass onto a clean surface
3. Air Sealing

3.1202.1c – Sash Preparation

Debris in the sash can cause new glass to seal improperly

Check closely to remove all pieces of broken glass and debris

With sash cleaned, glass will fit properly and glazing will seal
3. Air Sealing

3.1202.1d – New Glass Installation

Desired Outcome:

Glass complete and intact; improved energy efficiency performance of fenestration

Specification(s):

- Glass will be sized 1/8" to 3/16" smaller than opening to allow for movement of frame. Safety glass will be installed in accordance with local codes.
- Push points will be provided on each side to secure glass in frame.
- Glazing compound will be added in accordance with manufacturer specifications.

Objective(s):

- Ensure glazing compound will adhere to sash. Install, seal, and secure new glass in place.
- Allow glazing compound to harden to ensure secure installation.

Tools:

- Caulk gun
- Tape measure
- Paint brush

Materials:

- Primer
- Window glazing
- Push points
- Shims
- Replacement glass
- Tape
3. Air Sealing

3.1202.1d – New Glass Installation

With sash prepared, installation of new pane can begin

Replacement glass should be securely fixed with points and glazing
3. Air Sealing

3.1202.d – New glass installation

1. Always wear heavy work gloves when working with glass

2. With broken glass removed, measure opening for replacement glass

3. Cut replacement glass 1/8" smaller than measured opening

4. Use shims to center glass while installing push points

5. With push points in place, glaze to air seal new glass pane in sash

6. Secure pane in place with tape to hold until glazing sets
3. Air Sealing

3.14 Basements and Crawl Spaces

3.1402 Crawl Spaces

3.1402.1 Crawl Spaces: Sealing Floor Penetrations

3.1402.1a – Backing and Infill

Desired Outcome:

Air leakage prevented and indoor air quality protected

Specification(s):

- Backing or infill will be provided as needed to meet the specific characteristics of the selected sealant and the characteristics of the penetration
- The backing or infill will not bend, sag, or move once installed

Objective(s):

Ensure resulting closure is permanent and supports any load (e.g., insulation) Ensure sealant does not fall out

Tools:

- Headlamp

Materials:

- Backer rod
- Sealant
3. Air Sealing

3.1402.1a – Backing and Infill

1. Prepare work space by removing any insulation

2. Infill with backer rod

3. Apply appropriate caulking to ensure backing/infill does not move

4. Visually inspect to verify no gaps remain

Before
Gaps around floor penetrations, such as plumbing, HVAC, and electrical

After
Gaps should be sealed to maintain air barrier
3. Air Sealing

3.1402.1b – Sealant Selection

Desired Outcome:
Air leakage prevented and indoor air quality protected

Specification(s):
- Sealants will be used to fill holes no larger than recommended by manufacturer specifications. Sealants will be compatible with their intended surfaces.
- 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.

Objective(s):
- Create a permanent seal.
- Ensure sealant meets or exceeds the performance characteristics of the surrounding materials.

Tools:
- Caulk gun
- Spray foam gun

Materials:
- Caulk
- Spray foam

Best Practice
Flexible sealants compensate for differential expansion and maintain a seal.

Avoid sealants that do not allow for expansion between dissimilar materials.
3. Air Sealing

3.1402.1b – Sealant Selection

Caulking can be used to span gaps up to 1/4 inch

Spray foam can be used to span gaps up to 3 inches

Check manufacturer specifications to verify spanning capabilities

Also check manufacturer specs for incompatibility with intended surfaces
3. Air Sealing

3.1402.1c – High Temperature Application

Desired Outcome:
Air leakage prevented and indoor air quality protected

Specification(s):
Only non-combustible materials will be used in contact with chimneys, vents, and flues in accordance with authority having jurisdiction

Objective(s):
Prevent a fire hazard

Tools:
- Caulk gun
- Metal snips
- Drill/screwdriver

Materials:
- High-temperature caulk
- 26-gauge steel sheeting

Installation must comply with applicable code for Maine: IRC R302.11 Fire blocking. In combustible construction, fire blocking shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space. 4. At openings around vents, pipes, ducts, cables and wires at ceiling and floor level, with an approved material to resist the free passage of flame and products of combustion.

Before
Gaps around floor penetrations allow air and moisture movement

After
Use non-combustible materials, like 26-gauge steel and high-temp caulk
3. Air Sealing

3.1402.1c – High temperature application

1. Prepare work area by removing any insulation and debris

2. Use high-temperature caulking (600°F)

3. Apply first ring of caulking to match shape of opening

4. Apply second ring of caulking to size and shape of rigid material

5. Fasten rigid material (26-gauge steel) and apply additional caulking

6. Fasten rigid material to cover penetration and seal against flue with...
3.1402.2a – Vent Closure

**Desired Outcome:**

Air and moisture penetration through the existing vent into the crawl space blocked

**Specification(s):**

Vent opening will be permanently closed and sealed

**Objective(s):**

- Prevent air and moisture penetration
- Vent openings in crawl spaces that are within the thermal boundary must be sealed.
3. Air Sealing

3.1402.3 Closed Crawl Spaces – Air Sealing
Exterior Wall

3.1402.3a – Seal Penetrations

Desired Outcome:
Well-sealed exterior wall prevents leakage and pests

Specification(s):
- Penetrations will be sealed with a durable material
- A minimum expected service life of 10 years will be ensured

Objective(s):
Prevent air and moisture penetration into crawl space

Tools:
- Caulk gun
- Spray foam gun
- Metal snips
- Drill

Materials:
- Caulk
- Spray foam
- Metal mesh
- Fasteners

Before
Light showing through penetration in exterior block wall

After
Sealed with durable material to prevent air and water leakage, and pests
3. Air Sealing

3.1402.3a – Seal Penetrations

In holes larger than 1/4 inch, wire mesh should be used for backing

Spray foam or caulk seal the hole

Measure holes to determine the best backing and fill strategy
3. Air Sealing

3.1402.3b – Pest Exclusion

Desired Outcome:
Well-sealed exterior wall prevents leakage and pests

Specification(s):
If penetration is greater than ¼ inches, caulking, steel wool, or other pest-proof material will be used to fill the penetration before sealing

Objective(s):
Prevent pest entry

Tools:
• Caulk gun
• Spray foam gun
• Metal snips
• Drill

Materials:
• Caulk
• Spray foam
• Metal mesh
• Rigid backing

Before
For bigger holes, extra steps should be taken to keep out pests

After
Choose the backing and infill strategy that works best for the hole size
3.1402.3b – Pest Exclusion

For holes larger than 1/4”, rigid backing should be used to keep pests out.

Metal mesh or other rigid materials should be cut to fill the space.

Spray foam can be used to seal the hole and hold mesh in place.
3. Air Sealing

3.1402.5 Closed Crawl Spaces – Attached Under Unconditional Spaces

3.1402.5b – Entry Point

Desired Outcome:

Closed, attached crawl spaces sealed but accessible

Specification(s):

- When adding access to a crawl space:
  - 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 Chapter 4 2012 IRC
  - The rough-framed access opening dimensions will be a minimum of 22 inches by 30 inches and large enough to remove the largest appliance

Objective(s):

- Provide access to attached crawl space for inspections
3. Air Sealing

3.15 Attached Garages

3.1501 Garage Openings

3.1501.1 Penetrations, Cracks and Doors Between Garage and House

3.1501.1a – Penetrations

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
All lighting fixtures, wiring, plumbing, venting, ducting, and gas piping penetrations will be sealed

Objective(s):
Prevent air leakage and pollutant entry

Materials:
- Backer Rod
- Caulk
- Spray foam

Whatever air sealing methods are used, the Inspector shall use smoke and visual evaluation to confirm the living space is adequately separated from the garage.
3. Air Sealing

3.1501.1b – Ductwork

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
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

Objective(s):
Prevent air leakage and pollutant entry

Materials:
- Mesh tape
- Mastic

Before
Unsealed joints and connections need to be sealed to prevent health risks

After
Sealed ductwork connections help prevent leakage
3. Air Sealing

3.1501.1b – Ductwork

Prepare work area by assessing any safety concerns

Wrap joint with fiberglass mesh tape

Apply UL 181 mastic to seal joint
3. Air Sealing

3.1501.1c – Cracks

**Desired Outcome:**

Openings from garage sealed to prevent leakage

**Specification(s):**

- 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
- All cracks in ceiling surfaces will be sealed
- Whatever air sealing methods are used, the Inspector shall use smoke and visual evaluation to confirm the living space is adequately separated from the garage.

**Objective(s):**

Prevent air leakage and pollutant entry

**Materials:**

- Spray foam
- Approved thermal barrier for foam or beads of foam wider than ½’
- Fire-block caulk

![Before](image1.png)  ![After](image2.png)

Before

Cracks in shared walls of attached garages are a potential leakage site

After

Air sealing reduces pollutant entry, but does not diminish fire resistance
3.1501.1c – Cracks

Spray foam wider than ½” must be covered with thermal barrier in occupiable space.

Inspect wall and ceiling for cracks and penetrations.

Clear work area of obstacles and debris.

Determine which walls are shared between garage and living space.

Apply appropriate sealant dependent upon size of crack and location.
3. Air Sealing

3.1501.1d – Garage to House Door

**Desired Outcome:**
Openings from garage sealed to prevent leakage

**Specification(s):**
Weather stripping, door sweep, and threshold will be installed to stop air leakage

**Objective(s):**
Prevent air leakage and pollutant entry

**Tools:**
- Caulk gun
- Screwdriver
- Utility knife
- Hacksaw
- Saw
- Tape measure
- Drill
- Planer

**Materials:**
- Weatherstripping
- Door sweep
- Caulk
- Fasteners

Whatever air sealing methods are used, the Inspector shall use smoke and visual evaluation to confirm the living space is adequately separated from the garage.

Before

Daylight visible under door to garage indicates leakage

After

Door sweep, with weatherstripping, will minimize air exchange with garage
3. Air Sealing

3.1501.1d – Garage to house door

Remove door for access to work space and to install sweep

Measure for weather stripping around door

Install weather stripping into rabbit around door

Corners of weather stripping should be snug and secure

Adjust threshold to minimize contaminant and water infiltration
3. Air Sealing

3.1501.1d – Garage to house door

Caulk along threshold to minimize water and contaminant infiltration

Ensure door sweep fits tightly against bottom of door and fasten in place

Rehang door to verify snug fit and smooth operation

Cut door sweep to width of the door
3. Air Sealing

3.1501.1e – Glass

Desired Outcome:
Openings from garage sealed to prevent leakage

Specification(s):
Broken glass panes in doors will be replaced, pointed, and glazed where needed

Objective(s):
Prevent air leakage and pollutant entry

Tools:
• Hammer
• Pry bar
• Caulk gun
• Tape measure

Materials:
• Brads
• Caulk
• Glazing
• New glass cut to size of rough opening

Before
Broken glass in exterior and garage doors allows for leakage. Replace it

After
With new glass in place, take care to tightly seal and replace stops
3. Air Sealing

3.1501.1e – Glass

Remove stops, taking care not to damage them

Remove broken glass and clean old sealant and glazing from rough opening

Measure rough opening and cut new glass to size
3. Air Sealing

3.1501.1e – Glass

Seal glass into place from inside as well to ensure no air infiltration

Apply sealant to rough opening and place new glass

Replace stops and rehang door
3.1501.1f – Carbon Monoxide (CO) Alarm

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

CO alarms will be installed in accordance with ASHRAE 62.2, applicable codes and manufacturer specifications

Objective(s):

Warn occupants of CO exposure from attached garage

CO alarms should be installed one per floor and near sleeping areas.

Paraphrased from 2012 IRC R315: An approved CO alarm will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel-fired appliances are installed and in dwelling units that have attached garages. CO detectors will comply with UL 2075. Single-station CO alarms will comply with UL 2034 and will be installed in accordance with this code and the manufacturer’s installation instructions. Per WPN 17-07, full compliance with ASHRAE 62.2.2016 and NFPA 720 is required.

Best Practice

Carbon monoxide alarms should be installed throughout the

Best Practice

Occupants should be alerted to CO alarm locations and maintenance
3. Air Sealing

3.1501.1g – Occupant Education

Desired Outcome:

Openings from garage sealed to prevent leakage

Specification(s):

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

Objective(s):

Reduce risk of CO poisoning inside of garage and adjacent rooms

Unsafe

Communicate importance of never running vehicles in a closed garage

Best Practice

Speak with occupant about hazards of using gas appliances in the garage
3. Air Sealing

3.1501.1g – Occupant Education

Occupants should never run vehicles in a closed garage

Occupants should not light combustibles inside garages
3. Air Sealing

3.16 Ducts

3.1601 Duct Preparation

3.1601.3 Support

3.1601.3a – Support (applies to all duct types)

Desired Outcome:

Ducts and plenums properly supported

Specification(s):

- Flexible and duct board ducts and plenums will be supported every 4’ using a minimum of 1 ½” wide material
- 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

Objective(s):

Eliminate falling and sagging

Tools:

- Metal snips
- Utility knife
- Drill
- Stapler

Materials:

- 18 gauge metal strap (at least 1/2” wide)
- 12 gauge galvanized wire
- Fabric support straps (at least 1 1/2” wide)
- Staples
- Fasteners
3. Air Sealing

3.1601.3a – Support (applies to all duct types)

Installation must comply with applicable Maine Code: IRC M1601.4.3 Support. Metal ducts shall be supported by 1/2-inch (13 mm) wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other approved means. Nonmetallic ducts shall be supported in accordance with the manufacturer’s installation instructions.

Before

Ducts should not be allowed to droop and drag, adding distance to run

After

Properly supported ducts minimize heat loss and maximize duct run
3. Air Sealing

3.1601.3a – Support (applies to all duct types)

BAD: Make sure supports DO NOT compress insulation or duct

- Metal wire should be at least 12 gauge and galvanized
- Metal straps should be at least 18 gauge and 1/2 inch wide

Durable strap should be at least 1 1/2 inches wide

Flex ducts should have supports no less than every 4 feet

Metal ducts should be supported every 10 feet or less with straps or wire

Metal wire should be at least 12 gauge and galvanized
3. Air Sealing

3.1602 Duct Sealing

3.1602.1 Air Sealing System Components

3.1602.1c – Existing Component to Existing Component

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):

- Seams, cracks, joints, holes, and penetrations less than ¼” will be sealed using 181 fiber-embedded mastic
- Seams, cracks, joints, holes, and penetrations between ¼” and ¾” will be sealed in two stages:
  * They will be backed using temporary tape (e.g., foil tape) as a support prior to sealing
  * They will be sealed using fiberglass mesh and mastic
- Seams, cracks, joints, holes, and penetrations larger than ¾” will be repaired using rigid duct material
- Mastic will overlap repair joint or existing temporary tape by at least 1” on all sides

Objective(s):

- Eliminate air leakage into or out of ducts and plenums
- Ensure adhesion of primary seal (fiberglass mesh and mastic) to the duct
- Reinforce seal
- Support fiberglass mesh and mastic during curing

Materials:

- Mastic
- Fiberglass mesh tape

Before
Unsealed joints and connections need to be sealed to prevent health

After
Sealed ductwork connections help prevent leakage
3. Air Sealing

3.1602.1c – Existing Component to Existing Component

1. Prepare work area by assessing any safety concerns

2. Apply UL 181 mastic to seal joint

3. Wrap joint with fiberglass mesh tape
3. Air Sealing

3.1602.4 Air Sealing System to Components

3.1602.4a – Duct Boot to Interior Surface

Desired Outcome:
Ducts and plenums sealed to prevent leakage

Specification(s):
- All gaps between boot and interior surface that defines conditioned space will be air sealed Gypsum edge will be wetted before applying water-based sealant
- Sealants will be continuous and be in accordance with 2012 IRC R302.9

Objective(s):
Prevent air leakage Prevent a fire hazard

Tools:
- Utility knife
- Spray bottle
- Putty knife

Materials:
- Mastic
- Mesh tape

Before
Gaps around duct boots allow for leakage to and from the unconditioned space

After
Use a mesh in mastic system to seal duct boot to interior surface
3. Air Sealing

3.1602.4a – Duct boot to interior surface

1. Remove grill to expose duct boot and

2. Wet the edges of the drywall to ensure a good bond

3. Cut mesh tape to fit around duct boot and cover gaps

4. Apply mastic over mesh tape to create heat resistant, durable bond

5. Once mastic is set, grill can be replaced and mastic should not show
4. Insulation

4.10 Attics

4.1001 General Preparation

4.1001.1 Non-Insulation Contact (IC) Recessed Light

4.1001.1a – Air Barrier System

Desired Outcome:

Ensure safety from fire and prevent air leakage

Specification(s):

- 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:
  - A fire-rated airtight closure taller than surrounding attic insulation will be placed over non-IC rated recessed lights, or
  - The non-IC rated light fixture will be replaced with an airtight IC rated fixture or insert, or
  - The fixture(s) may be replaced with surface mounted fixture and opening sealed, or
  - Air sealing measures as approved by the authority having jurisdiction

Objective(s):

- Prevent a fire hazard
- Prevent air leakage through fixture

Materials:

- 5/8" fire-rated drywall
- Fire-rated caulk sealant

Tools:

- Utility knife
- Tape measure

Sealed box around non-IC light should be taller than surrounding insulation

Satisfies SWS
4. Insulation

4.1001.1a – Air Barrier System

Box should be constructed with clearances in mind

Sealed box should be constructed of fire-rated drywall

OR non-IC can light can be replaced with IC-rated recessed light
4. Insulation

4.1001.1b – Enclosure Top

Desired Outcome:
Ensure safety from fire and prevent air leakage

Specification(s):

- The top-fire rated enclosure material will have an R value of 0.56 or less
- The top of the enclosure will be left free of insulation

Objective(s):
Prevent heat build up

Tools:

- Utility knife
- Caulk gun

Materials:

- Drywall

Before
Non-IC rated recessed lights create excess heat and are a fire risk

After
Once dammed from insulation, it should still not have insulation on top
4. Insulation

4.1001.1c – Clearance

Desired Outcome:
Ensure safety from fire and prevent air leakage

Specification(s):
The entire closure will maintain a 3" clearance between the closure and the fixture including wiring, box, and ballast

Objective(s):
Keep an air space around the fixture

Tools:
• Utility knife
• Tape measure
• Caulk gun

Materials:
• Fire-rated sealant
• Drywall

Before
Non-IC rated recessed lights produce excess heat and can be a fire risk

Satisfies SWS
A 3 inch clearance should be kept from boxing materials
4. Insulation

4.1001.1d – Sealants and Weather Stripping

Desired Outcome:
Ensure safety from fire and prevent air leakage

Specification(s):
Caulk, mastic, or foam will be used on all edges, gaps, cracks, holes, and penetrations of closure material only

Objective(s):
To prevent air leakage, completely adhere the sealant to all surfaces to be sealed

Tools:
- Caulk gun
- Spray foam gun
- Putty knife

Materials:
- Fire-rated silicone caulk
- UL-181 mastic
- Spray foam

Non-IC recessed light fixtures produce excess heat and can be a fire risk

Entire box should be sealed, but none should come in contact with light
4. Insulation

4.1001.3 Fireplace Chimney and Combustion Flue Vents

4.1001.3a – Verify Attic Prep

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
- Holes, penetrations, and bypasses will be sealed
- Dams will be fixed in places that maintain required clearance

Objective(s):
- Prevent air leakage
- Ensure insulation dams maintain clearance

Tools:
- Metal snips
- Caulk gun
- Fasteners

Materials:
- 26-gauge steel sheeting
- High temperature caulk
- Mineral wool is also acceptable

Before

Gaps and penetrations in attic need to be sealed to maintain air barrier

Satisfies SWS

Roxul (mineral wool) dam secured against masonry chimney
4. Insulation

4.1001.3a – Verify attic prep

Only construct dam after sealing has been completed properly

Gauged steel should be used to construct seals and dams on flue

Dammed chimneys, flues and light fixtures prevent fires

Gaps around flues and penetrations need to be sealed before insulating

High temperature caulk should be used for flues and chimneys
4. Insulation

4.1001.3b – Required Clearance

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
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

Objective(s):
- Ensure dam material does not bend, move, or sag
- Prevent a fire hazard

Tools:
- Metal snips

Materials:
- 26-gauge steel sheeting
- Fasteners

Installation must comply with applicable Maine Code: NFPA 211, Table 7.2 and 7.3.1.1 (masonry chimneys) clearance from combustibles minimum 2". And NFPA 6.1.1 (factory-built chimneys) install per manufacturer's instructions.
4. Insulation

4.1001.3c – Safety

**Desired Outcome:**
Combustible materials kept away from combustion sources

**Specification(s):**
Insulation will not be allowed between a heat-generating appliance and a dam unless material is rated for contact with heat generating sources

**Objective(s):**
Prevent a fire hazard

---

**Before**
Dams around flues, chimneys, and light fixtures should hold back insulation

**After**
Clear dams of any loose insulation in order to minimize risk of fire
4. Insulation

4.1001.3d – Occupant Education

Desired Outcome:
Combustible materials kept away from combustion sources

Specification(s):
Documentation of material and R value will be provided to occupant

Objective(s):
Provide occupant with documentation of installation

Best Practice
Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R value
4. Insulation

4.1001.4 Vented Eave or Soffit Baffles

4.1001.4a – Installation

Desired Outcome:
Attic ventilation meets code requirements and insulation is protected from wind washing

Specification(s):
- If soffit venting or eave venting is present, baffles will be mechanically fastened to block wind entry into insulation or to prevent insulation from blowing back into the attic
- If soffit venting or eave venting is present, baffles will be installed to maintain clearance between the roof deck and baffle in accordance with manufacturer specifications
- Installation will allow for the highest possible R value above the top plate of the exterior wall

Objective(s):
Ensure insulation R value is not reduced  Maintain attic ventilation

Tools:
- Stapler

Materials:
- Baffles
- Staples

Bad Practice
Insulation should not block vented eaves

Satisfies SWS
Baffles installed in vented attics to allow air flow past insulation
4. Insulation

4.1001.4a – Installation

Baffles should be securely fastened to prevent movement over time

Allow a standard two inch gap for air flow through eave

Once baffles are properly installed, insulation can be placed against them

Baffles also hold insulation from falling into eave
4. Insulation

4.1001.5 Dense Pack Preparation

4.1001.5a – Preparation

Desired Outcome:

Proper material density achieved safely and cleanly

Specification(s):

- Lead safety procedures will be followed
- Cavities will be free of hazards, intact, and able to support dense pack pressures. All escape openings will be blocked for material
- 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

Objective(s):

- Prevent damage to house
- Provide thorough access to allow 100% coverage
- Use proper equipment and process to achieve consistent density, prevent settling, and retard air flow through cavities
4. Insulation

4.1003 Attic Ceilings
4.1003.1 Pitched / Vaulted / Cathedralized Ceilings
– Loose Fill Over

4.1003.1a – Ventilation

Desired Outcome:
Reduce the rate of heat transfer through cathedral or vaulted ceiling

Specification(s):
Venting will be continuous, if applicable

Objective(s):
Ensure capacity to increase R value while not altering ventilation

4.1003.1b – Lighting

Desired Outcome:
Reduce the rate of heat transfer through cathedral or vaulted ceiling

Specification(s):
• Existence of rated insulation contact can lights, which allow for insulation encapsulation, will be verified
• Non-insulation contact rated can lights will not be insulated

Objective(s):
Prevent a fire hazard
4. Insulation

4.1003.1c – Installation

Desired Outcome:

Reduce the rate of heat transfer through cathedral or vaulted ceiling

Specification(s):

- When using cellulose, stabilized product is preferred when available
- 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
- 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

Objective(s):

- Ensure appropriate material and application
- Insulate to prescribed R value
4. Insulation

4.1003.2 Pitched/Vaulted/Cathedralized Ceilings
(Dense Pack Over)

4.1003.2a – Fill Slant Ceilings

Desired Outcome:
Insulation reduces heat transfer through ceiling and closed attic sections as well as framing cavities inaccessible to other treatments.

Specification(s):
- Using fill tube, 100% of each cavity will be filled to a consistent density:
  - Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot
  - Loose fiberglass material will be installed and will be specifically approved for air flow resistance per manufacturer's recommendation
- The number of bags installed will be confirmed and will match the number required on the coverage chart
- Insulation consistency will be verified using IR scans when Delta T is within the range of the specific thermal imager being used.

Objective(s):
- Ensure complete and consistent coverage throughout ceiling plane
- Eliminate voids and settling
- Minimize framing cavity air flows
4. Insulation

4.1003.4 Cape Code Side Attic Roof (Dense Pack Installation)

4.1003.4a – Vapor Barrier Removal

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space

Specification(s):
Vapor barriers will be removed from existing attic floor

Objective(s):
Ensure the new conditioned space is coupled with the house

4.1003.4b – Netting, Fabric, Rigid Sheathing

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space

Specification(s):

- When using netting or fabric, staples will be placed in accordance with manufacturer specifications, whichever is more stringent
- Netting or fabric will meet local fire codes. Rigid materials will close the cavity

Objective(s):
Secure insulation
4. Insulation

4.1003.4c – Installation

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space

Specification(s):
- Roof cavities will be dense packed with loose fill insulation in accordance with manufacturer density specifications
- Insulation will be installed to prescribed R value

Objective(s):
Insulate to prescribed R value
4. Insulation

4.1003.5 Unvented Roof Deck (SPF Installation)

4.1003.5a – Installation

Desired Outcome:
Reduced heat transfer and air leakage through roof and closed attic sections as well as framing cavities inaccessible to other treatments

Specification(s):
- Insulation will be installed to prescribed R value in accordance with manufacturer specifications
- SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto roof sheathing between rafters or trusses
- When desired, underside of rafters or trusses will be covered with SPF to provide layer of continuous insulation
- Upper vent openings will be covered with SPF, including ridge, roof, and gable that are covered with a substrate
- In colder climates (IECC Zones 5-8), SPF will be installed to a thickness of least Class II vapor retarder or have at least Class II vapor retarder coating or covering in direct contact with the underside of the SPF

Objective(s):
- Ensure complete and consistent coverage throughout roof plane
  Eliminate cracks, gaps, and voids
- Improve structural integrity of roof deck (closed cell SPF only)
  Ensure alignment of insulation and air barrier
4. Insulation

4.1003.6 Vented Roof Deck (SPF Installation)

4.1003.6a – Installation

Desired Outcome:

Reduced heat transfer and air leakage through roof and closed attic sections as well as framing cavities inaccessible to other treatments

Specification(s):

- Insulation will be installed at the ceiling level to prescribed R value in accordance with manufacturer specifications
- SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto roof sheathing between rafters or trusses
- In colder climates (IECC Zones 5-8), SPF will be installed to a thickness of least Class II vapor retarder or have at least Class II vapor retarder coating or covering in direct contact with the underside of the SPF

Objective(s):

- Ensure complete and consistent coverage throughout ceiling plane Eliminate cracks, gaps, and voids
- Ensure alignment of insulation and air barrier
4. Insulation

4.1004 Knee Walls
4.1004.1 Preparation for Dense Packing

4.1004.1a – Backing

Desired Outcome:
Airtight cavity and insulated knee wall

Specification(s):

- All knee walls will have top and bottom plate or blockers installed using rigid materials
- When knee wall floor and walls are being insulated, the floor joist running under the knee wall will be air sealed
- If fabric is used before dense packing, it will be secured, according to manufacturer’s specifications or with furring strips every wall stud
- 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

Objective(s):

- Eliminate bending, sagging, or movement that may result in air leakage Prevent air leakage through the top or bottom of the knee wall
- Ensure material will not tear under stress from wind loads or insulation

Materials:

- Drywall
- XPS
- Caulk
- Spray foam
- Fasteners
- Staples
4. Insulation

4.1004.1a – Backing

Tools:

- Tape measure
- Utility knife
- Caulk gun
- Spray foam gun
- Drill
- Stapler

Before

*Knee walls often need sealing and insulation*

After

*Knee wall is prepped for dense pack insulation*

*Top plate holds dense pack insulation in cavity*

*Knee walls missing top plates need one created from rigid material*
4. Insulation

4.1004.1a – Backing

New top plate should be sealed to surrounding joists and studs

Bottom plates also need to be installed. Measure for size

Cut to size and attempt to install in line with air barrier above

Seal to surrounding joist

If using house-wrap or fabric, tack in place with furring strips or staples

Drywall is also a good barrier for dense packing knee walls
4. Insulation

4.1004.1b – Installation

Desired Outcome:

Airtight cavity and insulated knee wall

Specification(s):

- All existing batted insulation will be adjusted to ensure it is in full contact with the interior cladding and the top and bottom plates
- 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
- Follow manufacturer’s requirements for fiberglass dense pack applications

Objective(s):

Eliminate misalignment of existing insulation  Prevent insulation from settling or moving

Existing batt insulation should be adjusted to fit properly

If properly dense-packed, insulation should hold in place when finished
4.1004.1b – Installation

Insulation should meet manufacturer specifications for density

Attach furring strips to create pockets for dense-pack insulation

Access doors should be air tight and match knee wall R-value

Insulation should meet manufacturer specifications for density
4. Insulation

4.1004.5 Knee Walls and Gable End Walls
(Preparation for Installation of Spray Polyurethane Foam (SPF))

4.1004.5a – Installation of Backing

Desired Outcome:
Airtight and insulated knee and gable end walls

Specification(s):

- Knee walls will have a top and bottom plate or blockers installed using a rigid material
- A suitable backstop material attached to the back of the knee wall will be used to support the application of SPF
- If foam sheathing is used as a backstop, sheathing will be listed for uncovered use in an attic or covered with an ignition barrier, thermal barrier, or approved alternate assembly

Objective(s):
Provide a backstop or substrate for application of SPF
4. Insulation

4.1004.5b – Installation

**Desired Outcome:**

Airtight and insulated knee and gable end walls

**Specification(s):**

- Insulation will be installed to prescribed R value
- Using SPF application, SPF will be applied to desired thickness onto substrate material from top to bottom plate between studs using pass thickness maximum in accordance with manufacturer specifications
- In colder climates (IECC Zones 5-8), the SPF 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 interior of the SPF

**Objective(s):**

- Eliminate cracks, gaps, and voids Minimize framing cavity air flows
- Minimize moisture migration and unwanted condensation in insulation (vapor retarders) Ensure alignment of insulation and air barrier

Satisfies SWS

Satisfies SWS
4. Insulation

4.1005 Attic Floors
4.1005.2 Accessible Floors (Loose Fill Installation)

4.1005.2a – Preparation

Desired Outcome:
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):

- Subfloor or drywall will be removed to access cavities as necessary, including inaccessible knee- wall attic floor spaces
- Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier
- All electrical boxes will be flagged to be seen above the level of the insulation Open electrical junctions will have covers installed
- Insulation dams and enclosures will be installed as required

Objective(s):
Access the workspace
Verify uniformity of insulation material
Provide location of electrical boxes for future servicing
Prevent an electrical hazard

Tools:
- Pry bar
- Hammer
- Caulk gun
- Utility knife
- Staple gun
- Spray foam gun
- Tape measure

Materials:
- Flags
- Depth markers
- Staples
- XPS
- Caulk
- Spray foam
4.10052a – Preparation

**Before**

Accessible attic floors should be air sealed and insulated

**After**

Depth markers and insulation dams aid in proper insulation of attic spaces
4.10052a – Preparation

Check cavity for electrical junctions and penetrations

Flag and install covers on electrical junctions

Seal any penetrations

Install depth markers and insulation dams above height of insulation

Non-IC (insulation contact) can lights should be covered with a dam and have no insulation on top
4. Insulation

4.1005.2b – Air Barrier

**Desired Outcome:**
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

**Specification(s):**
- Existence of air barrier material in line with the knee walls will be installed or verified when dense packing
- Air barrier material will not bend, sag, or move once dense packed

**Objective(s):**
Hold dense pack in place

**Tools:**
- Tape measure
- Utility knife
- Saw
- Drill
- Spray foam gun
- Caulk gun

**Materials:**
- Spray foam
- XPS
- Drywall
- Plywood
- Fasteners
- Caulk sealant

*Before*
*When missing, bottom plates must be installed under knee walls*

*After*
*New bottom plates complete air barrier and hold insulation in place*
4. Insulation

4.1005.2b – Air barrier

Cut rigid material, such as XPS, to size to snugly fit into cavity

Measure floor cavity for new bottom plate

Align block with air barrier of conditioned space

Air seal around new bottom plate with spray foam
4. Insulation

4.1005.2c – Installation

Desired Outcome:

Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):

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

Objective(s):

- Reduce heating and air conditioning costs
- Improve comfort
- Minimize noise

Tools:

- Insulation machine

Materials:

- Loose fill insulation

Accessible attic floor should be air sealed and insulated

Check chart on package to ensure proper insulation depth to achieve R-value
4.1005.2c – Installation

Where flooring cannot be removed, verify insulation is meeting R-value goal

Use depth markers to ensure insulation has reached prescribed R-value

Satisfies SWS

Satisfies SWS
4. Insulation

4.1005.2d – Onsite Documentation

**Desired Outcome:**
Consistent, thermal boundary between conditioned and unconditioned space controls the heat flow

**Specification(s):**
- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R value
  - Installed thickness and settled thickness
  - Number of bags installed in accordance with manufacturer specification

**Objective(s):**
- Document job completion to contract specifications
- Confirm amount of insulation installed
- Ensure ability to match bags required for total area completed
- Comply with 16 CFR 460.17

Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R value, and the number of bags used. To figure out the R value of the insulation, use the data that the manufacturer gives you. The receipt must be dated and signed by the installer.

*Information on insulation installed should be posted nearby*

*Posted info includes insulation type, R value, depth, coverage area, etc.*
4. Insulation

4.1005.4 Accessible Floors (Loose Fill Over Existing Insulation)

4.1005.4a – Preparation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
- Existing insulation will be in contact with the air barrier prior to installing additional insulation on top
- Insulation will be adequately marked for depth a minimum of every 300 square feet of attic area, with measurement beginning at the air barrier
- All electrical junction boxes will be flagged to be seen above the level of the insulation. Open electrical junction boxes will have covers installed
- Insulation dams and enclosures will be installed as required

Objective(s):
- Ensure proper performance of insulation. Verify uniformity of insulation material. Provide location of electrical junctions for future servicing
- Prevent an electrical hazard

Satisfies SWS
4. Insulation

4.1005.4b – Installation

Desired Outcome:
Insulation controls heat transfer through ceiling

Specification(s):
The correct depth and number of bags will be blown in accordance with manufacturer specifications. Insulation will be installed to prescribed R value

Objective(s):
Insulate to prescribed R value
4. Insulation

4.1005.4d – Onsite Documentation

Desired Outcome:

Insulation controls heat transfer through ceiling

Specification(s):

- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R value
  - Installed thickness and minimum settled thickness
  - Number of bags installed in accordance with manufacturer specifications

Objective(s):

- Document job completion to contract specifications
- Confirm amount of insulation installed
- Ensure ability to match bags required for total area completed

Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R value, and the number of bags used. To figure out the R value of the insulation, use the data that the manufacturer gives you. The receipt must be dated and signed by the installer.
4. Insulation

4.1005 Enclosed Bonus Room Floor Over Unconditioned Space (Dense Pack Insulation)

4.1005.5a – Air Barrier

Desired Outcome:
A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):
- Existence of air barrier material in line with the knee walls will be installed or verified when dense packing
- Air barrier material will not bend, sag, or move once dense packed

Objective(s):
Hold dense pack in place

Tools:
- Drywall saw
- Utility knife
- Tape measure
- Straight edge

Materials:
- XPS or other rigid material

Before
This finished garage below a bonus room is an unconditioned space

After
Rigid material forms an air barrier located under the bonus room stem wall
4. Insulation

4.1005.5a – Air barrier

Measure joist cavity depth

Cut through garage ceiling to access joist cavities below bonus room

The rigid block should be placed in line with the stem wall above

Measure joist cavity width

Snap chalk lines to keep access cuts clean and easy to repair
4.1005.5a – Air barrier

Cut XPS, or other rigid material, to measured size of joist cavity

Rigid block should fit snugly into joist cavity to prevent insulation leaks

Blow insulation into cavities to density appropriate for chosen material

Rigid block will hold the insulation in place under the bonus room above
Desired Outcome:

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow.

Specification(s):

- Each cavity will be 100% filled to consistent density:
  - 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.
- The number of bags installed will be confirmed and will match the number required on the coverage chart.
- Insulation consistency will be verified using IR scans when Delta T is within the range of the specific thermal imager being used.

Objective(s):

- Eliminate voids and settling
- Minimize framing cavity air flows

Tools:

- Insulation machine
- Drill
- Blower door
- Small hole saw bit

Materials:

- Cellulose insulation
- Dense packable insulation
- Spackle
- Seam tape

Before

With rigid block in place under bonus room stem wall, insulation can begin.
4.1005.5b – Fill Floors

Tape and spackle access panel and test holes to repair garage ceiling when done

Cut small test holes in cavities to verify specified density has been met

Close cavities with access panel cut out at the beginning
4. Insulation

4.1005.5c – Safety

Desired Outcome:

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):

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

Objective(s):

Prevent a fire hazard

Before

Dams around flues, chimneys, and light fixtures should hold back insulation

After

Clear dams of any insulation or debris in order to minimize risk of fire

No insulation on top of non-insulation contact (non-IC) rated fixtures
4. Insulation

4.1005.5d – Onsite Documentation

Desired Outcome:

A consistent thermal boundary between conditioned and unconditioned space controls the heat flow

Specification(s):

- A dated receipt signed by the installer will be provided that includes:
  - Coverage area
  - Thickness
  - R value

Objective(s):

- Document job completion to contract specifications
- Confirm amount of insulation installed
- Comply with 16 CFR 460.17

Paraphrased from 16 CFR 460.17: If you are an installer, you must give your customers a contract or receipt for the insulation you install. For all insulation except loose-fill and aluminum foil, the receipt must show the coverage area, thickness, and R value of the insulation you installed. The receipt must be dated and signed by the installer. To figure out the R value of the insulation, use the data that the manufacturer gives you.
4. Insulation

4.1005.6 Enclosed Attic Storage Platform Floor
(Dense Pack Insulation)

4.1005.6a – Fill Floors

Desired Outcome:
Insulation reduces heat flow through floor and framing cavities inaccessible to other treatments

Specification(s):
- Each cavity will be 100% filled to consistent density:
  - 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
  - The number of bags installed will be confirmed and will match the number required on the coverage chart
- Insulation consistency will be verified using IR scans when Delta T is within the range of the specific thermal imager being used.

Objective(s):
- Eliminate voids and settling
- Minimize framing cavity air flows

4.1005.6b – Safety

Desired Outcome:
Insulation reduces heat flow through floor and framing cavities inaccessible to other treatments

Specification(s):
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

Objective(s):
Prevent a fire hazard
4. Insulation

4.1005.7 Attic Floor (Preparation and Installation of SPF)

4.1005.7a – Preparation

Desired Outcome:
Consistent, thermal boundary and air barrier between conditioned and unconditioned space controls the heat flow and air leakage

Specification(s):
- Subfloor or drywall will be removed to access cavities as necessary (e.g., beneath attic knee walls) All electrical junctions will be flagged to be seen above the level of the insulation
- Open electrical junction boxes will have covers installed

Objective(s):
- Access the workspace
- Provide location of electrical junctions for future servicing Prevent an electrical hazard

4.1005.7b – Installation

Desired Outcome:
Consistent, thermal boundary and air barrier between conditioned and unconditioned space controls the heat flow and air leakage

Specification(s):
- Insulation will be installed to prescribed R value
- SPF will be applied to desired thickness onto attic floor to ceiling material below between attic floor joists using pass thickness maximum as indicated by manufacturer

Objective(s):
Insulate to prescribed R value
4. Insulation

4.1005.7c – Safety

Desired Outcome:
Consistent, thermal boundary and air barrier between conditioned and unconditioned space controls the heat flow and air leakage

Specification(s):
Spray foam should never be installed over light fixtures regardless of if fixture is rated for IC or not. Nor between a heat-generating appliance and a dam, unless material is rated for contact with heat-generating sources.

Objective(s):
Prevent a fire hazard
4.1006 Attic Openings
4.106.1 Pull-Down Stairs

4.1006.1a – Installation

Desired Outcome:
Pull-down attic stair properly sealed and insulated

Specification(s):
- Top-side of the attic enclosure will be insulated to the maximum R value structurally allowable up to the R value of the adjoining insulated assembly
- Pull-down stair rough opening will be surrounded with a durable, rigid dam that is higher than the level of the attic floor insulation
- Counter-weights should be considered to ease accessibility for excessively heavy hatches

Objective(s):
- Achieve uniform R value
- Prevent loose insulation from entering the living area

Materials:
- Caulk sealant
- Lumber
- XPS
- Pre-fabricated stairwell cover

Tools:
- Tape measure
- Drill
- Saw
- Caulk gun

Before
Insulation needs to be dammed to keep from falling through during operation

Stairs hatch cover should be insulated to match R value of attic

Satisfies SWS
4. Insulation

4.1006.1b – Sealing

Desired Outcome:
Pull-down attic stair properly sealed and insulated

Specification(s):
- Entire pull-down stair assembly will be covered with an airtight and removable/openable enclosure inside the attic space
- Pull-down stair frame will be caulked, gasketed, weatherstripped, or otherwise sealed with an air barrier material, suitable film, frictionally engaging components or solid material that allows attic door operation

Objective(s):
Prevent air leakage

Tools:
- Caulk gun

Materials:
- Weatherstripping
- Spray foam
- Caulk

Satisfies SWS

Unsealed pull-down stairs leads to air leakage to and from the attic

To preserve thermal envelope, an airtight seal needs to be created
4.1006.1b – Sealing

Seal around frame of pull-down stairs with appropriate sealant

Weatherstrip around stair panel to encourage a tight seal

Remember to seal finish details and trim

*Insulation and sealing should be airtight but openable*
4. Insulation

4.1006.2 Access Doors and Hatches

4.1006.2a – Installation

Desired Outcome:
Attic access door properly sealed and insulated

Specification(s):
- Hatches will be insulated to the maximum R value structurally allowable up to the R value of the adjoining insulated assembly
- Attic hatches rough opening will be surrounded with a durable rigid protective baffle that is higher than the level of the surrounding attic floor insulation

Objective(s):
- Achieve uniform R value on the attic door or hatch
- Achieve uniform R value on the attic floor
- Prevent loose attic floor insulation from entering the living area

Materials:
- XPS
- Lumber
- Weatherstripping
- Fasteners

Before
Uninsulated attic hatches and access panels weaken the thermal envelope

After
Hatch cover or panel access door should match R value of attic insulation
4. Insulation

4.1006.2a – Installation

*Weatherstrip underside of hatch cover to create tight seal*

*Build dam to hold back attic insulation and hold cover in place tightly*

*Create hatch cover that matches r-value of surrounding insulation*

*Alternate installation for vertical access panel to attic*
4. Insulation

4.1006.2b – Sealing

**Desired Outcome:**
Attic access door properly sealed and insulated

**Specification(s):**
- Access hatch frames will be sealed using caulk, gasket, weatherstrip, or otherwise sealed with an air barrier material, suitable film, or solid material
- 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

**Objective(s):**
Prevent air leakage

**Materials:**
- Weatherstripping
- 3/4" Lumber
- Caulk

*Before*
Unsealed attic hatches and panel doors allow air leakage to and from attic

*After*
Once sealed, air leakage at attic hatch or door should be minimized
4.1006.2b – Sealing

- Build insulation dam from 3/4 inch lumber and seal around base

Remember to seal around finish details and framing on

Weatherstrip around bottom edge of hatch cover to create air tight seal

Satisfies SWS

Satisfies SWS
**Desired Outcome:**
Attic access door properly sealed and insulated

**Specification(s):**
Insulation will be permanently attached and in complete contact with the air barrier

**Objective(s):**
Insulate to prescribed R value

**Tools:**
- Caulk gun
- Utility knife

**Materials:**
- XPS
- Adhesive

---

*Before*
Unsealed and uninsulated attic hatches and access doors allow

*Satisfies SWS*
Rigid insulation on back of new hatch cover attached firmly and squarely to allow for air-tight fit
4. Insulation

4.1006.2c – Attachment

1. Apply foam tape to "warm side" face of attic hatch

2. Ensure an air tight seal by making sure foam tape has no gaps

3. Apply strong adhesive to "cold-side" of hatch

4. Adhesive should ring perimeter as well as crisscrossing hatch to ensure complete attachment of insulation
4. Insulation

4.1006.2c – Attachment

5

Affix XPS insulation to "cold-side" of hatch with adhesive, ensuring XPS is tight and square to hatch

6

Repeat adhesive and XPS layers to reach maximum R-value without making hatch excessively heavy or awkward

7

All XPS layers should be attached firmly to one another and square to hatch
4. Insulation

4.1088 Special Circumstances
4.1088.1 Attic Ventilation

4.1088.1a – Air Barrier and Thermal Boundary

Desired Outcome:
Properly restored vents minimize moisture and ice dams

Specification(s):
- Attic ventilation will be recommended or installed if local code requires attic ventilation during weatherization or retrofits
- 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

Objective(s):
Ensure presence of continuous air barrier and thermal boundary

4.1088.1b – Vent Type

Desired Outcome:
Properly restored vents minimize moisture and ice dams

Specification(s):
- 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)
- Attic-powered ventilators will not be used

Objective(s):
Ensure vent meets proper performance characteristics for location and roofing type
4. Insulation

4.1088.1c – Vent Location

Desired Outcome:

Properly restored vents minimize moisture and ice dams

Specification(s):

Placement of attic vents will be considered for proper air flow and prevention of entry of wind driven rain or snow

Objective(s):

- Encourage proper air flow
- Minimize entry of wind driven rain or snow
4. Insulation

4.1088.1d – Ventilation Baffling

Desired Outcome:

Properly restored vents minimize moisture and ice dams

Specification(s):

• Baffling for attic soffit vents will be installed to:
  • Ensure proper air flow
  • Prevent wind washing of insulation
  • Allow maximum insulation coverage
  • Ensure baffle terminates above insulation

Objective(s):

Ensure vent allows proper air flow without compromising insulation performance

Satisfies SWS

Satisfies SWS
4. Insulation

4.1088.1e – Ventilation Screens

**Desired Outcome:**

Properly restored vents minimize moisture and ice dams

**Specification(s):**

- 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)
- 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

**Objective(s):**

Prevent pest entry
4. Insulation

4.11 Walls

4.1101 Preparation

4.1101.1 Exterior Wall Dense Packing

4.1101.1a – Preparation

Desired Outcome:

Walls properly prepared to receive dense pack insulation

Specification(s):

- Lead and asbestos safety procedures will be followed
- Cavities will be free of hazards, intact, and able to support dense pack pressures. Drilling hazards (e.g., wiring, venting, fuel piping) will be located
- Blocking will be installed around:
  - All openings to inside crawl space and basement for fibrous material
  - High temperature fire-rated materials
  - Wiring and electrical hazards
  - Heat sources
- Access to exterior wall cavities will be gained, sheathing will be drilled as needed and probed to locate each cavity, wall studs, and blockers
- Interior will be masked and dust controlled during drilling when accessing from interior. 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 IWC or 2.9 psi for cellulose insulation; for other types of dense pack insulation, check manufacturer specification for blowing machine set up

Objective(s):

- Prevent damage to house. Provide a clean work space
- Provide thorough access to allow 100% coverage
- Ensure proper equipment and process results in consistent density
- Prevent settling and retard air flow through cavities. Protect worker and occupant health
4. Insulation

4.1101.1b – Exterior Dense Pack

Desired Outcome:

Walls properly prepared to receive dense pack insulation

Specification(s):

- Using fill tube, 100% of each cavity will be filled to a consistent density:
- Cellulose material will be installed to a minimum density of 3.5 pounds per cubic foot
- Loose fiber glass material will be installed and will be specifically approved for air flow resistance per manufacturer's specifications
- The number of bags installed will be confirmed and will match the number required on the coverage chart
- Insulation consistency will be verified using IR scans when Delta T is within the range of the specific thermal imager being used

Objective(s):

Eliminate voids and settling Minimize framing cavity air flows
4. Insulation

4.1101.3 Exterior Wall SPF (Masking and Surface Preparation)

4.1101.3a – Surface Protection

Desired Outcome:
Finished surfaces are protected and SPF has a suitable surface to adhere to

Specification(s):
- Finished surfaces that should not be covered with SPF (e.g., windows, doors) will be identified
- Surfaces will be covered or sealed with appropriate material (e.g., plastic film, masking tape) to protect from SPF overspray

Objective(s):
Prevent overspray and potential damage to finished surfaces

4.1101.3b – Substrate Repair

Desired Outcome:
Finished surfaces are protected and SPF has a suitable surface to adhere to

Specification(s):
Cracks, gaps, and holes in the substrate will be covered or sealed in accordance with manufacturer specifications with appropriate material

Objective(s):
- Prevent waste of SPF
- Prevent overspray into adjacent areas
4. Insulation

4.1101.3c – Substrate Cleaning

Desired Outcome:

Finished surfaces are protected and SPF has a suitable surface to adhere to

Specification(s):

- All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation. 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.

- Moisture content of all wood substrate materials will be checked to ensure it is below 20%.

Objective(s):

Ensure proper bonding of SPF to substrate surfaces.
4. Insulation

4.1101.4 Exterior Wall SPF (Electrical System Considerations)

4.1101.4a – Box Protection

Desired Outcome:
Outlet, junction, switch, and light fixture boxes and existing wiring are protected from SPF

Specification(s):
- All front and back openings of all outlet, switch, and light fixture boxes will be covered with masking tape
- All electrical junction boxes will be accessible after the installation of SPF. Open electrical junction boxes will have covers installed

Objective(s):
Prevent SPF from covering any switches and outlets and from entering the inside of any electrical box
4.1102 Accessible Walls
4.1102.1 Open Cavity Wall Insulation (General)

4.1102.1a – Sealing

Desired Outcome:
Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R value

Specification(s):
Holes and penetrations will be sealed Bypasses will be blocked and sealed

Objective(s):
Prevent air leakage

Tools:
• Caulk gun

Materials:
• Backer rod
• Spray foam
• Caulk

Before
Penetrations and bypasses create places where blown in insulation can leak

After
Sealed penetrations offer leakage protection and keep insulation in place
4. Insulation

4.1102.1a – Sealing

Open walls to be insulated and drywalled need air sealing

Penetrations and bypasses should be sealed to keep insulation in cavities

Use backer rod or other infill for larger penetrations

Seal penetration with caulk or fire-block, as appropriate
4. Insulation

4.102.1b – Installation

Desired Outcome:
Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R value

Specification(s):
- Insulation will be installed in accordance with manufacturer specifications without gaps, voids, compressions, misalignments, or wind intrusions
- Insulation will be installed to prescribed R value

Objective(s):
Insulate to prescribed R value

Tools:
- Insulation machine
- Staple gun

Materials:
- Loose fillable insulation
- Netting
- staples
- Fiberglass batts

Before
Open walls should be insulated

After
Well-insulated rooms are significantly more comfortable in all seasons
4.1102.1b – Installation

*Wall should be netted and insulation blow in to prescribed R value*

*OR: Wall can be insulated using batts installed without gaps*
4. Insulation

4.1102.1c – Pre-Drywall Verification

Desired Outcome:

Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R value

Specification(s):

Verification of complete installation without gaps, voids, compressions, misalignments, or wind intrusions will be provided

Objective(s):

Install insulation correctly

Tools:

- Hands
- Eyes

*Take a visual and physical inspection of insulation installation*

*Before*

Verify insulation is properly installed before drywalling

*After*

Once proper installation is verified, begin drywalling to finish wall
4. Insulation

4.1102.1d – Occupant Education

Desired Outcome:
Consistent, uniform thermal boundary between the conditioned space and unconditioned space to prescribed R value

Specification(s):
- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R value
  - Installed thickness and settled thickness (settled thickness required for loose-fill only)
  - Number of bags installed in accordance with manufacturer specifications (for loose-fill only)

Objective(s):
- Document job completion to contract specifications Confirm amount of insulation installed
- Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R value
4. Insulation

4.1102.2 Open Cavity Wall SPF Installation

4.1102.2a – Installation

Desired Outcome:

Exterior walls are insulated and sealed

Specification(s):

- Interior cladding or interior finish material will be removed on areas to be insulated
- SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer
- SPF will be applied onto exterior sheathing or interior finish materials between studs and top/bottom plates

Objective(s):

Insulate and seal exterior walls

4.1102.2b – Vapor Retarders

Desired Outcome:

Exterior walls are insulated and sealed

Specification(s):

- If vapor retarder is needed, it will be applied in proper location
- 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

Objective(s):

Minimize water vapor condensation in walls
4. Insulation

4.1102.2c – Fire Protection

Desired Outcome:

Exterior walls are insulated and sealed

Specification(s):

- 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)
- Check local codes for fire protection requirements

Objective(s):

- Provide necessary fire protection for combustible SPF insulation
- For Thermal Barrier or Ignition Barrier application over SPF adhere to: State of Maine Statute, Title 25, section 2447-B Foam Plastic Insulation Standards.
4. Insulation

4.1103 Enclosed Walls
4.1103 Dense Pack Exterior Walls

4.1103.1a – Exterior Dense Pack

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
- Using fill tube or an alternative method as approved by the authority having jurisdiction, 100% of each cavity will be filled to a consistent density:
  - Cellulose insulation used in an enclosed cavity will be installed at 3.5 pounds per cubic foot or greater density
  - 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 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
  - All holes and penetrations will be plugged and/or sealed
- Insulation consistency will be verified using IR scans when Delta T is within the range of the specific thermal imager being used.

Objective(s):
- Eliminate voids and settling
- Minimize framing cavity air flows

Materials:
- Cellulose or fiberglass insulation (any fiberglass material used must be specifically approved for air flow resistance by the manufacturer)
- Wooden, plastic, or foam plugs fill installation holes
- Piece of fiberglass batt or towel to stop insulation from blowing out around the hose
4.1103.1a – Exterior dense pack

Tools:

- Insulation blowing machine
- Pressure gauge
- Blower door
- Drill
- Tape measure
- Ladder
- Utility flag bent into a "Z" shape

Make accurate count of insulation bags to be installed

Calculate the number of bags needed and verify the number you actually install

Install insulation to correct density (at least 3.5 pounds per cubic foot for cellulose, or 1.5 pounds for fiberglass)

Check that the static pressure at the blowing machine and at the hose end is at least 2.9 PSI
4. Insulation

4.1103.1a – Exterior dense pack

3. Adjust the pressure with the blower controls.

4. Adjust the feed gate to fill an 8-foot wall cavity in 2 to 4 minutes.

5. With a rag or fiberglass batt to prevent insulation blowing out, fill all cavities in exterior walls with insulation.

6. Check to make sure all cavities are properly filled. One of these is empty, and another is not filled to proper density.

7. Check that cavities are filled and are the proper density.

8. Insert a bent utility flag into insulation. If it is possible to turn, the cavity needs more insulation.
4. Insulation

4.1103.1b – Onsite Documentation

Desired Outcome:

Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):

- A dated receipt signed by the installer will be provided that includes:
  - Coverage area
  - Thickness
  - R value

Objective(s):

- Document job completion to contract specifications
- Confirm amount of insulation installed
- Comply with 16 CFR 460.17

Before

Installer shall provide a dated insulation receipt showing coverage area, R-value, and thickness

After

Obtain a dated insulation receipt showing coverage area, R-value, and thickness from the installer
4.1103.2 Additional Exterior Wall Cavities

4.1103.2e – Close Holes

Desired Outcome:

Properly installed insulation reduces heat flow through walls and framing cavities inaccessible to other treatments

Specification(s):

- Installation holes will be plugged as follows:
- Exterior holes will be weather barrier patched
- Interior holes will be patched with applicable materials to ensure a permanent air seal. The patched surfaces will have no cracks or excessive material and will meet industry standards for first-coat mud techniques.
- All construction debris and dust will be collected and removed

Objective(s):

Ensure house is returned to watertight and clean condition

Tools:

- Taping knife
- Caulk gun
- Drill
- Paint brush

Materials:

- Spackle
- House wrap
- Lath
- Stucco
- Fasteners
- Adhesive
- Primer
- Drywall

In Progress

With insulation complete, wall needs to be patched to better-than-found

After

When repair is finished, it shouldn't be obvious any work was done
4.1103.2e – Close holes

For interior access, locate access holes at studs for easier patching

Patch holes and mud as needed to ensure seal

Plug holes with rigid material that will not move or sag over time

For exterior access, use a drop cloth or gutter to help with clean up
4. Insulation

4.1103.2e – Close holes

For stucco and plaster patches, lath will need to be used to hold weight.

If possible, maintain house wrap, or replace it after holes are plugged.

Put siding back in place, or return exterior finish to match remaining wall.
4 Insulation
4.13 Floors

4.1301 Accessible Floors
4.1301.2 Standard Floor System

4.1301.2a – Sealing

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope Prevent leakage

Tools:
- Caulk gun

Materials:
- Caulk
- Backer rod
- Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.

Before
Gaps around penetrations can cause air leakage and negate insulation

After
Sealed penetrations maintain the air barrier
4.1301.2a – Sealing

Locate gaps around penetrations for plumbing, electrical, etc.

Fill gaps greater than 1/4 inch with backer rod or spray foam

Caulk smaller gaps and to hold backer rod in place
4.1301.2b – Netting, Fabric

**Desired Outcome:**
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

**Specification(s):**
- When using netting or fabric, staples will be placed according to manufacturer specifications
- Netting or fabric will meet local fire codes

**Objective(s):**
Secure insulation

**Tools:**
- Utility knife
- Scissors
- Stapler

**Materials:**
- Fabric netting
- Staples

**Bad Practice**
Uninsulated floors above unconditioned spaces are an energy drain

**Best Practice**
Nutting is secured to joists and sills to create cavities for insulation
4.1301.2b – Netting, fabric

1. Secure netting across each joist to create separate cavities.

2. Secure netting across sills to prevent leakage of insulation.

3. Keep netting taut while stapling to prevent wrinkles and leakage.

4. Staples should be kept tightly together, placed no more than 1 1/2” apart.
4.1301.2c – Installation

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
- Insulation in netted or fabric cavities will be dense packed with loose fill insulation in accordance with manufacturer specifications
- Insulation will be installed to prescribed R value. Insulation will be in continuous contact with air barrier

Objective(s):
- Insulate to prescribed R value
- Ensure a continuous thermal boundary between conditioned and unconditioned space

Tools:
- Utility knife
- Insulation machine

Materials:
- Loose fill fiberglass or cellulose

Order and install insulation based on specifications in work order
4.1301.2c – Installation

1. Always wear proper PPE when blowing in insulation.

2. Cut holes in each individual cavity to insert insulation machine nozzle.

3. Ensure that hole is large enough for nozzle without allowing for outflow.

4. Consult manufacturer specs on insulation packaging for proper installation.

5. Blow in insulation to prescribed R value.
4. Insulation

4.1301.2d – Occupant Education

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):

- A dated receipt signed by the installer will be provided that includes:
  - Insulation type
  - Coverage area
  - R value
  - Installed thickness and minimum settled thickness
  - Number of bags installed in accordance with manufacturer specifications

Objective(s):

- Document job completion to contract specifications Confirm amount of insulation installed
- Ensure ability to match bags required for total area completed Comply with 16 CFR 460.17

Best Practice

Provide occupant with documentation of and about insulation installed

Documentation should include insulation material and R value
4. Insulation

4.1301.4 Dense Pack Floor System with Rigid Barrier

4.1301.4a – Sealing

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
Sealing the floor system will be completed before insulating

Objective(s):
Ensure airtight envelope Prevent leakage

Tools:
- Caulk gun

Materials:
- Caulk
- Backer rod
- Spray foam

Be alert to high-temperature flues and chimneys and use appropriate sealants and materials. See 3.1402.1c.
4.1301.4a – Sealing

Caulk small gaps and to hold backer rod in place

Fill gaps greater than 1/4 inch with backer rod or spray foam

Locate gaps around penetrations for plumbing, electrical, etc.
4. Insulation

4.1301.4b – Rigid Air Barrier

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
- A rigid air barrier will be mechanically fastened to underside of floor assembly, providing 100% coverage of the floor assembly
- Seams and penetrations will be sealed

Objective(s):
Relocate air barrier

Tools:
- Utility knife
- Saw
- Drill
- Tape measure
- Caulk gun

Materials:
- Rigid material -- drywall, XPS, plywood
- Fasteners
- Caulk

Before
Uninsulated floors over unconditioned spaces are an

After
Rigid barriers allow for air sealing and create cavities for insulation
4. Insulation

4.1301.4b – Rigid air barrier

Securely fasten rigid barrier, aligning seams with joist when possible

Seal all seams with caulk to prevent leakage

Pay particular attention at complex joints

Remember to caulk along sills
4.1301.4c – Installation

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
- Dense pack insulation will be installed between air barrier and subfloor according to manufacturer specifications
- Insulation will be installed to prescribed R value

Objective(s):
Insulate to prescribed R value

Tools:
- Insulation machine
- Caulk gun

Materials:
- Dense packable insulation
- Caulk

Before
Once rigid barrier is sealed, insulation can be blown in

After
Rigid barrier should be resealed to maintain air barrier after filling
4. Insulation

4.1301.4c – Installation

Ensure that proper PPE is worn while working with insulation

Check manufacturer specifications for R value before filling

Fill cavities to specified R value from Work Order
4.1301.4c – Installation

- **Drill hole slightly larger than nozzle into rigid barrier with hole saw**
- **Plug access hole and seal to maintain air barrier**
- **When filled to specified density and R value, fill access hole**
- **Dense pack insulation into floor cavities**
4. Insulation

4.1301.4d – Occupant Education

Desired Outcome:
Consistent, uniform thermal boundary between conditioned and unconditioned space to prescribed R value of an adjoining insulated assembly

Specification(s):
- A dated receipt signed by the installer will be provided that includes:
  - Coverage area
  - Thickness
  - R value

Objective(s):
- Document job completion to contract specifications
- Confirm amount of insulation installed
- Comply with 16 CFR 460.17

Best Practice
Provide occupant with documentation of and about insulation installed

Communicate professionally with occupant to provide information and support

Documentation should include insulation material and R value
4. Insulation

4.1301.9 Open Floors Over Unconditioned Space and Cantilevered Floors, Floors Over Garages, Floors Over Unconditioned Crawl Spaces (Spray Polyurethane)

4.1301.9a – Preparation

Desired Outcome:
Floors over unconditioned spaces (e.g., basements, garages) insulated and sealed

Specification(s):
- All floor areas will be open and accessible for SPF application
- Cracks, gaps, and holes will be covered or sealed per manufacturer guidelines with appropriate material
- Insulation dams or end blockers will be installed where needed
- All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation. 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
- Moisture content of all wood substrate materials will be checked to ensure it is below 20%

Objective(s):
Prepare all substrate surfaces for the application of SPF
4. Insulation

4.1301.9b – Installation

Desired Outcome:
Floors over unconditioned spaces (e.g., basements, garages) insulated and sealed

Specification(s):

- Insulation will be installed to prescribed R value according to manufacturer specifications
- SPF will be applied to desired thickness, using pass thickness maximum as indicated by manufacturer, onto subfloor between floor joists and all rim/band joists
- When desired, underside of joists will be covered with SPF to provide layer of continuous insulation

Objective(s):
Insulate and seal floors
4. Insulation

4.1301.9c – Fire Protection

Desired Outcome:
Floors over unconditioned spaces (e.g., basements, garages) insulated and sealed

Specification(s):
• SPF will be separated from the interior occupied space of the building with a 15-minute thermal barrier (typically ½” or thicker gypsum wallboard or approved ignition barrier coating)
• Check local codes for fire protection requirements

Objective(s):
Provide necessary fire protection for combustible SPF insulation

4.1301.9d – Onsite Documentation

Desired Outcome:
Floors over unconditioned spaces (e.g., basements, garages) insulated and sealed

Specification(s):
• A dated receipt signed by the installer will be provided that includes:
  • Coverage area
  • Thickness
  • R value

Objective(s):
• Document job completion to contract specifications Confirm amount of insulation installed
• Comply with 16 CFR 460.17
4.14 Basements and Crawl Spaces

4.1401 Band/Rim Joists

4.1401.1 Band/Rim Joists (SPF Installation)

4.1401.1a – Preparation

Desired Outcome:

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

Specification(s):

- All band/rim joist areas will be open and accessible for SPF application
- All surfaces where SPF is applied will be clean, dry, and free of contamination and degradation 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
- Moisture content of all wood substrate materials will be checked to ensure it is below 20%

Objective(s):

Prepare all substrate surfaces for the application of SPF
4. Insulation

4.1401.1b – Installation

Desired Outcome:

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

Specification(s):

- 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
- 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
- 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

Objective(s):

Insulate and seal floors

Satisfies SWS

Satisfies SWS
4. Insulation

4.1401.1c – Fire Protection

Desired Outcome:

Insulate and seal all band/rim joist areas between subfloor and foundation or top plate of wall below

Specification(s):

- 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)
- Application to rim/band joist up to 3" can be left exposed if the foam is Class I, unless the space is a habitable space and then cover it with drywall or another thermal barrier
- Local codes will be confirmed and followed for fire protection requirements

Objective(s):

Provide necessary fire protection for combustible SPF insulation

Satisfies SWS
4. Insulation

4.1401.2 Band/Rim Joists (Insulation Other Than SPF)

4.1401.2a – Preparation

Desired Outcome:
Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):
The rim joist, sill plate and adjacent surfaces will be sufficiently clean and free of debris to allow for the proper adhesion of any caulks, adhesives or spray foam used during installation.

Objective(s):
Prepare all surfaces for the installation of insulation

4.1401.2b – Insulation Installation

Desired Outcome:
Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):
A foam-based insulation will be installed so as to create a continuous thermal and pressure boundary. If rigid insulation is used, all edges will be sealed and the insulation will be installed tightly to the wood to prevent the movement of moisture throughout the assembly. Insulation will be installed in accordance with local/national code requirements and/or manufacturer’s instructions regarding flame spread.

Objective(s):
Improve thermal performance Prevent moisture condensation on the inside of the band joist
4. Insulation

4.1402 Basements and Crawl Space Walls
4.1402.1 Closed Crawl Spaces (Wall Insulation)

4.1402.1a – Insulation Selection

 Desired Outcome:

 Closed crawl spaces insulated to achieve best thermal performance possible

 Specification(s):

 A fire-rated insulation (25 or less flame spread or Class I or Class A) will be used with a minimum life expectancy of 10 years

 Objective(s):

 Provide fire-safe, durable insulation that will not exacerbate moisture issues in the crawl space

 Satisfies SWS

 4.1402.1b – R-Value

 Desired Outcome:

 Closed crawl spaces insulated to achieve best thermal performance possible

 Specification(s):

 Regional International Energy Conservation Code (IECC) will be followed for required R values

 Objective(s):

 Improve thermal performance

 Satisfies SWS
4. Insulation

4.1402.1b – R-Value

- Site built basement bulkhead door
- Door should be air tight and match basement wall R-value
- Upgrade existing doors to match wall R-value
- Replacement door to match pre-existing half-glass door
- Replace doors in poor condition if cost effective
- Satisfies SWS
4. Insulation

4.1402.1d – Attachment

Desired Outcome:

Closed crawl spaces insulated to achieve best thermal performance possible

Specification(s):

Insulation will be attached with a durable connection better than or equal to manufacturer specifications

Objective(s):

Prevent insulation from detaching from the foundation wall

Satisfies SWS

Bulkhead panel system
4.1402.2 Basement Wall Insulation (No Groundwater Leakage)

4.1402.2a – R-Value

Desired Outcome:

Basement insulation improves thermal performance and ensures sufficient drying potential

Specification(s):

Regional IECC will be followed for required R values

Objective(s):

- Improve thermal performance of the basement and living space
- Installation must comply with applicable Maine Code:

IECC Table 402.1. Basement Wall R value, Zones 6 and 7: "15/19"c. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home.

303.1.1 Building thermal envelope insulation. An R value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. ... For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and R value of installed thickness shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job.
4. Insulation

4.1402.2a – R-Value

Satisfies SWS

Satisfies SWS

Satisfies SWS

Satisfies SWS
4.16 Ducts
4.1601 Insulating Ducts
4.1601.2 Insulating Metal Ducts

4.1601.2a – Selection of Duct Insulation Material

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
- 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
- Hot humid and warm coastal regions will not bury ducts

Objective(s):
Decrease heat loss and condensation problems

Uninsulated ducts in unconditioned spaces are an energy drain
Properly insulated ducts operate at much higher rates of efficiency
4. Insulation

4.1601.2a – Selection of Duct Insulation Material

Ducts in unconditioned areas should have r-8 insulation with vapor barrier.

Burying ducts is discouraged in warm coastal and hot humid regions.

OR ducts can be buried in loose fill in attic spaces in drier climates.
4. Insulation

4.1601.2b – Duct Sealing

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Specification(s):**
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.

**Objective(s):**
Minimize duct leakage

**Materials:**
- Mesh tape
- Mastic

**Tools:**
- Putty knife

*Before*
*Unsealed joints and connections need to be sealed to prevent health risks*

*After*
*Sealed ductwork connections help prevent leakage*
4. Insulation

4.1601.2b – Duct Sealing

1. Prepare work area by assessing any safety concerns

2. Wrap joint with fiberglass mesh tape

3. Apply UL 181 mastic to seal joint
4. Insulation

4.1601.2c – Attachment of Duct Insulation

**Desired Outcome:**
Lowered thermal conductance of duct system and minimized condensation on the duct system

**Specification(s):**
Duct insulation will be secured to the duct system using metal wire or rot-proof nylon twine. Pattern of the wire or twine will be sufficient to securely hold the duct insulation tight to the duct.

**Objective(s):**
Ensure a secure connection between the duct system and the duct insulation.

**Tools:**
- Scissors
- Metal snips

**Materials:**
- Nylon twine
- Wire
- Tie bands

**Bad Practice**
*Materials holding insulation in place should not compress or kink duct*

**Satisfies SWS**
*Durable materials can be attached without compressing insulation*
4. Insulation

4.1601.2d – Taping Of the Duct Insulation

Desired Outcome:
Lowered thermal conductance of duct system and minimized condensation on the duct system

Specification(s):
- Using a tape approved by the manufacturer, all seams and connection of the duct insulation will be taped
- No gaps will exist between pieces of duct insulation

Objective(s):
Prevent gaps in the vapor barrier of the insulation

Materials:
- UL-181 tape
- R-8 duct insulation with vapor barrier

Tools:
- Utility knife

Unsecured and sealed insulation around ducts is useless
All seams should be sealed with UL-181 duct tape to preserve vapor barrier
4. Insulation

4.99 Insulation – Additional Resources

4.9901 Materials

4.9901.1 General Information on SPF

4.9901.1a – Low Pressure SPF

Desired Outcome:

To provide general Information on spray polyurethane foam

Specification(s):

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.

Objective(s):

To provide general Information on spray polyurethane foam
4. Insulation

4.9901.1b – High Pressure SPF

Desired Outcome:
To provide general Information on spray polyurethane foam

Specification(s):

• 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.

• 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.

• 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.

Objective(s):
To provide general Information on spray polyurethane foam
4.9901.1c – Manufacturer Installation Instructions

Desired Outcome:
To provide general Information on spray polyurethane foam

Specification(s):
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, MSDSs, and evaluation reports.

Objective(s):
To provide general Information on spray polyurethane foam
6 Ventilation

6.60 Exhaust

6.6002 Components

6.6002.1 Ducts

6.6002.1a – Duct Design and Configuration

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

- Ventilation ducts will be as short, straight, and smooth as possible
- Ventilation ducts will not be smaller than the connections to which they are attached

Objective(s):

Effectively move the required volume of air

Tools:

- Metal snips
- Drill

Materials:

- Metal duct piping
- Fasteners

See also ASHRAE 62.2-2016.

Before

Duct work for exhaust fans should be short, smooth, and not pinch down

After

Duct is the same size as the outlet and makes shortest run possible
6. Ventilation

6.6002.1b – Duct Insulation

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

Ducts installed outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local codes

Objective(s):

Prevent condensation from forming or collecting inside of the ductwork

Tools:

- Utility knife
- Metal snips

Materials:

- R-8 insulation with vapor barrier
- Nylon twine
- Wire
- UL-181 duct tape

See also ASHRAE 62.2-2016. Check local codes to see if R-8 is accepted level of insulation.

Before
Uninsulated ducts in unconditioned spaces are an energy drain

After
R-8 insulation with a vapor barrier should be securely wrapped around ducts
Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

- Flexible and duct board ducts and plenums will be supported every 4' using a minimum of 1 ½” wide material
- 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" or wider 18-gauge strapping or 12 gauge or thicker galvanized wire no less than 10' apart

Objective(s):

Effectively move the required volume of air Preserve the integrity of the duct system Eliminate falling and sagging

Tools:

- Drill
- Metal snips
- Utility knife

Materials:

- Durable straps at least 1 1/2" wide
- 18 gauge metal strap at least 1/2" wide
- 12 gauge galvanized wire
- Staples
- Fasteners

Installation must comply with applicable Maine Code: IRC M1601.4.3 Support. Metal ducts shall be supported by 1/2-inch (13 mm) wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other approved means. Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.

See also ASHRAE 62.2-2016.
6. Ventilation

6.002.1c – Duct support

Before

Ducts should not be allowed to droop or sag to maximize efficiency

After

Supports should be evenly spaced to allow for minimal distance of run

BAD: Make sure supports DO NOT compress insulation or duct

Flex ducts should have support straps at least every 4 feet

< 4 ft apart

Metal ducts should be supported at 10 feet or less with wire or metal strap

< 10 ft apart
6. Ventilation

6.6002.1c – Duct support

Metal strap should be at least 18 gauge and 1/2 inch wide

Metal wire should be at least 12 gauge and galvanized

Support straps should be at least 1 1/2 inches wide
6. Ventilation

6.6002.1d – Duct Connections

Desired Outcome:

Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):

- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- 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
- 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

Objective(s):

Effectively move the required volume of air Preserve the integrity of the duct system

Tools:

- Drill
- Tie band tensioner
- Brush

Materials:

- Tie bands
- Insulated flex duct
- Mastic
- PVC primer
- PVC cement
6.6002.1d – Duct Connections

Fan duct is disconnected and venting into the attic space.

Apply mastic to the connection fitting

Snug duct liner onto connection fitting

Use zip tie and tensioner to secure liner to connection fitting

Fan has been vented with sealed, insulated duct material.
### 6. Ventilation

#### 6.6002.1d – Duct Connections

**Sealants should show UL181-M or UL181B-M.**

**PVC-to-PVC connections should use PVC primer and cement.**

**Snug insulation to fan housing and strap into place.**

**Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum.**

**Using mechanical fasteners, secure.**

**Apply mastic to fan connection.**
6. Ventilation

6.6002.1e – Duct Materials

Desired Outcome:
Installed ducts effectively move the required volume of air and prevent condensation

Specification(s):
• Flexible materials will be UL 181 listed or Air Diffusion Council approved
• The metal gauge of rigid kitchen fan ducting shall meet code requirements or the approval of the authority having jurisdiction.

Objective(s):
• Effectively move the required volume of air
• Preserve the integrity of the duct system

Materials:
• All materials should be UL 181 Listed
• 30-gauge minimum Rigid Duct

Bad Practice
Existing duct is installed incorrectly and is not UL listed

Best Practice
This flexible duct conforms to UL 181
6. Ventilation

6.6002.1e – Duct Materials

Look for the Air Diffusion Council seal.

Flex installed should meet or exceed

When rigid duct is being used, its wall thickness should be 30 gauge minimum.
6. Ventilation

6.6002.2 Terminations

6.6002.2a – Hole in Building Shell

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

A hole no greater than a 1/4" greater than the fitting will be cut to accommodate termination fitting

Objective(s):

Allow for ease of weatherproofing

Tools:

- Hole saw
- Drill
- Tape measure

Exhaust fans need exterior ventilation, often through roofs and walls

Hole should be no more than 1/4" larger than termination fitting diameter
6. Ventilation

6.6002.2a – Hole in Building Shell

1. Locate the center of your vent hole by drilling from inside through roof.

2. Measure the termination fitting to determine proper hole saw diameter.

3. Based on termination fitting size (in this case, 4"), mark to cut hole.

4. Hole should be no more than 1/4" larger than termination fitting diameter.

5. Verify hole size is correct before installation.
6. Ventilation

6.6002.2b – Termination Fitting

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

- A termination fitting with an integrated collar will be used
- 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
- Fitting will be appropriate for regional weather conditions and installation location on house so as not to be rendered inoperable

Objective(s):

- Effectively move the required volume of air to the outside
  Preserve integrity of the building envelope
- Ensure durable installation

Tools:

- Drill

Materials:

- Fasteners

Termination fittings with no collar are to be avoided

After

Properly sized ducts with snug connections to collared fittings last longer
6. Ventilation

6.6002.2b – Termination Fitting

BAD: Termination fittings without collars should be avoided

Termination fittings with collars should be used for exhaust ventilation

Collared fittings extend through the roof to fasten securely with duct
6. Ventilation

6.6002.2c – Duct to Termination Connection

Desired Outcome:
Securely installed termination fittings with unrestricted air flow

Specification(s):
- Duct will be connected and sealed to termination fitting as follows:
- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- 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
- 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
- Fasteners will not inhibit damper operation

Objective(s):
- Effectively move the required volume of air to the outside
- Preserve integrity of the building envelope
- Ensure durable installation

Tools:
- Wire cutter
- Chip brush
- Zip tie tension tool
- Utility knife

Materials:
- Insulated flex duct with liner
- UL 181 sealant
- Zip tie straps
- PVC primer
- PVC cement
6. Ventilation

6.6002.2c – Duct to Termination Connection

**Before**
Termination is not mechanically fastened, or sealed appropriately

**After**
Termination fitting is secure, and duct is sealed to termination

1. **With other end of the duct connected to the fan, cut duct to desired length**

2. **Apply mastic to termination fitting**

3. **Fit duct liner on to termination fitting**

4. **With duct liner in place, use the zip tie tension tool to secure the liner to the fitting.**
6. Ventilation

6.6002.2c – Duct to termination connection

5. With liner secured and zip tie trimmed, you are ready to pull the insulation to cover the fitting.

6. Ensure termination damper functions as intended.

7. Round metal-to-metal connections require fiberglass mesh tape and 3 mechanical fasteners minimum.

8. PVC-to-PVC connections should use PVC primer and cement.

9. Sealants should be UL181-M or UL181B-M listed.
6.6002.2d – Weatherproof Installation

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

- Exterior termination fitting will be flashed or weather sealed
  Water will be directed away from penetration
- Installation will not inhibit damper operation Manufacturer specifications will be followed

Objective(s):

- Preserve integrity of the building envelope
- Ensure a weather tight and durable termination installation
  Ensure unrestricted air flow

Materials:

- Fasteners
- Caulk

Tools:

- Hole saw
- Caulk gun
- Drill

Before

Holes for termination fitting need to be sealed to weatherproof

Termination fitting is installed to repel water and sealed

After

Termination installation should follow shingling to deter water penetration

Weatherization Field Guide page 271 of 308 Abridged 12-2018
6. Ventilation

6.002.2e – Pest Exclusion

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Screen material with no less than ¼" and no greater than ½" hole size in any direction will be used. Installation will not inhibit damper operation or restrict air flow.

Objective(s):

Prevent pest entry Ensure proper air flow

Before

Exhaust terminations without screens are an invitation to pest intrusion

After

Screen mesh should be between 1/4" and 1/2" in either direction
6. Ventilation

6.6002.2f – Termination Location

Desired Outcome:
Securedly installed termination fittings with unrestricted air flow

Specification(s):
- 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.
- Terminations will be installed:
  - A minimum of 3' away from any property line
  - A minimum of 3' away from operable opening to houses
  - A minimum of 10' away from mechanical intake
  - As required by authority having jurisdiction

Objective(s):
Prevent exhaust from reentering house

Tools:
- Measuring tape
- Hole saw
- Drill

Exhaust vent was properly mounted over 3ft from door, window, and deed line

Exhaust vent has been improperly mounted too close to mechanical vent
6. Ventilation

6.6002.2g – Kitchen Exhaust

Desired Outcome:

Securely installed termination fittings with unrestricted air flow

Specification(s):

Galvanized steel, stainless steel, or copper will be used for termination fitting for kitchen exhaust

Objective(s):

Prevent a fire hazard

Before

Kitchen exhaust vents should not be made from highly combustible materials

After

This roof-mounted kitchen exhaust fan is galvanized steel—heat resistant
6. Ventilation

6.6002.3 Exhaust Only Ventilation (Fan Intake Grille Location)

6.6002.3a – Primary Whole House Ventilation

Desired Outcome:
Exhaust grille location optimizes either primary or local ventilation

Specification(s):
Fan intake grille will be installed in a central location within the main body of the house. Ensure it is accessible for filter change and cleaning.

Objective(s):
Provide whole house air exchange

6.6002.3b – Local Ventilation

Desired Outcome:
Exhaust grille location optimizes either primary or local ventilation

Specification(s):
Fan intake grille will be installed in the space where odor, moisture vapor, or other contaminants are generated

Objective(s):
Remove contaminated air at the source
6. Ventilation

6.6003 Fans
6.6003.1 Surface Mounted Ducted

6.6003.1a – Hole Through Interior Surface

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
A hole no greater than a 1/4" greater than the assembly will be cut to accommodate fan assembly

Objective(s):
Minimize repair work Ensure a secure installation

6.6003.1c – Fan Mounting

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
- Fan outlet will be oriented toward the final termination location
- Fan will be oriented so the equivalent length of the duct run is as short as possible Fan will be mounted securely in accordance with manufacturer specifications

Objective(s):
- Ensure short duct run to achieve optimum air flow Ensure a secure installation
- Ensure fan housing does not shake, rattle, or hum when operating
6. Ventilation

6.6003.1d – Backdraft Damper

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):
Prevent reverse air flow when the fan is off

6.6003.1e – Duct to Fan Connection

Desired Outcome:
Surface-mounted ducted fans installed to specification

Specification(s):
- Duct-to-fan outlet will be connected and sealed as follows:
  - Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
  - 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
  - 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 according to manufacturer specifications
  - In addition to mechanical fasteners, duct connections will be sealed with UL 181B or 181B-M listed material

Objective(s):
Exhaust to outside
6. Ventilation

6.6003.1f – Fan Housing Seal

**Desired Outcome:**
Surface-mounted ducted fans installed to specification

**Specification(s):**
- Gaps and holes in fan housing will be sealed with caulk or other sealants in accordance with manufacturer recommendations
- Sealants will be compatible with their intended surfaces
  Sealants will be continuous and meet fire barrier specifications

**Objective(s):**
- Prevent air leakage through fan housing
  Ensure a permanent seal
- Prevent a fire hazard

6.6003.1g – Fan to Interior Surface Seal

**Desired Outcome:**
Surface-mounted ducted fans installed to specification

**Specification(s):**
- Sealants will be compatible with their intended surfaces
  Sealants will be continuous and meet fire barrier specifications

**Objective(s):**
- Prevent air leakage between house and fan

6.6003.1h – Air Flow

**Desired Outcome:**
Surface-mounted ducted fans installed to specification

**Specification(s):**
- Air flows in cubic feet per minute (CFM) will be measured and adjusted to meet the whole house upgrade design requirements

**Objective(s):**
- Exhaust sufficient air from desired locations to outside
6. Ventilation

6.6003.2 Inline

6.6003.2a – Wiring

Desired Outcome:

Inline fans installed to specification

Specification(s):

Wiring will be installed in accordance with original equipment manufacturer specifications and local and national electrical and mechanical codes

Objective(s):

Prevent an electrical hazard

6.6003.2b – Access

Desired Outcome:

Inline fans installed to specification

Specification(s):

Fan and service switch will be accessible for maintenance according to NFPA 70 National Electric Code or local authority having jurisdiction

Objective(s):

Fan and service switch will be accessible for maintenance
6. Ventilation

**6.6003.2c – Fan Mounting**

**Desired Outcome:**

Inline fans installed to specification

**Specification(s):**

- Fan outlet will be oriented toward the final termination location
- Fan will be oriented so the equivalent length of the duct run is as short as possible Fan will be mounted securely in accordance with manufacturer specifications
- Fan will be isolated from the building framing unless specifically designed to be directly attached Fan will be installed remotely by installing ducting from intake grille

**Objective(s):**

- Ensure short duct run to achieve optimum air flow Ensure fan is installed securely
- Ensure fan housing or building framing does not shake, rattle, or hum when operating Minimize noise

*Inline fan mounted in basement*
6. Ventilation

6.6003.2d – Backdraft Damper

Desired Outcome:

Inline fans installed to specification

Specification(s):

A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):

Prevent reverse air flow when the fan is off

6.6003.2e – Duct Connections

Desired Outcome:

Inline fans installed to specification

Specification(s):

- Ducts will be connected and sealed to the intake fan and termination fitting as follows:
- Round metal-to-metal or metal-to-PVC will be fastened with a minimum of three equally spaced screws
- 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
- 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

Objective(s):

- Exhaust from desired location to outside
- Preserve integrity of the duct system and building envelope
6. Ventilation

6.6003.2f – Boot to Interior Surface

Desired Outcome:
Inline fans installed to specification

Specification(s):
Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications

Objective(s):
Prevent air leakage around intake housing Prevent a fire hazard

6.6003.2g – Air Flow

Desired Outcome:
Inline fans installed to specification

Specification(s):
Air flows in CFM will be measured and adjusted to meet the design requirements

Objective(s):
Exhaust sufficient air from desired locations to outside
6. Ventilation

6.6003.3 Through the Wall

6.6003.3a – Hole in Building Shell

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
A hole no greater than a 1/4 inch greater than the assembly will be cut to accommodate fan assembly

Objective(s):
Allow for ease of weatherproofing

Tools:
- Saw
- Prybar
- Goggles
- Gloves
- Measuring tape

Before
Measure the vent size to compare to opening. 1/4” gap or less is desired

After
Hole size allows sufficient room for vent installation and proper sealing
6. Ventilation

6.6003.3a – Hole in building shell

**Before**

Determine size to cut hole by measuring fan assembly and ducting

**After**

A snug fit should be ensured to minimize weatherproofing required

1. Measure the termination fitting to determine proper hole diameter (in this case, 4”)

2. Hole should be no more than 1/4” larger than assembly diameter

3. Clear wall surface and mark hole size 1/4” larger than termination fitting

4. Since opening is larger than most hole saws, precision cutting is important
6. Ventilation

6.6003.3c – Fan Mounting

Desired Outcome:

Through the wall fans installed to specification

Specification(s):

- Fan outlet will be oriented toward the final termination location
- Fan will be oriented so the equivalent length of the duct run is as short as possible
- Fan will be mounted securely according to manufacturer specifications

Objective(s):

- Install mounting fan securely
- Ensure fan housing does not shake, rattle, or hum when operating

Tools:

- Drill
- Drill bits

Materials:

- Fasteners

Before

Improperly aligned fan

After

Fan is mounted securely with the termination outlet lined up.
6. Ventilation

6.6003.3c – Fan Mounting

1. Fan is not properly supported, resulting in an improper alignment with the termination location.

2. Line the fan up so the outlet lines up with the termination.

3. Install the fan using factory mounting holes, ensuring a tight fit and quiet operation.
6. Ventilation

6.6003.3d – Weatherproof Installation

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
- Exterior termination fitting will be flashed or weather sealed
  Water will be directed away from penetration
- Termination fitting installation will not inhibit damper operation
  Manufacturer specifications will be followed

Objective(s):
Preserve integrity of the building envelope  Ensure a weather tight
and durable installation  Ensure unrestricted air flow

Tools:
- Caulk gun
- Drill
- Drill bits
- Reciprocating saw
- Drywall saw or utility knife

Materials:
- Weatherproof termination kit with pest screen
- Caulk or equivalent sealant
- Mechanical fasteners

Best Practice
Apply sealant behind termination cap,
taking care to apply sealant to all edges.

Best Practice
Termination is sealed and securely
attached to the wall.
6. Ventilation

6.6003.3d – Weatherproof installation

1. Clean existing sealant to ensure proper adhesion to the surface

2. Once area around the termination opening is cleaned, apply sealant to all four sides of the opening

3. Install screws through the sealant, which will tighten the fitting and squeeze out excess sealant

4. Wipe away excess sealant for a clean look

5. Ensure damper swings open freely, and closes with a tight fit
6. Ventilation

6.6003.3e – Backdraft Damper

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
A backdraft damper will be installed between the outlet side of the fan and the exterior

Objective(s):
Prevent reverse air flow when the fan is off

---

*Damper should be installed to maintain exterior air barrier*
6. Ventilation

6.6003.3f – Fan Housing Seal

**Desired Outcome:**
Through the wall fans installed to specification

**Specification(s):**
Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications

**Objective(s):**
- Prevent air leakage through fan housing
- Ensure a permanent seal to the building air barrier

**Tools:**
- Caulk gun

**Materials:**
- Weatherproof, code approved caulk

---

**Best Practice**
Sealant should be waterproof and adhere to the desired surfaces

**Best Practice**
Seal unused holes in the fan housing.
6. Ventilation

6.6003.3g – Fan to Interior Surface Seal

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Sealants will be compatible with their intended surfaces Sealants will be continuous and meet fire barrier specifications

Objective(s):
Prevent air leakage around intake housing Prevent a fire hazard

Tools:
Caulk gun

Materials:
Code approved caulk

Best Practice
Sealant should be waterproof and adhere to desired surfaces

Best Practice
Sealant should be applied to the fan housing where it comes in contact with the exterior wall
6. Ventilation

6.6003.3h – Insulation

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
- All components outside of the thermal envelope will be insulated to a minimum of R-8 or equivalent to local code
- Exception: If system operates continuously, fan housing need not be insulated

Objective(s):
Preserve integrity of the duct system
6.6003.3i – Air Flow

Desired Outcome:
Through the wall fans installed to specification

Specification(s):
Air flows in CFM will be measured and adjusted to meet the design requirements

Objective(s):
Exhaust sufficient air from desired locations to outside

Tools:
- Exhaust fan flow meter
- Manometer

Materials:
- Fabricated cover for fans larger than the flow meter

Best Practice
Using a digital manometer, exhaust flow meter and fabricated cover, measure the fan flow

Best Practice
Air flow should be within acceptable limits for the location of the fan
6. Ventilation

6.003.3i – Air flow

The exhaust fan flow meter won’t fit most range hoods. A fabricated cover is needed.

A fabricated cover can be used so long as the opening is smaller than the meter itself and larger than the E1.

Attach a pressure hose to the exhaust fan flow meter.

Attach the hose to a T connection on channels A & B with the manometer set to measure exhaust fan flow.
6. Ventilation

6.003.3i – Air flow

With manometer properly set up, prepare to test air flow.

Fans must pull the required CFM according to ASHRAE.

With the manometer Mode set to PR/FL, Device set to EXH, and Config set to E1, this fan pulls 111 CFM.
6. Ventilation

6.6005 Appliance Exhaust Vents
6.6005.1 Clothes Dryer

6.6005.1a – Clothes Dryer Ducting

Desired Outcome:
Dryer air exhausted efficiently and safely

Specification(s):

- 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
- 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
- Dryer ducts exceeding 35’ in duct equivalent length will have a dryer booster fan installed. Plastic venting material will not be used
- Uninsulated clothes dryer duct will not pass through unconditioned spaces such as attics and crawl spaces
- Ducts will be connected and sealed as follows:
  - UL listed foil type or semi-rigid sheet metal to rigid metal will be fastened with clamp
  - 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
- In addition:
  - Sheet metal screws or other fasteners that will obstruct the exhaust flow will not be used
  - Condensing dryers will be plumbed to a drain

Objective(s):

- Preserve integrity of building envelope
- Effectively move air from clothes dryer to outside
6. Ventilation

6.6005.1a – Clothes Dryer Ducting

Tools:
- Metal trimmers
- Drill

Materials:
- Metal flex duct
- Dryer vent kit
- Hose clamps

Before

Dryer is vented outside, but with the incorrect material.

After

Dryer is vented outdoors, with correct material. Run is as short and straight as possible ensuring maximum flow.
6. Ventilation

6.6005.1a – Clothes dryer ducting

Disconnect existing vent pipe from termination. If hose clamp is installed, save for reuse

Attach approved vent material to termination vent. Termination vent may need to be trimmed

Disconnect existing vent pipe from dryer.

Trim metal vent to ensure the run is as short and straight as possible.
6. Ventilation

6.6005.1a – Clothes dryer ducting

Connect vent pipe to dryer.

Dryer vents to outdoors, and exhaust

For vent runs >35 feet, a booster fan is required

Duct runs outside of conditioned space must be insulated and properly supported
6. Ventilation

6.6005.1b – Termination Fitting

Desired Outcome:

Dryer air exhausted efficiently and safely

Specification(s):

- Termination fitting manufactured for use with dryers will be installed
- A backdraft damper will be included, as described in termination fitting detail
- Mesh pest intrusion barriers are not allowed on dryer vents per IRC 2015

Objective(s):

- Preserve integrity of building envelope
- Effectively move air from clothes dryer to outside
**6. Ventilation**

### 6.6005.2 Kitchen Range

#### 6.6005.2b – Fan Venting

**Desired Outcome:**

Kitchen range fan installed to specification

**Specification(s):**

Kitchen range fans will be vented to the outdoors. Recirculating fans will not be used as a ventilating device.

**Objective(s):**

Remove cooking contaminants from the house. Preserve integrity of building envelope.

---

Before

*Recirculating fans over ranges do not actually remove contaminants*

After

*Daylight visible through dampered kitchen exhaust proves venting access*
6. Ventilation

6.6005.2c – Fan Ducting

Desired Outcome:

Kitchen range fan installed to specification

Specification(s):

- Kitchen range fans will be ducted to the outdoors
- As short a run as practical of smooth wall metal duct will be used, following manufacturer specifications
- Ducting will be connected and sealed as follows:
  - Metal-to-metal will be fastened with a minimum of three equally spaced screws
  - Other metal-to-metal connections will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, or tapes
  - For down-draft exhaust systems, 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

Objective(s):

- Preserve integrity of building envelope
- Effectively move air from range to outside

Tools:

- Drill
- Putty knife
- Tape measure
- Metal snips
- Saw

Materials:

- Round metal ducting
- Mastic
- Fiberglass mesh tape
- Fasteners
6. Ventilation

6.6005.2c – Fan Ducting

See also 6.6002.1d. Note: Only smooth-wall metal duct will be used, except for down-draft exhaust systems where PVC is acceptable as well. Flex duct is NOT acceptable for kitchen fan exhaust application.

Before

Exhaust duct should be smooth-walled and in as short a run as possible

After

Daylight visible through dampered kitchen exhaust proves outside access
6. Ventilation

6.005.2c – Fan ducting

Finally, joint should be secured with UL-181 mastic

Duct run should be as smooth and short as possible

Duct should be fastened securely with three evenly-spaced screws

Then joints should be secured with fiberglass tape
6. Ventilation

6.6005.2d – Termination Fitting

Desired Outcome:
Kitchen range fan installed to specification

Specification(s):
Termination fitting will be installed including a backdraft damper, as described in termination fitting detail

Objective(s):
Ensure safe operation of combustion appliances  Ensure occupant health and safety

*Kitchen fans should exhaust to the exterior, not just recirculate air*

*Exhaust fans should have backdraft dampers*
6.6005.2d – Termination Fitting

Backdraft damper on roof mounted exhaust fan

An interior backdraft damper can also be installed

Satisfies SWS

Kitchen vent termination must have a pest barrier screen
6. Ventilation

6.62 Air Flow

6.6201 Air Flow Requirements

6.6201.2 Primary Ventilation Air Flow Between Rooms

6.6201.2a – Balancing Pressure

Desired Outcome:

Air circulates freely between rooms

Specification(s):

- An appropriate means of pressure balancing will be installed (e.g., transfer grilles, jumper ducts, individual room returns)
- No room will exceed +/- 3 pascals with reference to the outdoors with all interior doors closed and ventilation systems running

Objective(s):

Ensure free flow of air between rooms  Preserve integrity of the building envelope

Before

If reading is > +/- 3pa, interior ventilation needs to be installed

After

Passive door vents and individual room returns are two possibilities
6. Ventilation

6.6201.2a – Balancing Pressure

1. Turn on exhaust fans and close interior doors.

2. With hose under door, check pressure again. Readings >+/−3pa are no good and require interior ventilation.

3. Take baseline reading.

4. With hose under door, check pressure again. Readings >+/−3pa are no good and require interior ventilation.

5. Turn on exhaust fans and close interior doors.