

## Section 1: Top of Building

### Flat Attics

There are air sealing & insulation requirements in every flat attic space.

#### Air Sealing Requirements |

All air bypasses into the attic shall be sealed airtight before completion of a weatherization project.<sup>1</sup>

Attic air sealing must address all wire penetrations, plumbing vent stacks, attic hatches, surface mounted ceiling fixtures, recessed lighting fixtures, exhaust fan assemblies, chimney/flue chases, partition walls, merger walls between adjoining building sections, and all other miscellaneous bypasses that provide pathways for indoor air to move into the attic.

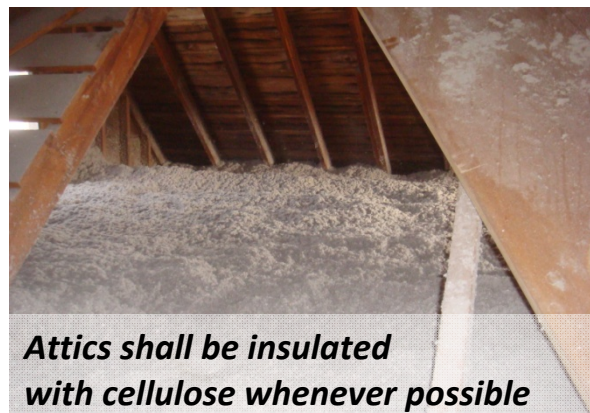
All air sealing measures must be screened for cost effectiveness. If attic air sealing measures do not screen as cost-effective for energy saving benefits alone, they can—and in most cases they must—be completed for air quality and building durability purposes. In the event an attic air sealing measure does not screen as a cost-effective energy saving measure, it shall be performed during the weatherization project as an incidental repair measure unless written OEO approval to omit specific measures on an individual job is attained/recorded in the job file using the “Atypical Project Approval” form.<sup>1</sup>

#### Insulation Requirements |

All attic insulation measures must be screened for cost effectiveness prior to installation & shall only be installed whenever the insulation measure screens as cost-effective.

All insulation—preexisting or added by WAP—must be assigned an “effective” insulation value based on the manner it is installed. “Engineered” R-values cannot to be used.

All “effective” R-values shall be determined using the BPI tables included in Appendix K.



***Attics shall be insulated with cellulose whenever possible***

**Final WAP Funded Insulation Levels:** Whenever insulation is added by the WAP, the effective R-value at project completion shall be R-49 (+/- R-3) wherever roof clearance allows. When the available roof clearance prevents an R-49 installation from being achieved, but the overall installation is still cost effective, insulation must be added up to the roofline.

\*The incremental cost to install R-values greater than R-49 must be paid for using Non-WAP funding.

## Section 1: Top of Building

### Flat Attics

#### Mandatory Attic Airsealing | 2016 Policy Adjustment


##### Effective July 2016

1. There is now an allowable testing procedure that can be performed at an energy audit, or before the WAP crew starts any shell work, to quantify the existing attic air leakage.
2. There is now a defined threshold for attic air-leakage levels that allows an agency to opt out of some mandatory attic airsealing measures for a project when the test results indicate that the air leakage into the attic is less than the established threshold.

**The Testing Procedure Required** | to opt out of some attic airsealing measures

 **Zonal Pressure Diagnostics using Add-a-Hole Zone Modification**

**The Threshold Required** | to opt out of some attic airsealing measures

 **If the CFM50 air leakage into the attic represents 30% or less of the attic sq. ft. before the WAP work begins then an agency can opt out of some attic airsealing measures during the project.**

##### ***Determining the Threshold | An Example Scenario:***

If the attic footprint is 1,000 sq. ft., then a maximum test result of 300 CFM50 leakage between the house and attic would be acceptable.

- 300 CFM50 = 30% of the attic sq. ft.
- 300 CFM50 would roughly translate to 30 sq. in. of leakage area.

### Mandatory v. Discretionary Attic Airsealing Measures

#### ***Mandatory attic airsealing measures become optional when:***

1. A ZPD test using add-a-hole zone modification is performed at an energy audit, or at some other time before the WAP crew begins any building shell work.  
-and-
2. The test results—from before the WAP crew begins any building shell work—indicate that the threshold required to opt out of some required attic airsealing measures is already met.



## Section 1: Top of Building

### Flat Attics

#### Mandatory Attic Airsealing | 2016 Policy Adjustment

#### Mandatory v. Discretionary Attic Airsealing Measures

Below is a breakdown of measure requirements when the allowable ZPD testing has been performed and the acceptable attic air leakage threshold for a given project is met prior to any building shell work being performed by weatherization crews.

Becomes Optional	Still Mandatory
(1) Accessing and airsealing at every wire penetration	(1) Airsealing attic hatches
(2) Accessing and airsealing at every interior wall top	(2) Airsealing around chimneys/flues
(3) Accessing and airsealing at every exterior wall top	(3) Airsealing recessed lights
	(4) Airsealing fans/fan venting
	(5) Airsealing plumbing penetrations and any other miscellaneous bypasses that are not specifically identified in this table

Note that if ZPD testing is not performed on an individual weatherization job as outlined in this 2016 policy revision, then all attic airsealing measures are mandatory unless written OEO approval to omit specific measures on an individual job is attained and recorded in the job file. This written approval shall be requested using the “Atypical Project Approval” form and uploaded to the HES job file.



## Section 1: Top of Building

### Flat Attics

#### Perimeter Pull, Air Sealing & Batt Insulation Encapsulation Requirements |

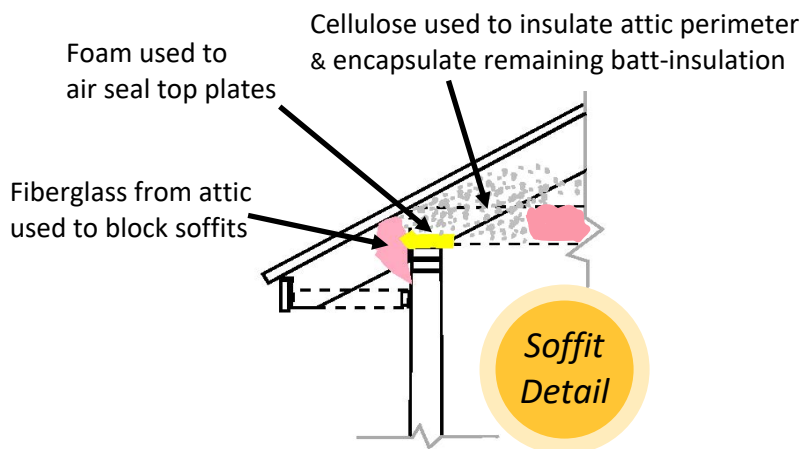
**Perimeter Pull Method:** Any preexisting fiberglass batting shall be removed from the outer perimeter of the attic before any additional insulation is installed. After the perimeter is cleared of fiberglass—and all attic air sealing measures are complete and verified to be effective—the remaining fiberglass batting must be completely encapsulated with loose-fill insulation. The new insulation gets blown in around the attic perimeter and on top of the fiberglass batting.



The perimeter pull, air sealing and encapsulation process is a lot of work, but it is essential to do this before adding more insulation over pre-existing fiberglass batting.

**Remember, if there are air pockets between the ceiling and the batt insulation, heat from the house will escape into and then out of the attic underneath that insulation.**

This type of heat loss is most problematic with strapped ceiling assemblies, but the perimeter pull is required on all WAP projects with flat attic areas, even those without ceiling strapping. Without performing a perimeter pull, airsealing and encapsulation process, additional insulation added into the attic will likely have a limited impact.



**At the eaves, all top plates must be evaluated, accessed and air sealed during every project.**<sup>i</sup>

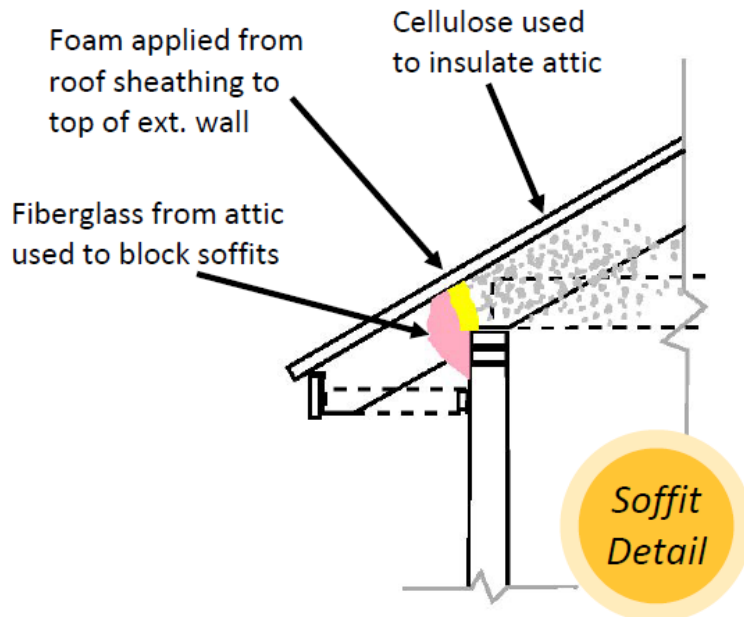
Whenever possible, it is recommended that a blocker/backing material be used to aid the adherence of spray-applied foam materials to the outer edge of the exterior wall top and to keep cellulose out of the soffit when insulating. In the detail above, a piece of scrap fiberglass batting is used for this purpose.

## Section 1: Top of Building

### Flat Attics

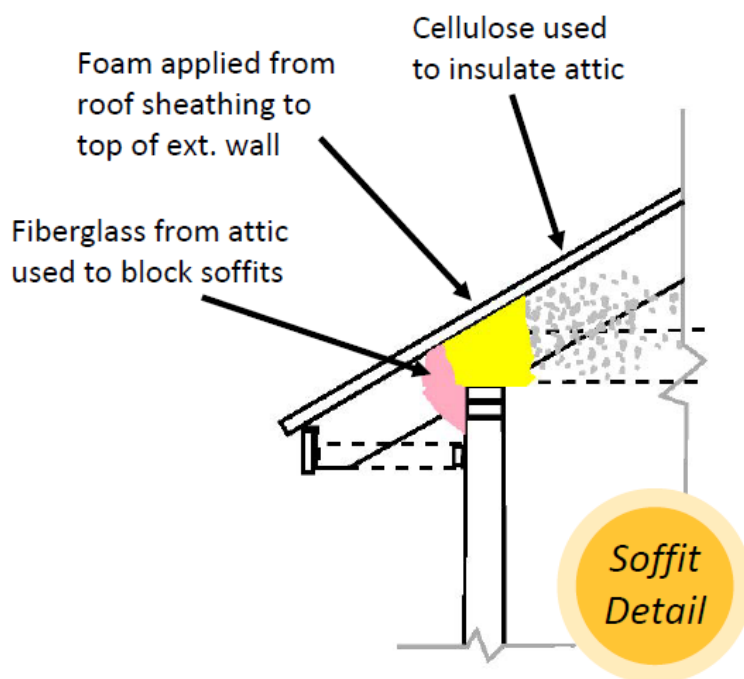
#### Non-Allowable Measure Installation Techniques |

##### 1. Installing a continuous spray foam barrier between soffit and attic



It is **not-allowable** practice to apply a continuous coating of spray foam from the underside of the roof sheathing down to the top of the exterior wall using WAP funding. Airsealing applications in this area of the building shall be focused on preventing indoor air from entering the attic space.

##### 2. Installing a wedge of spray foam at the eaves of shallow pitched roofs



It is **not-allowable** practice to apply a wedge of spray foam at the eaves of an attic using WAP funding. The technique of installing closed-cell spray foam in this manner does maximize the R-value achieved per-inch in low-roof-clearance areas and there can be positive impacts associated with this installation technique. However, the cost to effectively deliver R-6 per-inch insulation values in this area of the building using closed-cell spray foam compared to the cost to deliver between R-3 to 4 per-inch values using other insulation materials does not yield a large enough return on investment to justify investing WAP funding in this manner.



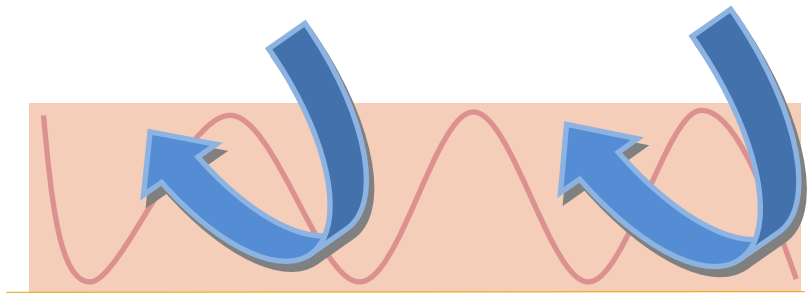
## Section 1: Top of Building

### Flat Attics

#### Intrusion & Wind-Washing |

According to the Department of Energy, intrusion and wind-washing can combine to reduce insulation effectiveness up to 50%.

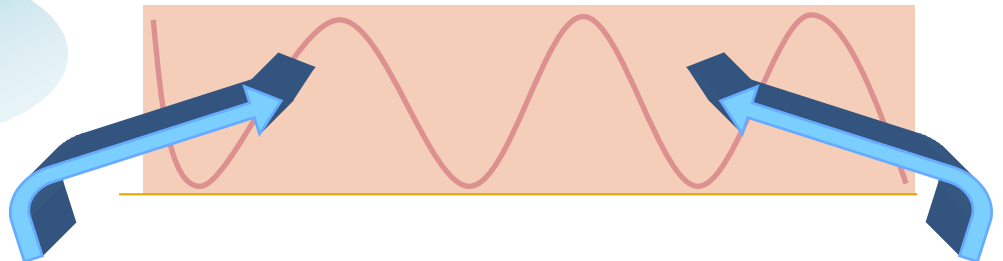
#### **Intrusion**



#### **Intrusion: Department of Energy Definition**

*Air moving into and out of insulation, without going through the wall or ceiling assembly. It will occur even when a good air barrier is present on one surface.*

#### **Wind-washing**



#### **Wind-washing: Department of Energy Definition**

*Wind-washing is a phenomenon particular-to fiberglass attic insulation. Air entering and leaving the attic through the attic vent openings is frequently able to blow through flat fiberglass attic insulation, removing heat as it goes.*

## Section 1: Top of Building

### Flat Attics & All Roof Systems

#### Passive Attic/Roof Ventilation Policy |

All attics & roof systems that the WAP will be airsealing or insulating shall be unvented attic/roof assemblies unless prior written approval to preserve or install a vented attic/roof system is granted by OEO for an individual project. Approval requests shall be made using the “Atypical Project Approval” form.

Approval requests to preserve or install a vented attic/roof system—in an attic/roof that the WAP will airseal or insulate—will only be considered when the local WAP provider can clearly demonstrate that all the conditions below are achievable by the completion of the project:

1. Every baffle must be installed in a manner that will protect the attic/ roof insulation from both intrusion and wind washing and the baffles must extend at least 6" beyond the final insulation level.
2. The perimeter top plates must be thoroughly evaluated using blower door assisted smoke testing and infrared scanning to verify air is not leaking between the house and the attic/roof assembly.
3. The airsealing work at all miscellaneous bypasses between the living space and the attic/roof assembly must be verified as effective with blower door assisted smoke testing.
4. The perimeter pull method must be utilized if there is any preexisting fiberglass batt insulation.



## Section 1: Top of Building

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### Flat Attics

#### Miscellaneous Policies |

##### Electrical Boxes

All electrical boxes that are exposed during the normal course of weatherization work will be flagged to be seen above the level of the attic insulation. Recessed lights and exhaust fans will also be flagged to be seen above the level of the insulation.

**Exception:** Pre-existing insulation will not be excavated for the sole purpose of identifying and flagging every electrical box when there is already pre-existing insulation covering areas where electrical boxes may or may not exist and there is no air-sealing work being performed in the area that would prompt the requirement to identify and mark the locations of each electrical junction.

##### Insulation Markers

Insulation will be adequately marked for depth in each separate accessible attic area. In larger attics, depth markers will be installed, at minimum, in every 300 square feet of attic area. All depth measurements will begin at the air barrier.

##### Recessed Lighting

All recessed light fixtures, including those that are IC rated, shall have an airtight enclosure installed that separates each recessed light from any airsealing and insulation materials. The enclosure must provide a three-inch minimum airspace around all components of the light fixture. If a recessed light fixture cannot be verified as IC rated, then the maximum allowable R-value for the top of the airtight enclosure shall be R-13. If a recessed light fixture can be verified as IC rated, then the R-value installed over the top of the airtight enclosure during a weatherization project must be between R-13 and R-49.

##### Exhaust Fans

All exhaust fans shall have an airtight enclosure installed that separates the device itself from any airsealing and insulation materials. The enclosure must provide a three-inch minimum airspace around all components of the exhaust fan except the vent outlet. The R-value installed over the top of the airtight enclosure during a weatherization project must be between R-13 and R-49.

##### Whole House Fans

In the rare case there is a functioning whole house fan in the attic, it is recommended that the device be disconnected and removed from operation as part of the project. If the client is not agreeable to removal of the whole house fan, then an enclosure like those built around pull-down attic access stairs shall be installed. All standards outlined on Section 1: Page 11 of this policy manual shall apply to this measure whenever operational whole house fans are present and the weatherization client is not amenable to disconnection and removal of the device as part of the weatherization project.





## Section 1: Top of Building

### Flat Attics

#### Attic Hatch | Standard Assembly

Whenever roof clearance allows a hatch assembly must be installed unless continued access into the attic from a ceiling hatch is not desired by the client. A durable insulation dam shall be installed around all attic hatch openings. The dam must extend at least 2" higher than the settled insulation depth at the completion of the weatherization project.



**Hatches built by Wx crews must have at least four inches of HI-R sealed to the interior surface of hatch assembly, w/all edges taped.**

**Attic hatch panels shall have a minimum effective R-value of 21.**

**Higher R- values are strongly encouraged whenever roof clearance allows.**

Hatch assemblies 7 sq. ft and smaller are not screened as individual measures.

They are ancillary to the energy saving work performed in the attic.



**Q-lon  
or  
comparable**

If pre-manufactured panels are being used as attic hatches, it is recommended that additional sheets of either Hi-R (*polyisocyanurate*) or pink/blue-board (*extruded polystyrene*) get added on top of the panel, with the edges sealed and taped, to maximize R-value.

Alternatively, additional inches of closed-cell spray foam can be applied to the top of the pre-manufactured panels.

**Use of felt  
weather-stripping  
is not allowable.**

## Section 1: Top of Building

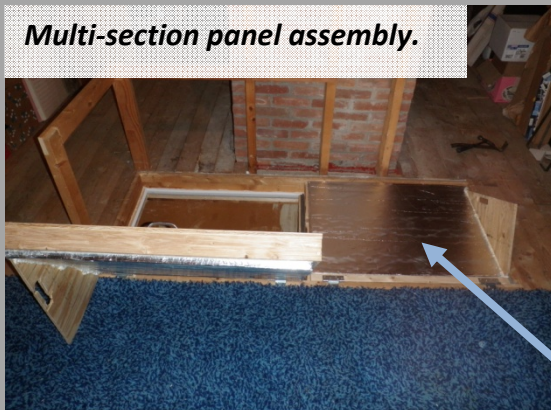
### Flat Attics

#### Attic Access | Walk up Staircase

Whenever possible a hatch panel shall be located at the top of the staircase.

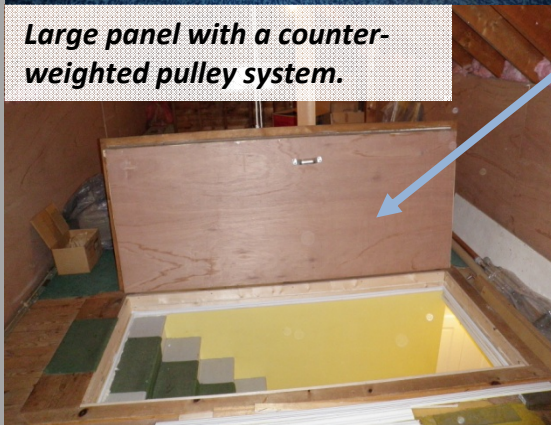
#### Plan A: One Surface separates house from attic

*Multi-section panel assembly.*



Less  
Surface  
Area

*Large panel with a counter-weighted pulley system.*



**Preferred  
Thermal  
Boundary**

**Better  
Results**

#### The Backup Plan: Making the stairwell the thermal boundary

increases the number of surfaces that need to be addressed and reduces the R-values between the house and attic. When the stairwell area is addressed in this manner, it is often difficult to get an effective airseal that keeps warm indoor air out of the attic. For these reasons, treating the walls of the stairwell, the stairs, and the door at the bottom of the staircase is discouraged practice. However, if building a hatch assembly at the top of the stairwell is not practical, or the weatherization client will not allow the installation, then it is allowable to make the stairwell the thermal boundary.

If the weight or functionality of a large hatch assembly presents a concern, the hatch panel should be divided into sections or a counter-weighted pulley system should be installed. Both hatches pictured above meet the minimum R-21 requirement and provide a good tight airseal when closed.

## Section 1: Top of Building

### Flat Attics

#### Attic Access | Pull Down Stairs

Unless the thermal boundary has been moved up to the roofline, a high quality attic hatch assembly shall be built and installed to enclose pull-down staircases.

The assembly is to include a durable insulation dam, a Q-lon (or comparable quality weatherstrip) and a removable top panel that provides an airtight seal when closed.

**R-21  
Minimum**



A Site Built Enclosure Over Pull Down Stairs



#### Assembly Requirements:

- ✓ R-21 is the minimum allowable insulation value for hatch assemblies of any size.
- ✓ Higher R-values should be strived for whenever:
  - a. Roof clearances allow
  - b. For assemblies 8 sq. ft. and larger only, the measure must screen as cost-effective to increase the hatch assembly R-value above R-21
- ✓ The sides of a hatch assembly/insulation dam shall be sealed air tight.
- ✓ The surrounding blown-in attic insulation should continue up the insulation dam to the height of the Q-lon whenever possible.

If the Q-lon is positioned above the settled depth of any blown-in insulation, then the sides of the assembly shall be insulated separately with either HI-R (polyisocyanurate) or closed-cell spray foam products. The R-value of the foam used on the sides of the insulation dam/hatch assembly will then become the reference point for standards requiring that the R-value for the top of the hatch assembly meets or exceeds the value of the “adjoining insulated assembly”.





## Section 1: Top of Building

### Sloped Ceilings | Closed Cavity

All possible efforts shall be undertaken to ensure sloped ceilings are insulated to the highest performance value possible within the existing closed cavity.

The same policy applies to decked attic floors which are covered on Section 1: Page 11.



Every roofline/attic must be evaluated & thoroughly airsealed regardless of how many there are.

*Whenever cost-effective, a roof insulation upgrade must also be performed.*

### Complicated/Numerous Rooflines & Attics



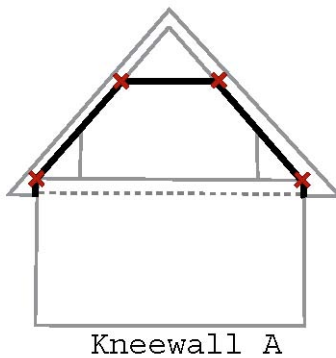
All air sealing measures must be screened for cost effectiveness. But, just like in a flat attic, even if roof air sealing measures do not screen as cost-effective for energy saving benefits alone, they still can—and must—be completed for building durability/air quality purposes. In the event a roof air sealing measure does not screen as an energy saving measure, it shall be considered a required incidental repair measure and completed during the weatherization project.

## Section 1: Top of Building

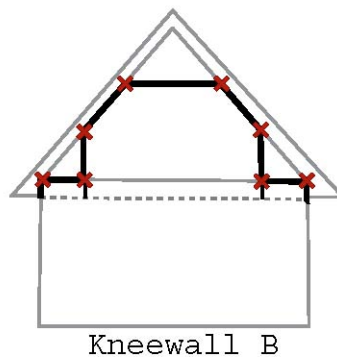
### Kneewall Closets | Placing the thermal boundary

The ***preferred thermal boundary*** shall be established at the slope as indicated here.

This method reduces the number and difficulty of the air sealing tasks required to properly establish a continuous thermal envelope. It also decreases the amount of surface area to be insulated.



When this method is used the floor system underneath the kneewall must be thoroughly air sealed. Tubing in and densepacking underneath the kneewall in each floor bay is not acceptable practice for this air sealing task. The area must be accessed and rigid insulation air sealed in place. Stuffing a fiberglass batt or alternative blocking/backing material under the kneewall in each floor bay and then spray foaming over the Blocking/backing material is also acceptable for this task.



#### Plan A: Treating the slope as the thermal boundary

To ensure a complete thermal envelope, the following surfaces shall always be air sealed and insulated:

- ✓ Sloped roof section between the eaves and the top of the kneewall
- ✓ Rimjoist area
- ✓ Gable end walls
- ✓ When applicable, any exterior walls extending above the kneewall closet.

#### Plan B: Treating the kneewall as the boundary

Allowable in two instances:

1. The kneewall framing provides a deeper cavity to insulate than the roof system framing does.
2. The kneewall closet is over unheated space (e.g. a bonus room above a garage or an exterior porch) and insulating the kneewall floor system will not be necessary.

## Section 1: Top of Building

### Kneewall Closets | Rim Joists/Beams

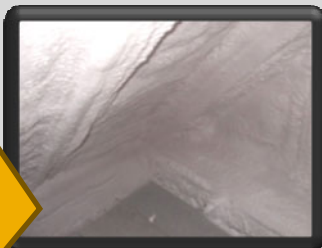
Whenever there is an accessible kneewall closet, the rim shall be addressed during a weatherization project.



**Rims Matter**

*With Spray-foamed slopes...*

*...With Dense-packed slopes*



**On the eaves sides** it is required to either:

- a) remove an outer floor board or cut a swath of the outer subflooring away to expose the rim area to make it possible to airseal & insulate the rim with foam products.
- or-
- b) drill through the kneewall closet floor and densepack out to the rimjoist/beam on the eaves sides of a building with cellulose.

**The rim & endwalls must always be thoroughly sealed and insulated inside each kneewall closet to ensure a complete thermal envelope.**



## Section 1: Top of Building

### Accessible Attics that could be used for storage<sup>ii</sup> |

**Insulating Decked Attic Floors** | Thoroughly densepacking the floor cavities is the minimum insulation requirement in floored attic spaces. Installing more insulation over the flooring is encouraged if cost-effective but it's not required.

#### Airsealing Decked Attic Floors |

In some cases, a densepacked cellulose installation alone can adequately air seal the house from the attic. **However, it is strongly encouraged that prior to densepacking... (a) sections of flooring get removed to allow for targeted airsealing work—including foam-sealing over the top of all partition walls—and then, (b) the flooring be reinstalled prior to the installation of the densepacked cellulose.**



#### Maximizing Thermal Performance in Accessible Attic Spaces

*It is allowable to divide an attic into sections or provide runways using [insulation dams](#). This is one way to maintain the level of attic functionality a weatherization client requests while still being able to maximize insulation value over portions of an attic floor.*

#### Project A



#### Example R-30 Assemblies



#### Project B

### Thermal Boundary Options

If a client does not want loose-fill cellulose installed over sections of a floored attic because the space is used, consider multiple approaches.

Either insulation method shown left is encouraged if...

- a) practical
- b) desired by client
- c) cost-effective

**Establish  
 Thermal Boundary...  
 Maintain  
 Storage Area...  
 Maximize  
 Insulation Value...**

During both Wx projects pictured above, 2-inch-thick HI-R (*polyisocyanurate*) provided another (R-13) over the 5-inch cavities that were densepacked with cellulose (R-18) during the projects. <sup>ii</sup>

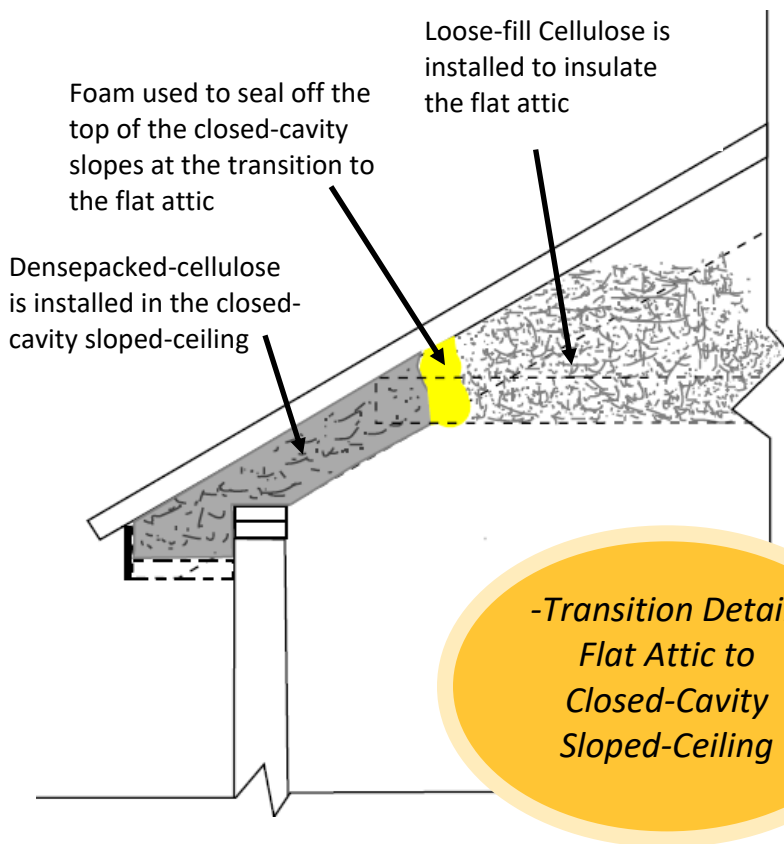
## Section 1: Top of Building

### Transition Between Flat Attic & Closed Cavity Sloped Ceiling

**Required Use of the Perimeter Pull Method** | Any preexisting fiberglass batting shall be removed from all sides around the outer perimeter of the flat attic section before any additional insulation is installed. This includes the area where the flat attic floor transitions down into a closed-cavity sloped-ceiling. After the perimeter is cleared of fiberglass batts—and all attic air sealing measures are complete and verified to be effective—the remaining fiberglass batting must be completely encapsulated with loose-fill insulation. The new insulation gets blown in around the attic perimeter and on top of the fiberglass batting. Additional information about the perimeter pull method is included on page 4 earlier in this section of the policy manual.

#### A Non-Allowable Measure Installation Technique |

##### 1. Installing a continuous foam barrier to separate the flat attic from the closed-cavity sloped-ceiling



It is **not-allowable** practice to separate the flat attic from the closed cavity slopes by installing a continuous foam barrier from the underside of the roof sheathing down to the flat attic floor. The installation restriction at this transition applies for spray foam barriers and rigid foam barriers sealed in place.

Permanently sealing off the top of the closed cavity slopes at the transition into a flat attic area would require an OEO approved atypical project approval form for the individual project.

## Section 1: Top of Building

### Top of Building Airsealing Protocols | Summary

Every “Top of Building” surface that is part of the pressure boundary—including attics, rooflines & exterior surfaces inside kneewall closets—must be evaluated and airsealed. <sup>i</sup>

#### Measure Screening Requirements

All airsealing measures must be screened for cost-effectiveness. If attic air sealing measures do not screen as cost-effective for energy saving benefits alone, they can—and in most cases they must—be completed for air quality and building durability purposes.

#### How to Proceed if this Type of Airsealing Measure Fails to Screen

In the event a “Top of Building” air sealing measure does not screen as an energy saving measure, it shall be considered a required building durability and air quality measure and be completed during the weatherization project as an incidental repair measure unless written approval to omit specific measures on a specific job is attained by OEO and recorded in the job file.

#### Verification of Measure Effectiveness

All “Top of Building” airsealing measures shall be verified for effectiveness using smoke sticks/pencils in tandem with a blower door assembly prior to project closeout.

- ✓ Note that the use of alternative pressure diagnostics and/or infrared cameras to verify the successful completion of airsealing measures is also encouraged. However, these techniques must be utilized in addition to, not instead of, the required use of blower door assisted smoke testing.

#### Measure Cost Allocation for Airsealing Related Work

Efforts to access surfaces and fixtures within flat attics so they can be airsealed, including performing perimeter pulls of pre-existing batt insulation shall be screened and charged to the attic airsealing measure(s), not to the attic insulation measure(s).

Time spent testing and verify the effectiveness of top of building airsealing efforts shall be recorded to airsealing measure(s), not to insulation measure(s).

Whenever cost-effective, the most applicable Airsealing measure coding shall be used. Whenever non-cost-effective, the Incidental Repair - Non-Screenable Top of Building AS Requirements measure coding shall be used.

#### Clarifying note about mandatory airsealing measures v. cost-effective airsealing

The only other area of a home where airsealing work is required regardless of individual measure cost-effectiveness, is at surfaces that separate a house from an attached or tuck-under garage. All other airsealing measures must be cost-effective to be included in a weatherization project scope of work.



## Section 1: Top of Building

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### Section End Notes

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<sup>i</sup> In July 2016 this mandatory attic airsealing policy was adapted to allow for certain attic airsealing measures to be considered optional rather than mandatory if a certain performance standard could be demonstrated by performing Zonal Pressure Diagnostics using Add-a-Hole Zone Modification. See pages 2-3 in this section of the policy manual for detailed information about this 2016 policy revision. Note that if ZPD testing is not performed on an individual weatherization job as outlined in this 2016 policy revision, then all attic airsealing measures are mandatory unless written OEO approval to omit specific measures on an individual job is attained and recorded in the job file. This written approval shall be requested using the “Atypical Project Approval” form and uploaded to the HES job file.

<sup>ii</sup> Fire retardant policies apply. The example photos included on page 15 (Projects A & B) were taken a number of years ago and do not meet current fire retardant policies. If installed on those example projects today, the foam board selected for the installations would need to be an appropriately rated foam board product or the foam board would need to be covered. See Appendix P of this policy manual for detailed information on current fire retardant policies.

