Cellulose Insulation Manufacturers Association

TECHNICAL BULLETIN

STANDARD PRACTICES FOR INSTALLATION OF CELLULOSE INSULATION IN CANADA

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Table of Contents

1. Introduction

Cellulose building thermal insulation is made from up to 85% recycled paper and cardboard—higher than almost any other commonly used building material. Other elements in cellulose insulation include chemicals like boric acid, which is used in cellulose insulation as a flame retardant and to repel insects but found in everything from agricultural to medical products.

Cellulose insulation is the lowest embodied carbon building material commercially available. It is also the only widely accessible form of insulation that stores carbon in the product itself.[1] Our insulation gets installed in homes that see immediate effects on thermal performance and home energy costs. This ultimately benefits all homeowners who use cellulose insulation, ranging from new construction to existing buildings (commonly referred to as retrofit applications). Homeowners may be eligible for weatherization programs and other opportunities to receive tax incentives by insulating their homes with cellulose. Other benefits of cellulose insulation include sound control, fire protection, and its unique hygroscopic properties. When properly installed, it can function well for decades.

Members of the Cellulose Insulation Manufacturers Association (CIMA) have developed these installation guidelines to cover the recommended methods of installing cellulose insulation for both new construction and retrofit applications.

These guidelines are intended for the installation of cellulose insulation manufactured in accordance with CAN/ULC-S703 standards for either thermal applications and/or acoustical applications. Purchasing cellulose insulation from a CIMA Producer Member located in Canada means your insulation has met these standards.

All new construction installation must consider the National Building Code of Canada (NBC) and other building code requirements as specified by your province and local municipality.

2. Symbols and Abbreviated Terms

ASTM	American Society for Testing and Materials
CCMC	Canadian Construction Materials Centre
CFI	Cellulose Fibre Insulation
CGSB	Canadian General Standards Board
CIMA	Cellulose Insulation Manufacturers Association
NBC	National Building Code of Canada
NRC	National Research Council of Canada
ULC	Underwriters Laboratory of Canada

[1] Builders for Climate Action - Low-Rise Buildings as a Climate Change Solution. https://www.buildersforclimateaction.org/

3. Definitions

APPLIED THICKNESS: the average thickness of insulation provided immediately after installation. For certain applications, it may be 5-12% greater than settled thickness. The terms "blown" and "installed thickness" are also used.

BACKER BOARD: a rigid, non-vapour barrier forming material such as gypsum board or plywood which is used to cover the open side of an existing wall and forms a cavity which may be filled with loose-fill insulation. It must have sufficient strength to withstand the pressure developed when filling the cavity.

BLOCKING: any material used to divide the area to be insulated from an area that is to be left free from insulation (such as soffit areas). When using blocking to isolate heat sources in attics, it is important to ensure that its height exceeds the intended thickness of insulation to be applied. Blocking is also used to divide tall wall cavities (i.e. over 10'/3m in height) for added settlement resistance.

DENSE-PACK: application technique to apply CFI to enclosed cavities such as walls, floors, or ceiling, where CFI is pneumatically injected to pack the cavity full.

DESIGN DENSITY: the mass-per-unit-volume at which the product attains the states thermal resistance. For attic applications, it represents the final density achieved once settlement has occurred; also known as "settled density" or "coverage density."

ENCLOSED CEILING CAVITIES: ceiling area (joists) covered on both top and bottom.

FILL TUBE: a tube or nozzle that enables a cavity to be filled through a single-entry hole.

INTERNAL WETTING SYSTEM: a tube that varies in length and diameter with internal mounted spray tips, mounted in-line with the blowing hose near the blowing machine, and pressure regulator whose purpose is to inject a metered mist of water into the product air stream of a blowing machine. Water for an internal wetting system is normally supplied by a standard water source, garden hose, or a pump system attached to a water tank.

OVERFILL: insulation sprayed beyond the stud face to insure a totally filled cavity after scrubbing.

OVERSPRAY: that portion of material from a spray pattern not filling or adhering to intended substrates.

R (RSI)-VALUE: common/recognized units of thermal resistance (or insulation value). "R" refers to imperial units of measurement while "RSI" refers to metric units. To convert from metric RSI-Value to Imperial R-Value, multiply by 5.67829.

SETTLED THICKNESS: the average thickness that the manufacturer declares will provide the corresponding thermal resistance listed in the coverage chart on the product package. The terms "declared" or "design density" are also used.

SIDEWALL: an exterior vertical wall (that is heated on the interior side).

SPRAY NOZZLE: a tube with a liquid atomizing unit attached to intermix fibers and liquid. These nozzles can have various numbers and configurations of spray tips.

STABILIZED CELLULOSE: a cellulosic insulation product treated to resist settling. Stabilized cellulose is defined as a cellulosic insulation that settles by no more than 5%.

TYPE 1 CFI: (re: CAN/ULC-S703) Loose-fill CFI pneumatically or manually applied to open spaces (with slopes up to 4.5-in-12) and/or injected into enclosed cavities.

TYPE 2 CFI: (re: CAN/ULC-S703) CFI pneumatically spray-applied with water to any open space (as in "stabilized" attic installations), or into any cavity (regardless of slope) that will be closed later. Some systems involve spray injection into cavities through a permeable retaining membrane or netting. Such product may also contain internal binders to increase the adhesive/cohesive capabilities of the sprayed fibres in order to reduce settlement.

WALL SCRUBBER: a tool with a rotating brush that grooms the insulation flush to the face of the studs.

4. Applicable Standards

- CAN/ULC-S703 where CAN represents Canada and ULC represents the Underwriter's Laboratories; the Standard CAN/ULC-S703 is the Standard for CFI for Buildings.
- Ecologo™ is a certification program developed by the ULE or Underwriter Laboratory Environment.
- ASTM is the American Society for Testing and Materials, which defines the following standards relating to CFI:
    - C168: Standard Definition of Terms Relating to Thermal Insulating Materials
    - C739: Standard Specification for Cellulosic Fiber (Wood based) Loose-Fill Thermal Insulation
    - C1015: Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation
    - C1149: Standard Specification for Self-Supported Spray Applied Cellulosic Thermal/Acoustical Insulation

5. Inspection

The following should be given special consideration prior to installing CFI.

A. Building Construction

An inspection of the building should be made prior to installation to identify problem areas. The installer should:

- Seal any holes or gaps in ceilings or sidewalls that would allow insulation to escape during application.
- Reinforce weak areas of interior walls that may not be able to withstand injection pressures or mark them for special filling (using less pressure). The builder/homeowner should be made aware of all such situations prior to filling such cavities.
- Seal wall cavities that open into lower floors, basements, crawl spaces, or upper floors so that insulation does not inadvertently flow in these areas.
- Determine any altered wall cavities, such as for built-in features, which may contain isolated cavities (bulkheads), and make them for special entry holes.
- Ensure interior wall cavities that serve as air ducts in older homes (or for multi-floor heating or air conditioning systems) are not filled unless alternate ducting is installed.
- Examine exterior walls, siding, roofs, and attics for evidence of moisture problems and note the results. Insulating alone may not resolve some problems and additional corrective action may be needed. Existing rot, water leakage, or condensation problems must be corrected before applying insulation.
- Ensure the homeowner has removed any items stored in the attic space prior to the installation.

B. Vapour Barriers

New Construction

Most building codes require a vapour barrier on the warm side of an insulated area. Regardless of whether a vapour barrier is used, properly installed cellulose insulation exhibits high resistance to air and moisture infiltration and condensation.

Vapour barriers are not required for below-grade wall applications if the building location rates less than 5000 heating degree-days. Check with your building official for the heating degree rating for your location.

A ground surface vapour barrier (6-mil CGSB-approved polyethylene film) is recommended in structures that have a crawl space beneath the floor (see Section 5C on Ventilation).

Retrofit Installation

Since cavities are already enclosed, it is often not possible or very difficult to apply polyethylene type vapour barrier films. In such cases, a low vapour permeable paint can be applied to the interior surfaces of walls and ceiling (and some floors) to help reduce excessive moisture transfer by diffusion.

A group surface vapour barrier (6mil CGSB-approved polyethylene film) is recommended in structures that have a crawl space beneath the floor (see Section 5C on Ventilation).

C. Ventilation

Attic Ventilation

- For vented attics with a vapour barrier, 1.0 ft^2 (0.1 m^2) of unobstructed vent area is recommended for every 300 ft^2 (30 m^2) of insulated ceiling area.
- For vented attics without a vapour barrier or where the roof slope is less than 2-in-12 or in roofs that are constructed with roof joists, 1.0 ft^2 (0.1 m^2) of unobstructed vent area is recommended for every 150 ft^2 (15 m^2) of insulated ceiling area.
- Where individual vents are used in the soffit, the joist space immediately in front of and on either side of a vent is to be provided with an air chute and partial blocking to permit air flow to the attic and to keep insulation from filling the soffit area. (Air chutes are more convenient and practical to install in retrofit applications compared to insulation stops.) Other spaces should be totally blocked: scrap wood is recommended in new construction, and a scrap piece of fibreglass batt (stuffed into place) is recommended for retrofit applications.
- Where a continuous strip vent is used in the soffit, an airflow vent should be provided every third joist space with the other spaces completely blocked.
- Vents are recommended to be installed with no less than 25% of the total required vent areas in the eaves (soffit) and no less than 25% of vent area in the root near the peak.

Flat Roofs and Sloped Ceilings

The NBC states that no less than 2.5" (63 mm) of space shall be provided between the top of the insulation and the underside of the roof sheathing. This does not apply to roof joist spaces interconnected on the top surface by 1.5" x 1.5" (38 x 38 mm) purlins, provided the area between the purlins remains unobstructed and vented to the outside. In retrofit applications, filling such cavities completely (leaving no air space) with dense-pack cellulose insulation (at a minimum of 2.5 lb/ft^3 or 40 kg/m^3, providing high resistance to air infiltration and convective heat loss) is a common practice that has no known associated moisture problems.

Enclosed roof assemblies with slopes exceeding 8:12 (60º) are considered walls. Such assemblies should not require ventilation, provided the assembly has enough depth to achieve the minimum thermal resistance value for your area.

Unheated Crawl Spaces

The NBC states that there is to be a minimum of 1.0 ft^2 (0.1 m^2) of unobstructed vent area for every 538 ft^2 (50 m^2) of floor area.

D. Limitations & Safety Precautions

- Exposure to free water can damage the chemicals in cellulose insulation, reducing its effectiveness and lowering thermal resistance. Cellulose insulation is not recommended for use inside cement block cavities or for filling the cavities of masonry walls.

- Cellulose insulation cannot be in direct contact with high-temperature sources or be installed where the service temperature exceeds 90° C.
- Insulation (of any type) must not contact chimneys or flues. A minimum of 3" (76 mm) of air space must be maintained with blocking used to retain the insulation. Refer to the applicable codes or local building officials for specific requirements.
- Heaters and recessed light fixtures must not be covered by the insulation unless the fixture has an insulation contact (IC) rating. Local and national codes must be followed where applicable. A minimum of 3" (7.62 cm) of air space must be maintained between fixtures and the blocking.
- Cold air returns and combustion air intakes for hot air furnaces must not be blocked; insulation must not be installed in a manner that would allow it to be drawn into the heating/cooling system. Air ducts should be checked for loose connections and sealed as required to ensure insulation material cannot be drawn in.
- The installer is advised to wear appropriate respiratory and eye protection during application of any fibrous insulation product. A NIOSH-approved N95 nuisance dust mask (3M 8210 or equivalent) and eye goggles are recommended as minimum protection.
- The installer should wear adequate head protection to guard against protruding roofing nails, rafter ties, etc.
- For all enclosed cavity-drilling procedures, extreme caution must be taken to avoid electrical wiring and plumbing pipes.
- All open electrical boxes must be covered or masked off prior to insulating.
- In homes with an attached garage, it is important that the wall between the living area and the garage be insulated and well-sealed to reduce the possibility of carbon monoxide from the garage entering the living area. The same goes for the ceiling cavity if there is living space above the garage.
- Installers and specifiers (i.e. architects, engineers, etc.) are advised to refer to other relevant documents, including the NBC, for additional information.

6. Preparation

A. New Construction

- Walkways in attics can be provided by means of boards laid over joists or truss chords.
- Adequate lighting of the area to be insulated must be provided while work is in progress. Since light bulbs give off considerable heat, trouble lights should hang free (i.e., from a nail in a central rafter tie for attics) and must never be laid on any surface.
- Where individual vents are used in the soffit, the joist/truss space immediately in front of and on either side of a vent is to be provided with an insulation stop that provides partial blocking to permit airflow to the attic but keep insulation from filling the soffit area.
- Seal all open cavities to exterior or interior walls below. If necessary, fasten backer board to seal any openings before cavities. Even cavities that open into the attic but are not to

be insulated (such as cabinet bulkheads and stairway wells) can be covered with backer board to support the insulation and keep it in place.

- Seal or block all other entries to the attic area. This may include plumbing stacks, exhaust fans, recessed light fixtures, etc. Special attention must be given to chimneys and flues; applicable codes must be followed.
- The open side of any wall between a heated area and an unheated area must be insulated. This would apply to homes with an attached garage or kneewall attic areas of split-level homes The open (cold) side of these cavities can be enclosed with backer board, gypsum board or netting secured with 1 x 3" (19 x 64mm) furring to form a cavity that can be filled with insulation.
- Very small cavities around windows and doors that are impractical to fill with loose-fill insulation should still be insulated. Such cavities can be foam-filled prior to the installation of the interior covering. Care must be taken not to overfill with foam so that frames and jambs are not distorted.
- Insulating the corners of attics in buildings with hip roofs may require special nozzles or placement tools. Alternately, these corners can be manually insulated (i.e., stuffed by hand) by any suitable material before the interior covering is installed. Any other areas that will be inaccessible once the interior covering is installed can then be handled in a similar manner.
- Above-grade wood frame walls in new construction will require the application of a suitable netting or mesh (as provided by the manufacturer) on the interior (open) side of the wall. To prevent excessive bulging of the insulated cavities, the netting must be stretched as tight as possible over the wall surface and fastened to the stud faces using standard 1/2" (13 mm) staples spaced no more than 2-3" (50-75mm) apart. Moderate bulges of insulated cavities can be rolled back into place (using a paint roller or similar tool) so that gypsum board may be easily applied.
    - To help minimize bulging, especially on walls with 24" (600 mm) stud spacing, wood furring can be fastened horizontally every 24" (600mm) over top of the applied nesting. Nominal 1 x 3" (19mm x64mm) furring is recommended for 16" (400 mm) stud spacing, and 1 x 4" (19 x 89mm) furring is recommended for 24" (600 mm) stud spacing.
    - Furring must be fastened to framing with not less than 2" (50 mm) nails.
    - Please note that electrical boxes and other fixtures must be appropriately located to compensate for thickness of the furring. Similarly, window extensions must also be sized to compensate for the additional thickness.
- On below-grade wall cavities, to protect insulation from moisture damage due to potential foundation wall and window well leaks, it is recommended that a continuous moisture barrier, such as CGSB polyethylene film or air barrier membrane, be applied and secured against the foundation wall. In circumstances where flooding may occur, the bottom 6-8" (150-200 mm) of the foundation wall should be blocked off and not insulated.
    - The barrier is to be placed approximately 6" (150 mm) above the grade line. Fastening of the barrier to the foundation wall may be accomplished with a bead

of acoustical caulking placed on the foundation wall. An overlapping film must be sealed with caulking or vapour barrier tape.
  - Once the barrier is applied to the foundation wall, the interior wood frame can be erected, and if necessary, the bottom 6-8" (150-200 mm) blocked off from the rest of the cavity. When installing the full height of the cavity, the excess vapour barrier extending out from the bottom of the frame wall can be folded up and fastened to the studs to provide additional protection against moisture damage. When not installing full height insulation, cut the excess off at the bottom place of the wall.
  - Application of netting on the interior side of the wall is to be carried out in accordance with the previous (above-grade wall) paragraph.
- All piping, ducting, conduits, wiring, and outlets must be installed prior to application; electrical boxes and all other areas that should not receive insulation are to be blocked or masked.
- Windows and frames should also be masked during spray applications.

B. Retrofit Installations

- Where individual vents are used in the soffit, the joist/truss space immediately in front of and on either side of a vent should be provided with an air chute and partial blocking to permit airflow to the attic but keep insulation from filling the soffit area. (Air chutes are more convenient and practical to install in retrofit applications compared to insulation stops.) Other spaces should be totally blocked using scrap wood or other suitable materials.
- Where a continuous strip vent is used in the soffit, an air chute and blocking should be provided at every third joist space. The other joist spaces should be completely blocked.
- All ventilation requirements must be met before insulating. This will also minimize potential air pressure build-up in the attic during the blowing operation that would force dust back into the living area.
- Seal or block all other entries to the attic area. This may include plumbing stacks, exhaust fans, recessed light fixtures, etc. Special attention must be given to chimneys and flues; applicable codes must be followed.
- The open side of any wall between a heated area and an unheated area must be insulated. This would apply to homes with an attached garage or kneewall attic areas of split-level homes. The open (cold) side of these cavities can be enclosed with backer board, gypsum board or netting secured with 1 x 3" (19 x 64mm) furring to form a cavity that can be filled with insulation.
- Blocking is to be placed around the access to the attic to prevent installed insulation from falling out whenever the attic area is entered. The most rigid barrier possible is best; using scrap 2x4's with plywood is recommended. In addition, foam or sufficient batt-type insulation should be attached to the attic side of the access cover or hatch if it does not connect a heated area to the attic space.

7. Coverage Requirements

- When installing CFI, care must be taken to meet the area coverage shown on the chart printed on the manufacturer's package. It is very important that the proper coverage density be achieved for the particular application so that the insulation's best performance may be realized.
- Values for area coverage are calculated from the manufacturer's design density and thermal resistivity (i.e., the R/RSI value per unit thickness), determined and verified through testing, for a particular product application. Area coverage values per bag are dependent on the package size; refer to the outside of each bag used in the event multiple sized bags or product from different manufacturers is used for the same project.
- For horizontal (attic) installations, the "minimum thickness" or "settled thickness" listed is the final settled thickness required to provide a given R/RSI value. The "initial/applied thickness" (that is, the thickness installed while insulating) will exceed this value in order to compensate for settlement and is intended as a guideline only; the actual degree of settlement depends on specific job conditions and installation technique.
- The bag count provides the total weight of material used and the actual area insulated is known (verified by measurements taken prior to insulating). The weight-per-unit-area values specified on the coverage chart must be followed to provide the specified R/RSI-value at the manufacturer's design density.
- As previously stated, optimum coverage and product performance is provided by pneumatic (machine-blown) applications. Manual (hand pour) methods are useful for small projects or repair applications. The do-it-yourself retrofit customer is advised to rent a blowing machine for larger applications to get the best results.

8. Application Procedures

When installing insulation by pneumatic means, it is important to use the settings recommended by the machine's manufacturer. In all such applications, it is recommended that the installer use a minimum of 100' (30 m) of hose to help ensure maximized dispersion of the product. Optimum hose diameter varies with the type of application.

A. Accessible Ceilings

- Markers such as attic rulers should be placed wherever possible to indicate proper installation thickness. The more markers in place, the easier it will be to provide a consistent application.
- Machine air settings should be set low at the outset and then adjusted once application begins. Material flow should be like water from a hose, falling between 4-6' (1.5–2 m) from the end of the hose or nozzle. Start at the perimeter and work back towards the attic access. Material can be applied more evenly to the outer edge of the attic by using a rigid extension tube, which is removed when working in the centre of the attic.
- The application hose should be held parallel with the ceiling joists whenever possible (or practical) at a height of 2-3' (0.6-0.9 m). This ensures the trajectory of applied material

does not contribute to excessive compaction of the product. Aiming too high or too low results in increased or variable density (and decreased or inconsistent coverage).

- Obstructions such as cross-framing may require the hose to be kept much closer to the surface to direct material underneath. Product should be blown on both sides of such obstructions in order to eliminate potential voids. Only where space limitations make it necessary should the stream of material be deflected by hand.

B. Enclosed Ceiling Cavities (Retrofit Applications)

- It must be established whether the cavities have existing batt insulation.
- If batts do not fill the cavity and allow a 2-3" space above them, cellulose insulation could be injected into the cavity over top of the batts. It should be noted that the presence of batts in the cavity would affect coverage estimates. The batts will compress somewhat as the insulation fills the space.
- Such cavities should be treated as horizontally placed walls and pneumatically injected using a fill tube in each cavity. As the insulation fills the cavity, the fill tube is withdrawn. The air setting should be set as recommended by the machine manufacturer for sidewall application. Coverage will be proportional to that shown on the manufacturer's sidewall application chart, depending on the cavity size and the package size being used.

C. Wall Applications (New Construction)

- Open wall cavities are usually either dry-injected through some type of retaining membrane such as netting or polyethylene, or wet-sprayed applied from the interior side of the sidewall.
- Prior to installing cellulose insulation, ensure the machine is adjusted to the recommended setting as defined by the equipment manufacturer. The machine must be adjusted to deliver the insulation into the cavity under significantly higher pressures than what is used for attic applications. The purpose of this is to compress the material to a non-settling state.
- Cavities are filled by injecting the cellulose insulation through one of more entry holes made along the length of the cavity. If a one-hole method is used, the hose is lowered to within 12" (300 mm) of the bottom of the cavity through an entry hole made near the top of the cavity. The hose is slowly withdrawn up the cavity as the injected material is compressed around the end of the hose and the hose begins to plug off (indicated by a change in blower noise).
- If a multiple-hole method is used, the cavity is completely filled through an initial entry point located near the middle or top portion of the cavity. Additional insulation is then injected and packed into the cavity through subsequent entry holes evenly spaced along the cavity.

D. Wall Applications (Retrofit Applications)

- It must be established whether the cavities have existing batt insulation. Existing batts can interfere with an effective installation.

- Machine air settings should be recommended by the machine manufacturer according to the nozzle being used.
- Fill holes are to be drilled with a hole saw. Hole size can range between 1" and 2.25" (25 to 56mm) and is dependent on the filling method. Prior to filling, all cavities should be checked for obstructions with electrician's fish tape, plumb bob, or similar tool. Drill extra holes to access any isolated cavities found.
- Density checks are recommended once the first few stud spaces are filled in order to ensure the material is being installed properly.
- When filling a smaller cavity through a single-entry point using a fill tube, the fill tube is inserted into the cavity until it reaches within 12" (300 mm) of the top or bottom portion of the cavity. Fill tube will depend on the size of hole that can be drilled. Possible entry points are:
    - Through the bottom plate (from the basement or crawl space);
    - Through the top plate (from the attic);
    - Through the interior side (behind the baseboard or casing);
    - Through the interior side (at drywall tape joint);
    - Through the exterior siding (strip moving), drilled through sheathing; and
    - Through the exterior, entering through soffit vent (removed) and drilling through the sub-siding or sheathing in soffit area.
- Cellulose insulation is injected into the cavity until the area around the end of the fill tube is full, then by retracting the fill tube 12" (300 mm) at a time, allowing additional insulation to fill the void created.
- When filling cavities through two entry points, which is recommended for each 8' (2.3 m) of stud space, location of the holes should not be more than 1' (0.3 m) from the top plate and 2' (0.6 m) from the bottom plate.
    - Start with the bottom hole—insert the hose/nozzle and fill the area below the hole. The machine back pressure will indicate when the area is full so that the hose/nozzle can be retracted and adjusted for the areas at and above the hole.
    - When two-thirds of the cavity is full, remove the hose/nozzle from the bottom hole and place it in the top hole, repeating the action until the entire cavity is pressure-filled. Take extra care to ensure sufficient density is applied to the uppermost part of the cavity and its corners to ensure against settlement, but not so dense as to detach the gypsum board on the interior.
    - Entry for this method may be made from either the inside or outside depending on conditions, preference, and whether existing insulation or a vapour barrier is present. Homes with shingle or lapped siding should be insulated from the interior side—drilling directly through siding is generally not recommended due to the difficulty in colour-matching after. Exceptions would include wood siding that will be repainted following the installation. Homes with brick exteriors could have holes drilled in the mortar joints, or whenever possible, remove a single brick for each entry—return them and re- mortar once done.
- All holes should be closed with suitable plugs. Plugs applied to exterior entry holes in sheathing should be properly sealed as well.

E. Sloped Ceilings and Flat Roofs

- Installations of sloped ceiling and flat roof cavities are essentially the same as vertical wall applications. In new construction where cavities are still open, dense-pack applications are possible with a combination of webbings and pneumatically-placed cellulose insulation.
- In retrofit applications where existing sloped roof cavities are to be filled (and verified to be empty), cellulose insulation may be used:
    - Prior to installing new shingles, cut strips out of the roof sheathing and fill the exposed cavity with cellulose insulation. Fasten the strips back into back and seal with pitch or suitable caulking and install new shingles.
    - Remove the soffit, and using a rigid 2" (50 mm) fill tube the length of the roof cavity and marked every 12" (300 mm), insert it to within 12" (300 mm) of the end of the cavity. Fill the cavity with cellulose insulation and retract the fill tube in 12" (300 mm) intervals, the same as for attic floors. Replace the soffit.
    - In the case of very long cavities, such as a 20' (6 m) cathedral ceiling, it is more practical to remove shingles and sheathing at the ridge and inject cellulose insulation into the exposed cavities with the fill tube from there. The soffit end must be blocked to prevent material from filling it.
- The practice of completely filling these retrofit cavities with dense-pack CFI without the ventilated air space or vapour barrier required from new construction provides maximum insulating value for a limited space. CIMA is not aware of any associated problems with this practice.
- For retrofitting flat roof cavities, adapting the sloped ceiling method to enter cavities from the outside through the fascia board applies. When repairs or renovations are required for tar and gravel roofs, entry can be made by temporarily removing strips cut in the sheathing; locate bracing and other obstacles within the cavities so that isolated cavities are not missed. Once cavities are insulated, the strip is replaced, sealed, and the area can be resurfaced.

F. Windows and Doors

The small cavities around windows and doors must be insulated. For new construction, this is covered under Section 6 on Preparation. In retrofit applications where these cavities are enclosed, it may be necessary and easier to fill them with foamed-in-place products by drilling and plugging the window casement itself. Sophisticated electronic stud-finders or infrared imaging devices are available to detect even the most elusive cavities so that none are missed.

G. Floors and Rim Joists

- Floors built over unheated or crawl spaces must be insulated. This includes floors of structures built on piers (such as some cottages). This can be achieved from the basement or crawl space side by creating cavities with netting and filling like an open sidewall.

- If enclosed cavities already exist and do not contain batt insulation, the attic floor method may be used, entering through from either above or below. If renovating the floor, entry holes could be drilled through the subfloor from above and plugged after insulting the cavity. Ensure all isolated cavities are located and filled.
- Sometimes the degree of cross bracing and blocking is high, requiring several holes to access all the isolated cavities. Instead, it may be necessary and more practical to cut strips from the subfloor to expose all cavities and insulate as described for flat roofs.

9. Equipment

A. Insulating Machines

Commercial Machines

CIMA Associate Members include manufacturers of blowing equipment for commercial operations. For a given material, the speed of the airflow and the ratio of material quantity to air volume largely control coverage results. Machines have three basic controls to regulate these factors: (1) the throttle setting of the engine, (2) the relief valve on the blower, and (3) the slide-gate or gate feed control which controls the feed rate of the fiber. Only experimentation with these settings will determine the proper adjustments needed to provide optimum coverage.

For attic applications, a simple test for airflow and pressure is to hold the hose horizontally at a height of about 3′ (1 m) while blowing the material. The blown insulation should fall gently onto the surface about 4-6′ (1.5-2 m) from the end of the hose. If the material bounces as it strikes the surface, or falls beyond 6′ (2 m), first open the relief valve to allow some air pressure to escape and, if necessary, reduce the throttle setting to achieve the proper flow of material.

For dense-pack applications, material should bounce as it strikes surfaces, should fall beyond 6′ (2 m), and would be difficult to stop the flow of material leaving the hose with your hand.

Feeder seals should be inspected regularly and replaced periodically to avoid air leakage, as this will interfere with control of the optimum of material.

Rental Machines

The smaller machines available to the do-it-yourself installer from building supply stores are usually of the through-blower type, which do not have an airlock or throttle adjustment. As such, material flow is not as well-regulated and, since the blower operates at a constant speed, control is limited to air adjustment. These machines are considerably slower in terms of application rate but are suitable for smaller insulation jobs.

Machine for Spray Application

Only machines designed specifically for spray applications are recommended, but most commercial machine manufacturers build spray models as well. Spray machines differ from

loose-fill machines in terms of airlock size, agitator design and speed, and material application rate. Rental (through-blower) machines are not suitable for any type of spray application.

B. Delivery Hose and Nozzles

Hose length, diameter, and condition are extremely important for the proper conditioning of any CFI product.

- A minimum length of 100' (30 m) of hose is recommended for most loose-fill applications.
- A minimum of 200' (60 m) of hose is often recommended for spray applications.

Optimum hose diameter depends on the intended application:

- 2.5-3" (65-75 mm) diameter is recommended for open blow (attic) applications.
- 2.5" (65 mm) diameter is recommended for sidewalls and cavities.
- 2" (50 mm) diameter is often recommended for spray applications.

Damaged hose can affect the material flow and coverage of the product. Air leakage through worn spots will reduce fluffing at the delivery end of the hose since it is the corrugated interior surface of a good hose that helps create the turbulence to properly fluff the product and provide optimum coverage. A bent or kinked hose affects consistent material flow.

C. Maintenance

The importance of well-maintained equipment in any installation cannot be over-emphasized in providing control of airflow, pressure, and material delivery to achieve the best insulating job. Reduced coverage is most often a result of worn feeder seals and/or hose, not the insulation product being installed.

A comprehensive maintenance inspection should be conducted regularly on all application equipment. Such activities should also be documented; a review of the number of bags of product blown between inspections may be determining the expected life of machine parts, feeder seals, and hose. The installer should refer to the equipment manufacturer's recommendations for adjustments, settings and for maintenance requirements.

10. Job Site Placard

It is strongly recommended that all contractors provide their customers with a completed job site placard, sometimes called a "Data card" or "Coverage chart". The purpose of this card is to provide the customer with a permanent record of the materials used and the work performed and is often required to validate product warranties. For attic installations, this is often referred to as an "attic card," filled out upon completion of the work by the installer. Many manufacturers supply customers with data cards that can be signed and dated and used accordingly in job sites. The completed card should be affixed to the building structure near an attic hatch.

Placards typically contain the following information:

- Product and manufacturer
- Job site address
- Installation date
- Homeowner's (and/or builder's) name
- Total area insulated
- Intended thermal resistance (R/RSI value)
- Minimum thickness
- Minimum area weight
- Weight per package and the number of packages used
- Name and contact information of the installation company
- Printed name and signature of the installer

For more information on cellulose insulation, visit
www.cellulose.org

APPENDIX A

GUIDELINES FOR HAND-POUR (MANUAL) APPLICATION

Pneumatic (machine-blown) installations of cellulose insulation provide the most effective and economical full-size application of the product. However, for small jobs of retrofit/repair applications in attics, it is as practical and/or convenient to manually apply cellulose insulation as it is to install batt insulation. Consider that:

- It is difficult to install batts without leaving voids or gaps, especially around obstructions. Such poor fitting leads to significantly reduced thermal performance. Loose-fill cellulose insulation will eliminate voids and gaps by filling in and around obstructions—no measuring or cutting is needed to provide an effective fit.
- Cellulose insulation provides a higher R-value per unit thickness.
- Installing glass fibre products is irritating to the skin and inhalation of their fibres is considered a possible cancer risk. Cellulose insulation is non-irritating, not considered a health hazard, and only a nuisance dust.

Compared to machine-blown applications, hand-pouring provides at least 30% less coverage, depending on the effort given by the installer to break up the material. The more effort given to dispersing the fibres, the better the coverage will be. In larger applications, providing an effective installation would also be more time consuming, but for small retrofitting jobs this may be considered insignificant.

Well-dispersed material will provide an R-value of about 3.6 per inch. Poorly dispersed material can be significantly less.

Manually applied cellulose insulation is not known to settle. In a properly ventilated attic, the thickness applied is the final thickness that provides the R-value.

CIMA recommends the following method for hand-pour applications:

1. Set up a 60W trouble light over the area to be insulated. You will also need a fan-type leaf rake (with many open tines), sharp knife, tape measure, and a good particle mask.
2. Transfer a few of the bags of CFI to be installed to the attic area where they will be applied. Since attics tend to have limited space to work in, allow yourself enough room. Stack bags so that their weight is distributed across joist members and not directly on the ceiling.
3. Cut open a bag lengthwise and empty the contents near the area to be insulated. Break up large lumps with your hands and the rake. Turn the rake over with the tines facing upwards and scoop up portions of the worked material to check that no lumps remain.
4. Use the rake once more to scoop up some of the worked material and transfer it to the area to be insulated. Gently shake the scooped material back and forth, sifting it through the tines of the rake onto the space to be insulated. Continue with this process until the desired thickness is achieved, checking the depth with the tape measure.
5. Repeat steps 3 and 4 until the installation is complete.

APPENDIX B

ALTERNATIVES FOR RETROFITTING SIDEWALLS

In many retrofit cases, the cavities to be re-insulated contain some form of insulation, often batt-type insulation. CIMA recommends homeowners hire professional contractors when retrofitting existing sidewalls. The following methods are suggested as guidelines in alternative retrofitting of sidewalls where existing batt insulation is encountered and is to be replaced with CFI.

When exterior renovations are to be done (such as re-siding or installing some other new exterior finish) and the old finish is removed, a strip of sheathing can be temporarily taken out of the centre of the wall and the existing batt insulation can be removed. The opened space is netted, the exposed cavities filled with cellulose insulation, and the strip is put back and sealed. The new exterior finish is then applied. Recommendations are as follows:

1. Once the old exterior finish is removed, cut a horizontal strip in the sheathing 12” wide (depending on the framing and exterior finish) in the centre of the wall cavity and remove it.
    a. A circular saw is most often used. Set the saw blade depth to the thickness of the sheathing (if known) or a maximum of 1/2”. Most plywood sheathing is not likely to exceed 1/2" thickness in homes built in the 1960s or later. Older homes may have other types and thicknesses of sheathing (such as 3/4” shiplap) and may not require cutting to remove it.
    b. Whenever possible, a wider strip (14-16”) can be cut for greater ease of batt removal and inspection. This also improves the maneuverability of the hose to allow for a more effective installation.
2. Remove the existing batt insulation.
3. Visually inspect each cavity to ensure all pieces of the batts are removed and that any isolated cavities are detected.
    a. Depending on the requirements of the customer, the small cavities above window frames may be left with existing batt insulation, otherwise an additional short strip must be cut to fill such cavities. It is often more practical to leave these cavities alone unless they are known to be empty.
    b. Verify the length, width, and thickness of the cavity to ensure coverage calculations will be correct.
4. Cut the strip of netting about 2” wider than the width of the sheathing strip. Fold about 1” over on top edge of netting strip and staple to the exposed stud faces with the folded edge tight up against the upper edge of the sheathing opening. Ensure netting is pulled tight as you go. Fold the bottom edge of the netting strip so it is tight against the bottom edge of the sheathing opening and secure with staples.
5. Cut an entry slit in the netting for each cavity for the delivery hose. In addition to the recommended 150’ length of hose, a 3-3.5’ section of rigid or semi-rigid hose should be attached to the delivery end.

6. Insert rigid hose to the bottom of the cavity and inject cellulose insulation until it fills the cavity up to the netting, retracting the nozzle about 12" at a time.
7. Remove enough hose to turn it upwards and re-insert to the top corners of the upper half of cavity. Proper attention must be given to pack each of the top corners of the cavity to ensure against settlement. Once corners are packed, retract nozzle about 12" at a time.
    a. It is important that proper installation density be achieved (i.e., 3.0-3.5 lb/ft^3, 48-56 kg/m^3) to properly resist settlement, but not too much so that the interior finish is compromised. Ensure the proper air setting and material volume is used to avoid dislocating gypsum board on the interior.
8. Remove enough hose to pack by "jabbing" the central area behind the netting and stop the installation.
9. Repeat steps 6-8 for the remaining cavities.
10. Roll the netting of each filled cavity to eliminate bulging.
11. Put the strip of sheathing back into place and fasten, including the strip of building paper or house wrap that may have been there. Apply exterior caulking to the cut lines and finish with sheathing tape to seal the jab.
12. The new exterior finish can then be installed.

When the exterior finish is siding and is not to be replaced with new siding, the existing siding can be partially removed so that the sheathing strip can be cut. When removal is not possible, cut through the siding (at an edge or shadow line) and sheathing all at once. Once cellulose insulation has been installed, the netting is rolled to eliminate bulges and the sheathing is replaced, fastened, and sealed and the siding replaced and sealed.

When the interior finish is to be renovated, it is possible to retrofit the sidewall cavities from the interior side in a similar manner to the above. A 12" strip of gypsum board is cut from the centre of the wall and the existing batt insulation is removed. Once the cavities are inspected for completeness of the removal and isolated cavities are located, the space opened is netted and filled with cellulose insulation, and the strip is replaced, sealed, and patched with drywall compound in the normal manner. The interior is then repainted, wall-papered, or otherwise refinished.