GENERAL INSTALLATION GUIDELINES
FOR
CELLULOSE FIBRE INSULATION
(C F I)

SECOND EDITION
May 2009

Prepared By:

Cellulose Insulation Manufacturers Association of Canada

TABLE OF CONTENTS

GENERAL INSTALLATION GUIDELINES FOR CELLULOSE FIBRE INSULATION (CFI)

PREFACE

The Cellulose Insulation Manufacturers Association of Canada (CIMAC) has prepared this edition of the "General Installation Guidelines for Cellulose Fibre Insulation (CFI)".

These guidelines were developed to provide installers with the common elements and generally recommended practices and application procedures used across Canada to provide quality installations of cellulose fibre insulation (CFI) products. This guideline does not preclude the use of manufacturer's instructions. Manufacturer's instructions may vary from what is found in these guidelines and often will take precedence over this document in order to validate specific product warranties.

These guidelines can be used by anyone and is not intended to limit the use of CFI or restrict who may apply CFI products.

It is important to note that it remains the responsibility of the user of these installation guidelines to judge their suitability for the particular application. Not all possible scenarios are represented here.

An application of CFI that appears to follow these guidelines will not necessarily be acceptable if, upon inspection, it is found to employ significantly different coverage values, forms of construction or other features not covered by the Guidelines, which may impair the intended result in quality and/or performance.

1. SCOPE & SIGNIFICANCE

These installation guidelines cover the recommended methods of pneumatically installing *Type 1* and *Type 2* cellulose fibre insulation (CFI) in attics, flat or sloped roofs, wall cavities, cathedral ceiling cavities, floors, rim joists and in crawl spaces of single and multi-family dwellings, for both new construction and retrofit applications (see 3. Definitions). Manual (hand-pour) application of CFI in attics is not covered here. The guidelines also identify precautions that need to be taken.

These guidelines are intended for the installation CFI manufactured in accordance with CAN/ULC-S703 for either thermal applications and/or acoustical applications. Floor installations intended for acoustical control need only be partially filled – a minimum average thickness of 3.5" (89 mm) is recommended unless full thermal or acoustical value is also desired.

All new construction installations must consider the National Building Code (NBC) or other code requirements. Purely retrofit applications allow for proven alternative techniques to be used.

2. REFERENCES

Underwriter's Laboratories of Canada (ULC)

CAN/ULC-S703 – Standard for Cellulose Fibre Insulation (CFI) for Buildings

American Society for Testing and Materials (ASTM)

C-168 – Standard Definition of Terms Relating to Thermal Insulating Materials

C-739 – Standard Specification for Cellulosic Fiber (Wood Base) Loose Fill Thermal Insulation

C-1015 – Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation

C-1149 – Standard Specification for Self-Supported Spray Applied Cellulosic Thermal/Acoustical Insulation

3. DEFINITIONS

Applied Thickness – the average thickness of applied insulation immediately after installation necessary to provide the design thickness after settlement. It is greater than or equal to the *design thickness,* depending upon the application type, method used and installer technique. The terms *"blown thickness"* or *"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 forming a cavity which may be filled with insulation. It must have sufficient strength to withstand pressures developed if injection-filling the cavity.

Blocking – any material used to divide the area to be insulated from an area that is to be left free of 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.

Dense-Pack – application to enclosed cavities (walls, floors, ceilings) where CFI is pneumatically injected to pack the cavity full.

Design Density – the mass per unit volume at which the product attains the stated thermal transmission properties.

Design Thickness – the average thickness that the manufacturer declares will provide the corresponding thermal resistance listed in the coverage chart on the product package. The term *"settled thickness"* is also used.

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 an entry hole.

R(RSI)-Value – common/recognized units of *thermal resistance* (or insulation value). R-value refers to imperial units; RSI refers to metric units. To convert from metric RSI-Value to imperial R-value, multiply by 5.67829.

Sidewall – an exterior vertical wall (that is heated on the interior side).

Thermal Resistance – quantity determined by the temperature difference, at a steady state, between two surfaces of a material that induces a unit heat flow rate through a unit area.

Type 1 CFI – CFI intended for pneumatic application to open areas (such as attic spaces, with slopes up to 4.5-in-12) and/or injected into closed cavities (such as walls, floors and cathedral ceilings). Type 1 may also be manually applied (hand-poured).

Type 2 CFI – CFI intended for spray-application with water or liquid adhesive to open areas regardless of slope (such as attics), exposed surfaces (such as walls or ceilings) and/or into any open cavity (such as wall, floor or ceiling cavities) that may be closed later. Some systems involve spray injection into cavities through a permeable retaining membrane or netting. This product may also contain internal binders to increase the adhesive/cohesive capabilities of the sprayed fibres in order to reduce settlement and/or ensure it remains in place.

4. SYMBOLS AND ABBREVIATED TERMS

CCMC	*Canadian Construction Materials Centre*
CFI	*Cellulose Fibre Insulation*
CGSB	*Canadian General Standards Board*
CIMA	*Cellulose Insulation Manufacturers Association*
CIMAC	*Cellulose Insulation Manufacturers Association of Canada*
FG	*Fibreglass (glass fibre insulation products)*
NBC	*National Building Code of Canada*
NRC	*National Research Council of Canada*

5. GENERAL CHARACTERISTICS OF CELLULOSE FIBRE INSULATION (CFI)

5.1 Composition:

CFI products are manufactured from select paper stocks and modified with chemical additives to provide fire, fungi and corrosion resistance, as well as other desired characteristics.

CFI products are commonly packaged in polyethylene bags, ranging in weight from 20-33 lbs. (9-15 kg) depending on the manufacturer.

5.2 General Properties:

- *CFI* provides a relatively high thermal resistance per unit thickness.
- *CFI* provides a highly stable thermal value due to its high resistance to air infiltration and convective heat loss.
- *CFI* provides superior acoustical control properties. This is particularly apparent when cavity systems are pneumatically injected full with *CFI.*
- *CFI* is not subject to installation defects (such as leaving gaps and voids around structural irregularities) that allow heat to escape easily. Its short-fibre nature allows for effectively filling all areas.
- *CFI*'s fire retardant additives also function to provide high resistance to mould and fungal growth and may also function to deter pests and other vermin.

5.3 Physical Properties:

- Quality *CFI* products conform to the specified requirements of *CAN/ULC-S703* and provide the following field characteristics:

Thermal Resistance:	*RSI/mm:*	*0.025-0.028 (attic);*	*0.024-0.027 (cavity)*
(pneumatically applied)	*R/inch:*	*3.5 – 3.9*	*; 3.5 – 3.8*

Application Densities:	*Open (attic):*	*1.4 – 1.8 lb/ft³*	*(22 - 29 kg/m³)*
(pneumatically applied)	*Closed (cavity):*	*2.8 – 3.5 lb/ft³*	*(45 - 56 kg/m³)*
	Sprayed (cavity):	*1.5 – 3.5 lb/ft³*	*(24 - 56 kg/m³)*

- Fire Resistance – *CFI* products can increase the overall fire resistance of walls and floors. Recognized in NBC Part 9 for use in fire separations.

5.4 Storage:

CFI products must be protected from damage and deterioration and properly stored. Ideally, they should be stored indoors or in secured trucks or trailers. However, if stored outdoors, all CFI products must be covered and stored off the ground in a dry area (protected from precipitation).

6. INSPECTION

The following considerations are recommended for review prior to installing insulation:

6.1 Building Construction:

A brief inspection of the building's construction is required prior to installation in order 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 any wall cavities that open into lower floors, basements, crawl spaces, or upper floors so that insulation does not inadvertently flow into these areas.*
- *Determine any altered wall cavities, such as for built-in features, which may contain isolated cavities (bulkheads), and mark them for special entry holes.*
- *Ensure interior wall cavities that serve as return air ducts in older homes (or for multi-floor heating or air conditioning systems) are not to be 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.*
- *Remove existing batt insulation in sidewalls that are intended for retrofit application. This may only be practically done during other renovations, from the exterior when re-siding or from the interior when re-covering.*
- *Ensure the homeowner has removed any items stored in the attic space prior to the installation.*

6.2 Vapour Barriers:

New Construction

Most building codes require a vapour barrier on the warm side of an insulated area. Regardless whether a vapour barrier is used, properly installed CFI products exhibit 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 (6mil CGSB-approved polyethylene film) is recommended in structures that have a crawl space beneath the floor (see also 6.3 Ventilation).

Retrofit Installations

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 ceilings (and some floors) to help reduce excessive moisture transfer by diffusion.

A ground surface vapour barrier (6mil CGSB-approved polyethylene film) is recommended in structures that have a crawl space beneath the floor (see also 6.3 Ventilation).

6.3 Ventilation:

Attic Ventilation

- For vented attics with a vapour barrier*, 1.0 ft² (0.1 m²) of unobstructed vent area is recommended for every 300 ft² (30 m²) 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 ft² (0.1 m²) of unobstructed vent area is recommended for every 150 ft² (15 m²) 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, a scrap piece of FG batt (stuffed into place with a broomstick) for retrofit.

- Typically, when a continuous strip vent is used in the soffit, an airflow vent and blocking is to be provided at every third joist space. The other joist spaces should be completely blocked.

Vents are recommended to be installed with not less than 25% of the total required vent area in the eaves (soffit) and not less than 25% of vent area in the roof near the peak.

Flat Roofs and Sloped Ceilings

The NBC states that not less than 2½" (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 1½" (38 mm) x 1½" (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 *CFI* (at a minimum of 2.5 lb./ft³ (40 kg/m³), 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 (60°) are considered walls. Such assemblies should not require ventilation provided the assembly provides 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 ft² (0.1 m²) of unobstructed vent area for every 538 ft² (50 m²) of floor area.

6.4 Limitations & Safety Precautions:

- Exposure to free water can damage *CFI*'s chemical treatment, thus reducing its effectiveness and lowering thermal resistance.
- CFI is not recommended for use inside cement block cavities or for filling the cavities of masonry walls.
- CFI products must not be in direct contact with high-temperature sources or be installed where the service temperature exceeds 90°C. *See also the following caution:*

CAUTION: *Maintain building, electrical, gas and oil safety code clearances between the insulation and heat emitting devices, such as fuel burning appliances, chimney pipes, ducts and vents to these appliances (at least 50 mm) and recessed light fixtures (at least 75 mm) unless approved for insulation contact.*

- *Heaters and recessed light fixtures must not be covered by the insulation unless the fixture has an IC rating (CSA-approved, with 90°C safety cut-off). If not so rated, then applicable building codes must be followed – most require a minimum of 3 inches (76 mm) of air space to be maintained between the fixture and its blocking (or its enclosure).*

- *Insulation (of any type) must not contact chimneys or flues. A minimum of 3 inches (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.*

- *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 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 (see also 2. -References), for additional information.*

7. PREPARATION

7.1 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 (e.g. 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 air flow to the attic but keep insulation from filling the soffit area. Other spaces should be totally blocked using scrap wood or other suitable materials.

- All ventilation requirements must be met before insulating.

- Seal all open cavities to exterior or interior walls below. If necessary, fasten backer board to seal any openings before insulating. Even cavities which 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 (and out of such cavities).

- 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 1x3 (19 mm x 64 mm) 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 (or at least the outer half foam-filled and the inner half stuffed full with pieces of FG batt) 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) with 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.

- Blocking must be placed around the access to the attic to prevent installed insulation from falling out whenever the attic area is entered. In addition, foam or sufficient batt-type insulation should be attached to the attic side of the access cover or hatch even if it does not connect a heated area to the attic space.

- 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 ½" (13 mm) staples spaced approximately 3" to 4" (76 mm to 100 mm) 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", 600 mm) over top of the applied netting. Nominal 1x3 (19 mm x 64 mm) furring is recommended for 16" (400 mm) stud spacing, and 1x4 (19 mm x 89 mm) 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 the thickness of the furring. Similarly, window extensions must also be sized to compensate for the additional thickness.*

- 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" to 8" (150 mm to 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. All overlapping film must be sealed with caulking or vapour barrier tape.

- Once the barrier is applied to the foundation wall, the interior wood frame wall can be erected and, if necessary, the bottom 6" to 8" (150 mm to 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 plate 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.

7.2 Retrofit Installations:

- 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 1x3 (19 mm x 64 mm) 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 even if it does not connect a heated area to the attic space.

- For Below-Grade applications, refer to Section 7.1.

8. COVERAGE REQUIREMENTS

When installing *CFI,* care must be taken to meet the area coverage shown on the chart printed on the product's package. Check with the manufacturer's recommendations.

Values for area coverage are calculated from the product's design density and thermal resistivity (i.e. the R/RSI-value per unit thickness), determined and verified through testing by the manufacturer, for a particular product application. Area coverage values per bag are dependent on the package size – separate application/coverage charts are also available from the manufacturer.

For horizontal (attic) installations, the "minimum thickness" or "settled thickness" listed is the final 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. The bag count provides the total weight of material used and the actual area insulated is known (verified by measurements taken prior to insulating).

A sidewall application chart may also be available on the bag to indicate wall coverage requirements to be followed. Coverage densities are considerably higher for walls than for attics to ensure a complete fit of the cavity and resist settlement.

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 small blowing machine for larger applications to get the best results. Recommendations for hand-pour application in attics are available from the manufacturer.

9. APPLICATION PROCEDURES

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

9.1 Attic & Ceiling Installations

Open Attic Spaces (new construction or retrofit)

- Marks or markers, such as a cardboard attic ruler, 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 are to 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 feet (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 edges 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 feet (0.6-0.9 m). This is so that the impact due to 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 under them. It is recommended that product be applied to 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.

Enclosed Ceiling Cavities (Retrofitting Attic Floors)

- It must be established whether the cavities have existing batt insulation. If batts fill the whole cavity space, they must be removed prior to insulating. If batts do not fill the cavity but do allow a 2-3" (50-75mm) space above them, *CFI* could be injected in over top of the batts (from the attic side) – the batts may compress as the insulation fills the space.

- Such cavities can 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 product's sidewall application chart, depending on the cavity size and the package size of material being used.

9.2 Wall Applications

New Construction

- Prior to installing the insulation, ensure the application equipment is adjusted to the recommended settings as defined by the equipment or product manufacturer. It is important to note that 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 for this is to compress the material to a non-settling state. The amount of material required in each for cavity coverage is defined on the product manufacturer's package.

- Cavities are filled by injecting the material through one or 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.

- In spray applications, the interior of each wall cavity can be lightly wetted (using water or water-adhesive mixture) prior to applying sprayed product. This facilitates better adherence of the sprayed material to the interior surfaces of the cavity.

    - Each cavity is spray-filled, starting from the bottom, using a fluid side-to-side motion (from stud to stud). Once the sprayed material thickness surpasses the stud face at the bottom, the hose and nozzle is elevated to make similar passes to build on it, continuing up the cavity until it is completed. The process is repeated for each cavity space.

    - After spray-application, the insulation is levelled with the stud faces by using a screeding (surface finishing) tool known as a "stud scrubber", available through the CFI manufacturer or machine manufacturers.

    - The wall can be closed shortly after installation, even when a vapour barrier or other vapour retardant materials, such as some types of paints and vinyl wallcoverings, will be applied. *Walls sprayed with CFI products requiring less than 20% added moisture can be immediately closed. Walls sprayed with products requiring more than 20% moisture may require a short drying period (usually 24-48 hours) under ventilated conditions.*

    - Specific application instructions or installation manuals for the product (available from the manufacturer) should be consulted for further details.

Retrofit Application

- It must be established whether the cavities have existing FG batt insulation. Existing batts will interfere with an effective installation. Unless the batts are removed, do not install *CFI* into such cavities.

- Machine air settings should be as recommended by the machine manufacturer according to the nozzle being used. The CFI manufacturer can provide this information as well.

- Fill holes are to be drilled with a hole saw. Hole size can range between 1" and 2¼" (25-56mm) 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 smaller cavities through a single entry point using a fill tube, the fill tube is inserted into the cavity until it is within 12" (300 mm) of top or

bottom portion of the cavity. Fill tube size 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 removed), drilling through sheathing
  - Through the exterior, entering through soffit vent (removed) and drilling through the sub-siding or sheathing in soffit area.

- *CFI* is injected into the cavity until the area around the end of the fill tube is full, then retracting the fill tube 12" (300 mm) at a time, allowing additional insulation to fill the void created.

- When filling cavities with a wall nozzle, two entry points are recommended for each 8 feet (2.4 m) of stud space. The location of the holes should not be more than one foot (0.3 m) from the top plate and 2 feet (0.6 m) from the bottom plate.

  - *Start at bottom hole – insert the nozzle and fill the area. The machine backpressure will indicate when area is full (approx. two-thirds of cavity). Remove the nozzle from the bottom hole and place in the top hole, repeating the action until the entire cavity is pressure-filled. Take 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 must be closed with suitable plugs. Plugs applied to exterior entry holes in sheathing must be properly sealed as well.

9.3 Sloped Ceilings & Flat Roofs:

- Installation procedures for sloped ceiling and flat roof cavities are essentially the same as vertical wall applications.

- In retrofit applications where existing sloped roof cavities are to be filled (and verified to be empty), *CFI* may be used:

    - *Prior to installing new shingles, cut strips out of the roof sheathing, net the exposed area and inject the cavity full with CFI. Fasten strips back into place and seal with 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 with CFI 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 the CFI 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 for new construction, provides maximum insulating value for a limited space. CIMAC is not aware of any associated problems with this practice. Manufacturers often warrant the product's service when properly installed.

- 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.

9.4 Windows & Doors:

The small cavities around windows and doors must be insulated. In considering new construction, this is covered under *Section 7 (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.

9.5 Floors & Rim Joists:

Floors built over unheated basements or crawl spaces should 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 insulating 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.*

Perimeter rim joist areas of the home must be insulated. If the area under the floor is heated, it is only necessary to insulate the rim joist areas of the perimeter, unless added acoustical control is required for the floor.

- *From the underside, smaller cavities are created at the perimeter with netting and injected full with CFI (similar to above).*

When acoustical control is required for the floor to reduce noise in the heated basement below, joist cavities are created from below with netting (after the rim joist areas are insulated) and injected with *CFI* – the cavities need not be completely filled for good acoustical control. Installations providing a minimum of 3½" (89 mm) are recommended.

- *If enclosed cavities already exist and do not contain batt insulation, the attic floor method may be used to provide about the required amount of insulation in the main cavity but allowing the perimeter rim joist areas to pack full.*
- *If renovating the floor, entry holes could be drilled through the subfloor from above and plugged after insulating 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.*

10. EQUIPMENT

10.1 Insulating Machines:

Commercial Machine Function

- *The contents of the CFI package are manually placed into the feed hopper where rotating paddles break up the insulation material and automatically deliver it to the airlock chamber. This is an enclosed cylinder containing a rotor with several blades that form separate chambers within the cylinder.*
- *Blade rotation permits material to enter the chambers at a controlled rate and be injected into the air stream without disruption of the pressure or flow of air.*
- *The blower supplies the airflow and pressure to move the material from the feeder into and through the hose.*
- *In the hose, the air stream turbulence and the length of time the material dwells in the hose combine to further fluff the loosened material into a suitable form for delivery at the end of the hose.*

For a given material, the speed of the airflow and the ratio of material quantity to air volume largely control coverage results. Machines have two basic controls to regulate these factors. The primary control is the throttle setting of the engine and the secondary control is the relief valve on the blower. 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 feet (1 m) while blowing material. The blown CFI material should fall gently onto the surface about 4-6 feet (1½ -2 m) from the end of the hose. If the material bounces as it strikes the surface, or falls beyond 6 feet (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, fall beyond 6’ (2 m) and it would be relatively difficult to stop the flow of air and material leaving the hose with your hand.

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

Rental Machines

The smaller machines available to the do-it-yourself installer from building supply stores can be either a through-blower type or an airlock type. Refer to manufacturer’s instructions for proper settings and operation.

Machines for Spray Application

Only machines designed specifically for spray application 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. Some commercial models can be modified for spray application. Rental (through-blower) machines are not suitable for any type of spray application.

10.2 Delivery Hose & Nozzles:

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

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

The optimum hose diameter depends on the intended application:

- *2½" (65 mm) to 3" (75 mm) ID is recommended for open blow (attic) applications.*
- *2½" (65 mm) ID is recommended for sidewalls and cavities.*
- *2" (50 mm) ID 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. Bent or kinked hose affects consistent material flow. Worn hose provides less effective fluffing of the product since it is the corrugated interior surface of good hose that helps create the turbulence to properly fluff the product and provide optimum coverage.

The various types of hose recommended for the application of CFI products are available through the CFI manufacturer. Fill tubes, extension tubes, deflectors, reducers, and other types of nozzles (including spray nozzles and tips) that are recommended for use with CFI products are also available.

10.3 Maintenance:

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

A comprehensive maintenance inspection should be conducted regularly on all application equipment.

The installer should refer to the equipment manufacturer's recommendations for adjustments, settings and for maintenance requirements. Such information, including troubleshooting tips, is often available from CFI manufacturers as well.

11. JOB SITE PLACARD

It is strongly recommended that all contractors provide their customers with a completed job site placard. The purpose of the 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. Placards typically contain the following information:

- *Product (Name) and manufacturer*
- *Job Site Address*
- *Installation Date*
- *Homeowner's (and/or builder's) name*
- *Total Area Insulated (in square feet or square metres)*
- *Thermal Resistance (R(RSI)-Value) installed*
- *Applied Thickness (in inches or millimetres)*
- *Design Thickness (in inches or millimetres) Type 1 attic applications only*
- *Weight per Package (lb. or kg) and the number of packages used*
- *Name of Installation Company (including address, phone number, etc.)*
- *Printed name and signature of applicator (installer)*

The completed attic card should then be affixed to the building structure near the attic hatch or access or given directly to the customer.

Blank attic cards for CFI products are available from the manufacturer.