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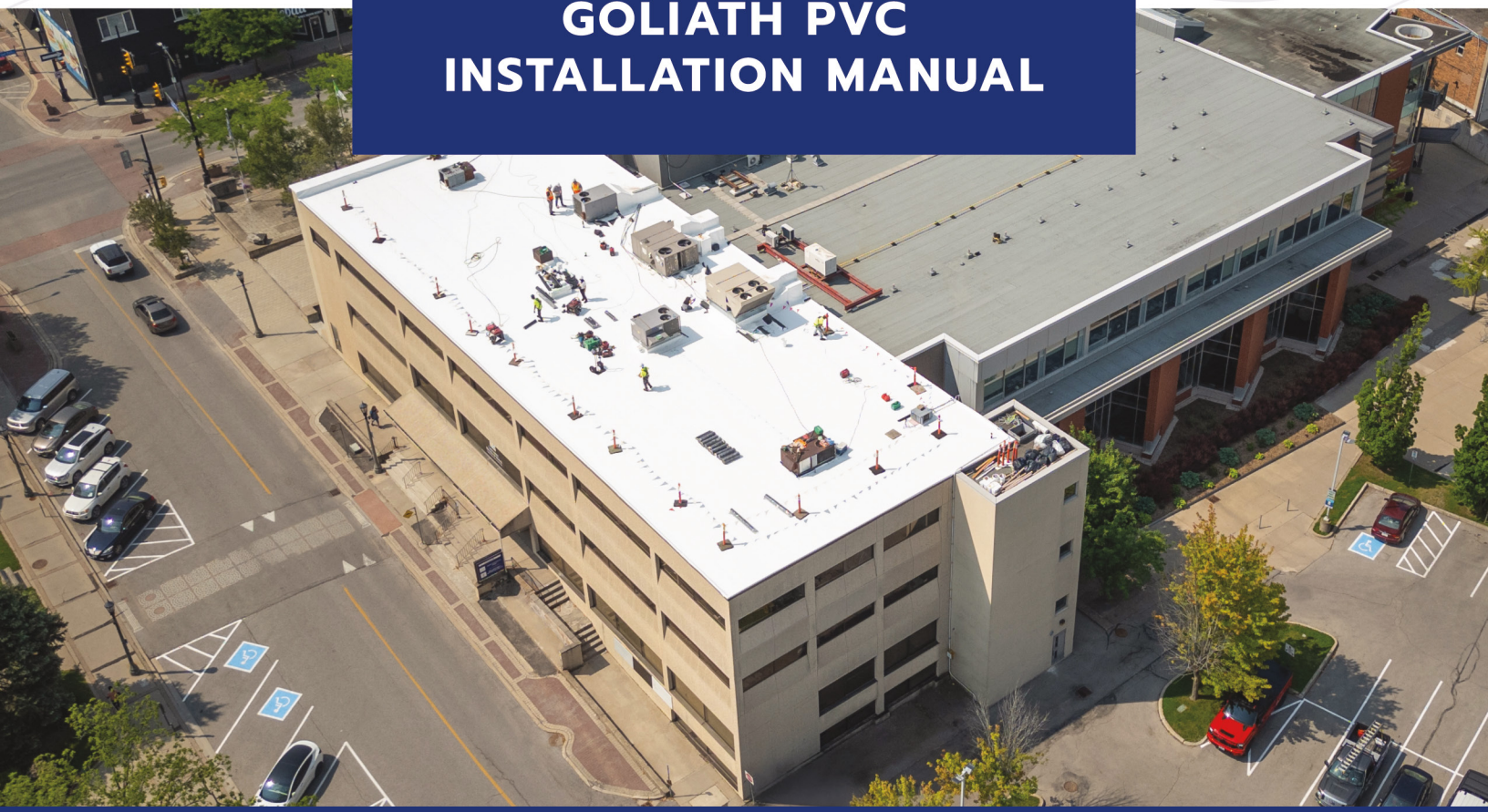
GOLIATH PVC INSTALLATION MANUAL



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INTRODUCTION:

The quality of a roof construction depends on several factors that must function together towards a common objective ensuring the long-term performance of the waterproofing system.

The main role of a roof is to keep the building dry and protect it from the weather. In addition, the roof assembly must be designed to ensure continuous waterproofing through all elements of the building envelope. The vertical roof elements, as well as the waterproofing of the various roof details and penetrations, must therefore be addressed with the same care as the sealing of the roof field surface. Next to rain and snow, the roof must also withstand internal condensation and water vapor migration to prevent the roof components from deteriorating over time.

In addition to protection against the weather, the roof components must be stable and properly fixed to the structure. The fastening and adhesion methods must allow the roof assembly to withstand thermal cycles and live loads in order to limit the material deformation that could compromise the waterproofing. Beyond stability of the materials, the roof system must also bear the normal negative pressures exerted by the wind.

Several factors should be considered so a roof meets its long-term performance objectives while working as expected:

- The selection of appropriate materials for the building location and environment conditions.
- The correct design of the roof assembly
- Proper installation of all of the roofing system's components
- The proper maintenance of the roof assembly

The main purpose of this PVC Installation document is to provide the applicator with the best installation procedures for installing a PVC roofing membrane system as recommended by Goliath.

The general information section states the requirements by **Goliath**, regarding surface preparation, membrane layout, slope and other elements to be considered when designing or building a roof. These requirements unlike product installation methods, must be followed to meet the requirements of **Canadian General Tower (Goliath)** warranties.

In this installation guide, emphasis will be put on the installation steps for the different types of **Goliath's** single ply PVC membranes. Descriptions are organized by adhesion methods:

- Loose Laid
- Mechanically fastened
- Induction Welded
- Fully Adhered

- Partially Adhered
- Protected Membrane

This PVC installation guide will also include methods for installing other components other than the PVC membrane, including the vapour barrier system, insulation panels, cover boards, flashing details and other accessories to ensure that the roofing system is completely waterproof.

In conclusion, this PVC installation guide contains information that is relevant to all installers, project managers, estimators and any other person involved in roof construction and looking for answers regarding the installation of **Goliath** main roofing systems.

General Information:

Installation Tips:

Before you start roofing:

- Evaluate the site conditions for any unusual or specialized conditions. Before beginning any roofing, inspect site conditions that might affect productivity or present problem.
- Inspect the building structure. If there are any concerns or issues, a licensed engineer should be retained to make sure the building structure is capable of carrying the weight of a new roofing system.
- Verify adequate slope-to-drain conditions. Make sure there is positive drainage. Add new drains where necessary to eliminate ponding, which can lead to membrane damage and possible roof collapse.
- Correct all defects in the deck. Replace damaged decking or substrate that can lessen the overall roof performance.

Note: The roofing contractor is responsible for the acceptance of the roof deck/substrate surface. In order to install a roofing system that will perform properly, the deck or substrate must be:

- Clean
- Dry
- Smooth
- Sound

Surface Preparation:

Roof area preparation is important. Prepare for new roof installations properly. New roofs will have fewer problems and perform longer if the proper preparation is done.

Use the following guidelines:

- Remove all existing roofing materials unless they are to remain and are in good condition.
- Remove wet or damaged materials to ensure a good roof installation and avoid interior damage.
- Clean substrate surfaces of all contaminants.
- If leaving the existing roof in place, remove blisters and ridges to provide a smooth surface.
- Cut existing membrane away from penetrations and perimeters. This will allow new membrane to expand and contract independently of the existing membrane.
- Inspect substrate condition and perform fastener pull-out tests and moisture surveys if needed (or required) to determine substrate condition.
- Confirm equipment support heights as they must be a minimum of 8” (203mm) to allow proper flashing heights.
- Raise flashing height as necessary.
- Flashings that are lower than 8” (203mm) have increased potential for moisture intrusion in the roof system from rain and/or snow.

Inspection Issues System Type: PVC Roofing Membrane System

Roof Area:

1. Seams
2. Insulation/Fastening
3. Wall/Curb Flashings
4. Perimeter Metal/Scuppers
5. Drains
6. Pipe Flashings/Pitch Pans
7. Field of Roof
8. Terminations
9. Corners
10. Ballast
11. Other Conditions

The following tables list potential problems that may be identified and provide a remedy to correct the problem.

Area 1	Description of Problem	Corrective Action
Seams	Voids found when probing fields	Clean and repair to spec. Use unsupported membrane
	Voids in seam at T-joint intersections	Clean/repair to spec. Use unsupported membrane
	Excessive bleed out caused damage to sheet	Clean and repair to spec.
	Seams not positioned properly/correct overlapping	Clean and repair to Spec.
	Bonding adhesive contaminating welded seam	Clean and repair to Spec.
	Missing in-seam fastener or spaced incorrectly	Add fasteners to meet spec. Clean and patch accordingly
	In-seam spec not installed per spec.	Install discs to spec. Clean and patch accordingly.
	Wrinkle or air pockets found in 1.5” (38 mm) seam	Clean and repair to spec.
	Missing ½ sheets per systems requirements	Install fastening at 3’ (0.91M) intervals to meet requirement. Clean and strip to spec.

Area 2	Description of Problem	Corrective Action
Insulation/ Fastening	Wet Insulation	Remove & replace insulation / membrane
	Incorrect number of fasteners	Reinstall to spec. Call **CGT** field services manager for written instructions
	Incorrect type of fastener or wrong sized plates	Call **CGT Technical** services for written instructions

Insulation/ Fastening	Fastener penetration of less than 1” (25 mm) spec.	Call **CGT Technical** services for written instructions
	Unsecured or insufficiently installed fasteners	Remove and replace fastener. Clean and repair to spec.
	Bowing or damaged insulation boards	Remove and replace insulation boards. Refasten if necessary. Clean and repair to spec.
	Unapproved Insulation	Call **CGT Technical** services for written instructions
	Poly Isocyanurate insulation facer delaminating	Remove and replace insulation. Install new insulation to spec.
	Unadhered field sheet on fully adhered system	Remove membrane and insulation. Install new insulation and membrane to spec.

Area 3	**Description of Problem**	**Corrective Action**
Wall/Curb Flashings	Voids found when probing flashing seams	Clean and repair to Spec.
	Voids found at T-Joints	Clean and repair to spec. Use unsupported membrane
	Excessive bridging at angle change	Cut out bridged areas. Clean and flash in affected area. Probe and check all seams
	Water trapped behind membrane	Cut flashing and completely dry the area. Probe and check all seams
	Flashing seam is less than 2” (51mm) past seam plate	Clean and repair to spec.
	Curb/wall flashing is missing base attachment	Install base attachment to spec. Clean and strip-in to spec.

Wall/Curb Flashings	Conduits or other penetration protruding the wall/curb flashing	Install field fabricated pipe flashing or pipe boot
	High wall flashing is missing attachment	Install mechanical attachment 12” (305mm) o.c. over wall flashing. Strip in attachment
	Missing in-seam fastener or spaced incorrectly	Add fasteners to meet spec. Clean and repair to spec.
	Unadhered wall flashing	Cut open affected area. Clean and repair to spec.

Area 4	Description of Problem	Corrective Action
Perimeter Metal / Scuppers	Voids, wrinkles, burns at coated metal weld	Clean and repair to spec.
	Continuous clip milling behind face of metal	Face fasten metal 12” o.c. Use approved fastener.
	No nailer present under metal flange	Remove perimeter metal, insulation and install appropriately sized nailer
	Termination bar/plates not installed	Install to spec. (i.e. fastener spacing, caulk missing)
	Flashing does not extend a min. 2” (51mm) past flange onto deck	Install proper edge detail flashings to spec.
	Caulk is missing at metal overlaps and T-Joint patches	Install CGT approved caulking to Spec.
	Improperly fastened	Install approved fastener 12” (305) o.c.
	Non-hemmed edge in contact with PVC	Remove all metal, install slip-sheets under metal, reinstall to spec

Perimeter Metal / Scuppers	Missing drip edge at gutter	Replace with gravel stop, scuppers
	Seam in metal sleeve installed on deck	Install slightly smaller new scupper and flash into spec.
	Unsecured flanges	Face fasten trough membrane into substrate. Clean and repair to Spec.
	Open corner including top corners	Clean and repair to Spec.
	Scupper not sealed where it protrudes through outside of building	Properly seal void between the wall and scupper
	Scupper missing or existing being reused	Install new scupper to spec.

Area 5	**Description of Problem**	**Corrective Action**
Drains	Water-block Caulking missing non-approved caulking	Install one full tube of water-block, reinstall drain ring to spec
	Missing, broken or untightened bolts or clamps	Replace and/or drill out and recap and tighten all bolts.
	Broken drain ring bowl	Replace any broken drain parts
	Seam runs through drain ring or sump	Install target patch to spec. If not leaking, clean and strip in with 8” flashing strip
	Insulation not properly tapered around drain	Install tapered insulation and drain target to spec.

Area 6	Description of Problem	Corrective Action
Pipe flashing/ Pitch Pans	Voids found when probing flashing seams	Clean and repair to spec.
	Void Found at T-joints	Clean and repair to spec. Use unsupported membrane.
	Field fabricated pipe slashing less than 8” (203mm)	Extend pipe wrap to a minimum of 8” (203mm) above roof line
	Field fabricated pipe flashing missing target	Remove wrap install target, rewrap pipe flashing
	Pipe boots and field fabricated missing water stop, clamps or caulking	Install to spec.
	Lead flashing left on pipe	Remove pipe flashing and lead, reinstall new pipe flashing to spec.
	Pipe boots and field fabricated pipe flashing under tension	Remove clamp, release tension, reinstall clamp and caulk
	New pipes added	Flash in new pipes to spec.
	Pitch pans filler not set up	Dig out soft filler and repour to current spec.
	Non-CGT approved filler used	Completely remove filler and refill to CGT spec.
	Pan not filled to the top	Clean existing filler, prime and fill to top
	Filler poured around line insulation	Cut out insulation and filler around line and repour.
	Less than 1” (25mm) separation between lines and sides of pan	Remove existing filler, separate lines, refill.

Area 7	Description of Problem	Corrective Action

Field of Roof	Noles or damage to field membrane	Clean and repair to spec.
	Splits or contamination on field membrane	Cut out spills or contaminants and repair to spec.
	Missing slip sheets under wood blocking, pavers, sleepers or satellite dish	Install approved slip sheet.
	Debris on roof	Remove debris and check for damage
	Excessive gravel of other sharp objects under field membrane	Cut out debris and repair
	Walkways displaced	Realign walkways and weld to spec.
	Walkways deteriorated	Replace deteriorated walkway
	Walkways needed at roof access point	Install walkways as indicated

Area 8	**Description of Problem**	**Corrective Action**
Terminations	Missing vertical terminating at end wall	Install termination bar or L-shaped metal to spec
	Missing caulking on vertical termination bars	Clean and install caulking on all sides of bar and fastener holes
	Missing caulking on horizontal termination bars	Clean and install caulking to Spec.
Terminations	Missing counterflashing on curbs/ walls	Install counterflashing and fasten 12” (305mm) o.c.
	Incorrect placement of termination bar (i.e. above weep holes, etc.)	Remove and relocate termination bar/ counter-flashing and reinstall termination to spec.

Terminations	Voids in caulking on top edge of termination bar/ counterflashing	Clean and caulk the top edge of termination
	Excess flashing extends past termination bar/ counterflashing	Remove caulk and trim excess membrane below kick, re-caulk
	Missing or incomplete termination	Terminate all membrane to spec
	Non-approved **CGT** caulking used on termination bar	Remove existing caulk and re-caulk with **CGT** approved caulking
	Termination is not approved by **CGT**	Warning given this project only.
	Incorrect use of termination bar (over siding, wood or non-watertight surfaces	Replace with appropriate counterflashing.

Area 9	**Description of Problem**	**Corrective Action**
Corners	Voids found when probing inside corners	Clean and repair to spec.
	Bridging on inside corner	Cut out bridging, clean and repair to spec.
	Damaged outside corner, torn by electrical cords etc.	Clean and repair to spec. Use unsupported membrane.
	Bridges or over stretched corner	Cut out bridging. Clean
	Voids found when probing outside corners	Clean and repair to spec. Use unsupported membrane
Corners	Missing inside and/or outside corner	Install pre-fabricated or unsupported field fabricated corner.

Area 10	Description of Problem	Corrective Action
Ballast	Ballast too small	Call CGT Technical services for written instructions
	Inconsistent Coverage	Redistribute ballast, add if necessary (20# per square foot minimum
	Non-approved ballast or no filter fabric	Call CGT Technical services for written instructions
	Slip sheet, wood blocking and/ or pavers installed on top of ballast	Sweep PVC free of ballast and fines, reinstall slip sheet, push back ballast

Area 11	Description of Problem	Corrective Action
Other Conditions	Spills or contamination on field membrane	Contractor to notify building owner of condition.
	Clogged drains	Contractor to notify building owner of condition.
	Mortar joints deteriorated	Contractor to notify building owner of condition.
	Grease vents discharging grease on membrane	Contractor to notify building owner of condition.
	Sealant joints deteriorated	Contractor to notify building owner of condition.
	Roof top Units Leaking	Contractor to notify building owner of condition.

Adhesion Testing Guidelines and Procedures

Purpose:

- Testing is required to ensure foam adhesive will bond the insulation to an existing substrate.
- **CGT** requires roofing contractors (or a qualified third party) to conduct an adhesion test prior to registering for a **CGT** warranty.

Guidelines:

- Do not use adhesive to install roofing materials on any roof deck or other substrate that shows signs of deterioration or loss of integrity.
- **CGT** recommends that contractors keep test results on file to be submitted to **CGT** upon request. Submission of results to **CGT** is not required in the ordinary course; however, **CGT** may request them on a job-to-job basis. Failure to perform the required testing or to be able to produce the test results may delay or prevent the issuance of the CGT warranty.
- **CGT** may at its sole discretion require additional testing prior to the job start or prior to issuance of the **CGT** warranty. In accordance with ANSI/SPRI IA-1 2010 Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates – V2.

Procedures:

Acceptable Adhesion Test Methods are outlined below:

1. **CGT** Preferred Test Method: “Shovel Test” Materials:
    - Adhesive Low-Rise Foam (LRF)
    - Square edge shovel or similar
    - Minimum 12” x 12” (305mm x 305mm) piece(s) of minimum 1 ½” (38mm) polyiso roof insulation or minimum 15/32” (25mm) plywood.

Frequency:

- Minimum of 4 tests for the first 50,000 square feet [500 squares] (4,650 square meters) of roof surface area.
- 2 additional tests for each additional 50,000 square feet [500 squares] (4,650 square meters) of roof surface.
- Tests should not be performed in close proximity to each other.

Directions:

- Install low-rise foam adhesive on roof deck or roof substrate in accordance with CGT or other approved manufacturer’s requirements.

- Place a minimum 12” x 12” (305mm x 305mm) piece of polyiso roof insulation or plywood in the foam adhesive (ribbons or spatter pattern) over the roof deck or roof substrate that is being tested. One or more ribbons are required.
- Allow adhesive to cure for a minimum of 1 hour.
- Pull up on the adhered board by placing a shovel under the corner of end of the board. The direction of the adhesive ribbon(s) should not affect adhesion results. Make sure that the shovel* is placed squarely under the board.
- If the existing substrate is insulation, CGT requires that a piece of plywood be placed under the bottom of the shovel in order to not crush the underlying insulation. Failure to do so can lead to inaccurate test results.
- Gently push down on shovel until the bond between the board and substrate is broken.
- Examine the board and substrate to determine the location of the bond failure.
- Failure should be within the adhesive or board.
- If the foam adhesive has separated from the substrate, this is unacceptable and foam adhesive should not be used to bond the new roof to this substrate.
- When testing adhesion to a deck, if a failure occurs in the deck, the deck is not suitable for use with foam adhesive to bond the roof to the deck.
- Record mode of failure and place in project file with:

1. Photographs
2. Date, time & air temperature

Fig 4-1: Shovel Placement

Fig. 4-2 Push Down on Shovel

Fig. 4-3: Broken Bond

Fig. 4-4 Bond Failure

3. **ANSI/SPRI IA-1 2010:** Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates – **V2, modified using a 12" x 12" (305mm x 305mm) test size**
4. **ANSI/SPRI IA-1 2010** Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates – **V2 (no modifications)**

Thermoplastic Membrane Seam Cleaning Guidelines

Proper preparation of the area to be heat-welded is critical to forming a good, long-lasting seam. Heat-welding uses the thermoplastic nature of the material to melt two pieces of material together, fusing it into a single piece. In order to properly fuse two pieces of material together, the pieces must be clean and dry. If it is not clean and dry, contaminants will interfere with the weld and may result in a poor or false weld.

General

- Satisfactory heat-welding requires that the membrane be clean of dirt and contaminates, and free from dew, rain, and other sources of moisture.
- Factory-fresh new membrane should be clean when unwrapped and unrolled on the job site. Typically, the new membrane will not require cleaning prior to welding, provided that welding is performed immediately after placement of the membrane. Therefore, any material rolled out and put into place should be welded the same day, including welding of any detail work.
- Membrane will require cleaning if it has been exposed for a longer period of time (e.g., for more than 12 hours or overnight) or has become dirty due to foot traffic or other contamination. Cleaning methods will depend on the type of contamination present.
- Cleaning recommendations depend on the type of contamination. The following are types of contamination that may be encountered with membrane:
    - **Light Contamination:** Membrane that has been exposed for a few days or less to air-borne debris, foot traffic, or dew or light precipitation can usually be cleaned with a cloth moistened with PVC membranes, MEK (methyl ethyl ketone) or acetone can be used. Be sure to wait for solvent to flash-off prior to welding.
    - **Dirt-Encrusted Contamination:** Membrane that is dirt-encrusted will require the use of a low-residue cleaner such as Formula 409® and a mildly abrasive scrubbing pad to remove the dirt. Rinse area thoroughly with clean water and allow it to dry. This must be followed by cleaning with a cloth moistened with for PVC membranes, MEK (methyl ethyl ketone) or acetone can be used. Be sure to wait for solvent to flash-off prior to welding.
    - **Weather or Oxidized Contamination:** Membrane that is weathered/oxidized will require the use of a low-residue cleaner such as Formula 409® and a mildly abrasive scrubbing pad

to remove the dirt. This must be followed by cleaning with a cloth moistened with for PVC membranes, MEK (methyl ethyl ketone) or acetone can be used. Be sure to wait for solvent to flash-off prior to welding.

- **Chemical Based Contamination:** Membrane that is contaminated with bonding adhesive, asphalt, flashing cement, grease and oil, and most other contaminants usually cannot be cleaned sufficiently to allow an adequate heat-weld to the membrane surface. Removal and replacement of the membrane is indicated in these situations.

Heat-Welding Goliath PVC Membrane Guidelines

Successful hot air welding requires the use of specialized, properly maintained and adjusted equipment operated by experienced personnel familiar with hot air welding techniques. Achieving consistent welds is a function of ensuring that the roofing membrane surface is clean and prepared for heat-welding, conducting test welds to determine proper equipment settings, and evaluating weld quality after welding has been completed.

Equipment

Welding equipment consists of three main components: power supply, hot air welder (either automatic or hand-held), and extension cords. The newest automatic welding equipment provides improved control of speed, temperature, pressure, and membrane. The use of the latest model of automatic welder is highly recommended. Older models may not achieve consistent welds. Follow the equipment manufacturer's recommendations regarding correct equipment operation and adjustment.

- Current generation automatic hot-air welder (recommended)
- Minimum Power Supply: 220 volts, 30 amps, 10,000 watts continuous
- Current generation hand-held hot-air welder (recommended)
- Minimum Power Supply: 110 volts, 15 amps, 2500 watt continuous
- Commercial Grade 10,000-watt voltage-controlled generator (minimum)
- THD (Total Harmonic Distortion) rating should be six (6) or less for quality welds
- 240v & 120v Outlets
- GFCI Line Cords
- Volt Meters
- Extension Cords

Automatic Welders extension cords - 10-gauge wires with a standard plug configuration. Maximum 100' (30.5 m) in length.

- Hand-Held Welders -12-gauge wire with a standard plug configuration. Maximum 100' (30.5 m) in length.

- For longer lengths, consult an electrician for line voltage drop. Heavier-gauge extension cords are likely to be required.
- Silicone Hand Roller (used in conjunction with hand-held welders)
- Ensure that the roller is in good condition. Rollers with rounded edges should be replaced.

A stable power supply of adequate wattage and consistent voltage is critical to obtaining consistent hot air welds and to prevent damage to the welder. The use of a contractor-supplied portable generator is recommended, although house-supplied power may be acceptable as well for hand-welding.

Do not connect to a power source that is:

Used for other equipment that cycles on and off.
It is subject to momentary disruptions or power surges.
Incapable of providing sufficient power.
THD greater than six (6) may lead to fluctuations which may impact welding

Note: Outdated welding equipment and inadequate or fluctuating electrical power are the most common causes of poor seam welds.

Equipment Maintenance

- Owner maintenance of welding equipment includes keeping the equipment safe from physical abuse and damage from the elements, keeping the welding, nozzles clean from membrane residue, keeping the air filters free from clogging, and replacing heating elements when needed.
- Follow the equipment manufacturer's recommendations regarding other aspects of equipment maintenance and repair (i.e., motor brushes, switches, belts, etc.).
- Store welding equipment in weather tight toolboxes. Toolboxes for automatic welders in particular should be fitted with cushioning foam material to protect the welder during transit and hoisting operations.
- Clean welding nozzles on a daily basis with a wire brush. Nozzles tend to retain membrane residue on their surfaces. This buildup of residue can interfere with welding practices if not removed.
- Clean air filters on a weekly basis. Clogged air filters restrict air flow. This prevents the welding tool from operating efficiently and can cause the fan motor to overheat.
- Heating elements are readily field-replaceable. Heating elements are vulnerable to both physical and thermal shock, particularly if the welder is shut off without first being allowed to cool down.

Equipment Settings

Setting up a hot air robotic welder properly is key to having a properly installed roof and performing test welds is one of the most important steps. Making appropriate adjustments before you begin the final welding process assures that the correct combinations are achieved.

- The correct speed and temperature settings for automatic welders are determined by preparing test welds at various settings. The welds are tested by application of pressure causing the seam to peel apart. A satisfactory weld will fail by exposing the scrim reinforcement called a “film tearing bond.” A deficient weld fails by separating between the two layers of the membrane.
- Adjustments to Equipment Settings—many factors will affect the settings:
- Thicker membranes, lower air temperatures, and overcast skies will generally require a slower speed than would be required with thinner membranes, higher air temperatures, and sunny skies. The slower speed provides additional heat energy to compensate for heat- draining conditions. For initial automatic air welder setting, use the formula below:
- **Speed Formula: (ambient temp/10) +2 = FPM (Feet Per Minute)**
- **Example: (80/10) +2=10FPM for an 80°F (26°C) day.**

Note: This formula serves as an initial starting point. Adjustments may need to be made accordingly.

- Test welds should be performed at the beginning of every work period.
- Just before welding in the morning
- Upon returning from lunch in the afternoon
- When there’s been a significant change in weather (e.g., air temperature, wind speed, cloud cover, etc.)

Cautions and Warnings

- Do not touch the welding nozzle and heat shield and avoid keeping unprotected skin in the flow of hot air. The welding nozzle, heat shield, and hot air being expelled from hot air welders is very hot and can result in severe burns.
- A robotic welder at a speed greater than 16 ft. (9.6 m)/min. maybe too fast for safe operation and may result in defective seam welds.
- Setting the speed of the welder too fast can also pose potential problems with the ability of the operator to maintain control of the welder. This is particularly true in reroofing or over uneven substrates.
- Robotic welders running too fast may not allow the operator to monitor the weld width and ensure that critical T-joint areas have been correctly creased.
- The operator must keep in mind the relationship between ambient temperature, automatic air welder speed, heat setting and how much weight is on the machine in order to achieve a film tearing bond (weld).

Automatic Hot Air Welding of Seams

Successful automatic welding is primarily a function of proper machine adjustment and ensuring a consistent power supply.

- Membrane MUST be cleaned and free from all dirt and debris prior to hot air welding of seams.
- Verify correct power supply voltage with a voltmeter.
- Determine proper welder speed and temperature settings by performing the test weld procedure.
- Mark all locations where automatic welding starts and stops to identify locations of possible weld discontinuities. These areas should be carefully probed and repaired as required.
- The weld must provide a maximum film-tearing bond of 1.5" (38 mm) and a minimum 1" (25 mm) film-tearing bond.
- Membrane laps must be heat-welded together. All welds must be continuous, without voids or partial welds.
- Attend to all T-joints by carefully pressing each joint down by silicone roller edge or other hard-edged tool immediately after the T-joint has emerged from the automatic welder.
- 50, 60, and 80 mil PVC membrane T-joints require the installation of a heat welded membrane cover patch.
- Welds must be free of burns or scorch marks. However, seaming of PVC membrane should exhibit bleed-out when properly welded.
- All reinforced PVC field seams should be made using an automatic hot air welder.
    - PVC reinforced membranes do not require a Cut Edge Sealant.

Hand-Held Welding of Seams

Successful hand-welding is a skill that involves individual technique, normally developed and refined over time. Operator should be proficient in different nozzle configurations. Correct selection of welder temperature and nozzle width can have an effect on the quality of the hand-weld. Hand-held welding should only be done when automatic hot air welding cannot be used.

- Membrane MUST be cleaned and free from all dirt and debris prior to hand-welding.
- During basic hand-welding, the hot air welder is held in one hand, and a hard silicone roller is typically held in the other hand. When hand-welding with a roller, finger pressure is often used to place and tack the upper piece of membrane in position. However, a silicone roller must always be used for final welding. Tack welding is not permitted in the field welding of seams.
- The membrane must be heat-welded together using the "two-pass method." Weld from the interior on the first pass and finish the weld with the second pass.
- The welding nozzle is introduced between the two layers of membrane, and the silicone roller is rolled back and forth perpendicular to the nozzle mouth to press the membrane together and accomplish the weld. The roller should remain flat to ensure proper compression.
- All welds must be continuous, without voids or partial welds.
- There should be no bleed out on TPO. TPO welds must be free of burns or scorch marks. However, seaming of PVC membrane should exhibit bleed out when properly welded.
- The ability to achieve satisfactory welds with the hot air welder being held in either hand facilitates

welding at various angles and in various situations.

- The weld must provide a maximum film-tearing bond of 1.5” (38 mm) and a minimum 1” (25 mm) film-tearing bond.
- Depending on the type of welding being performed, the temperature setting will vary, as will the width of the welding nozzle.
- Welding Seams, Prefabricated Flashings and Repair Patches – Use a temperature setting that the roofer is comfortable with.
- Welding Field-Fabricated Pipe and Corner Flashings – Use a temperature setting that the roofer is comfortable with.

Cooler Weather

Many factors will affect the settings, including overcast skies and lower air temperatures. This will generally require a slower speed and lower heat settings. The slower speed and heat provides the additional heat energy to compensate for heat-draining conditions.

- The correct speed and temperature settings for automatic welders are determined by preparing test welds at various speed and heat settings.
- Hand-welding during colder temperatures also needs to be adjusted.
- Perform test welds on membrane you will be using that day.
- Do not use scrap material to create test welds.
- A daily quality control including probing and checking seams at the end of the day.

During cooler temperatures it is even more critical to perform test welds in the morning, after any extended break such as lunch, or after significant change in weather (e.g., air temperature, wind speed, cloud cover, etc.).

Quality Control Procedures

- There are three basic methods of evaluating the quality of a heat-weld: visual inspection, physical probing, and test cuts. All heat-welds must be visually inspected and physically probed.
- **Visual inspection** can determine adequacy of weld width, presence of fasteners and plates within the weld area, overheating or tearing within the weld area, indications of special sealing at T-joints, and gross under heating or skipping of seam areas. Properly welded PVC seams will exhibit a slight [i.e., 1/8” (3 mm)] bleed-out of the bottom membrane layer.
  Note: TPO should exhibit no bleed out.
- **Physical probing** involves the use of a blunt pointed seam probe such as a dulled cotter pin puller. The weld must be allowed to cool before being probed. The probe tool is pressed with some force against the weld edge and drawn along the seam. The probe tool will enter into the heat-weld area between the two layers of membrane at locations where the seams are partially

welded when a "void" is found. The probe tool can then be used to open up the seam area until a solid weld is encountered.

- **Seam test cuts** involve removing a small portion of a welded seam once it has cooled and peeling the seam apart. Cut a sample strip across the seam approximately 1" (25 mm) wide by 10" (254 mm) long. Apply even pressure to peel the seam apart and evaluate the weld. A satisfactory weld fails by exposing the scrim reinforcement. A deficient weld fails by separating between the two layers of membrane.
- **Defects** may be corrected by heat-welding a piece of UN-55 membrane over the deficient weld area, the same day. The deficient weld may be re-welded only if the seam interior has not been contaminated by the presence of dirt, bonding adhesive, asphalt, etc.

Hot Air Welding Guidelines

Setting up a hot air robotic welder properly is key to having a properly installed roof and performing test welds is one of the most important steps. Making appropriate adjustments before you begin the final welding process assures that the correct combinations are achieved.

Test welds should be performed at the beginning of every work period.

- Just before welding in the morning
- Upon returning from lunch in the afternoon
- When there's been a significant change in weather (e.g., air temperature, wind speed, cloud cover, etc.)

Procedure

- Take 2 pieces of "bag fresh" Goliath PVC membrane approximately 18" (457 mm) long.
- Set your automatic welder's speed and heat.
  For full size welders, such as the BAK LarOn, CGT suggests starting at the following settings:
  - Temperature between 800˚F (427˚C) and 1,148˚F (620˚C)
  - Speed 10-16 feet (3.05-4.88 m) per minute. New equipment may run faster and hotter.
  - For an initial setting, use the formula below as a general guideline:
- **Speed Formula: ambient temp/10+2 =FPM (Feet Per Minute)**
- **Example Scenario:** Start out by setting the speed at 10 FPM, air flow at 100% and the temperature at 600°F (315˚C) degrees and do a test weld. Bump temperature up 100°F (38˚C) to 700°F (371˚C) keeping same 10 FPM and air flow. Perform another test weld. Continue doing this in 100°F (38˚C) degree increments keeping speed the same until machine is maxed out [typically 1,148˚F (620˚C)] and find the weld window. Set up machine in the middle of the weld window.

Note: Remember, settings required for a good weld will change based on equipment type, weather conditions and membrane thickness.

- Weld the 18” (457 mm) pieces together and then allow the membrane to cool for at least 10 minutes.
- Cut 1” (25 mm) wide strips across the welded material.
- The welds are tested by application of pressure causing the seam to peel apart.

Results

- Acceptable welds – only those with full film tearing bonds (Fig 4-5)
- Unacceptable welds – may have partial welds or may be cold welds (Figs 4-6 & 4-7)

Fig: 4-5 *Fig. 4-6* *Fig. 4-7*

Adjustments to the Hot Air Robotic Welder Settings

- Only make one change at a time and avoid changing heat and speed together.
- If you are welding at 1,148˚F (620˚C) and do not get a good weld, do not automatically adjust the speed because the temperature may be too high. Lowering the temperature or increasing speed may be a necessary adjustment.
- If the weld is greater than 1.5” (38 mm), you may have the temperature too high, and this could lead to a failed weld over time.
- Having too much weight on the automatic hot-air welder combined with too high of a speed setting can potentially cause wrinkle issues in the weld area.

Results

- Acceptable welds – only those with full film tearing bonds (Fig 4-5)
- Unacceptable welds – may have partial welds or may be cold welds (Figs 4-6 & 4-7)

Seam Probing Guidelines

Seam probing is the physical inspection of a hot air weld area by running a suitable blunt probe along the length of a seam with horizontal pressure applied into the bottom edge of the weld. Seam probing checks the integrity of the weld to help ensure a water-tight roofing system and is critical to locating small skips in a welded lap. Seam probing is **NOT** a replacement for conducting test welds.

All hot air welded seams must be physically probed with a blunt or dull cotter key puller hand tool (sharp points or edges must be filed down).

- Contractors are responsible for initial probing of their welds. Do **NOT** wait for a CGT Field Service Representative to find issues with the welds during the roof inspection after the roof is already completed. This could lead to more difficult and costly repairs requiring re-inspection by CGT.
- Probing **MUST** be conducted daily.
- Initial probing should be done on hands and knees.
- Subsequent probing may be completed with a cotter key hand tool that can be affixed to standard extension handle, which allows the tool to be used from a standing position.
- CGT seam probing guidelines should be followed:
- Exercise care when handling and walking with the seam probe to avoid injuries from the point end.
- Continuous use of the probe will cause it to become sharper. Ensure that the point is blunted/rounded off at all times.
- Allow the seam to cool down at least 30 minutes or to ambient temperature before probing. Premature probing can damage seams because the welds may still be warm.
- Run the probing tool parallel to the edge of the seam applying ample pressure at the base of the weld. Use caution to avoid damaging the membrane surface with the point of the probing tool (Fig. 4-8).
- When probing, extra attention must be given to all membrane seam intersections, heat-welded seams above insulation joints and areas where the robotic welder stops and starts again.
- Mark all voids, open welds or cold-welds using a water-soluble marker or crayon so repairs can be made (Fig. 4-9).
- Repair all voids, open welds or cold-welds routinely throughout the day but no later than the end of each workday using a hand-welder.
- To make a minor repair on a seam, use a T-Joint Cover Patch, UN-55 Detailing Membrane, or the same material type being used for the field sheet.
- If repairs are needed for an entire open seam, use reinforced membrane a minimum of 4” (102 mm) wide. Finish the detail by heat-welding T-Joint Cover Patches at each corner. Any damage caused to the field sheet (not in the seams) must be patched with reinforced membrane.

- All repaired seams should be probed after they have cooled completely to determine if the weld is acceptable. If the repaired seam is not acceptable, repair areas as necessary until corrected.
- Cut-Edge Sealant is **NOT** required when using Goliath PVC membranes.

Fig. 4-8

Fig. 4-9

Walkway Installation

Rooftop traffic can be harmful to the completed roof system. Protect completed roofing from other trades and routine maintenance traffic on the roof.

- Installation of walkway pads are required at the roof's egress but can be also used at other locations on the roof such as high traffic and mechanical areas.
- Pads need to be placed 6" (152 mm) away from seam welds, so these welds can be inspected, and 6" (152 mm) from each other for drainage. (Fig. 4-10)
- Walkway pads are constructed from Goliath Walkway Rolls. Goliath Walkway Rolls are cut into smaller manageable pads.
- Membrane MUST be cleaned and free from all dirt and debris prior to installation. When installing the walkway pads remember these are thick and require different settings of the robot welder.

Note: Because of this thickness especially on thinner mil membrane, there is a very real possibility of overheating the roof membrane or actually burning the membrane. For that reason, you may not accomplish a "film tearing" bond when welding.

Welding Method

- Walkway rolls contain non-textured edges. These should be used for the robot welding. (Fig. 4-11)
- Weld along both non-textured ends. Set up the welder with a lower heat setting and adjust the speed accordingly. This way you won't overheat the membrane, and you will achieve a tight seam weld.

- The interior of the pads must be hand-welded. Use the two-pass method, welding from the interior on the first pass. (Fig. 4-12)
- Finish the weld with the second pass.
- Repeat the hand-weld “two-pass” method for all remaining pads.

Fig. 4-10

Fig. 4-11

Fig.4-12

Cold Storage

CGT defines cold storage as a building or portion of a building or structure designed to promote extended shelf life of products or commodities and typically has year-round temperatures below 50˚ F (10˚ C).

It is the responsibility of the design professional to specify the appropriate cold storage system.

Extremes in internal temperature/humidity are often associated with cold storage/freezer buildings and food processing plants. What makes these building applications unusual is that the pronounced difference in vapor pressure between the building interior and the exterior can cause a pronounced vapor flow through the roof assembly. This can result in a significant build-up of condensation within the roof assembly, and severe deterioration of both the roof assembly itself and the structural deck.

Relevant design considerations include:

- Attention to vapor-tight seal between roof and side walls/penetrations.
- Utilization of closed-cell foam insulation and stainless-steel fasteners to minimize potential for condensation related degradation of roof system.
- Limitation of penetrations through roof deck; and
- Avoidance of roof system attachment through any vapor retarder.

Refer to CGT’s Cold Storage Guidelines for further information.

The following requirements and restrictions apply:

1. Available for adhered and ballasted membrane roofing systems only.

2. Available for new and tear-off systems only. Not available for recover systems.
3. Minimum 2 layers of insulation is required. The top layer of insulation is to be adhered and may be an approved cover board.
4. Best roofing practices must be followed. Building envelope specifications provided by the designer for sealing of all penetrations and edges must be followed.
5. Goliath PVC accessories must be used with the Goliath PVC systems only.
6. Requires inspection after all work is completed.
7. Goliath's PVC 50 mil membranes are not eligible for warranty coverage when used over cold storage.
8. For additional information on cold storage installations, please consult CGT's Technical Services.

Roof Decks

Prior to installing any roof system, a deck should be visually inspected to verify that it is smooth, clean, dry and free from any irregularities.

Any bituminous substances must be removed prior to the installation of a PVC membrane as theses membranes are incompatible with bitumen and will degrade rapidly when in contact with bituminous substances or their residues. If the bitumen cannot be completely removed, a separation layer consisting of a thin layer of insulation or a protection mat must be installed to protect the PVC membrane.

Different types of decks or substrates have different preparation requirements to ensure proper installation of the PVC roofing membrane.

Concrete:

Concrete decks must be fully dry and have a smooth surface. This may require grinding of the concrete surface to remove fins and protrusions prior to installation of the membrane, or the installation of a vapour barrier or protection board or mat over rough surfaces.

Precast concrete decks must be level to provide a smooth surface. In fully adhered systems, roof joints should be grouted to prevent seepage of adhesive into the building.

1. Cast-in-place and precast concrete decks must cure for at least 28 days before receiving an adhered roof membrane ("adhered", as it is used in this requirement, means fully or intermittently bonding any membrane to the ***deck*** with an adhesive, hot asphalt (bitumen), or heat), but this limitation may be reduced if
    1) both the building envelope engineer and the manufacturer expressly permit membrane application within the first 28 days after pouring, and
    2) their respective signed letters of permission are furnished to the ***Guarantor*** forthwith, to be included with the project record.

2. shotcrete-formed concrete decks are not an acceptable substrate for the application of sheet membranes.

Wood:

1. Wood sheathing decks must be exterior grade, securely fastened, air or kiln-dried lumber. Do not apply a fully adhered a **Goliath** PVC membrane directly to pressure treated wood as the adhesives are not compatible with the preservatives used in treated wood. Dimensional lumber decks must be covered with exterior grade plywood, good one side, or a suitable layer of insulation.
2. Plywood panels should conform to CSA 0121, “Douglas Fir Plywood”, CSA 0151, “Canadian Softwood Plywood”, or CSA 0153, “Poplar Plywood”, but in any event must conform to the requirements published in the Code having jurisdiction.
3. All plywood decks (notwithstanding the minimum requirements for plywood used to overlay mass timber and wood board ***decks***; shall be constructed to conform to the National and Provincial Building Codes” for either Part 3 or Part 9 buildings, and shall be:
   - At least 12.7 mm (1/2”) thick, unless exceeded by the specified securement design.
   - Free of loose knots and cracks, which are considered defects and must be covered with sheet metal, mechanically fastened in place,
   - Securely fastened to roof framing, and installed so that the surface grain (plywood) runs at right angles to the roof framing,
   - Properly gapped between panels
   - Fully supported along all panel edges.
4. When a plywood *deck* is intended to support a protected roof system and a **Vegetated Roof System**,
   1) the deck and any vertical planes that contact the vegetated roof system should be pressure treated tongue-and-groove plywood at least 19.05mm (3/4”) thick, but when the existing deck and adjoining wall surfaces are untreated wood, they should be overlaid with no less than one layer of an accepted deck overlay panel listed in this manual.
   2) the **Design Authority** shall be responsible to calculate the anticipated live and dead loads of the system and design suitable approaches to mitigate deflection.
5. Mass timber decks, which include cross-laminated timbers (CLT), nail-laminated timbers (NLT), dowel-laminated timbers (DLT), and traditional glue-laminated timbers (Glulam), are acceptable to the **manufacturer** and do not require an overlay, but when an overlay is required by the manufacturer it must be plywood.
6. A mass timber deck that will support a vegetated roof system may be overlaid with a vapour permeable membrane followed by screw-fastened marine-grade T&G plywood at least 19.05mm (3/4”) thick, to which the roof system may be applied.

Non-veneered Panel Roof Decks

Wood Board Roof Decks

1. Wood board ***decks*** should be of sound seasoned lumber, properly secured to the supporting structure.
2. Wood board decks must be overlaid with plywood conforming to the manufacturer's requirements to render the deck suitable for roofing.

Steel:

All decks must be clean and dry prior to the installation of any roofing material. PVC membranes cannot be installed directly over a steel deck, a leveling layer of a suitable insulation, plywood, or gypsum board must be installed over the deck prior to installing the **Goliath** PVC membrane.

1. Steel decks must be acceptable to the manufacturer and must conform to either
   1) ASTM Standard Specification A653 / A653M, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process": Structural (Physical) Quality, minimum Grade 33, with a design thickness of 22-gauge (0.759 mm) or greater and a minimum zinc coating designation ***Z275***, or
   2) ASTM Standard Specification A792 / A792M, "Steel Sheet, Aluminum-Zinc Alloy-Coated by the Hot-Dip Process": General Requirements, minimum Grade 33, with a design thickness of 22-gauge (0.759 mm) or greater and a minimum aluminum-zinc alloy coating designation ***AZ150***.

Walls

General

1. Wall surfaces must be clean, dry, and smooth, suitable for the application of PVC roof system materials.
2. Wood or steel-stud walls must be sheathed with a material suitable for adhering membranes and securing metal flashings; when sheathing is unsuitable, it must be overlaid with an accepted wall overlay.
3. Sheathing is considered a wall surface for the purpose of this manual.
4. Wall surfaces suitable for receiving waterproofing materials must extend beyond the maximum installed height of the waterproofing, but in any event must be installed at least 203.2 mm (8") above the finished roof system surface.

Insulation

The purpose of insulation is to provide a proper substrate to install the roof membrane and to provide thermal resistance. It is important that only insulations compatible and approved by the manufacturer be used with the **Goliath** PVC membrane assemblies. In loose-laid ballasted and mechanically fastened systems, many different types of insulation can be used**. However, expanded or extruded polystyrene insulations cannot be used in direct contact with the PVC roofing membrane. In addition, insulation with bituminous facers may require a separation layer.** Only specific types of insulation can be used in a fully adhered system. These insulations must be solvent resistant and have suitable facers. Always ensure that **Goliath** technical department approved insulation is used for the particular system type.

The first step is successfully installing a Goliath PVC membrane roofing system is to properly plan and coordinate the job. This means that you will require the proper tools and correctly estimate the quantity of materials needed. Along with the tools you would need for any roofing job, you may also need the following:

- Good scissors
- T Square
- Seam Rollers
- Paint Brushes and Rollers
- Chalk Lines
- Roofing Knife with Hook Blades
- Cordless Screw Guns
- Wire Brush
- Floor Roller
- Hot Air Automatic Welding Machine
- Generators; Minimum10,000 Watt (1 Auto) 3,000 Watt (2 Hand Welders)
- 10 Gauge Wire Extension Cords, Maximum 100’
- Hot Air Hand Welder
- 12 Gauge Extension Cord, Maximum 100’

Estimating Material

To correctly estimate the membrane material that will be required, you will have to calculate the following:

1. The area of the roof (length x width)
2. The perimeter of the roof.
3. The length, width and height of all parapets.

4. The length and height of all walls that require flashing
5. The length and height of all curbs.
6. The dimensions of all roof penetrations including drains, vent pipes, anchors, chimneys, etc. These dimensions sill allow you to estimate the following materials:
    - Number of membrane rolls.
    - There are various widths of rolls for specific purposes, such as 3.0' starter rolls and 6.0" full rolls.
    - In estimating the coverage of each roll, you must allow for the side and end labs of the rolls. (Size of side laps will vary depending on the method of installation).
    - Length of termination bars (battens) or number and type of plates (depending on the type of attachment)
    - Quantity of adhesive (depending on type of attachment (fully bonded or partially bonded)
    - Length and dimensions of metal flashing (PVC coated metal or 26 gauge Galvanized pre-painted metal)
    - Number of rolls of protection mat (if required)
    - Length and number of screws, plates and compression bars.
    - Tonnage of River Washed Ballast (if required)
    - Quantity of Sealants.

Goliath PVC membranes can be installed in either a conventional (where roofing membrane is installed on top of the roof insulation) or protected membrane roof assembly (where roofing membrane is installed below the insulation).

PVC membranes require caution during their installation. Careful attention should be taken to avoid damage or puncture of the membrane during application and correct welding of the seams is also critical to prevent water leakage.

There are **three** basic steps to follow when installing a Goliath PVC roofing system.

1. Lay the membrane.
2. Hot air welds the seams.
3. Install the membrane flashing (stripping).

Inspection Issues System Type: PVC

Roof Area:

1. Seams
2. Insulation/Fastening
3. Wall/Curb Flashings

4. Perimeter Metal/Scuppers
5. Drains
6. Pipe Flashings/Pitch Pans
7. Field of Roof
8. Terminations
9. Corners
10. Ballast
11. Other Conditions

Air and Vapour Controls

General

1. Words that appear in italics are defined in the Glossary. Additionally, the following terms are used in this Part:
    1) *Air barrier* means a material that is manufactured and tested to prohibit the passage of air through that material.
    2) *Continuity* means a sealed, resistive, continuous connection between control layers that have the same function, and between a control layer and another material or object it joins to (i.e., a roof drain or penetration).
    3) *Control layer* means a material used in a roof assembly or wall assembly, that is manufactured and tested to resist or control the movement of air, vapour, or liquid water into or through that assembly.
    4) *Vapour retarder* means a material that is manufactured and tested to prohibit or regulate the passage of water vapour through that material.
    5) *Water resistive barrier* (WRB) means a material that is manufactured and tested to resist the transmission of liquid water through the material and is usually used in wall assemblies.

Responsibility for Design

1. The *Design Authority* is responsible to specify
    1) air and vapour control materials,
    2) the placement of continuous air and vapour control layers in relation to a roof system and its components, and
    3) the selection of suitable materials for that application.
2. The *Design Authority* is urged to review and consider the performance characteristics of materials available for such applications.
3. Coverage under the **CGT Warranty** shall be as described in warranty requirements.

4. Notwithstanding coverage provisions in **the CGT warranty** program nor the *Contractor* will accept any responsibility for damage to, or failure of, the *roof system* caused by the use or absence of air or vapour *control layers*.

Continuity of Control Layers

1. The *Design Authority*, and trades constructing walls and roofs, are jointly responsible for making proper connections (continuity) between air and vapour control *systems*, including the transitions between *wall systems* and *roof systems*.
2. Where air, vapour, or water *control layers* intersect a *roof drain*, *overflow drain*, *scupper drain*, or penetration, the intersection must be designed for *continuity*, and drawings must detail the execution of *continuity* for the *Contractor*.
3. *Overflow drains* and *scupper drains* that penetrate *wall assemblies* must be designed and drawn to prevent air intrusion from the outside environment.

Use of Air Control Materials

1. The *Design Authority* is responsible for the selection of air control materials (some air *control layers* are considered vapour permeable, others vapour-impermeable); *roof systems* intended to qualify for a CGT warranty program should be designed according to the regulatory design and installation requirements for effective, continuous air control *systems*.
2. All materials selected by the *Design Authority* should conform to the material and performance characteristics required in the “National and Provincial Building Codes”,

Use of Vapour Control Materials

1. Because continuous vapour *control layers* may be needed to limit “water vapour transmission and condensation, burn protection, and severe climatic conditions” they are considered discretionary and must be specified by the *Design Authority*.
2. Where continuous vapour *control layers* are required and specified by Code, the **CGT Warranty** *Program* requires that a suitable vapour control *system* be selected by the *Design Authority* and properly installed by the *Contractor* in conformity with the vapour *control layer* manufacturer’s published instructions, and with the *Design Authority’s* specified details.

High-humidity Building Interiors

1. Careful consideration should be given to the performance characteristics of air and vapour *control layers* when specifying such a membrane for *roof systems* constructed over high-humidity building interiors, which may be susceptible to the accumulation of moisture within the *roof system* unless effective air and vapour controls are installed; these building interiors include (but are not limited to)

1) swimming pools,
2) commercial laundry facilities,
3) large aquariums, and
4) paper mills.

2. While responsibility for the selection of suitable air and vapour control layers rests with the *Design Authority*, a roof designed and built to qualify for **a CGT Warranty** shall not include
    1) bitumen-impregnated kraft paper.

Puncture Resistance and Thickness

1. Air and vapour controls should be installed over a continuous smooth plane, regardless of a material's ability to span voids or spaces in the deck.
2. Fully supported air and vapour control layers should possess a minimum published static puncture resistance rating of 150 N (34 lb.) (Ref. CGSB-37.56-M for both test method and standard limits) and be either self-adhering or torch-applied; a high puncture resistance is necessary for the membrane to withstand accidental damage during construction.
3. Where no ***deck*** overlay board is installed and the air and vapour control layers are partially unsupported (for example, on a steel ***deck***), the control layers must possess a published static puncture resistance of at least 400 N (90 lb./f).
4. Should the air or vapour control layers be used as a temporary roof during ***project*** construction by either the ***Contractor*** or by other trades, a minimum 2 mm thick bituminous membrane is recommended.

Self-adhered and Torch-applied Materials

1. Self-adhering or adhesive-applied materials should be considered as alternatives to torch-applied membranes when the substrate to which they will be applied is combustible, or when nearby structures, openings or materials present a fire hazard.
2. A suitable separation or overlay material may be used as protection from open flame is acceptable; the application of materials to a combustible surface, using a torch, is strictly prohibited.

6 Mil Polyethylene Sheeting:

This is a widely used, cost-effective, and easily installed vapor barrier. It's available in various thicknesses and sizes for different applications. Polyethylene is often used in residential construction and is suitable for use under concrete slabs and in foundations. All overlaps should be taped together to provide a continuous vapour barrier.

Vapour Controls for Concrete Decks

1. Because curing concrete releases considerable moisture that can compromise the performance

of a ***roof system***, a vapour control layer installed on new concrete ***decks*** (28 days or older) must be selected to prevent condensation inside the ***roof system***.

2. A membrane with a permeability of 0.01 perms (Class I) is recommended for applications on concrete substrates, but the selection of vapour control materials is nevertheless the responsibility of the *Design Authority*.

Continuity and Support

1. The Contractor must
    1) ensure that air and vapour ***control layers*** in the ***roof system*** field, and at perimeters, are installed to provide at least 101.6 mm (4") of overlap, for ***continuity*** of matching layers in adjacent assemblies,
    2) ensure that air and vapour control layers are sealed to penetrations and drains that pass through or enter the ***roof assembly***, and
    3) seal all control layers to matching layers in adjacent assemblies (i.e., walls), when a roof is replaced.
2. Installation of all air and vapour control materials must be smooth and uniform, without wrinkles or fish-mouths, and must also conform to the manufacturer's published requirements and the ***Design Authority's*** design details.
3. All air and vapour control membrane side and end laps must be fully supported, in the field and at transitions with curbs, ***parapets***, ***walls***, and penetrations.
4. When self-adhered membranes are applied directly to a steel supporting ***deck***,
    1) membranes should be oriented parallel to the direction of ***deck*** flutes, and
    2) membrane laps and changes in plane must be supported by deck flutes, or by flat metal supports secured to the deck to span gaps.
5. When metal supports are used to span gaps between steel deck flutes, they must be
    1) fabricated from pre-finished steel with a thickness no less than 24-gauge, and
    2) secured to the ***deck*** with no fewer than two (2) compatible screw fasteners per flute (See: **Figure 6.3.2.1.-A** and **Figure 6.3.2.1.-B**).
6. *Roof drains*, *overflow drains*, *scupper drains*, and penetrations must be detailed where they intersect an air, vapour, or water ***control layer***, to provide ***continuity***.

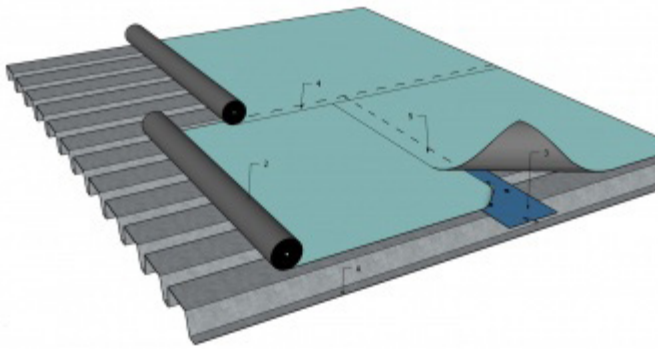


Figure 6.3.2.1.-A Air, Vapour Controls Over Steel Deck with Metal Support (Click to expand illustration)

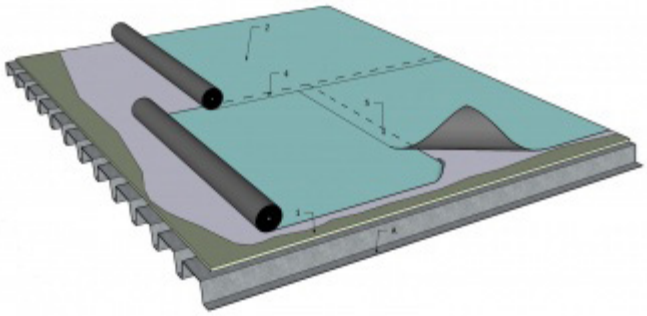


Figure 6.3.2.1.-B Air, Vapour Controls Over Steel Deck with Deck Overlay Panel (Click to expand illustration)

Torch-applied Materials

1. The application of materials to an unprotected combustible material, using a torch, is strictly prohibited.
2. All combustible materials MUST be protected from open flame by an acceptable separation or overlay material; this includes, without limitation, combustible materials on ***decks***, ***walls***, blocking, and canted edges, and that are hidden or obscured within voids, cracks, or orifices.
3. When a torch-applied membrane is specified over combustible materials, all joints between overlay panels, and at roof-wall transitions, must be sealed with the primary membrane manufacturer's approved self-adhered membrane or tapes.

Where torch-applied membranes are not permitted or desirable, the installation of bituminous air and vapour control layers should align with the approaches described and required in the manufacturer's recommendations.

Securement on Slopes

1. Self-adhered membranes applied to slopes greater than 1:6 (2" in 12") should be additionally secured with mechanical fasteners in locations where slippage may occur, to counter-act material displacement resulting from temperatures that exceed the membrane's service temperature.

CGT (Goliath PVC) Warranties

- The manufacturer of the waterproofing membranes will provide a written document, issued in the name of the owner and valid for the designated period of years, which indicates that the manufacturer will repair any leaks in the membrane in order to restore the roofing system to a dry and waterproof condition, as long as faults in the manufacture or installation of one or more components lead to water infiltration.
- The warranty may cover the total repair cost during the warranty period. This warranty may also include post-work inspections and the issuance of reports to the owner indicating the condition of the sections of roof covered by the warranty.
- Following the completion of the roofing work and before issuing the certificate, as well as in the years of coverage under the warranty, the membrane manufacturer will carry out an inspection and make available a summary of the condition, as well as an inspection report on the building roof and sections covered by the warranty.
- The warranty may be transferable, at an additional cost, to subsequent purchasers of the building. The warranty certificate shall reflect these requirements.
- The membrane manufacturer will issue a written document in the owner's name, valid for the warranty period, stating that it will repair any leaks in the roofing membrane to restore the roofing system to a dry and watertight condition, to the extent that manufacturing or installation defects caused such water infiltration.
- The warranty must cover the total cost of repair(s) during the entire warranty period. The warranty may be transferable, at an extra cost, to subsequent building owners. The warranty certificate must reflect these requirements.

CGT (Goliath PVC) warranties available

	Goliath PVC **Limited Membrane Only Warranty**	Goliath PVC Limited **Material and Labour Warranty**	Goliath PVC **Total Roofing System Warranty**	Goliath PVC **Total Roofing System NDL Warranty**	**Notes**
Roofing Type	PVC 50, 60, 80 mil	PVC 50, 60, 80 mil	PVC 60, 80 mil	PVC 60, 80 mil	
Material Coverage	Yes	Yes	Yes	Yes	
Workmanship Coverage	No	No	Yes	Yes	
Maximum Coverage Period	10 Years 15 Years 20 Years[1]	10 Years 15 Years 20 Years	10 Years 15 Years 20 Years 25 Years 30 Years	10 Years 15 Years 20 Years 25 Years 30 Years	[1]20 years for 60 and 80 Mil only
Warranty Cost/ Sq Ft	No Cost No Cost No Cost	$ 0.02 $ 0.04 $ 0.06	$ 0.05 $ 0.08 $ 0.10 $ 0.14 $ 0.17	$ 0.08 $ 0.10 $ 0.14 $ 0.17 $ 0.20	
Who can offer this Warranty	Building Owner/with proof of purchase	Only contractors certified by CGT	Only contractors certified by CGT	Only contractors certified by CGT	
Covers entire Goliath roofing system	No	No	Yes	Yes	
Unlimited dollar amount for covered repairs	No	No	No[1]	Yes	[1] Coverage limited to original $ value of the contract
Includes replacement material	Yes[1]	Yes[2]	Yes 100%	Yes 100%	[1] membrane only [2] membrane plus labour to install membrane
Includes cost of labour to correct leak	No	Yes[1]	Yes	Yes	Only includes labour to replace defective membrane
Is Warranty transferable to next owner	No	Yes	Yes	Yes	Administration cost is applicable

Quality Assurance and Environmental Management

Contractor Qualifications

Roofing contractors and sub-contractors must, when tendering and during works, possess a roofing contractor operating license.

[Roofing contractors and sub-contractors must also be registered with CGT's Approved Installer program and provide the architect with a written certificate issued by CGT to this effect before beginning any roofing work.

Materials Storage And Delivery

All materials will be delivered and stored in their original packaging, in conformance with the requirements described in the manufacturer's technical documentation.

At all times, materials will be adequately protected and stored in a dry and properly ventilated area, away from any welding flame or spark, and sheltered from the elements and any harmful substances.

Store adhesives and solvent-based mastics at a minimum of 5 °C (41 °F).

Avoid gathering construction materials on the roof, which may affect the structural integrity by imposing loads exceeding what is admissible.

Fire Protection

Prior to the start of work, conduct a site inspection to ensure its safety in order to minimize fire risks and hazards.

Respect safety measures recommended by the related local authorities.

Throughout roofing installation, maintain a clean site. Respect all safety measures described in technical data sheets of sealants.

On-Site General Material Storage Recommendations:

Proper job site storage is essential for maintaining the integrity and warranty of PVC roofing materials. Key recommendations include

keeping all materials clean, dry, elevated off the ground, and protected from direct sunlight and physical damage. Always follow the specific instructions from the manufacturer for each product component.

Chart of Job Site Storage Recommendations for PVC Roofing Systems

Material Type	Short-Term Storage (Days/ Weeks)	Long-Term Storage (Weeks/Months)	Key Precautions/ Notes
PVC Membrane Rolls	Store on a flat, elevated surface (e.g., pallets) to prevent point loading and core damage. Protect from moisture and direct sunlight using light-colored, breathable, waterproof tarpaulins.	Store indoors in a dry, well-ventilated warehouse if possible. If outdoor storage is unavoidable, cover securely with a breathable, waterproof tarp, ensuring adequate airflow.	Store rolls on end, on a clean surface, to keep ends free of foreign matter. Do not store with dissimilar metals to avoid chemical reactions. Allow the membrane to relax for 30–60 minutes before installation, especially in cold weather.
Insulation Boards	Store bundles flat and elevated above the ground (on pallets or included feet). Use the original, undamaged weather-tight packaging for temporary protection.	Slit the original plastic wrap prior to covering with a breathable tarpaulin to allow for venting and prevent moisture accumulation. For storage over a month, store indoors in a dry, well-ventilated warehouse.	Protect from physical damage, moisture, and sunlight. Do not store in or around standing water. Only install the amount of insulation that can be covered with membrane on the same day.
Liquid Materials (Adhesives, Primers, Coatings)	Store in original, unopened containers in a clean, dry, protected location. Protect from direct sunlight and extreme temperatures.	Maintain storage within the manufacturer's specified temperature range, typically between 60°F and 80°F (15.5°C and 26.6°C). A heated enclosure may be necessary in cold weather.	Keep lids tightly sealed to prevent the escape of vapors and maintain product integrity. Ensure materials are restored to the proper application temperature before use. Check labels for shelf life and expiration dates.

Accessories & Tools	Store in an organized, covered area to prevent loss, damage, and exposure to elements.	Store in a secure, dry place, ideally indoors.	Keep sharp objects in a bucket or tool belt to prevent punctures to the membrane. Use protective mats or bases when performing work or placing heavy equipment on the finished roof surface.

General Guidelines

- **Elevate Materials:** Never store materials directly on the ground (dirt, grass, or concrete). Use raised platforms or pallets to ensure air circulation and prevent moisture absorption.
- **Protect from Weather:** Cover all outdoor-stored materials with a secured, light-colored, waterproof, and breathable tarp to protect against rain, snow, and UV exposure.
- **Organize and Secure:** Label storage areas for easy identification and rotate stock using a first-in, first-out (FIFO) system. Secure materials to prevent wind displacement.
- **Minimize On-Site Time:** Coordinate deliveries with the installation schedule to minimize the duration of on-site storage.
- **Inspect Deliveries:** Inspect all materials upon delivery and note any damage on the bill of lading. Remove and replace any damaged or wet materials immediately.
- **Follow Manufacturer Instructions:** Always refer to the specific manufacturer's written instructions, as guidelines can vary by product and climate.
- Job site storage for **PVC roofing systems** requires keeping all components dry, elevated, and protected from physical damage and extreme weather. Adhesives and liquid materials have specific temperature requirements.
- Here is a summary of storage recommendations for various PVC roofing system components:

Pima (Polyiso Insulation Manufacturer's Association) Tech Bulletin # 109 On-Site Storage

Storage

Polyiso insulation is typically shipped protected by a plastic wrap, plastic bag or both. This factory packaging is intended for handling the polyiso in the manufacturing plant and during transit. The factory packaging should not be relied upon as protection at jobsites or other outdoor storage locations unless specified otherwise by the manufacturer.

Note: Polyiso insulation is fully cured and fit for installation upon delivery. No additional storage time is required.

Material delivery should be carefully coordinated with the roof application schedule to minimize outdoor storage. When short-term outdoor storage is necessary, whether at grade or on the roof deck, the following precautions should be observed unless specified otherwise by the manufacturer:

- Bundles should be stored flat above the ground (or other surface) utilizing included feet or on raised pallets. If possible, the bundles should be placed on a finished surface such as gravel, pavement, or concrete rather than on dirt or grass.
- Cover the package and pallet with a breathable tarpaulin and secure cover to prevent wind displacement.

Handling

Exercise care during handling of polyiso insulation to prevent breaking or crushing of the square edges and surfaces. Remove the polyiso bundles from trucks with proper equipment. Other means of mishandling, such as pushing pallets off the edge of the truck or “rolling” the pallet across the roof deck, must be avoided.

Product Application

Polyiso should always be installed on dry, clean roof decks in dry conditions. Follow the manufacturer’s recommendations regarding product application to ensure performance to the intended design life of the roofing system. Apply only as much polyiso roof insulation as can be covered by completed roofing the same day.

Construction Traffic

Avoid excessive traffic during roof construction or on a completed roof surface. Although polyiso has been designed to withstand limited foot traffic, protection from damage by construction traffic and/or abuse is extremely

important. Roof surface protection such as plywood should be used in areas where storage and staging are planned and heavy or repeated traffic is anticipated during or after installation.

Some designers and membrane manufacturers specify the use of cover boards as a means of protecting the insulation. If specified, installers should ensure that the cover board used is compatible with all components of the roofing system, acceptable to the membrane manufacturer, and meets specified fire, wind and other code requirements.

Final Thoughts

Polyiso roof insulation, like other roofing materials, requires a proper understanding of storage, handling and application practices in order to deliver a properly constructed roof system

Atlas Roof Insulation Requirements:

The document provides installation guidelines and recommendations for ACFoam® polyiso roof insulation, including fastening methods, vapor/air retarder considerations, and liability limitations.

General Installation Guidelines for ACFoam® Products

ACFoam® products require specific installation conditions to ensure effectiveness and prevent damage.

- Roof deck must be firm, well-attached, even, clean, and dry.
- Proper attachment is crucial to avoid roof failures; Atlas is not liable for improper installation.
- ACFoam® should be kept dry before, during, and after installation.
- Use plywood for protection in high-traffic areas during installation.
- Follow Atlas Technical Bulletin TB-5 for additional guidance.

Multi-Layer Installation Recommendations

Using multiple layers of insulation can enhance thermal performance and reduce condensation. Recommended for insulation thickness greater than 2.7 inches.

- Stagger joints in each layer to avoid continuous vertical joints.
- Improves insulation performance by eliminating thermal bridges.

Mechanical Attachment Guidelines

Mechanical fastening is the preferred method for attaching ACFoam® to various deck types.

- General fastening frequency and spacing are provided in the ACFoam® Fastening Pattern Guide.
- Consult FM Loss Prevention Data Sheet 1-29 for perimeter and corner considerations.
- Do not adhere ACFoam® directly to lightweight insulating concrete decks.

Adhesive Attachment Instructions

Adhesive methods are recommended for attaching ACFoam® to structural concrete decks.

- Priming is necessary when using hot bitumen; apply at 50°F below EVT.
- Use 18 to 30 pounds of bitumen per square for proper attachment.
- Roll or weigh down insulation to ensure adhesive contact.

Vapor/Air Retarders Usage

Vapor/air retarders are essential to control moisture migration in roofing assemblies.

- Necessary calculations based on humidity, temperature, and design temperature must be performed.
- Construction-generated moisture can damage insulation; Atlas is not liable for such damage.
- Consult NRCA Roofing Manual for vapor retarder recommendations.

Storage Recommendations for ACFoam®

Proper storage is crucial to maintain the integrity of ACFoam® products.

- Stack insulation on pallets at least three inches above ground and cover with weatherproof material.
- Remove temporary packaging to prevent condensation accumulation.
- Wet or damaged insulation must be replaced with solid, dry insulation.

Limitations of Liability for ACFoam® Products

Atlas Roofing Corporation limits its liability regarding ACFoam® products.

- No additional warranties beyond those stated, limited warranty on LTTR-value available upon request.
- Seller is not liable for incidental or consequential damages related to installation or replacement.
- Remedies are limited to repayment or resupply of equivalent product.

Fastening Patterns for Various Systems

Specific fastening patterns are provided for different roofing systems.

- Fastening patterns vary based on system type, such as built-up, modified bitumen, and single-ply systems.
- Minimum insulation thickness requirements are specified for each system type.
- Consult Factory Mutual Approval Guide for approved fasteners and plates.
- Refer to AC-FOAM Document: 201612 Atlas Roof Guide – Fastening Pattern-ATL-1650-V2.1 pdf

Expanded Polystyrene (EPS) Roof Insulation

Truefoam's EPS roof insulation is reliable, cost-effective and compatible with major roofing materials and systems.

TrueFoam has been producing quality EPS roof insulation for over 40 years. Expanded Polystyrene (EPS)

stands the test of time and EPS roof insulation is a proven performer in roofing applications. Field studies of EPS roof installations that are 20 to 25 years old and older show that EPS roofing insulation performs well in roof applications.

EPS roof insulation has no thermal drift and does not use blowing agents that diffuse out of the insulation. EPS roof insulation R-values remain stable over their entire life without loss of R-value.

TrueFoam EPS roof insulations are engineered to give you the greatest possible control for your roofing system application. From design and timelines to materials and costs, TrueFoam products have virtually unlimited design flexibility and can be easily customized. This gives our products the ability to be used for any industrial structure in a wide variety of applications and excellent for flat roof home remodel.

Green Energy Efficient Products

The advantages to using TrueFoam EPS roof insulations are:

- State-of-the-art insulation and energy efficiency
- Improves interior comfort and reduces high energy costs of keeping a building comfortable
- Longer term Thermal Resistance (stable R-value: no thermal drift like XPS or ISO)
- Unlimited fabrication available: tapered and flat
- Variety of density, thickness and size
- Optimum design flexibility for the architect and saves the roofer/applicator time and labour
- Quick production time: plants in Atlantic Canada mean shorter shipping distances combined with a lightweight and easy-to-handle product will simplify your operations and reduce labour costs
- Cost-effective
- EPS is unaffected by moisture. Exposure to water, or water vapor, does not cause swelling
- EPS withstands the rigors of temperature cycling, assuring long-term performance
- EPS will not decompose and will not support mold or mildew growth
- Meets ASTM C578
- Building code recognized
- FM approved
- PVC Single-Ply compatible with a separation layer of Polyiso insulation, gypsum board, or a separation layer.
- Contains no CFC, HCFC or HFC blowing agents
- EPS is inert and stable and does not produce methane gas or contaminating leachates
- EPS roof insulation is recyclable and environmentally friendly

Roof Drainage

TrueFoam Tapered Roof Insulation was developed more than 30 years ago with a dual purpose: to drain and insulate dead-level roof decks. Lightweight TrueFoam EPS is a value-engineered system that has been proven in new and re-roof applications.

The roofing industry accepts that membrane performance and roof drainage go hand-in-hand. Membrane manufacturers will not guarantee the performance of their system without positive drainage and building codes mandate this.

Simply stated, all single-ply, modified bitumen and BUR roofing membranes are less likely to leak and fail if water is not standing on top of them. Potential water damage to the building and its contents is thus eliminated. Tapered EPS provides the drainage and insulation necessary under all commercial roofing systems. It has been used successfully in millions of square feet of single-ply, modified bitumen and built-up roofing. TrueFoam Tapered Roof Insulation is a great solution for low-slope roofing.

Pre-engineered, factory cut, cricket systems provide effective and economical drainage on structurally sloped roof decks.

Low Slope Roof Insulation

TrueFoam Flat Roof Insulation provides the high, long-term R-value of EPS. Suitable for use with all roofing membrane materials, EPS roof insulation is compatible with loose-laid and attached single-ply membranes, conventional built-up roofing or modified bitumen systems.

TrueFoam Flat Roof Insulation is unfaced EPS and is suitable for use with loosely laid single-ply membranes. It is also used with conventional BUR and mechanically or adhesively attached single-ply and modified bitumen membranes when field-applied coverboards are use. Boards are standard 4’ x 4’ and 4’ x 8’ sizes.

Extruded Polystyrene Roof Insulation (XPS)

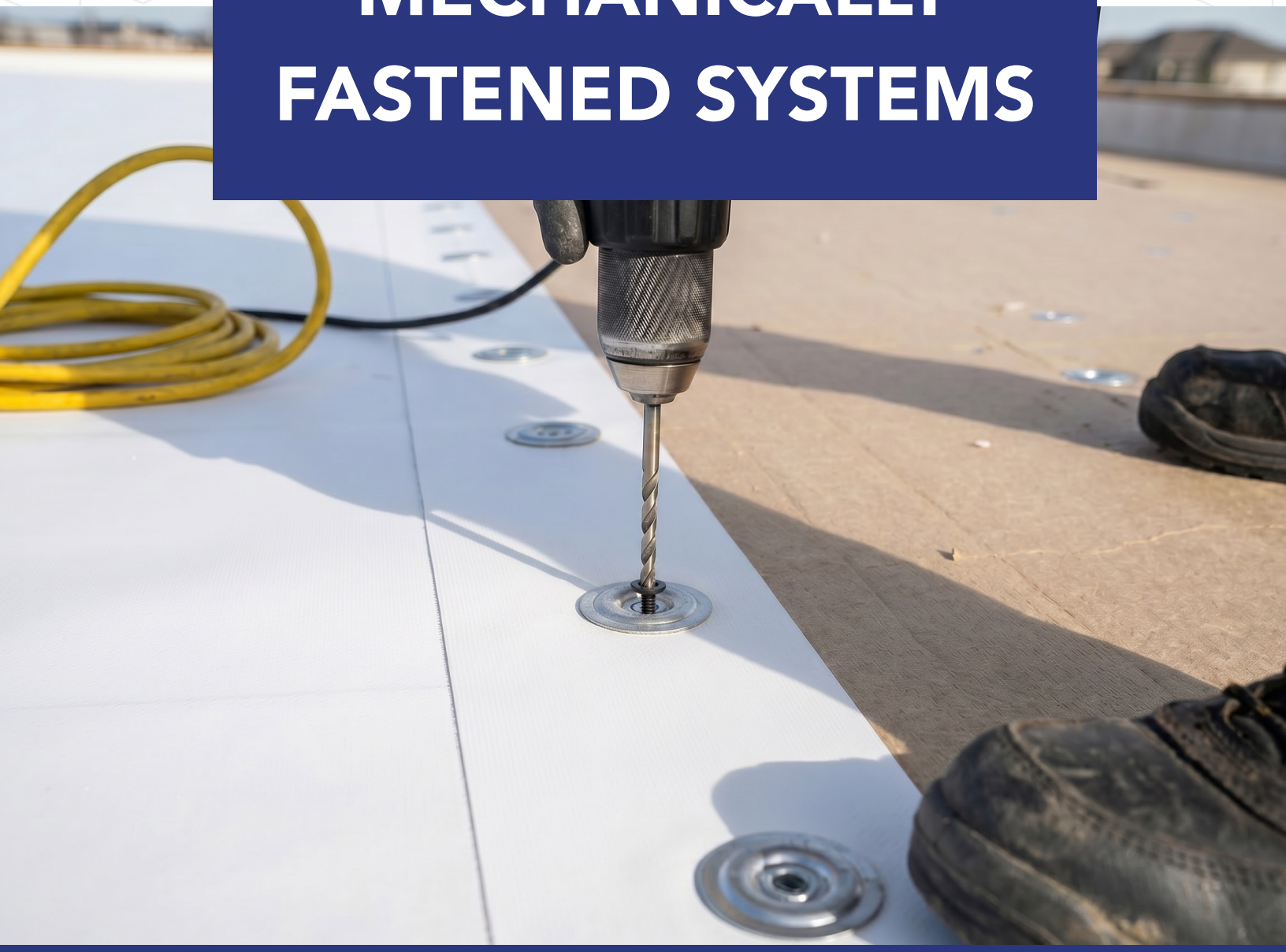
New FOAMULAR® NGX™ (Next Generation Extruded) Insulation Reduces Embodied Carbon and Supports Sustainable, High-Performing Commercial Buildings Innovation meets or exceeds new regulations in Canada and several U.S. states Jan. 13, 2021, Canada and several U.S. states enacted stringent new environmental regulations to address concerns about high-Global Warming Potential (GWP) hydrofluorocarbon (HFC) blowing agents.

- Rigid insulation board for protected membrane roofing applications. High density continuous insulation for use on commercial flat roof assemblies. This insulation product requires a separation

layer between the insulation and PVC roofing membrane.

- With this change, sustainability and smart material performance are coming together in FOAMULAR® NGX™ (Next Generation Extruded) insulation. Developed by Owens Corning, the latest innovation in extruded polystyrene (XPS) insulation contains a proprietary blowing agent that completely eliminates HFC 134a. FOAMULAR® NGX™ delivers a 90% reduction in blowing agent GWP compared to legacy FOAMULAR® insulation and is optimized to demonstrate a greater than 80% reduction in embodied carbon.
- Sustainability and Performance The efforts of Owens Corning to achieve a higher level of sustainability in rigid foam building materials predate this latest regulatory moment. More than six years of research and development and the evaluation of over 100 blowing agent formulations support the introduction of FOAMULAR® NGX™. In developing the new insulation, research and development teams sought to reduce the blowing agent's GWP without sacrificing the material's many performance attributes, including high R-value per inch, a wide range of compressive strengths, superior moisture-resistance and durability. Manufactured with patented Hydrovac® technology, FOAMULAR® NGX™ is highly resistant to moisture and retains its high R-value even after prolonged exposure to moisture and freeze/thaw cycling.
- FOAMULAR® NGX™ is available in many compressive strengths, up to 100 psi, and is well suited to applications across the enclosure, from load-bearing vegetative roofs and foundational supports to wall assemblies. And as a further measure of confidence, FOAMULAR® NGX™ is the only XPS on the market with a limited lifetime warranty guaranteeing a minimum 90% of R-value for the life of the product.
- Environmental Product Declaration Qualifies for Option 2 Optimization Credit in LEED 4.1 The sustainability profile of FOAMULAR® NGX™ is validated by a third-party verified Environmental Product Declaration and Optimization Report.
- A greater than 80% reduction in GWP qualifies FOAMULAR® NGX™ as 1.5 products toward LEED 4.1 points for Options 1 and 2 under the Materials and Resources: Environmental Product Declaration (EPD) —a feat achieved by very few building products.

MECHANICALLY FASTENED SYSTEMS



Three Basic Steps to Follow When Installing A PVC Roof System

Laying The Membrane

Unroll the sheet and allow a minimum of 30 minutes for the membrane to relax and lie flat. Draw tight to remove folds or wrinkles. Use the largest pieces that are workable.

Unroll the next roll in a similar manner. The new roll typically laps the previous roll a minimum of 75 mm (3 in). Manufacturer requirements shall be consulted for material specific lapping requirements.

Welding the Seams

While welding seams, temporary weight may be required to hold the membrane in place, or alternatively the seam may be tack welded every 900 mm (36 in). Continue to lay remaining rows in same manner.

Install Membrane Flashings (Stripping)

Install perimeter fastening (metal plates and fasteners) around perimeters and openings. Fastening bars generally consist of 25 mm (1 in) wide metal plates with pre-drilled holes for fasteners.

Goliath Mechanically Fastened Roofing Installation Procedures:

General Design Considerations

It is the responsibility of the building owner or his/her designated representative to verify structural load limitation. In addition, a core cut may be taken to verify weight of existing components when the roofing system is to be specified on an existing facility.

On new construction projects, especially in cold climate regions, moisture generated due to the construction process could adversely impact various components within the roofing assembly if not addressed. [Refer to Design Reference DR-01 “Construction Generated

CAUTION: If left unaddressed, collected moisture could weaken insulation boards and facers resulting in a blow-off or increase the probability of mold growth.

Vapor Retarders

- CGT does not require a vapor retarder for the protection of the membrane; however, it should be considered by the specifier for the protection of the roofing assembly (i.e. primarily insulation, underlayment and adhesives). The following criteria should be considered by the specifier:
- Use of a vapor retarder to protect insulation and reduce moisture accumulation within an insulated roofing assembly, should be investigated by the specifier.
- In the generally temperate climate of Canada and the United States, during the winter months, water vapor flows upward from a heated, more humid interior toward a colder, drier exterior. Vapor retarders are more commonly required in northern climates than in southern regions, where downward vapor pressure may be expected and the roofing membrane itself becomes the vapor retarder.

Products

The components of this roofing system are to be products of CGT or accepted by CGT as compatible. The installation, performance or integrity of products by others, when selected by the specifier and accepted by CGT, is not the responsibility of CGT and is expressly disclaimed by the CGT Warranty.

PVC Roofing Membrane

Goliath 50-mil (90’ long), 60-mil (90’ long) or 80-mil (60’ long) reinforced Polyvinyl Chloride (PVC) membrane is used for this system. Field membrane sheets are 6’ or 72” wide. Perimeter sheets are 3’ or 36” wide. For physical properties of the membrane, refer to Goliath PVC Technical Data Sheets.

Related Materials

Goliath Non-Reinforced Flashing, Water Cut-Off Mastic, PVC Membrane Cleaner, Heat Weldable Walkway Pads, Pre-Molded Inside/Outside Corners, Pipe Flashings, 1 Part Pourable Penetration Sealer and Sealant Pockets.

Execution

General

When feasible, begin the application at the highest point of the highest roof level and work to the lowest point to prevent moisture infiltration and to minimize construction traffic on completed sections. This will include completion of all flashings, terminations and daily seals.

Roof Deck Criteria

1. Proper substrate shall be provided by the building owner. The structure should be sufficient to withstand normal construction loads and live loads.
2. Defects in the roof deck must be reported and documented to the specifier, general contractor and building owner for assessment. The CGT Authorized Applicator shall not proceed with installation unless defects are corrected.
3. Refer to CGT Technical Manual for acceptable decks and the applicable CGT Fasteners (when mechanical attachment of insulation is specified).

Substrate Preparation

1. On all retrofit-recover projects, cut and remove wet insulation, as identified by specifier, and fill all voids with new insulation so it is relatively flush with existing surface.
2. For all projects, substrate must be even without noticeable high spots or depressions, and must be free of accumulated water, ice or snow.
3. Clear the substrate of debris and foreign material. PVC Incompatible products including bitumen-based roof cement EPS or XEPS insulation must be removed or concealed by using a separation membrane or coverboard.

Installation

Refer to the applicable Safety Data Sheets and Technical Data Bulletins for applicable cautions and warnings.

Insulation Attachment

1. CGT approve Low-Rise Foam Adhesive may be specified for insulation securement in full spray or beads with spacing as outlined in the CGT Technical Manual.
2. CGT's approved SFS fasteners may be used, when specified, to secure CGT's approved Insulation at the specified density outlined in the CGT's Technical Manual.

Membrane Placement, Attachment and Heat Welding

1. A minimum of two 3' or 36" wide perimeter sheets shall be installed at edges of each roof level and 6' or 72" wide membrane shall be installed in the field of the roof.
2. Membrane sheets shall be mechanically fastened with the appropriate CGT Fastener/Fastening Plate spaced 6"or 12" on center, depending on project criteria, within the membrane splice. Refer to the PVC Specification for required number of perimeter membrane sheets and fastener spacing.
3. Overlap adjacent membrane sheets approximately 5-1/2" at those locations where Fastening Plates are located (along length of the membrane) and a minimum of 3" at end roll sections (width of the membrane).
4. Heat weld the membrane sheets a minimum of 1-1/2" with an Automatic Heat Welding Machine.

Additional Membrane Securement

The membrane must be secured at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any angle change which exceeds 2" in one horizontal foot and at all other penetrations in accordance with CGT's Details published with CGT's Specifications.

Membrane Flashing

1. Use continuous deck membrane where feasible as outlined in appropriate CGT Detail.
2. Non-Fleece membrane shall be limited to inside and outside corners, field fabricated pipe seals, scuppers and Sealant Pockets where the use of pre-molded accessories are not practical.
3. On vertical surfaces, such as walls, curbs and pipes, Bonding Adhesive is not required when the flashing height is 12" or less and the membrane is terminated under a metal counterflashing (nailed). When a coping or termination bar is used for vertical terminations, Bonding Adhesive may be eliminated for flashing heights 18" or less.
4. When using the Overlayment Strip to overlay metal edging flanges or fasteners/plates, CGT (Goliath) PVC and Membrane Cleaner is used to clean surfaces as needed.
5. Terminate the flashing in accordance with the appropriate CGT Details above anticipated slush line.

Note: Fleece backing must be removed from the back of the membrane prior to completing

compression seal terminations, so Water Cut-Off Mastic is applied directly to the membrane surface. Apply heat to the fleece material and scrape to fully remove.

Thermoplastic membranes can be installed in either a conventional (where roofing membrane is installed on top of insulation) or protected membrane roof assembly (where roofing membrane is installed below insulation).

Thermoplastic membranes require caution during their installation. Careful attention should be taken to avoid damage or puncture of the membrane during application and correct welding of the seams is also critical to prevent water leakage.

Mechanically fastened systems are often used on flexible decks which require lightweight design, where possible movement is expected to occur or on projects that have specific wind or fire resistance requirements. Mechanically fastened systems can be used on decks with slopes ranging from flat to nearly vertical. However, because it is important that single-ply membranes drain properly. It is recommended that the roof have a minimum slope of 1:50 (2%).

Unroll the sheet and allow a minimum of 30 minutes for the membrane to relax and lie flat. Draw tight to remove folds or wrinkles. Use the largest pieces that are workable.

Unroll the next roll in a similar manner. The new roll typically laps the previous roll a minimum of 140 mm (5.5 in**). CGT's** side lap requirements shall be consulted for material specific lapping requirements.

While welding seams, temporary weight may be required to hold the membrane in place, or alternatively the seam may be tack welded every 900 mm (36 in). Continue to lay remaining rows in same manner.

1. The membrane rolls are set to run true with the laps set as required to accommodate the installation of any in-seam fasteners as well as the seam sealing components. The sheet layout is typically provided in the membrane system manufacturers shop drawings and typically requires the sheets to be installed perpendicular to the roof deck so that the in-seam fasteners will spread wind uplift loads evenly to the deck and structure.
2. Place metal plates in the seams in strict accordance with the manufacturer's requirements. Fasten the metal plates into the deck with approved fasteners. The spacing and fastening of the metal plates will depend on the membrane manufacturer, local wind pressures, and the shape and size of the roof. **Do not** deviate from the manufacturer's recommendations.
3. After screws and metal plates are installed in the field of the membrane (outside of the seams), a cover strip is installed over the discs on to the roof membrane extending past the edges of the discs a minimum of 75 mm (3 in) in all directions or as required by the membrane system manufacturer. Weld the cover strip to the surface of the roof membrane.
4. Install perimeter fastening bars or metal plates around perimeters and openings as per manufacturer requirements. Fastening bars normally consist of 25 mm (1 in) wide metal or metal plates

with pre-drilled holes for fasteners.

5. Install strip flashing.

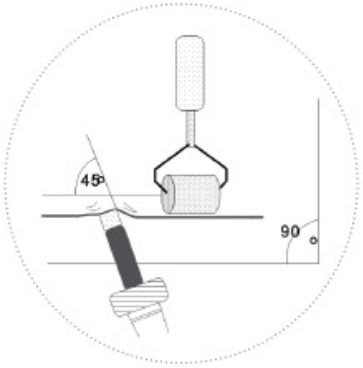
Welding Seams

Only skilled workers, trained according to manufacturer's specifications, are to weld the seams and laps. Laps are generally hand welded at flashing, terminations, or in small areas and machine welded where possible in the field of the roof.

Care must be taken with the welding process. If there is not sufficient heat to melt the membrane, a good bond will not occur. Too much heat will damage the membrane.

Hand Welding

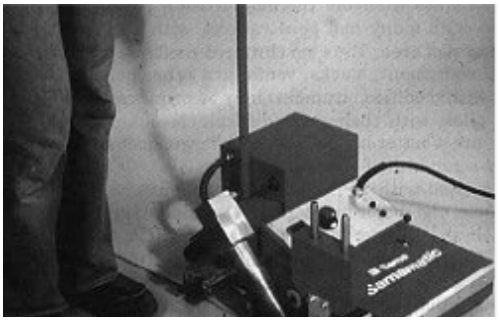
Hand welding is performed in three stages. Before the hand welder is turned on, fit the welder with a 38 mm (1 1/2 in) wide nozzle for straight joints and 19 mm (3/4 in) nozzle for corner joints. Prior to starting, set the hand welder at the highest heat setting for at least one minute to preheat the nozzle. Adjust the heat output and complete test welds to confirm that the welder heat setting is appropriate for the material being welded and current work conditions.

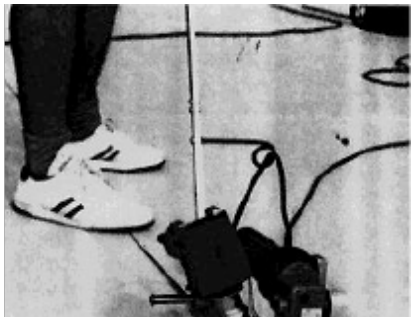


1. Weld the back-edge lap with a thin continuous weld bead to prevent hot air loss in the final welding process. Insert the nozzle between the lapped sheets to heat the area where the outside edge of the bottom sheet meets the top layer and press into contact with a hand roller.
2. Insert the welder nozzle between the laps at a 45º angle. The correct temperature for welding is reached when the material begins to flow. At this point slowly slide the welder nozzle along the joint and at the same time use a hand roller to lightly press the two membranes together. The hand roller must be used at a 90º angle to the nozzle.

Automatic Welding (Machine welded)

Automatic welders are used in a similar manner to hand welders. The welding speed of an automatic welding machine is generally higher than that of a hand welder.





During the welding, look for these signs of a good weld which may vary depending on the membrane being welded. For PVC membranes, typical signs of a good weld include:

- A shiny membrane surface.
- Smoke development during welding.
- A continuous bead of melted membrane material from the joint.

Inspection of Seams

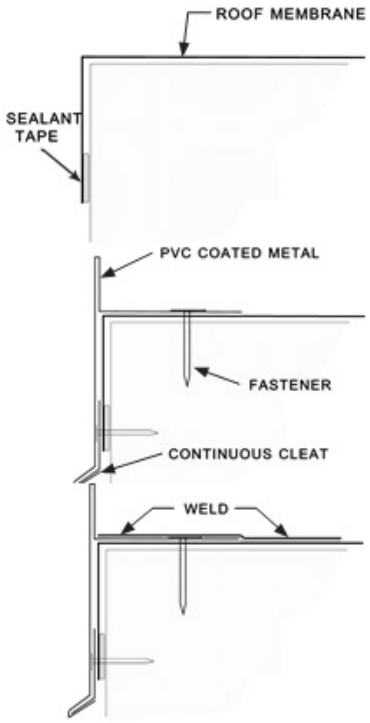
After cooling, all weld joints must be inspected for continuous bonding. A simple way of doing this is to slide a blunt nosed trowel or probe along the seam. If the trowel or probe lifts the lap, the area must be rewelded.

Flashing Installation

The materials and methods used to install the flashing (or stripping) will vary depending on the specific application. Although there are many possible applications, we will describe the three basic types of membrane flashing.

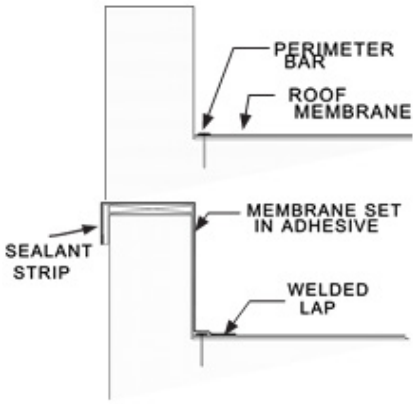
Drip Edge Flashing

This method is used with a typical gravel stop drip edge. In this method, the membrane is hot-air welded to the metal flashing. Whenever a PVC membrane is welded to metal flashing, metal coated with the same PVC coated metal from the same manufacturer must be used.



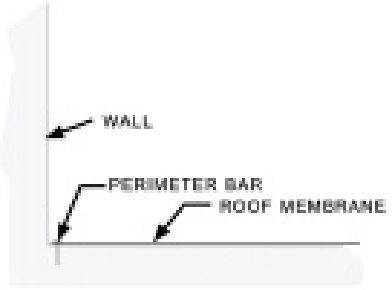
1. Before installing the flashing, apply a strip of sealant tape or compatible weather stripping at the outside perimeter just at the bottom of the fascia.
2. Fit the membrane into position making sure that it exceeds the roof edge for a distance of the width of the outside fascia. Fold membrane over the edge and press firmly into the sealing strip.
3. Place the PVC coated metal flashing along the edge of the perimeter. Fasten the metal flashing along the flange 150 mm (6 in) on center.
4. Butt and cover or otherwise treat and seal end joints and miters in accordance with the membrane system manufacturers' written instructions.
5. Cut strips of membrane flashing wide enough to extend from the outside edge to a minimum of 75 mm (3 in) beyond the flange.
6. Weld the flashing strip on to the PVC coated metal flange and on to the roof membrane.

Parapet Wall

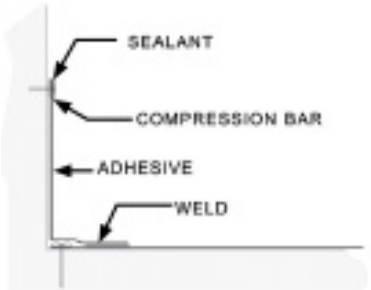


1. Cut and place the field membrane. The edge of the roof membrane should be flush with inside wall of the parapet.
2. Install the perimeter mechanical fastening system (bars or plates and fasteners) in accordance with the **CGT's** written instructions.
3. Cut strips of membrane flashing. Strips must be wide enough to be carried down the outside face of the parapet, over the top of the parapet, down inside wall and out on to the roof at least 75 mm (3 in) past the perimeter fastening system.
4. Install the sealing tape (weather stripping) continuously along the outside face of the parapet. The bottom edge of the sealing strip should be flush with the outside bottom edge of the membrane flashing.
5. Apply the adhesive to all surfaces to receive the membrane stripping. Take care not to get any glue on the lap area.
6. Firmly press the flashing membrane into the glued area as per **CGTs**' recommendations.
7. Weld the lap between the roof membrane and the flashing strip.

Walls



1. Cut, fit and position the field membrane. The edge of the roof membrane should be flush with the wall.
2. Install the perimeter mechanical fastening system (bars or plates and fasteners) in accordance with the **CGT's** written instructions.
3. Cut strips of membrane flashing. Strips must be wide enough to extend up the wall to the desired height and on to the roof at least 75 mm (3 in) beyond the fastening system.

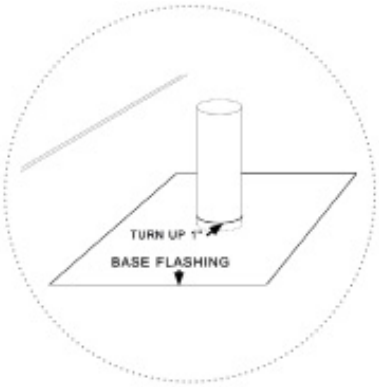


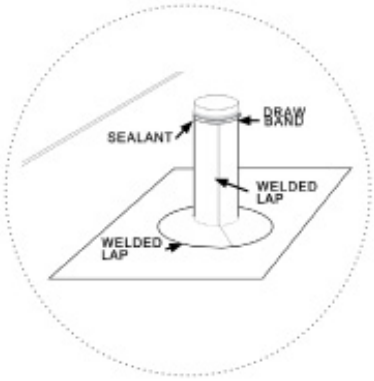
4. Apply the adhesive to the wall surface that will receive the membrane. Make sure no glue gets on to the lap area to be welded.
    1) Firmly press the flashing strips into the glued area as per **CGT's** recommendations.
    2) Apply bead of sealant between the top edge of the membrane and the wall.
    3) Weld the lap between the flashing strip and the roof membrane.
    4) Secure the top of the membrane to the wall with a metal plate and fastener or a termination (compression) bar fasted 300 mm (12 in) on center.

Vents and Pipes

Goliath PVC roofing systems include pre-molded flashing for vent pipes, conduits, etc. When installing these, follow the manufacturer's instructions carefully. Flashing for most roof penetrations can also be field fabricated.

When field flashing a vent pipe you will need two pieces of flashing membrane (typically glass fiber reinforced or unreinforced) cut to suit.





1. The first base flashing piece is cut to fit over the pipe and extend on to the roof a minimum of 150 mm (6 in) in all directions.
2. Cut the base flashing piece to correct size with an opening slightly smaller than the pipe being flashed. Carefully warm the membrane at the penetration and stretch to form a raised edge that will be a tight fit to the pipe.
3. Place the base flashing over the pipe and carefully push down on to the roof. The flashing should fit snugly over the pipe and when in place be turned up on the outside of the pipe about 12.7 to 25 mm (½ to 1 in).
4. Weld the outside perimeter lap of the flashing piece onto the roof.
5. Cut another piece of membrane equal to the height of the pipe, plus 50 mm (2 in) and wide enough to wrap completely around the pipe plus 75 mm (3 in).
6. Apply adhesive to the pipe and/or the pipe in accordance with the manufacturer's instructions. Turn up the bottom 25 mm (1 in) and wrap the membrane flashing tightly around the pipe pressing into the adhesive for a full bond. The bottom of the flashing is then gently warmed and stretched out onto the surface of the base flange piece approximately 25 mm (1 in).
7. Weld the flashing strip up the vertical seam and along the lap on to the base flashing piece.
8. Finish the top edge by installing a stainless-steel draw band, clamped tightly and caulked with an approved sealant as recommended by the membrane manufacturer.

PRODUCTS

Vapour Barrier Support Panels

1. Gypsum-Fibre Roof Board
2. Description: Dens Deck gypsum fiber incombustible roof board used as thermal barrier and membrane support panel.
3. In conformance with: ASTM E84 and ASTM C1177

Polyisocyanurate Foam Insulation

- Description: Closed cell polyisocyanurate foam flat insulation board laminated on both sides with a fiberglass yarn-reinforced organic paper.
  Specified product: **Atlas ACFoam - II or ACFoam - III**
- Description: Closed cell polyisocyanurate foam insulation board laminated on both sides with a coated glass fiber facer.
  Specified product: **Atlas ACFoam – II or ACFoam -III**

Tapered Polyisocyanurate Insulation

- Description: Closed cell polyisocyanurate foam insulation panel designed to create an increase in the percent (%) slope to the roof system.
  Specified product: **Atlas ACFoam II or ACFoam III**

Polyisocyanurate Cricket

- Description: Pre-cut closed cell polyisocyanurate foam insulation panel made to prevent water from stagnating on the roof.
  Specified product: [Pre-Cut Hinged Cricket] [Pre-Cut Cricket for Mechanical Units]
  Atlas Sure Slope-CKT

Sump Insulation Board for Drain Location

- Description: Sump insulation panel made of polyisocyanurate designed to facilitate proper drainage around drain.
  Specified product: **Atlas ACFoam Sure Slope DST**

Support Panel

- **Description: Closed cell high-density polyisocyanurate foam insulation board and support panel laminated on both sides with a coated glass fiber facer.**
  Specified product: **Atlas ACFoam HD Coverboard**

PVC Membranes for Field Surfaces

Polyester Reinforced Membranes

- Description: **GOLIATH PVC** is a polyester-reinforced, thermoplastic PVC waterproofing membrane for single-ply roofing systems. GOLIATH PVC is compounded high quality polyvinyl chloride resin, resilient plasticizers, stabilizers, pigments and other proprietary materials and manufactured in a variety of thicknesses.
- Thickness: 50mil (1.27mm), 60 mil (1.52mm) and 80 mil (2.0mm)
  Specified product: **Goliath PVC Membrane**

Fleece Backed Membranes

- Description: **GOLIATH PVC** is a polyester-reinforced, thermoplastic PVC waterproofing membrane for single-ply roofing systems. GOLIATH PVC is compounded high quality polyvinyl chloride resin, resilient plasticizers, stabilizers, pigments and other proprietary materials and manufactured in a variety of thicknesses. There is fleece backing installed on the underside of the PVC membrane.
- Thickness: 115 mil (2.93mm), 135 mil (3.43mm)
  Specified product: **Goliath Fleece Back PVC Membrane**

PVC Membrane for Perimeter, Flashing and Parapet Surfaces Complementary Waterproofing Products

Flashing Membrane

- Description: **GOLIATH PVC** is a polyester-reinforced, thermoplastic PVC waterproofing membrane for single-ply roofing systems. **GOLIATH PVC** is compounded high quality polyvinyl chloride resin, resilient plasticizers, stabilizers, pigments and other proprietary materials and manufactured in a variety of thicknesses.
- Thickness: 1.2mm (50mil), 1.5mm (60mil) and 2.0mm (80mil)
  Specified product: **Goliath PVC Membrane**

Adhesives

Two Part Low-Rise Foam Adhesive

Millennium PG-1 EF ECO is a two-component, low-rise, solvent-free, polyurethane foamable adhesive that contains no high Global Warming Potential (GWP) propellants. Application is quick, easy, sets in minutes and is designed for use as an adhesive for bonding approved roof insulations to a building's structural roof deck, base sheets, other insulation board stock and smooth or gravel built-up asphaltic roof surfaces. It can also be used for fleeceback membrane installations. Learn more about how to get started with PG-1 EF ECO.

Specified product: **Millennium PG-1 EF ECO by HB Fuller**

Insulation Adhesive

- Description: Two-part urethane low rise foam Adhesive, quick-setting, low-expansion foam urethane adhesive that can be applied at any temperature.
  Specified product: **One Step Foamable Adhesive by HB Fuller**

PVC Membrane Adhesive

- Description: Roller-applied, solvent-based contact adhesive used to adhere bare-backed PVC roofing membranes to horizontal and vertical surfaces.
  Specified product: **Millennium KEE/PVC Single Ply Bonding Adhesive by H. B. Fuller**
- Description: Spray-applied, organic solvent-based adhesive, made with synthetic polymer, designed for bonding bare-backed PVC membranes on horizontal and vertical applications.
  Specified product: **Millennium Sprayable PVC Single-Ply Bonding Adhesive**

PVC Membrane and Insulation Adhesive

- Description: Low pressure, two-component spray elastomeric polyurethane foam adhesive for adhering heavy fleece backed membranes as well as insulation and support panels.
  Specified product: **Millennium PG-1 EF ECO2 by H. B. Fuller**

SFS Fasteners & Plates

Note: Mechanically fastened PVC Membranes require that the insulation boards be preliminary fastened to the roof deck. Coordinate the density of fasteners and plates based on the CSA a123.21 publications. Fasteners by SFS.

Description: # 12 Phillips Head, Dekfast DF-#12-PH3

- For insulation attachment to wood and steel roof decks
- #3 Phillips drive
- Drill point design prevents fastener walking
- 13 threads per inch
- e-coat

Description: # 12 Purlin Dekfast DF-#12-PC-SQ3

- For retrofit roofing systems where heavy gauge purlin material must be penetrated
- #3 Square Drive
- Pancake head
- 24 threads per inch
- Up to 1/4” purlin steel
- e-coat

Description: # 14-13 Phillips Head, Dekfast DF-#14PH3

- For insulation and membrane attachment to wood, steel and structural concrete roof decks
- #3 Phillips drive
- Reduced drill point provides for ultimate pull-out values by producing a minimum opening. Thread engagement is superior as compared to standard drill points.
- 13 threads per inch
- e-coat

Description: # 14 Insulation Panel Fastener, Dekfast IPF-#14-PC-SQ3

- For use in vented and/or composite nailboard applications
- #3 Square Drive
- Flat profile head for flush engagement to the nailboard
- 5/8” oversized head reduces fastener patterns
- No plates necessary

Description: #15 Phillips Head Dekfast DF-#15PH3

- For insulation and membrane attachment to wood, steel and structural concrete roof decks
- #3 Phillips drive
- Above average pull-out values in 24, 26-gauge metal panels
- 13 threads per inch
- e-coat

Galvalume Steel 3" Round Insulation Plate

isoweld® PVC Plate

Insulation and cover board attachment to steel and wood roof deck

- OD: 3" Round
- ID: .260"
- Thickness: . 019"
- Finish: AZ50 Galvalume
- Available pre-assembled to Dekfast™ #12 Phillips head fastener

PVC/KEE membrane attachment using isoweld® induction welding`

- OD: 3.12" Round
- ID: .260"
- Material: G90 Steel w/proprietary PVC adhesive coating
- Color: Purple
- Coating back of plate: polyester gray

Galvalume Steel 2-3/8" Round Barbed Plate Membrane attachment to steel and wood roof decks

- 20 Ga. Galvalume Steel
- OD: 2-3/8"
- ID: .260/.262"
- Thickness: .038"
- Finish: AZ50 Galvalume

Note: Insulation and membrane stress plates are not one-size-fits-all.

Stealth pre-assembly tool & fasteners

Increase productivity up to 30% when using the Stealth tool to install pre-assembled #12 Dekfast™ fasteners with 3" round insulation plates

SFS brings the ultimate flat roof fastening system for maximum efficiency and safety. Pre-assembled fasteners can be placed on the deck or loaded into the Stealth installation tool, granting you the flexibility to choose the optimal method and allocation of resources. What's more, the system provides a more ergonomically correct position than standard installation methods. The pre-assembled screw and plate

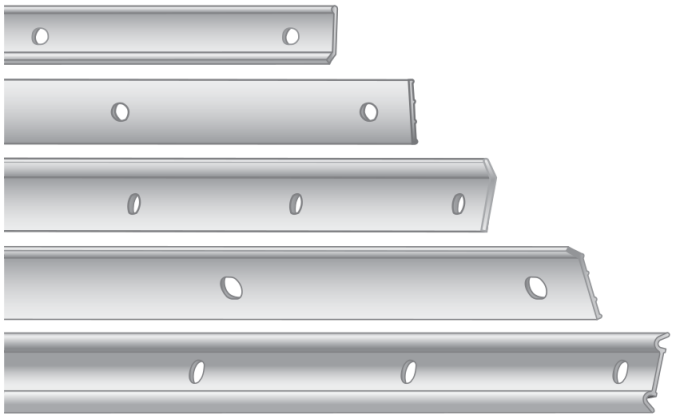
are automatically perpendicular to ensure quality results with minimal effort.

- Screw and plate relationship is perpendicular every time, allowing for proper and quicker installations.
- Pre-assembled fasteners can be placed on the deck or loaded into the Stealth installation tool, giving the contractor the ability to use crew members in other areas of the roof project.
- Provides a more ergonomically correct position versus standard installation methods.

Pre-assembled fastener & plate

- #12 Phillips Dekfast™
- 3” Round Galvalume plate
- Available lengths: 1-5/8” to 8”

Termination Bars TB, TB-AP, TB-SL, TB-RSL, TB-R, TB-LB Application Wall termination application Features and Benefits



- Manufactured from specialty extruded aluminum without sharp edges
- Reinforced strengthening ribs allow for use in high wind applications

Sealants

- **Water Block Sealant** - one synthetic rubber blend used as a termination sealant between Goliath PVC membranes and approved substrates.
  Specified product: **Pliobond 9508 or approved equal.**
- **Caulking** - one part polyether caulking used as a sealant on certain details. Specified product: **Chem Link M-1 Universal Sealant or approved equal.**
- **Pourable Sealer**- two-part urethane sealant used as a pitch pan filler.
  Specified product: **Chem Link Pro Pack or approved equal.**

Goliath PVC Accessories

T-Joint Patch

- Description: 114mm (4.5in) round piece of membrane used as reinforcement at “T” joint locations.
  Specified product: **T-Joint Patch by Goliath**

Molded Corners

- Description: Injection molded inside and outside corner.
- Dimensions: 125mm x 125mm x 125mm (5in x 5in x 5in) 175mm (7in) diameter
- Color: White
  Specified product: **Molded Inside Corner, Molded Outside Corner by Goliath**

Prefabricated Corners

- Description: Prefabricated [inside] [outside] corner.
- Dimensions: 150mm x 150mm x 150mm (6in x 6in x 6in)
  Specified product: **Prefabricated Iside Corner, Prefabricated Outside Corner by Goliath**

Prefabricated Pipe Flashing

- Description: Round, split type prefabricated pipe flashing made of PVC membrane reinforced with a polyester mat.
- Dimensions: 25.4mm (1in); 50.8mm (2in); 76.2mm (3in); 101.6mm (4in); 127mm (5in); 152.4mm (6in) in diameter
  Specified product: **PVC Pipe Flashing by Goliath**

Prefabricated Boot Flashing

- Description: Prefabricated closed or split type pipe flashing made of PVC membrane polyester reinforced.
- Dimensions: 25.4-152.4mm (1-6in) and 152.4-304.8mm (6-12in)
  Specified product: **PVC Boot Flashing by Goliath**

Primer for SBS Modified Bitumen Self-Adhesive Vapour Barrier (if required)

- Description: Primer composed of SBS synthetic rubber, adhesive resins and volatile solvents. It is used as primer to improve the adhesion of self-adhesive membranes.
  Specified product: **Elastcol Stick by Soprema**

Leveling Layer

– non-asphaltic, non-woven polypropylene geotextile fabric used as an asphalt barrier or leveling layer. Weight 12 oz/yd2 (400 g/m2) approved by Goliath

Slip Sheet

– woven polypropylene fabric used as a separation layer between Goliath PVC membrane and EPS and XPS (polystyrene) insulation. Weight 2.5 oz/yd2 (90 g/m2)

PVC Roof Drains

- Description: Drain made with a pre-applied and weldable PVC reinforcement membrane. The sleeve and plate are made from a single piece of aluminum with no weld.
  Specified product: **PVC Roof Drains and Drain inserts, supplied by Goliath**

Through Wall Scupper

- The prefabricated membrane coated scupper insert detail with heat welded seams is a superior detail to the galvanized scupper sleeve and bonding adhesive alternative.
  Specified product: **Through wall PVC scupper supplied by Goliath**

Sheet Metal Flashing

- PVC coated metal - 24 gauge galvanized (G-90) sheet metal laminated with a minimum 25 mil (0.6 mm) Goliath PVC film, used where Goliath PVC roofing membranes are to be welded directly to the metal flashing.

Walkway

- Description: Bare-backed PVC membranes used as protection for roof membranes from damage caused by necessary foot traffic or accidental tool drops.
  Specified product: **PVC Walkway Roll 2.5'x60' (76.2cm x 18.29m**)

Wood blocking

1. Wood blocking shall be #2 quality or better and be treated for fire and rot resistance (wolmanized or osmose treated). Creosote or asphaltic treated lumber is not acceptable. Goliath PVC membrane may not be directly adhered to wolmanized or osmose treated lumber.
2. Wood blocking shall conform to Factory Mutual's Loss Prevention Data Sheet 1-49.
3. Wood shall have maximum moisture content of 19% by weight on a dry weight basis.

Plywood

1. When bonding directly to plywood, a minimum standard 3/4” (75mm) smooth surfaced, exterior grade plywood, good one side, non-pressure treated, with exterior grade glue shall be used.
2. Plywood shall have maximum moisture content of 19% by weight on a dry weight basis.

EXECUTION OF WORK

Surface Examination and Preparation

1. Surface examination and preparation must be completed in conformance with instructions in the membrane manufacturer's technical documentation.
2. Before roofing work begins, the owner's representative and roofing foreman will inspect and approve deck conditions (including slopes and wood grounds) as well as flashings at parapets, roof drains, plumbing vents, ventilation outlets and other construction joints. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be carried out. The start of roofing work will be considered as acceptance of conditions for work completion.
3. Do not begin any portion of work before surfaces are clean, smooth, dry, and free of ice and debris. Use of calcium or salt is forbidden for ice or snow removal.
4. Be sure plumbing, carpentry and all other works have been duly completed.
5. No materials will be installed during rain or snowfall.

Method of Execution

NOTE TO THE SPECIFIER: When demolition work is required, or when work is needed on existing materials, be sure to respect the requirements of the Workplace Hazardous Materials Information System (WHMIS). Refer to Section 01545: Safety Measures in the NMS.

1. Roofing work must be completed in a continuous fashion as surfaces are readied and as weather conditions allows it.
2. Install night seals on all joints that are not covered by the PVC Membrane the same day. A second PVC roofing membrane cannot be installed if any moisture is present in joints.
3. Ensure PVC Membrane and substrates are dry, clean and free of asphalt and all bitumen-based products.
4. Ensure PVC Membrane and substrates are dry, clean and free of asphalt and all bitumen-based products.
5. Ensure air is never entrapped between the fully adhered membranes and the substrates and that the wrinkles are always removed.

Site Protection

Protect the exposed surfaces of finished work to avoid damage during roof installation and material transportation. [Install walkways over installed roofing materials to enable passage of people and transport of products.] Assume full responsibility for any damage.

Application of Primer

NOTE TO THE SPECIFIER: Please refer to Technical Data Sheets for application rate of specified products.

1. Roofing work must be completed in a continuous fashion as surfaces are readied and as weather conditions allows it.
2. Install night seals on all joints that are not covered by the PVC Membrane the same day. A second PVC roofing membrane cannot be installed if any moisture is present in joints.
3. Ensure PVC Membrane and substrates are dry, clean and free of asphalt and all bitumen-based products.
4. Do not allow bare PVC to come in contact with asphalt or bitumen-based products at all times.
5. Ensure air is never entrapped between the fully adhered membranes and the substrates and that the wrinkles are always removed.
6. Ensure field membranes are fastened and secured to the substrate at all membrane terminations before the installation of the PVC Membranes for Perimeter, Flashing and Parapets Surfaces.
7. Protect the exposed surfaces of finished work to avoid damage during roof installation and material transportation. [Install walkways over installed roofing materials to enable passage of people and transport of products.] Assume full responsibility for any damage.

Wooden, metallic, concrete, and masonry surfaces or gypsum insulation substrate will receive a coat of primer at a rate of [0.2 to 0.4] L/m^2 (no primer is required for factory-painted metals). All surfaces to be primed must be free of rust, dust or any residue that may hinder adherence. Primed surfaces must be covered with the roofing membrane as soon as possible (on the same day for self-adhesive membranes).

Installation of Self-Adhesive Vapour Barrier

Primer must be dry prior to the installation of the vapour barrier membrane, (if required0.

Starting at the bottom of the slope, without adhering the membrane, unroll it onto the substrate for alignment. Do not immediately remove the silicone release film.

Align the roll parallel to the ribs of the steel deck. Make sure membrane overlaps are supported along their entire length.

Remove one end of the silicone release film and adhere this part of the membrane to the substrate. Remove the remaining release film at a 45° angle to avoid wrinkles in the membrane.

Overlap adjacent rolls of 75 mm (3 in) or 100 mm (4 in). End laps must be 150 mm (6 in). Space end laps by at least 300 mm (12 in).

Installation of PE Vapour Retarder

- Vapor barriers for use in The Mechanically Attached Inseam - Roof System shall meet identified building code requirements and/or insurance requirements e.g. UL/ULC, FM, ASTM, CGSB standards.
- Vapor barriers are to be approved in writing by the vapor barrier manufacturer for their in-tended use
- Vapor barriers are to be compatible with insulation and other accessories.
- All seams must be sealed with appropriate system (tape, caulking or other).

Installation of Tapered Insulation Panels

Install tapered insulation panels in conformance with [the shop drawings provided by Atlas manufacturer's instructions and recommendations.

Installation of Insulation

Adhere insulation by using specified adhesive in continuous strips spaced of on the field surface, on the perimeter, and on the corners.

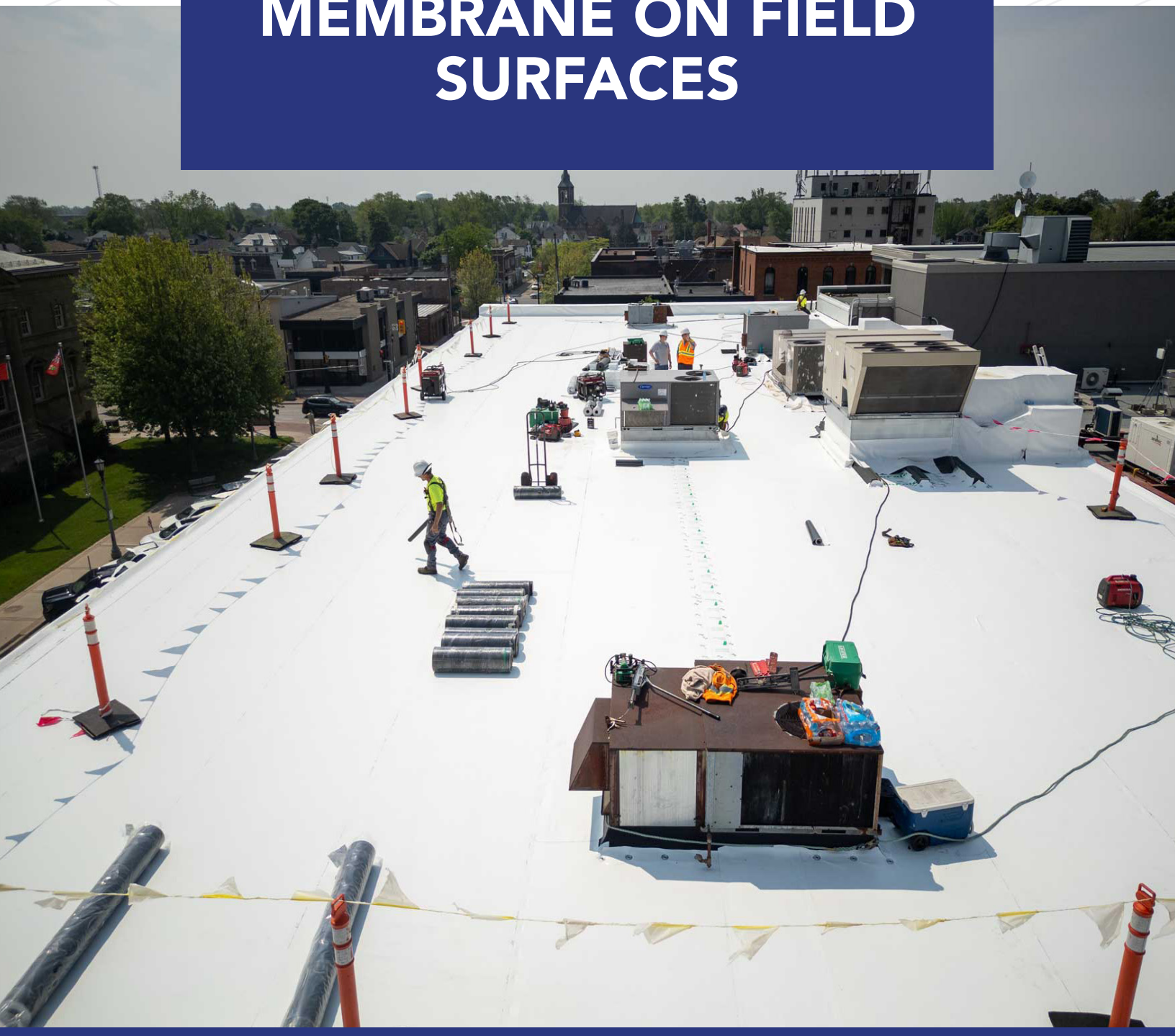
NOTE TO THE SPECIFIER: Select the right density of fastener according to the dimensions of the insulation boards. 4ft x 4ft boards require 4 fasteners (1 fastener per corner) 4ft x 8ft boards require 6 fasteners (1 fastener per corner, 2 in the center).

Fasten insulation a rate of [4] [6] fasteners per board.

Installation of Support Panel

Adhere support panel using specified adhesive applied in continuous strips spaced [12"] on the field surface [8"] on the perimeter, and [6"] on corners.

INSTALLATION OF PVC MEMBRANE ON FIELD SURFACES



PVC Membrane Adhesive

Place the roll on the center of the roof drain, unroll the membrane by taking care to align the edge of the membrane parallel to the edge of the roof.

Apply the PVC Membrane Adhesive to the underside of the bare-backed membrane and to the substrate [using a 3/8 in nap solvent resistant roller][using a sprayer and making sure to overlap 50 % with the previous pattern to achieve 100 % coverage, holding the tip approximately 305 mm (12 in) perpendicular to the substrate].

Allow the adhesive on both surfaces to dry to a tacky feel when touched with a dry finger.

Mate the membrane to the substrate avoiding any air entrapment or wrinkles and apply pressure with a roller or push broom to ensure complete bonding.

At the end of the sheet where it terminates at roof edges, walls and curbs, fasten the perimeter of the membrane with fasteners and seam plates to the deck or with fixation bar at the base of the upstand.

Each selvedge will overlap the previous one along the lines provided for this purpose and by 150 mm (6 in) at the ends. Space end laps a minimum of 300 mm (12 in).

Hot air weld all side laps and end laps with an automatic welding machine or electric hot air welder maintaining a minimum 38 mm (1.5 in) wide continuous weld.

Hot-air weld the T-joint Patch to the membrane at all t-joint intersections. Chamfer the welding seam prior to installing the T-Joint Patch using an edging tool or by heating the edge and rolling.

Probe all seams/laps once the hot air welds have thoroughly cooled.

Repair all seam deficiencies the same day they are discovered.

Foam Adhesive for PVC Membrane

Place the roll on the center of the roof drain, unroll the membrane by taking care to align the edge of the membrane parallel to the edge of the roof.

Apply the PVC Membrane and Insulation Adhesive to clean and dry substrate, from spray nozzle using a sweeping fashion from side to side to evenly distribute the adhesive.

Apply to prevent contact between bare PVC side laps and the adhesive.

Unroll the Fleece Back PVC Membrane into the adhesive so only the fleece contacts the adhesive. Prevent adhesive from contacting the membrane at the side and end-laps that are to be hot-air welded.

Unroll the membrane to prevent wrinkles and apply pressure with a roller or push broom to ensure complete bonding.

[At the end of the sheet where it terminates at roof edges, walls and curbs, fasten the perimeter of the membrane with appropriate fasteners and seam plates to the deck or vertical surface at the base of the upstand.]

Each selvedge will overlap the previous one along the lines provided for this purpose. End laps shall be butted in a way to let a maximum of 6 mm (1/4 in) wide joint in between the two membranes.

Hot-air weld all side laps and end laps with an automatic welding machine or hand welder maintaining a minimum 38 mm (1.5 in) wide continuous weld.

Hot-air weld a 150 mm (6 in) wide bare-backed PVC Membrane cover strip over the butted end joint.

Hot-air weld the T-joint Patch to the membrane at all t-joint intersections. Chamfer the welding seam prior to installing the T-Joint Patch using an edging tool or by heating the edge and rolling.

Probe all seams/laps once the hot air welds have thoroughly cooled.

Repair all seam deficiencies the same day they are discovered

Mechanically Fastened PVC Membrane

Place the roll on the center of the roof drain, unroll the membrane by taking care to align the edge of the membrane parallel to the edge of the roof.

Remove all wrinkles from the membrane.

Starting at one end of the membrane, mechanically fasten the membranes with screws and plates for PVC membranes. Fasteners must be installed in the center of the membrane side selvedge at a rate of [12”] on the field surface, at a rate of [6”] in the perimeter zone, and [6”] in the corner zones. Corners and perimeters must be installed as per FM requirements listed in the PLPDS 1-29. Firmly set the fastener and seam plate tight against the membrane, do not over-drive fasteners.

[At the end of the sheet where it terminates at roof edges, walls and curbs, fasten the perimeter of the membrane with appropriate fasteners and seam plates to the deck or vertical surface at the base of the upstand.]

Each selvedge will overlap the previous one along the lines provided for this purpose and by 150 mm (6 in) at the ends. Space end laps a minimum of 300 mm (12 in).

Hot-air weld all side laps and end laps with an automatic welding machine or hand welder maintaining a minimum 38mm (1.5in) continuous weld.

Hot-air weld the T-joint Patch to the membrane at all t-joint intersections. Chamfer (rounding of corners) the welding seam prior to installing the T-Joint Patch using an edging tool or by heating the edge and rolling.

[Cover the rows of fasteners installed at perimeter and corner zones with a minimum 200mm (8in) wide strip. Hot-air weld the strip with a continuous 28mm (1.5in) continuous weld on all sides.]

Probe all seams/laps once the hot air welds have thoroughly cooled.

Repair all seam deficiencies the same day they are discovered.

Induction Welded PVC Membrane

Avoid locating membrane side and end laps over the stress plates. Refer to the induction welding tool operating instructions where multiple layers of membrane at seams require induction welding.

Attach induction plates to the structural deck using fasteners designed for this purpose at a rate of [12”] on the field surface, at a rate of [6”] in the perimeter zone, and [6”] in the corner zones. Corners and perimeters must be installed as per FM requirements listed in the PLPDS 1-29.

Fasten the area of roofing that is to be induction welded to all plates the same day.

Ensure the side and end laps are a minimum of 3 in to accommodate minimum 1-1/2 in welded lap seams.

Clean side and end laps as necessary before welding seams.

Remove all membrane wrinkles.

Hot air-weld all laps.

Ensure the induction welding plates and bottom surface of the PVC membrane are dry and free of condensation before beginning induction welding.

Locate each stress plate beneath the PVC membrane. Center the induction welder over each plate and activate the induction welding tool. Do not move the induction welder during the induction welding cycle.

Once the weld is complete**, IMMEDIATELY** place a specialized magnet directly over each plate. Allow the magnets to remain in place until the plates have cooled.

Where induction welds are suspect, examine the membrane attachment using a suction plate or plunger.

At the end of the sheet where it terminates at roof edges, walls and curbs, fasten the perimeter of the membrane with appropriate fasteners and seam plates to the deck or vertical surface at the base of the upstand.

Installation of PVC Membrane on Flashings and Parapets

1. At the end of the sheet where it terminates at roof edges, walls and curbs, fasten the perimeter of the membrane with coated PVC induction fasteners and seam plates to the deck or vertical surface at the base of the upstand.
2. The PVC roof membrane can now be extended up and over the parapet flashing and fully bonded to the substrate.
3. Apply the PVC Membrane Adhesive to the area to be covered using 3/8 in nap solvent resistant rollers.
4. Apply the PVC Membrane Adhesive to the underside of the bare-backed membrane and the Molded Corner and the Prefabricated Corner at a rate of [0.2 to 0.4] L/m2.
5. Prevent adhesive from contacting the membrane at the side and end-laps that are to be hot-air welded
6. Allow the adhesive on both surfaces to dry to a tacky feel when touched with a dry finger.
7. Mate the PVC Membrane to the flashing substrate. Apply pressure with a roller or a broom to ensure adhesion.
8. Hot-air weld all laps maintaining a minimum 38mm (1.5in) continuous weld.
9. Apply the Molded Prefabricated Corner.
10. Probe all seams/laps once the hot air welds have thoroughly cooled.
11. Repair all seam deficiencies the same day they are discovered.
12. Fasten top leading edge of vertical PVC flashings.

Installation of PVC Drain

Apply sealant under drain base.

Insert drain sleeve into roof opening leading to storm drain.

Apply even pressure over entire drain base to impregnate drain with sealant.

Secure around drain base with screws, evenly distributed.

Clean the field surface membrane with non-greasy cleaner.

Weld perimeter of drain membrane to a minimum width of 38 mm (1-1/2”) on field surface, using electric hot air welder and a membrane roller.

Installation of Prefabricated Flashings

Hot-air weld the base of the prefabricated [Pipe] [Boot] Flashing maintaining a minimum 38.mm (1.5in) wide continuous weld.

Probe all seams one the hot air welds have thoroughly cooled.

Install the pipe clamp and seal the top with the Sealant.

Installation of Sheet Metal Flashing

Fastened the sheet metal flashing onto place prior the installation of the PVC membrane.

Refer to sheet metal flashing detail drawings, and follow technical data sheets

Remove any loose debris and clean PVC roof membrane, then allow to dry prior the installation.

Roll out and cut desired length up to 3 m (10 ft) and allow the membrane to relax while placing into the desired position.

Install Walkways with a continuous weld around the perimeter.

APPENDIXES

Roof Decks

General Requirements

1. The architect, engineer, or building owner is responsible for properly designing and constructing the roof deck as well as for the proper interrelationship of all building components. The density, internal moisture, integrity, and other inherent elements of the deck must also be suitable to receive the roof. Goliath is not responsible for any of the previously mentioned factors and assumes no responsibility under any circumstances.
2. The roof deck construction and deck surface preparation requirements, which follow, are provided as a supplemental guide for the architect, engineer, or building owner. Goliath's acceptance of a roof deck as satisfactory to receive the Goliath PVC roofing system refers only to the deck surface and not the design, construction, structural integrity, or attachment of the said deck.
3. Deck types not listed in this guide must be accepted, in writing, by the Goliath's Technical Services department to be eligible for a CGT Limited Warranty.
4. The surface of the roof deck, regardless of type, shall be dry, clean, smooth, firm, properly constructed, properly attached, and properly designed for anticipated loads with deflection not to exceed 1/240 of the span at mid-span.
5. The roof deck shall be constructed in accordance with the project specification or Goliath guidelines and the roof deck manufacturer's requirements – whichever is more stringent.
6. All penetrations through the roof deck should be completed before installation of the roofing system. Projections may not penetrate cant strips around the parapet or other locations where cant strips are required. Penetrations shall not be placed closer than twenty-four inches (24") (610 mm) from the base of the parapet wall. Proper bracing is required around the opening as per the deck manufacturer's guidelines or Steel Deck Institute (SDI) requirements and in compliance with the applicable building code.
7. Utility piping, such as electrical conduit or gas lines, may not be installed on the surface of the roof deck. If installed above the surface of the roof, utility piping should be installed on support blocking.
8. If the roof deck slopes more than one inch (1") per foot (8%), see Section 6.03.1 of this manual for wood nailer insulation stops and backnailing guidelines for membrane systems. I. Roof decks shall be designed and constructed with expansion joints in appropriate quantity and placement. Expansion joints must extend through the structural system to be functional. Expansion joints shall be incorporated to separate adjoining buildings or sections of buildings as determined by the designer. See also Section 3.03.1.
9. Thermal barriers, minimally one-half inch (1/2") (12.7 mm) thickness, if necessary to meet local

building code or insurance requirements, may be installed directly over the roof deck and under the roofing system assembly.

New Construction or Complete Tear Off

When roofing over existing steel support decks, stipulations shall be made for:

1. Removal of surface corrosion and subsequent painting.
2. Repair to holes or severely corroded sections.
3. Fastening of loose decking.
4. Replacement of decking that is corroded beyond repair or otherwise unsuitable as a substrate. 3.01.1.2

Steel Decks

1. Steel decks must be a minimum of 22 gauge (0.8 mm), manufactured from mild steel, and be factory primed or galvanized to resist rusting. The top flanges of sheet panels shall be flat and properly installed such that the panels are aligned, smooth, and level.
2. Steel decks must comply with gauge, span, and fastening requirements listed in the current Factory Mutual Research Corporation (FMRC) Approval Guide and Loss Prevention Data Sheet 1-28, and/or as specified by the decking manufacturer.
3. Wood nailers of equal thickness of the roof insulation must be provided at perimeters and projection openings to function as insulation stops and to provide a fastening base for flanges of metal curb and flashings.
4. In some cases, steel decks may require the installation of an acceptable insulation or separation panel product before the application of a roof membrane assembly. The rigid board must be of the minimum thickness necessary to span the flutes, as well as capable of withstanding traffic, as recommended by the manufacturer. The rigid separation panels must be securely attached to the decking.
5. For Factory Mutual (FM) compliant assemblies, the first layer of rigid insulation must be mechanically attached with approved screws and plates. The subsequent layers may be attached using adhesives or hot asphalt, or all layers can be attached through the top layer with common fasteners through the deck. For CSA-compliant systems, contact the Goliath Technical Services department for specifics.
6. Perimeter nailers must be provided.
7. Any of the Goliath guidelines for use over insulation may be applied over a steel deck, provided the steel deck is covered with acceptable rigid roof insulation or separation panel products.

Poured-In-Place Structural Concrete Decks

1. Poured-in-place structural concrete decks must have a minimum compressive strength of 3,000 PSI and be properly cured for a period specified by the concrete manufacturer or a minimum of twenty-eight days (28) before the application of the roofing system.
2. All poured-in-place structural concrete decks shall provide for bottom side drying. Decks poured over non-venting forms that remain in place are not acceptable.
3. **Note:** In such cases, special design and product considerations may be applied to address venting and drying concerns. Contact the Goliath Technical Services department for further information.
4. All poured-in-place structural concrete decks shall be dry before the installation of the new roofing system. Wet decks must be permitted to dry, and frozen decks must be permitted to thaw and dry. All necessary precautions must be taken to avoid entrapment of moisture. Goliath shall not be responsible or liable for damage to the roofing system caused by trapped moisture under the roofing system, whether it is from the concrete deck or some other source.
5. If there is any doubt concerning deck dryness, especially in the case of hot asphalt attachment, the manufacturers recommend using the deck dryness test. When hot asphalt is used for the attachment of the insulation or base sheet, the following NRCA deck dryness test is recommended to verify the dryness of the concrete: 1. Pour one (1) pint (0.5 L) of the specified bitumen that has been heated to a minimum of 204ºC (400ºF) on to the concrete deck. 2. If the bitumen bubbles or foams, then the deck is not dry enough. 3. After cooling, peel the bitumen off the deck. If the bitumen can be removed cleanly, then the deck is not dry enough.
6. All poured-in-place structural concrete decks shall be smooth, level, and free from dirt or contaminants. Concrete curing agents shall be checked for compatibility with roofing materials.
7. All roof deck ridges, depressions, or irregularities must be leveled before the application of the roofing system. Grind down ridges or irregularities. Fill depressions with cement grout or other material accepted by the roof deck manufacturer. Cracks greater than one-eighth inch (1/8”) (3.2 mm) in width shall be repaired in accordance with the deck manufacturer’s requirements.
8. G. All poured-in-place structural concrete decks receiving heat fused roofing materials or hot asphalt must first be primed with a suitable primer. Self-adhesive and adhesive-applied components may also require priming of the deck. Check with the Goliath Technical Services department for specific applications of individual products. VER1219
9. H. Perimeter nailers must be provided. All cant strips used in conjunction with poured-in-place structural concrete roof decks must be properly secured to the structure.
10. I. It is the responsibility of the architect, engineer, building owner, or roofing contractor to determine the suitability of the deck for direct membrane application to the concrete deck. Decks with textured finishes are not acceptable where the membrane system will be applied directly to the poured-in-place structural concrete deck.

Precast Concrete Decks

1. Precast concrete decks shall be properly cured and installed in strict accordance with the deck manufacturer's specifications before the application of the roofing system. Any critically mis-shaped sections shall be replaced.
2. All Goliath installation guidelines over precast concrete decks, which require a CGT Limited Warranty, must have an acceptable insulation or separation panel solidly mopped, glued, or mechanically fastened over the deck.
3. All precast concrete decks shall be dry before the installation of the new roofing system. Wet decks must be permitted to dry, and frozen decks must be permitted to thaw and dry. All necessary precautions must be taken to avoid entrapment of moisture. Goliath shall not be responsible or liable for damage to the roofing system caused by trapped moisture under the roofing system, whether it is from the concrete deck or any other source.
4. If there is any doubt concerning deck dryness, especially in the case of hot asphalt attachment, Goliath recommends using the deck dryness test as outlined in subsection 3.01.1.3 Poured-In-Place Structural Concrete Decks.
5. All precast concrete decks shall be smooth, level, and free from dirt or contaminants.
6. All roof deck ridges, depressions, or irregularities must be leveled before the application of the roofing system. Grind down ridges or irregularities. Fill depressions and top joints between precast slabs with cement grout, or other materials accepted by the roof deck manufacturer, to provide a smooth deck surface. To permit maximum contact surface for roofing materials to be applied, leveling shall be gradual and smooth. Cracks greater than one-eighth inch (1/8") (3.2 mm) in width shall be repaired in accordance with the deck manufacturer's requirements.
7. All precast structural concrete decks receiving heat fused roofing materials or hot asphalt must first be primed with a suitable primer. Self-adhesive and adhesive-applied components may also require priming of the deck. Check with the Goliath Technical Services department for specific applications of individual products. PART 3 Decks
8. Perimeter nailers must be provided.
9. It is the responsibility of the architect, engineer, building owner, or roofing contractor to determine the suitability of the deck for direct membrane application to the precast concrete deck. Decks with textured finishes are not acceptable where the membrane system will be applied directly to the precast concrete deck.
10. Cast-in-place lightweight insulated concrete (LWIC) decking and top-pour surfacing require the attachment of separation panel products and the first layer of the membrane system with mechanical fasteners specific for such applications. For adhered membranes installed directly to the LWIC decking, a vented base sheet or spot-adhered base sheet must be used to minimize blistering due to trapped moisture, which can result in vapour pressure.

Pre-Stressed Concrete Decks

1. Pre-stressed concrete decks shall be properly cured and installed in strict accordance with the deck manufacturer's specifications before the application of the roofing system. Any critically mis-shaped sections shall be replaced.
2. All Goliath installation guidelines over pre-stressed concrete decks, which require an CGT Limited Warranty, must have accepted rigid board stock solidly mopped, glued, or mechanically fastened to the deck before the application of a membrane system.
3. All pre-stressed concrete decks shall be dry before the installation of the new roofing system. Wet decks must be permitted to dry, and frozen decks must be permitted to thaw and dry. All the necessary precautions must be taken to avoid entrapment of moisture. Goliath shall not be responsible or liable for damage to the roofing system caused by trapped moisture under the roofing system, whether it be from the concrete deck or some other source.
4. If there is any doubt concerning deck dryness, especially in the case of hot asphalt attachment, the manufacturers recommend using the deck dryness test as outlined in subsection 3.01.1.3.
5. All pre-stressed concrete decks shall be smooth, level, and free from dirt or contaminants.
6. All roof deck ridges, depressions, or irregularities must be leveled before the application of the roofing system. Grind down ridges or irregularities. Fill depressions and top joints between pre-cast slabs with cement grout, or other material acceptable to the roof deck manufacturer, to provide a smooth deck surface. To permit maximum contact surface for roofing materials to be applied, leveling shall be gradual and smooth. Cracks greater than one-eighth inch (1/8") (3.2 mm) in width shall be repaired in accordance with the deck manufacturer's requirements.
7. All pre-stressed structural concrete decks receiving heat fused roofing materials or hot asphalt must first be primed with a suitable primer. Self-adhesive and adhesive applied components may also require priming of the deck. Check with the Goliath Technical Services department for specific applications of individual products.
8. Perimeter nailers must be provided.
9. It is the responsibility of the architect, engineer, building owner, or roofing contractor to determine the suitability of the deck for direct membrane application to the prestressed concrete deck. Decks with textured finishes are not acceptable where the membrane system will be applied directly to the pre-stressed concrete deck.

Plank and Heavy Timber Wood Decks

1. Wood shall be a minimum of one inch (1") (25 mm) thick, between four inches (4") (100 mm) and eight inches (8") (200 mm) wide, and kiln dried. Tongue and groove, or sidelap lumber, is preferred over square edge lumber.

2. Confirm the compatibility between roofing materials and preservatives used to treat the wood. Contact the Goliath Technical Services department before membrane application if there are any questions.
3. All wood shall be stored on skids or raised platforms and be covered with a waterproof tarp. Wood decks shall be roofed promptly after installation.
4. All wood planks must have a bearing on rafters at each end and be securely fastened to the joists or trusses.
5. Any knotholes or cracks in the lumber more than three-eighths inch (3/8") (9.5 mm) shall be covered with strips of securely fastened sheet metal.
6. Plank and heavy timber wood decks require the installation of a layer of mechanically fastened insulation, a separation panel, or a base sheet.

Plywood Decks

1. Plywood decks must be a minimum of fifteen-thirty seconds inch (15/32") (12 mm) thick with joist spacing not to exceed twenty-four inches (24") (610 mm) on the center. Various provincial codes may require specific board thickness and/or joist spacing and should, therefore, be consulted to ensure compliance.
2. Plywood decks shall be exterior grade, American Plywood Association's (APA) Product Standard PS-1. Fire retardant plywood is not acceptable.
3. If plywood other than APA Product Standard PS-1 is considered, then the roofing contractor must confirm the compatibility between the roofing materials and any preservatives used to treat the plywood.
4. All plywood shall be stored on skids or raised platforms and be covered with a waterproof tarp. Plywood decks shall be roofed promptly after installation.
5. Joints in the plywood deck must be supported by wood framing or some other means to prevent deflection.
6. The plywood deck must be secured to joists or trusses in accordance with the building code and APA recommendations. Plywood decks require the installation of a layer of mechanically fastened insulation, a separation panel, or a base sheet.
7. When roofing over plywood decks, stipulations shall be made for: 1. Repairs of holes; 2. The adhesion of new materials to the existing materials unless the new materials are mechanically attached through to the deck, or any issues attributable to the materials are left in place; and 3. Replacement of decking that is warped, rotted, or deteriorated beyond repair or otherwise unsuitable as a substrate.
8. Decks not specified herein may be encountered. Contact the Goliath Technical Services department for confirmation of suitability to receive an Goliath roof assembly.

Roof Decks — Re-Cover

1. Tear-off to the roof deck is considered new construction. Refer to the appropriate part of section 3.01.1.
2. When Goliath PVC roofing systems are attached directly to existing smooth built-up or modified bitumen roofs, there must be a separation layer installed between the PVC and the existing roof. Decks damaged during the course of demolition must be evaluated for suitability to receive a new Goliath roofing system. It is recommended that the new system be secured through the existing system into the decking using appropriate screws and plates where possible to ensure that the new system is suitably attached to the structure.
3. Re-cover is defined as the installation of a new roofing system over an existing system. The existing roof must present a suitable surface to receive the new roofing system.
4. The roof deck must be clean, dry, and free of projections or depressions and comply with the minimum general requirements as outlined in Part 3, Section 3.01.1.
5. It is recommended that an Infrared Scan be performed to locate any wet insulation under the existing roof membrane. Any wet insulation shall be removed and any blisters repaired. When wet insulation is removed and replaced, it must be covered with a layer of like materials of equal thickness to the layer of smooth surface built-up or modified bitumen that was removed. Goliath will not be responsible for diminished life and/or premature failure of the membrane assembly due to pre-existing conditions within the old assembly left in place.
6. Existing flashings must be removed before the installation of the new flashing system.
7. If the existing metal flashing is damaged or deteriorating, or otherwise not reusable, then the existing metal flashing must be removed and replaced. All existing lead flashings must be removed. All metal flashing forming a part of the membrane assembly.

Gravel Surface Asphalt or Coal Tar Built-Up or Modified Bitumen Roofs

1. Gravel surfaces on built-up roofs and the high spots must be removed and the depressions filled.
2. Any wet insulation shall be removed and any blisters repaired. When wet insulation is removed and replaced, it must be covered with a layer of like material or built-up roof of equal thickness to the layer of gravel surface built-up roof that was removed.
3. Conditioned surfaces of BUR systems meant to receive a new membrane must be dry, smooth, free of debris, have large voids over one-eighth inch (1/8”) (3.2 mm), and be sufficiently stable so as not to impede the performance of the new assembly.
4. Embedded gravel after scarification on built-up roofs requires the installation of an accepted insulation and base sheet or a separation panel such as Protectoboard. The initial layer of insulation

and base sheet shall be mechanically fastened with a common fastener and plate. For alternate attachment options, please contact the Goliath Technical Services department.

5. A mechanically fastened separation panel, a minimum of one-eighth inch (1/8”) (3.2 mm) thick (recommended to be one-quarter inch (1/4”) (6.4 mm) thick) is required over the existing roof if the roof is not smooth or the existing roof is coal tar pitch. All loose gravel must be removed. Refer to Section 2.04.1.
6. If removing the existing membrane causes surface damage to the existing insulation, then a separation panel must be installed over the existing insulation to provide a smooth surface. Caution: Fastener penetration of the existing roof and roof deck may cause a flow of coal tar/bitumen into the building.

Expansion Joints — Flashing Recommendations

1. All metal/elastomeric composite expansion joint covers that penetrate the membrane shall be elevated on curbs a minimum of eight inches (8”) (200 mm) above the surface of the roof.
2. Roof level expansion joints must be waterproof, monolithic, and factory vulcanized. The standard of quality referenced herein is Redline by Situra Inc. Call the Goliath Technical Services department or Situra Inc. for information on acceptable roof level expansion joints relative to the Goliaht roofing systems.
    1) Redline (Situra brand name) is installed typically in an asphaltic-based medium. Apply the base coat of the asphalt medium directly to the substrate and embed the Redline waterproof expansion joint material making sure that the bottom polyester fleece is in full contact with the hot asphalt bitumen. Press the Redline material into the hot asphalt to ensure a continuous and even bond.
    2) Spread an even coat of asphalt on the top surface of the Redline expansion joint ensuring that the top white polyester fleece is completely covered and strip in felt plies. The system is to be wholly encapsulated between plies in an asphalt/bitumen compatible roofing/waterproofing system with a flood coat (mopping is acceptable) of asphalt. The joint shall not obstruct water flow across its surface and shall form a continuous monolithic waterproof barrier.
    3) Always lay the Redline expansion joint material in lengths of ten feet (10’) (3 m) or less to allow for full contact with the hot bitumen adhesive. Do not lay Redline into cold asphalt. The application temperatures for hot asphalt referenced elsewhere in this guideline shall apply to the Redline product as well.
    4) Flamline by Situra is a permissible heat-fusible expansion joint option.
3. Expansion joints shall be continuous and shall not be terminated before the break in the structure.
4. For expansion joints to function properly, construction ties must be removed. E. Effective

treatment of expansion joints may be satisfied by other methods and products. The IKO Technical Services department shall approve such treatments before application.

Area Dividers and Control Joints

1. Area dividers and control joints are not expansion joints; however, they do serve the same purpose in some applications. Area dividers are an acceptable alternative to expansion joints if they are installed where expansion joints were not included in the original design. Area dividers shall be designed and installed using the same criteria as expansion joints.

SOPRAVAP'R Self-Adhesive Vapour Barrier Membrane

SOPRAVAP'R is a self-adhesive vapour barrier membrane composed of SBS modified bitumen and resistant to foot traffic. The width of the membrane was designed so that it fits with the top flutes of most steel deck profiles. Thus, the area covered by a roll is optimized and wastage is reduced. SOPRAVAP'R can also be applied at low temperatures.

Surface Preparation

With the exception of steel decks, all substrates must be primed with ELASTOCOL STICK or ELASTOCOL STICK ZERO. The substrate must be clean, sound, and free of loose materials or contaminants, such as water and grease, which may compromise the adhesion of the product.

SOPRAVAP'R Installation Instructions

Step 1

Starting at the bottom of the slope, unroll the SOPRAVAP'R membrane to align it, without yet adhering it onto the substrate.

Do not immediately remove the silicone release film.

Step 2

Align the roll parallel to the flutes of the steel deck. Make sure membrane overlaps are supported along their entire length.

Step 3

Remove one end of the silicone release film and adhere this part of the membrane to the substrate. Remove the remaining release film at a 45° angle to avoid wrinkling the membrane.

Step 4

Overlap adjacent rolls by 75 mm (3 in). End laps must overlap by 150 mm

1. (6 in). Space end laps by at least 300 mm (12 in).

Step 5

When the vapour barrier is installed directly on a steel deck, place a thin sheet of metal under the end laps of the vapour barrier.

Step 6

* The installation is completed.

*SOPRAVAP'R may be left in place during construction. When left exposed to precipitation, positive slope and adequate drainage is required. The effects of weathering may vary based upon local climate and project conditions. Cover as soon as possible to limit exposure to UV and construction traffic. Not recommended for use as a temporary roof assembly.

COMPLEMENTARY PRODUCTS ELASTOCOL STICK and ELASTOCOL STICK ZERO Primers

Facilitate the adhesion of the SOPRAVAP'R membranes on all sub-strates, except steel surfaces.

SOPRAVAP'R

Thickness	0.8 mm
Dimensions	40.8m x 1.14m (134 ft. x 3.7 ft.
Surface	Tri-laminated woven polyethylene
Underface	Silicone release film

Commercial Roof Insulation Comes in Various Forms

Commercial roof insulation comes in various forms, each with its own strengths and weaknesses. Common types include polyisocyanurate, extruded polystyrene, spray foam, expanded polystyrene, mineral wool, and fiberglass. These materials offer different levels of thermal performance, moisture resistance, and fire resistance, making them suitable for various building needs and climate conditions.

Types of Commercial Roof Insulation:

- **Polyisocyanurate (Polyiso):**

This rigid foam board insulation offers excellent thermal performance (high R-value per inch) and is commonly used in commercial roofing, according to the Polyisocyanurate Insulation Manufacturers Association (PIMA).

- **Extruded Polystyrene (XPS):**

XPS is known for its high R-value, moisture resistance, and structural strength. It's a versatile option for various roofing applications, including those with high moisture exposure.

- **Expanded Polystyrene (EPS):**

EPS is a lightweight, cost-effective insulation material that provides good thermal performance. It is often used in combination with other insulation materials to achieve desired R-values.

- **Spray Foam:**

Spray foam insulation offers excellent air sealing capabilities, reducing air leakage and improving energy efficiency. It can be applied in various thicknesses to achieve desired thermal performance.

- **Mineral Wool:**

Mineral wool insulation, including both rockwool and slagwool, is known for its excellent fire resistance and sound absorption properties. It is a good choice for buildings in areas with high fire risk or noise pollution.

- **Fiberglass:**

Fiberglass insulation is a widely used and cost-effective option, available in batts, rolls, and loose-fill forms. It provides good thermal performance and is often used in conjunction with other insulation materials.

- **Cellulose:**

Cellulose insulation is made from recycled paper and offers good thermal and acoustic performance. It is typically installed by blowing it into wall cavities or attics.

- **Perlite Board:**

Perlite board insulation is a lightweight, rigid insulation made from expanded volcanic glass. It offers good thermal performance and is often used in roofing applications.

- **Structural Insulated Panels (SIPs):**

SIPs are prefabricated panels that combine structural support and insulation in one unit. They are known for their energy efficiency and ease of installation.

Considerations when choosing insulation:

- **Climate and Weather Conditions:**

The climate and weather patterns of the area will influence the type of insulation needed.

- **Building Use and Occupancy:**

The intended use of the building and the number of occupants can affect insulation choices.

- **Regulatory and Building Codes:**

Local building codes and energy efficiency standards will dictate minimum insulation requirements.

- **Cost and Availability:**

The cost of materials and installation, as well as the availability of specific products, should be considered.

Commercial Roof Insulation Options Explained

Want the best commercial roof insulation to reduce energy costs and protect your commercial building? Commercial roof insulation is a vital component of your roofing system and knowing which best suits your roofing type is critical. This article covers the main types of insulation, their benefits, and tips for choosing the best one for your needs.

Key Takeaways

- Proper commercial roof insulation is crucial for energy efficiency, reducing heating and cooling costs, and extending the roof's lifespan.
- Key insulation options include spray foam, polyisocyanurate (Polyiso), extruded polystyrene (XPS), expanded polystyrene (EPS), and mineral wool, each offering unique benefits based on specific applications.
- Choosing the right insulation involves considering factors like building type, climate, budget, and compliance with local regulations, while professional installation and maintenance are essential for long-term performance.

Understanding Commercial Roof Insulation

Commercial roofing insulation is essential and often required by building codes. Proper installation significantly reduces heating and cooling costs by limiting thermal transfer. This helps maintain comfortable indoor temperatures and enhances the building's overall energy efficiency. The proper insulation can lower utility bills and extend your roof's lifespan.

Conversely, neglecting proper insulation can cause long-term damage. Roofs without adequate insulation are more vulnerable to weather-related wear and tear, leading to premature replacement and higher maintenance costs. Understanding the importance of roof insulation enables informed decisions that benefit both your building and your finances.

Key Types of Commercial Roof Insulation

Choosing from the many commercial roofing insulation options can be overwhelming. Knowing the most common types simplifies the selection process. Material type, installation method, and R-value are crucial factors in determining the best insulation for your commercial roof.

We'll explore common types of commercial roof insulation: spray foam, polyisocyanurate (Polyiso), extruded polystyrene (XPS), expanded polystyrene (EPS), and mineral wool. Each type offers unique benefits and suits different applications, making it important to understand their specific properties.

Spray Foam Insulation

Spray foam insulation is **renowned for its high thermal resistance and soundproofing** capabilities. It can achieve an R-value of up to 7.2 per inch, making it one of the most efficient insulators. **Its ability to conform to irregular surfaces** ensures complete coverage and reduces potential insulation gaps.

Beyond its thermal properties, spray foam insulation also offers structural benefits. It enhances dimensional stability, resists moisture, and provides fire resistance, making it a versatile choice for various commercial roofing applications. It also helps reduce energy bills, making it a cost-effective long-term option.

Polyisocyanurate (Polyiso) Insulation

Polyisocyanurate, or Polyiso, is another popular choice for commercial roofing insulation. It offers an initial R-value of 6.8 per inch, **providing excellent thermal efficiency**. Certain polyiso products maintain a stable R-value at various temperatures, ensuring consistent performance.

Polyiso is highly versatile and suitable for various roofing systems, including single-ply systems like **PVC** or **TPO**. The outer foil-facing layer enhances insulation efficiency and protects against environmental impacts. The tapered design of some Polyiso products ensures effective drainage on low-slope roofs, enhancing their utility.

Extruded Polystyrene (XPS) Insulation

Extruded polystyrene (XPS) insulation, often recognized by its color-coded dye, is a common choice for commercial roofs. **XPS excels in moisture resistance**, making it suitable for below-grade and various roofing assemblies, including flat and **low-slope roofs**.

XPS insulation maintains a stable R-value over time, ensuring consistent thermal performance throughout its lifespan. This stability, combined with its lightweight nature, makes XPS a reliable and efficient choice for commercial roofing projects.

Expanded Polystyrene (EPS) Insulation

Expanded polystyrene (EPS) insulation is known for its cost-effectiveness and lightweight properties. It provides similar insulation performance to XPS but at a lower cost, **making it an attractive option for budget-conscious projects**. EPS is compatible with various membrane systems, including PVC and **EPDM**, allowing versatile applications in roofing assemblies.

High-density EPS offers an R-value of 4.6 and comes with a 100% R-value warranty from Insulfoam, which makes EPS a reliable and durable choice for commercial roofing insulation.

Mineral Wool Insulation

Mineral wool insulation is renowned for its fire resistance and stability at high temperatures, making it **ideal for demanding environments**. Its water-repellent properties further enhance its suitability for various commercial roofing applications.

In addition to its thermal and fire-resistant properties, mineral wool also provides soundproofing benefits, contributing to a more comfortable indoor environment. These features make mineral wool a highly effective insulation option for commercial roofs.

Choosing the Right Insulation for Your Commercial Roof

Choosing the right insulation for your commercial roof involves considering factors like building type, age, local regulations, and budget. Climate is crucial, as regions with extreme temperatures need insulation with higher thermal resistance.

Budget constraints are significant, as some insulation materials with higher upfront costs can yield considerable energy savings over time. Compatibility with the chosen roofing system and adhesives is essential to avoid future installation issues. Consulting roofing professionals can provide insights tailored to your specific needs and requirements.

Installation Best Practices

Proper installation is crucial for achieving optimal thermal efficiency and longevity. For example, polyisocyanurate can be applied directly to steel decks to meet specific fire safety approvals.

Adequate attic ventilation prevents heat and moisture buildup, prolonging the life of roof insulation.

Regular professional inspections can detect unnoticed issues, ensuring roof integrity and preventing costly repairs.

Maximizing Energy Efficiency with Roof Insulation

Energy-efficient roofing systems reduce energy expenditures by lowering the need for artificial heating and cooling. A well-insulated roof minimizes heat loss in winter and keeps interiors cool in summer, contributing to consistent indoor temperatures and comfort.

Investing in energy-efficient roofing can result in substantial long-term savings on energy bills. Following ASHRAE standards and energy codes ensures insulation selection and promotes energy efficiency in commercial buildings. Choosing eco-friendly insulation materials can enhance indoor air quality and reduce energy consumption.

Maintenance and Longevity of Roof Insulation

Regular maintenance of roof insulation is crucial to maintaining its energy efficiency and longevity. Coverboards can protect roofing systems from mechanical damage, reduce maintenance costs, and extend the roof's lifespan.

Regular inspections help identify issues like missing shingles and cracks, allowing for timely repairs. Monitoring granule loss in gutters and promptly removing moss and algae can prevent significant damage to roof materials.

The Role of Cover Boards in Roofing Systems

Coverboards are essential components that protect the underlying insulation from damage and enhance overall roof performance. They shield roof insulation from mechanical damage, foot traffic, and environmental impacts, ensuring the long-term performance of the cover board.

Common types of cover boards include:

- High-density polyiso
- Low-density polyiso
- Cement
- Gypsum

Each type offers different performance benefits. Coverboards enhance the durability of flat and low slope commercial roofing while improving moisture resistance and acoustic comfort.

Sustainable Insulation Options

Energy-efficient roofs significantly reduce a commercial building's environmental impact by lowering carbon emissions. Sustainable roofing solutions benefit the environment, enhance a business's reputation, and appeal to eco-conscious consumers.

Eco-friendly insulation materials, such as cellulosic fibers and wool, are sourced from renewable resources and often have a longer lifespan, reducing replacement frequency. Using recycled or reclaimed materials in insulation minimizes landfill waste and supports local economies.

Working with Professional Contractors

Hiring professional contractors ensures comprehensive roof health and optimal performance. Regular inspections, at least every two years, can identify potential issues early and recommend the best insulation options.

Professional contractors bring extensive experience and expertise, ensuring the roofing system is installed correctly and efficiently. Their knowledge of insulation materials and techniques helps tailor the project to meet specific needs and budget constraints.

Commercial Roof Insulation Summary

Understanding and selecting the right commercial roof insulation can lead to significant energy savings, increased lifespan of the roofing system, and enhanced building performance. From spray foam to mineral wool, each insulation type offers unique benefits. Proper installation and regular maintenance further ensure the longevity and efficiency of the insulation. By investing in sustainable and energy-efficient roofing solutions, businesses can not only reduce their environmental impact but also appeal to eco-conscious consumers.

Insulation Frequently Asked Questions

What is the most energy-efficient type of commercial roof insulation?

Spray foam insulation is the most energy-efficient type of commercial roof insulation, offering a high thermal resistance with an impressive R-value of up to 7.2 per inch. This makes it an optimal choice for maximizing energy efficiency in commercial buildings.

How often should I inspect my commercial roof insulation?

Regular inspections of your commercial roof insulation should occur at least once every two years to ensure its integrity and address any potential issues promptly. Adhering to this schedule will help maintain the overall health of your roof.

What factors should I consider when choosing roof insulation?

When choosing roof insulation, it is essential to consider the building type, age, local regulations, budget, climate, and compatibility with the roofing system and adhesives. These factors will ensure optimal performance and compliance with standards.

How does proper roof insulation contribute to energy efficiency?

Proper roof insulation enhances energy efficiency by minimizing heat loss in winter and maintaining cooler interior temperatures in summer, reducing reliance on heating and cooling systems and significant energy savings.

Are there eco-friendly insulation options for commercial roofs?

Eco-friendly insulation options for commercial roofs include materials like cellulose and wool, which are derived from renewable resources and contribute to reduced environmental impact through longevity. These choices not only enhance sustainability but also lower the need for frequent replacements.

Pros and Cons of EPS and XPS

EPS (expanded polystyrene) and XPS (extruded polystyrene) are two common types of rigid foam insulation used in building construction. Both materials are made from polystyrene and have similar physical properties, but there are some differences in how they are manufactured and their performance characteristics. EPS is commonly used as insulation in walls, roofs, and foundations due to its low thermal conductivity and ability to resist moisture. XPS is a popular insulation material for roofs, walls, and foundations, particularly in areas that experience extreme temperatures or high levels of moisture. In addition, XPS can be used as an underlay for underfloor heating systems due to its high compressive strength and low thermal conductivity (Green Insulation Group. 2023). Here are some pros and cons of each:

Pros of EPS:

- Lower cost compared to XPS
- Lighter weight, which can make it easier to install
- Can be recycled into new EPS products

Cons of EPS:

- More fragile and prone to damage during installation and handling
- Lower R-value per inch of thickness compared XPS (3.6 – 4.2 for EPS, compared to 5 for XPS)
- More susceptible to water absorption, which can reduce its insulation performance and potentially cause structural damage
- More susceptible to pests and rodents, who can tunnel through the material

Pros of XPS:

- More durable and resistant to damage during installation and handling
- Higher R-value per inch than EPS
- More resistant to water absorption than EPS, which can make it a better choice for applications where moisture is a concern
- More resistant to pests and rodents
- Higher compressive strength, which can make it suitable for use in certain structural applications

Cons of XPS:

- Higher cost compared to EPS
- Heavier weight, which can make it more difficult to handle and install
- It is more difficult to recycle, as it is often coated with materials that make it difficult to separate the polystyrene from other materials

In summary, the choice between EPS and XPS will depend on a variety of factors, including cost, insulation requirements, moisture concerns, and structural requirements. EPS is generally the more affordable and higher performing option in terms of insulation, while XPS is more durable and resistant to water damage.

Pros and Cons Common to Both EPS and XPS

Pros:

- Recyclable products that assist with LEED points.
- It won't support mold or mildew growth.
- Long-term, stable R-value.
- Can be placed below grade.
- Can be utilized for inverted assemblies (over membrane).

Cons:

- Exposure to sun will deteriorate the product.
- Solvents/solvent-based materials cause irreversible damage.
- Elevated temperatures (above 250 degrees F.) will "melt" polystyrene.
- Incompatible with certain thermoplastics, polystyrene insulations are known to draw plasticizers out of thermoplastic membranes, causing permanent degradation.
- Polystyrene is flammable, requiring proper placement in any assembly

Flat roof insulations according to R-value

One of the most important factors in selecting the optimum flat or low-slope commercial roof insulation is designing to the desired thermal efficiency. R-value is a measurement to quantify the insulating properties of a building material. The highest R-value per inch is the best, and this helps determine flat roof insulation thickness for building regulations. Understanding relative R-values will help rank the comparison of various materials choices.

Let's take a look at how the most common types of flat roof insulations rank according to R-value.

1. Polyurethane Roof Insulation R = 6.6

Polyurethane roof insulation

Polyurethane in sprayed-on foam is a high R-value choice for flat roof insulations. The American Chemistry Council Center for the Polyurethanes Industry reports R-values of up to 6.6 per inch. For commercial flat roofing, either 1-component or 2-component spray polyurethane foam is commonly used as well as insulated metal panels for the building envelope. Cold storage buildings with freezers or coolers often utilize polyurethane insulated metal panels.

There are several advantages to polyurethane: structural performance, dimensional stability and moisture resistance. The major benefit of spray polyurethane foam (SPF) is that it can conform to irregular surfaces on a wide variety of substrates. There is typically long-term stability of the R-value as well as high fire resistance. Polyurethane does have a narrower window of application temperature and humidity limitations in some climate conditions.

Note: This insulation cannot be used as a part any membrane roofing system – SBS, APP, TPO, PVC, EPDM, KEE. Also, when a SPUF roof needs to be replaced, it is very difficult to remove from the structure due to its inherent adhesive and physical properties.

2. Polyisocyanurate Roof Insulation R = 5.6

Polyiso rigid foam insulation

Polyisocyanurate (polyiso) is closed-cell foam bonded to various facers, such as glass or foil. The blowing agents used to manufacture the product have evolved over time to meet environmental goals. Manufacturers certify their EPA-compliant blowing agents as not having any CFCs or HCFCs to meet zero ozone depletion potential (ODP) roof insulation standards.

Polyiso is the only foam plastic insulation product for direct application to steel decks to achieve FM Approval for Class 1 Roof Systems. It is also classified by UL for direct-to-steel deck insulation under both single-ply and asphaltic roof membranes.

The polyiso industry has established a standard called “LTTR” — Long Term Thermal Resistance — that indicates how polyiso will insulate over time; it is essentially an aged R-value.

As an example, the R-value of a foil-faced polyisocyanurate panel produced with pentane ranges from an initial R-value of 6.8 per inch to 5.7 per inch as projected over time. Polyisocyanurate foam board roof insulation is one of the best roofing insulations and is one of the top choices for very high thermal efficiency. Polyiso is available for flat roof insulation systems, and it also can be supplied as tapered insulation board for flat roofs.

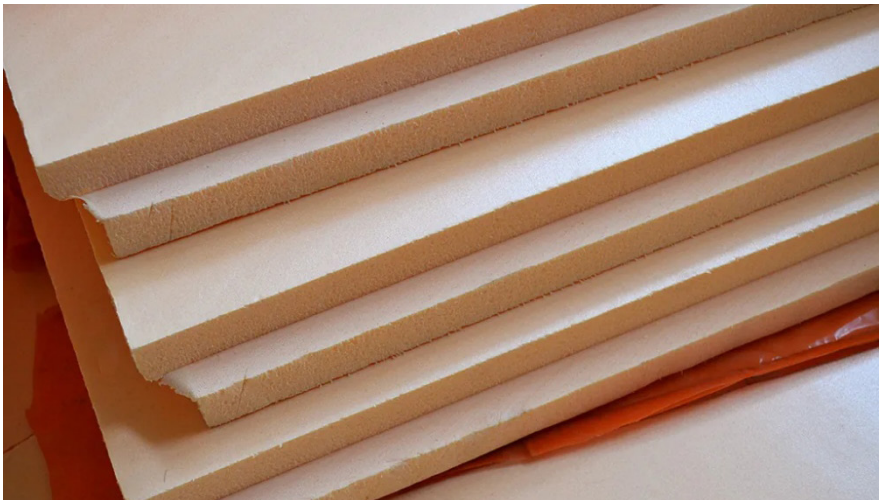
Designers who pursue certifications under green building rating systems, such as LEED®v4, would want to review adding insulation to a flat roof, such as nonhalogenated polyisocyanurate roof insulation. These formulations do not have flame-retardant chemicals that may adversely affect the environment.

Polyiso roof insulation can also be produced at high density (HD) to become a high-compressive strength (80 psi and higher) cover board. HD polyiso coverboards help prolong the service life of a roofing system by providing protection from foot traffic and third-party damage without adding significant weight to the structure. These roof cover boards are resilient and lightweight.

The Polyisocyanurate Insulation Manufacturers Association (PIMA) does outstanding work in researching the latest trends in polyiso advances and is a great support for the insulation industry.

*Initial, not LTTR aged value, to make an effective comparison with other products

3. High-Density Extruded Polystyrene (XPS) Roof Insulation R = 5



Extruded polystyrene XPS insulatioE

With an R-value of approximately 5 per inch, extruded polystyrene (XPS) is created utilizing an extrusion process to produce closed-cell rigid foam insulation with polystyrene polymer. Many manufacturers add a dye to the formulation to add a unique colouration, typically pink, green or blue to distinguish the product brand.

Most XPS is used for wall and below-grade applications. For commercial roofing, it is most commonly specified for Inverted Roof membrane Assembly (IRMA) or Protected Membrane Roof (PMR) systems. Extruded polystyrene is usually ranked in the middle of cost vs. R-value in terms of cost/benefit evaluation of flat roofing materials.

It is vulnerable to solvent-based adhesives and hot asphalt, and its use in PMR systems requiring ballast can make structural weight of the assembly an issue.

4. High-Density Expanded Polystyrene (EPS) Roof Insulation R = 4.6

Expanded polystyrene EPS Insulation

Expanded polystyrene (EPS) is made from the same base polystyrene resins as XPS, but the manufacturing process is different, resulting in beads that are formed and cut into different sizes and shapes or molded. High-density products have an approximate R-value of 4.6 as a relative comparison.

Contractors like to install EPS as it can be cut easily to meet site conditions, and it is lightweight. Theoretically, it has a more stable R-value over time as there are no chemical blowing agents that can outgas. There are no current studies that can confirm this attribute.

EPS has several disadvantages, however. It is combustible, will absorb water, can shrink and warp with high temperature exposure, and is not compatible with petroleum-based products, such as solvents, coatings and adhesives. In addition, foot traffic on the roof can damage the material.

5. Glass Fiber and Mineral Fiber Batts and Panels R = Variable by Manufacturer

Glass fiber insulation

The commercial roofing industry phased out rigid fiberglass two-by-four panels as single-ply roofing systems became a larger share of the market. Soft underfoot, fiberglass was not recommended for EPDM, PVC or TPO systems. Traditionally, fiberglass sheets were used as a substrate for hot roofing systems, and they had several advantages: They provided high fire resistance and flexibility, and they were chemically inert and resistant to mold growth.

There were few suppliers dedicated to market commercial roofing systems with the necessary resources to support various code testing in contemporary assemblies. Currently, fiberglass rolls can be purchased for specialized uses, such as metal building insulations. Additionally, there are formaldehyde-free mineral wool options for certain applications.

6. Perlite Board R = 2.7

Perlite insulation

Considered a “low thermal insulation” in the manufacturing process, it is typically combined with binders and reinforcing cellulosic fibers. In production since the late 1950s, perlite was considered the pioneer environmental flat roof insulation product due to its high recycled content of paper waste, often manufactured with used phone books. It is economical and has a stable R-value. High-density versions of the product can be installed over wide flutes with metal deck spans of up to 2 1/2 inches. With hot roofing systems, perlite is available in a number of composite construction boards, including OSB and gypsums.

Perlite boards can rot when wet and need surface treatment or coatings to prevent excessive absorption of asphalt during installation. Again, with the advent of single-ply roofing systems and their increasing specifications, this product is losing favor as a choice in commercial roofing.

Rockwool roof insulation, also known as stone wool or mineral wool insulation, is a type of insulation made from natural rock materials, such as basalt and diabase, and recycled slag. These materials are melted and spun into fibers, then compressed to create a dense, heat-resistant, and sound-absorbing material. Rockwool insulation is known for its thermal, fire, and acoustic performance.

Key characteristics and benefits of Rockwool roof insulation:

- **Thermal Insulation:**

Rockwool traps air within its fibers, providing excellent thermal resistance, which helps to regulate temperature inside a building and reduce heating and cooling costs. R-3.8 per inch.

- **Fire Resistance:**

It is non-combustible and can withstand high temperatures, offering a significant fire safety benefit.

- **Acoustic Insulation:**

Rockwool's density and fiber structure help to absorb sound, reducing noise transmission and creating a more peaceful indoor environment.

- **Moisture Resistance:**

While it can handle moisture, it's also designed to be vapor permeable, allowing moisture to escape while resisting water absorption, which is crucial for preventing damage to the roof structure.

- **Durability and Longevity:**

Rockwool is known for its resistance to sagging, settling, and degradation over time, ensuring long-lasting performance.

- **Sustainability:**

Rockwool is made from natural and recycled materials, making it an environmentally friendly insulation option.

- **Flat Roof Insulation:**

Used in flat roofs, often in combination with other materials to create a durable and effective insulation system. In addition to these benefits, Rockwool insulation can also:

  - Help prevent moisture damage and rot.
  - Resist mold and bacterial growth.
  - Be a safer option than some other insulation materials.

7. Insulations and R-value

R-value is but one of many criteria in the selection of flat roofing insulations for commercial applications. Insulation is just one component in a full roofing assembly. Other determining factors can be:

Compliance with ASHRAE Standard 90.1, International Energy Conservation Code (IECC), International Building Code (IBC), International Green Construction Code (IgCC), Canadian provinces and territory standards.

UL or FM requirements.

ASHRAE Standard 189.

S. Green Building Council LEED Rating System.

Stone Wool Insulation in Low Slope Roofs

When designing and building a roof system, achieving the greatest performance and resilience comes from selecting the right products for your project. ROCKWOOL low slope roof insulation products can be used to help minimize the fire, sound and longterm performance risks of your project.

With numerous ROCKWOOL stone wool products available, you will find insulation options that support optimizing system cost, thermal performance, fire and acoustic resistance and long-term durability.

Fire resistant:

Noncombustible, stone wool roof insulation products can be used in Class 1 roof deck construction and are classified as a noncombustible core (NCC) roof insulation under FM 4470.

ROCKWOOL roof products are suitable for WUI zone construction and are listed within the California Office of the State Fire Marshall's Building Materials listing.

Sound absorbent:

The non-direction fiber orientation and increased mass effectively reduces sound transmission, with performance that conforms to the 2015 International Green Construction Code's OITC and STC requirements for buildings in close proximity to high noise sources

Find acoustic rated low slope roof solutions in out assembly catalog.

Download our roof acoustic catalog

Durable:

Dimensionally stable and providing long term thermal efficiency, stone wool roof boards maintain their structural integrity even when exposed to hail and wind.

ROCKWOOL roof board products have been tested for severe and very severe hail (VSH) and is acceptable as a coverboard in VSH regions.

Learn more about stone wool insulation and VSH testing

Vapor-permeable and moisture-resistant:

Structural integrity of stone wool insulation boards are not affected by the presence of water, and the vapor permeability of stone wool can benefit a roof assembly designed to promote drying

Sustainable:

Stone wool insulation is manufactured from one of the world's most abundant raw materials without the use of blowing agents or toxic flame retardants, stone wool can contribute towards LEED credits for your project

For commercial buildings in Canada, minimum roof insulation R-values typically range from R-25 to R-40, and are dictated by provincial and local building codes, as well as climate zone. Specific requirements can vary significantly by location, so it's crucial to consult local building codes and an Elevate sales representative for precise guidance.

Factors Influencing R-Value Requirements:

- **Climate Zone:**

Different climate zones have varying temperature extremes, requiring different levels of insulation.

- **Building Type:**

Specific building codes may have different requirements for different types of commercial buildings.

- **Local Building Codes:**

Building codes are set at the provincial and local levels, so they are the ultimate authority on R-value requirements.

- **Energy Efficiency Goals:**

Some building owners may choose to exceed minimum code requirements for enhanced energy efficiency.

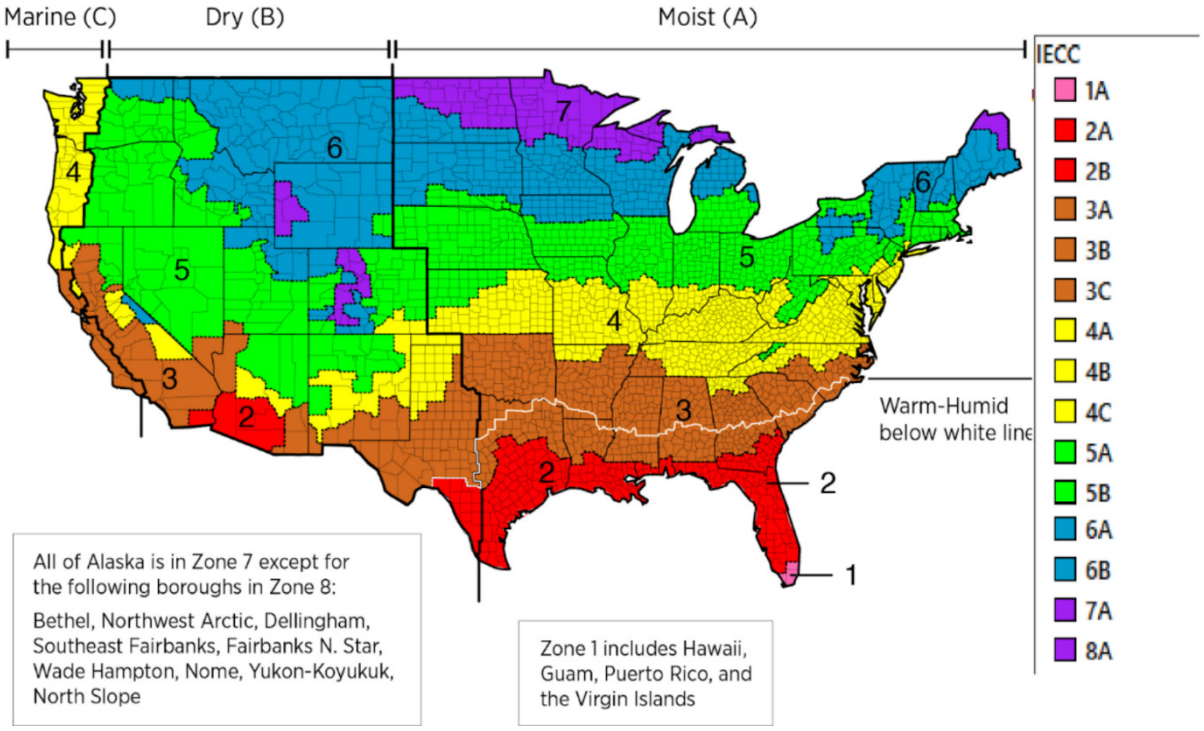
General Recommendations:

- **Minimum R-Value:** Consult your local building code, but generally, R-25 to R-40 is a good starting point for commercial roof insulation.
- **Above Deck Insulation:** For insulation installed entirely above the roof deck, the International Energy Conservation Code (IECC) specifies R-25 for Climate Zone 3 and R-30 for Climate Zone 4.

- **Consult Professionals:** For accurate recommendations based on your specific situation, consult a roofing professional or an Elevate sales representative.

Additional Information:

- **R-value:** measures a material's resistance to heat transmision; higher R-values indicate better insulation.
- **Various insulation materials:** like spray foam, XPS, and polyiso have different R-values per inch,
- **Blown-in insulation:** can be a good option for commercial buildings, offering high R-values and flexibility in application.
- **Moisture management, settling, and proper installation:** are important considerations when using blown-in insulation.



Step 2: Know Your Climate Zone

The IECC sets efficiency standards for new structures based on nationwide climate zones, shown in the map below. The requirements differ the further north or south a project is in relation to a region's seasonal temperatures and climates.

What R Value Is Needed for a Commercial Roof 3

The insulation R-value standards for each region are then dictated by their specific climate zone. The current requirements are:

Zone 1: R20

Zone 2-3: R25

Zone 4-6: R30

Zone 7-8: R35

The IECC publishes the climate zone map every year, and every three years officials meet to vote on proposed changes that incorporate new practices and building technologies. It is important to stay updated on any changes and new advancements to guarantee you are using the correct and most efficient materials.

Comparison of IECC's various editions

Commercial Buildings (Insulation component R-value-based method)

Climate Zone	IECC 2003	IECC 2006	IECC 2009	IECC 2012*	IECC 2015*	IECC 2018*
1	R-12 ci	R-15 ci	R-15 ci	R-20 ci	R-20 ci	R-20 ci
2	R-14 ci		R-20ci		R-25 ci	R-25 ci
3	R-10 ci					
4	R-12 ci			R-25 ci	R-30 ci	R-30 ci
5	R-15 ci	R-20 ci				
6	R-11 ci					
7	R-15 ci	R-25 ci	R-25 ci	R-30 ci	R-35 ci	R-35 ci
8						

* Applies to roof replacement projects
ci = continuous insulation

Insulation wall boards are different from these other types and come with some unique advantages, including easier installation, increased R-values, better fire resistance, and the ability to customize the installation.

For example, let's compare the R-values, in descending order, of various materials per a one-inch-thick application.

Material	Type	Typical R-Value Per 1"
Closed-Cell Polyurethane (SPF)	Spray Foam	R7
Polyiso	Board	R6
XPS	Board	R5
Mineral Wool	Board	R4.2
EPS	Board	R4
Open-Cell Polyurethane (SPF)	Spray Foam	R3.6
Cellulose	Loose Fill	R3.5
Fiberglass Blanket	Batts or Rolls	R3.2

H.B. Fuller Millennium PG-1 EF ECO Roof Insulation Adhesive

Description

Millennium PG-1 EF ECO is a two component, low rise, solvent-free, polyurethane foamable adhesive that contains no high Global Warming Potential (GWP) propellants. Application is quick & easy and adhesive sets in minutes resulting in significant labor savings for the contractor. Millennium PG-1 EF ECO is packaged in dual pressurized canisters and dispensed utilizing a disposable adhesive applicator assembly and twenty-five-foot hoses. Millennium PG-1 EF ECO does not contain HFC-134a or other high Global Warming Potential (GWP) propellants. This product is approved for use in all US and Canadian markets that regulate ozone-depleting substances.

Basic Use

Millennium PG-1 EF ECO is designed for use as an adhesive for bonding approved roof insulations to a building's structural roof deck, base sheets, other insulation board stock, and smooth or gravel built-up asphaltic roof surfaces. Millennium PG-1 EF ECO is also designed for fleeceback membrane attachment in ribbon or spatter applications. It is dispensed in 1" – 1.5" (2.5cm – 3.8cm) wide beads or in a spatter application using our proprietary dual-purpose static mixer. Our unique design allows both ribbon and spatter applications from a single static mixer. Millennium PG-1 EF ECO expands and rises to fill minor surface irregularities.

Approved Insulations and Substrates

- Polyisocyanurate (PolyISO)
- Expanded Polystyrene (EPS) & Extruded Polystyrene (XPS)
- Mineral wool
- Gypsum cover board
- Asphaltic coverboards
- Cementitious wood fiber
- HD wood fiber
- HD Polyiso Cover Board
- Concrete
- Gypsum roof deck
- Wood or steel
- Lightweight insulating concrete
- Modified bitumen membranes and base sheets (sanded or granule surfaced)
- Approved insulations (multi-layer applications)
- Smooth or gravel surface asphaltic built-up roof (re-roof applications)

Features Benefits

Contains no CFC or HCFC, high global warming potential propellants	Using no high GWP propellants ensure PG-1 EF ECO meets all current national and state regulations.
Proprietary spray nozzle allows for multiple applications through a single static mixer	Millennium PG-1 EF ECO can be used for spatter or ribbon application depending on the need, increasing productivity and limiting products needed on the job.
VOC content <50 g/L	Ultra-low VOC content formula is approved for use in all OTC and SCAQMD regulated regions.
No extra equipment required	Applicator, hose, and all accessories needed are included with each canister set, ensuring there is no extra equipment or additional steps needed.
Faster and easier application than using mechanical fasteners	Millennium PG-1 EF ECO eliminates potential for roof deck corrosion and disruption of building occupants due to fastening.
Solvent free formula	Millennium PG-1 EF ECO contains no solvents, making it suitable for use with EPS and XPS insulation in addition to PolyISO.
Eliminates Thermal Bridging	Using Millennium PG-1 EF ECO in lieu of mechanical fasteners eliminates thermal bridging and ensures maximum R-Value.

Surface Preparation

- All work surfaces should be clean, dry, and free of dirt, dust, debris, oils, loose and/or embedded gravel, un-adhered coatings, deteriorated membrane and other contaminants that may result in a surface that is not sound or is uneven.
- For re-cover applications over gravel surfaced BUR apply Millennium Universal Primer prior to the application of Millennium PG-1 EF ECO.
- For applications over fresh and/or non-oxidized asphalt, coal tar or plastic film membranes, Millennium Surface Treatment may be required prior to the application of Millennium PG-1 EF ECO.**STORAGE**

- Keep temperature of contents between 60°F to 90°F (16°C to 32°C). Bring temperature of material to approximately 70°F (21°C) for approximately 24 hours before use.
- Do not store in direct sunlight or above 95°F (35°C). Store canisters valve side up.
- KEEP FROM FREEZING!
- Millennium PG-1 EF ECO has a shelf life of 12 months when stored properly.

Color

Part 1 - Amber

Part 2 - Clear

Foamed Adhesive will appear as a homogeneous light amber color with no streaking or marbling.

Packaging

Millennium PG-1 EF ECO is available in the following packages:

Package Size	Part #	Canisters/Pallet
Part 1, 49# Canister	PG-SPECO-A01	36
Part 2, 43# Canister	PG-SPECO-B01	36

Part 1 and Part 2 canister and packaged in individual labeled boxes. The Part 1 box will contain one applicator, hoses, four dual-purpose static mixers, a wrench, petroleum jelly and a set of gloves.

Limitations

- Do not apply to wet surface.
- Not recommended for use with insulation boards larger than 4’x4’ (1.2m x 1.2m).
- Do not use warped or curled insulation boards. All insulation boards must lay flat upon the roof surface.
- Do not apply when temperatures are below 40°F (4°C)

Property Value

Skin Time*	5-8 Minutes
VOC Content	<50 g/L
Coverage Rate (Ribbon Application)	Up to 35 squares per set**
Coverage Rate (Spatter Application)	Up to 24 squares per set**
Shelf Life	12 months

For a complete list of approved substrates and insulation types, or for additional information, contact our Technical Department.

Safety

Prior to working with Millennium PG-1 EF ECO or any adhesive product consult product label and Safety Data Sheet (SDS) for necessary health and safety precautions.

H.B. Fuller - Millennium Sprayable PVC Single-Ply Bonding Adhesive

Description

Millennium Sprayable PVC Single-Ply Bonding Adhesive is a fast drying, sprayable bonding adhesive for adhering PVC and Fleece membranes to horizontal and vertical roof surfaces. The adhesive formula offers excellent adhesion and quick drying over a wide range of temperatures. Millennium Sprayable PVC Single-Ply Bonding Adhesive is approved for use in all VOC regulated regions per current requirements.

Basic Use

The adhesive is applied in a variable web spray pattern via a self-contained spray system. Product is applied full coverage to adhere PVC and Fleece membranes to approved insulation, cover board, OSB etc. The adhesive must be applied to both the membrane and substrate to which it will be mated. Once dry the membrane can be mated to the substrate and brushed in.

Approved Substrates

Acceptable substrates include: Polyiso, Polyiso HD, DensDeck® Prime, SECUROCK®, OSB, plywood, metal, residual asphalt, masonry, and most gypsum-based cover boards.

Approved Membranes

Goliath PVC and PVC Fleeceback membranes.

COLOR: Neutral

Surface Preparation

All work surfaces should be clean, dry, and free of dirt, dust, debris, oils, un-adhered coatings, deteriorated membrane or other contaminants that may result in a surface that is not sound or is uneven.

Safety

Millennium Sprayable PVC Single-Ply Bonding Adhesive contains a flammable liquid propellant and

vapor. Vapors from applied adhesive are heavier than air and may travel along the ground or through ventilation and may be ignited by pilot lights, other flames, sparks, heaters, smoking, electrical motors, static discharge, or other ignition sources. Residual vapors may ignite even though adhesive is not being actively applied. Keep away from open flame. Use in well-ventilated areas. Avoid inhalation of spray mist or vapors. Appropriate PPE, gloves and goggles must be worn when using this product. Never aim spray gun at people. Read label and safety data sheet prior to use for complete safety, precaution and warning information.

Limitations

Not for use on EPDM, TPO, or KEE membranes.

Equipment

Hose, applicator tip, and spray applicator must be purchased separately.

Features Benefits

VOC <200 g/l	Approved for use in all regulated areas
Quick and easy application	Reduce labor cost and minimal clean up
Excellent adhesion to PVC & Fleeceback membrane	Superior long term uplift performance
Fast drying, <7 minutes in most conditions	Allows for faster membrane application
Open Time 1-20 minutes @ 68°F (20°C)	Provides flexibility for proper installation

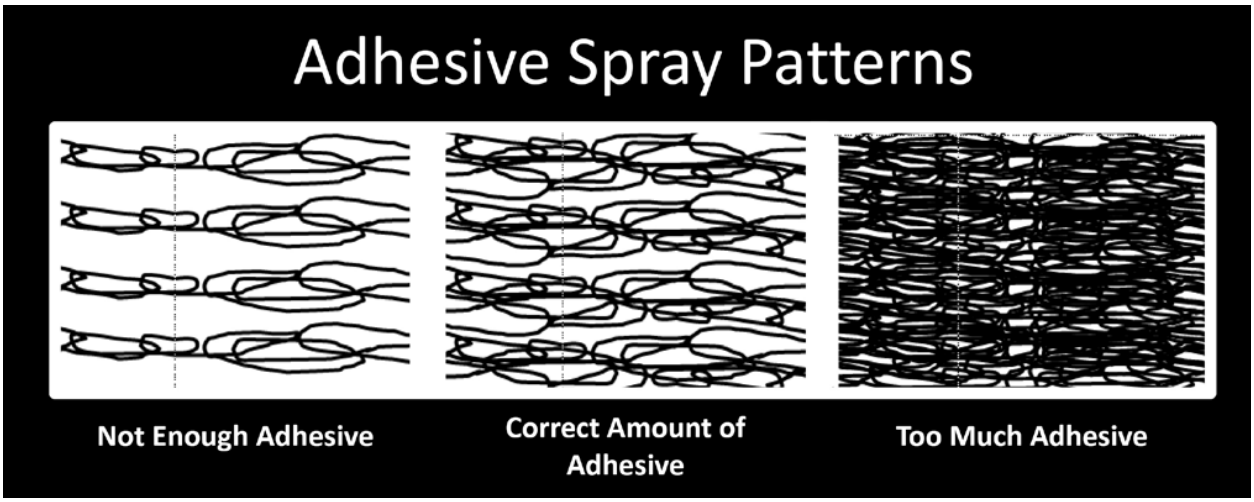
CAUTION: All statements and technical information in this document are based on tests or data that H.B. Fuller believes is reliable. However, H.B. Fuller does not warrant or guarantee the accuracy or completeness of this information. The user has sole knowledge and control of factors that can affect the performance of H.B. Fuller's products in the user's

Application

1. Shake adhesive canister for 30 seconds prior to use.
2. Connect spray applicator to hose and connect hose to adhesive canister.

- **NOTE**: Must use a stainless-steel braided metal hose - contact H.B. Fuller for details. Open valve on canister to check fittings for leaks. Keep adhesive canister valve open to maintain pressure in the hose/spray applicator when not in use. Once valve has been turned on, do not turn the valve off until the adhesive canister is completely empty or proper cleaning is performed. Refer to guidelines on canister label for cleaning.

3. Millennium Sprayable PVC Single-Ply Bonding Adhesive can be applied at ambient temperature of 40°F and above. Adhesive canister temperature must be at least 70°F prior to use and for the product to spray properly. Utilize H.B. Fuller Warming Blanket, and hot boxes when necessary. Substrate must be clean, dry, and free of debris and contaminants.
4. Adjust the spray pattern/fan by slowly adjusting trigger lock to the desired pattern. Lock trigger when not in use.
5. Visually target the “Correct Amount of Adhesive” coverage pattern detailed in the image below to both membrane and substrate. Apply adhesive with proper overlap to ensure adequate adhesive coverage. For vertical surfaces apply adhesive in a heavier application.



6. For applications taking place in ambient temperature below 70°F, store adhesive canister in heated space and move to project area during application. Adhesive canisters must be kept warm on the jobsite. Dispense product from canister while it is still warm. When product in canister becomes too cold, it will begin to spit rather than spray. If this occurs, swap cold canister for warmer one and return cold canister to heated area. When changing canister, close the valve on the canister and depressurize the hose completely. Remove the hose and attach it to the new canister. Open valve and perform a test spray.
7. Allow Millennium Sprayable PVC Single-Ply Bonding Adhesive to flash-off until it does not transfer

to finger when touched. Limit application to surfaces that will be covered with membrane the same day.

8. Follow OEM membrane manufacturer's guidelines when laying membrane into adhesive.
9. Read Product Information Sheet and Safety Data Sheet before use.

Cleanup

Short Term Storage:

1. Leave valve on adhesive canister open and lock applicator so trigger cannot be engaged.
2. Make sure to clean spray tip in a well-ventilated area using appropriate PPE.
3. Remove spray tip by removing retaining nut. Clean spray tip and retaining nut by soaking in appropriate solvent (ketone, aromatic, etc.).
    a. Spray tip may require manual cleaning with appropriately sized probe (small wire or pipe cleaner) to help remove build up.
    b. An aerosol solvent-based cleaner may also be used to help remove build up.
    c. Recommend H.B. Fuller's EternaClean or equivalent.
5. Clean applicator tip and threads with appropriate solvent.

Long Term Storage:

1. Make sure to clean applicator/hose assembly in a well-ventilated area using appropriate PPE.
2. Close valve on canister and engage trigger to completely relieve pressure on applicator/hose.
3. Disconnect the hose from the canister outlet.
4. Remove spray tip by removing retaining nut. Clean spray tip and retaining nut by soaking in appropriate solvent following instructions detailed in "Short Term Storage Cleaning".
6. Connect hose to outlet of Millennium Canister Flush Solution; tighten with a wrench using caution not to over tighten.
7. Open canister valve fully on flush cylinder and squeeze handle of spray applicator to allow flow of flush solvent through hose.

a. Flush an adequate amount of solvent through the hose into an appropriate collection container.

8. Once flushed, close the flush canister valve, and engage trigger to relieve pressure on applicator/hose.

a. Make sure to collect all flush solution into an appropriate container.

9. Disconnect the hose from the canister outlet and drain any residual flush solvent into an appropriate collection container.
10. Clean applicator tip and threads with appropriate solvent.
11. Read Product Information Sheet and Safety Data Sheet before use.

Storage and Shelf Life

Store canister in a safe, conditioned space with temperature maintained above 70°F. Do not store canister in areas where temperatures reach 90°F or higher. Contents are flammable. Store in accordance with local, state, and federal regulations.

With the hose and applicator attached, keep canister valve open to maintain pressure in the hose and spray gun. Periodically spray in a safe manner to help prevent possible clogging. Keep spray applicator trigger locked when not in use.

Shelf life is 12 months in unopened packaging and stored at temperatures of 40°F to 90°F.

Pliobond 1746 PVC Bonding Adhesive

Pliobond 1746 is a VOC-compliant, solvent-based, thermosetting adhesive specifically designed for bonding PVC membrane in roofing and deck applications. It is a specialized, high-performance adhesive used in building construction to secure membrane to various substrates.

Key Details and Usage:

- **Application:** It is used as a bonding adhesive for PVC membranes, specifically in roofing assemblies, to wood, cement board, or concrete substrates.
- **Coverage:** Typically applied at a rate of 100 - 120 ft^2/gal, covering approximately 50 – 70 ft^2/gal of membrane.
- **Compliance:** It is recognized for meeting specific building code requirements, such as those in Miami-Dade County (NOA - Notice of Acceptance).
- **Characteristics:** Provides a secure bond for flexible roofing systems, including those that might incorporate solar panels.
- **Availability:** Listed as a product from Ashland or Bostik.

Safety and Handling:

- **MSDS:** A Material Safety Data Sheet is available for this product, which is necessary for understanding handling precautions.
- **Regulation:** As it is a VOC-compliant product, it is designed for use in regions with strict regulations, although specific VOC restrictions may vary.

Note: The results also indicate related products such as Pliobond 20, 30, and 35 LV, which are general-purpose adhesives, but Pliobond 1746 is distinct for its PVC membrane application.

Pliobond 1746

Pliobong 1746 is a **VOC-compliant adhesive** specifically designed for bonding **PVC (polyvinyl chloride) membranes** in roofing and decking assemblies. It is manufactured by **Bostik** (formerly associated with Ashland Adhesives) and is recognized for its use in professional construction applications.

Key Specifications & Use

- **Primary Application**: Used to adhere flexible PVC membranes to substrates like wood, concrete, and cement board.

- **Coverage Rate**: Typically applied to both the substrate and the membrane at a rate of **100–120 ft²/gallon**, which results in a finished bond covering roughly **50–70 ft²/gallon**.
- **Compliance**: Meets strict environmental and safety standards, often appearing in Miami-Dade County Notice of Acceptance (NOA) documents for high-velocity hurricane zones.
- **Composition**: A solvent-based adhesive formulated to comply with **VOC (Volatile Organic Compound)** regulations, making it suitable for use in regions with stricter air quality laws.

Common Industry Roles

- **Roofing Systems**: Frequently specified in high-performance roofing systems, such as those by O'Sullivan Films (Continental Deck Membrane).
- **Solar Installations**: Utilized in patented methods for securing flexible photovoltaic solar panels directly to PVC roofing membranes.

Safety and Documentation

- **SDS/MSDS**: Safety Data Sheets for Pliobond 1746 are available through professional databases like MSDS Digital for detailed chemical and handling information.
- **Installation**: Must be installed in strict compliance with the specific roof assembly's published literature and local building codes.

Pliobond 1746 and 7008 PVC Bonding Adhesives

Pliobond 1746

is a specific type of solvent-based, VOC-compliant, thermosetting adhesive, primarily used in commercial roofing for bonding PVC (Polyvinyl Chloride) membranes to substrates like roof boards, offering a strong, flexible, and durable bond resistant to environmental factors. Manufactured by Ashland Inc., it's applied to both the membrane and substrate for secure adhesion in roofing systems, often approved for high-wind areas like Florida.

Key Characteristics:

- **Type:** Thermosetting, solvent-based, PVC bonding adhesive.
- **Application:** Used to adhere PVC roofing membranes to roof deck layers.
- **Performance:** Creates tough, chip-resistant, flexible bonds.
- **Compliance:** VOC (Volatile Organic Compound) compliant, meeting environmental standards.
- **Approval:** Miami-Dade County and UL Classified for roofing applications.

In essence, it's a specialized industrial glue for putting roofs together, particularly PVC ones, ensuring they stay stuck even in tough conditions.

Pliobond 7008

is a specific type of water-based, thermosetting urethane adhesive from Bostik (formerly Ashland), primarily used in commercial roofing to bond PVC or TPO membranes (like DeckShield) to substrates such as wood, concrete, or cement board, providing strong, flexible, and durable bonds resistant to weathering and high winds.

Key Characteristics & Uses:

- **Type:** Water-based, urethane adhesive.
- **Application:** Used for adhering roofing membranes to decks, providing waterproofing and structural integrity.
- **Compatibility:** Bonds well with PVC roofing membranes and various substrates like concrete, wood, and cement board.
- **Performance:** Offers durable, flexible bonds suitable for high-velocity hurricane zones (HVHZ), as confirmed by Miami-Dade County approvals.
- **Manufacturer:** Produced by Bostik (formerly Ashland).

In essence, it's a specialized construction adhesive for durable commercial roofing systems.

Hot Air Welding Equipment Maintenance

Before Welding Visually inspect all hot air welders, both hand-held and robotic, for damage, loose parts or screws, and cleanliness. Check drive wheel and drive belt, pressure wheel, rear guide wheel, and all other mechanical parts. Motion testing of the robotic welder to ensure it is tracking straight should also be done before welder is used for membrane seaming. Ensure you have a clean, consistent power source for your hot air welders. Generators should not be used to power other tools when hot air welders are in use. The surging created by other power tools cycling on and off can cause inconsistencies in the final welded product. Often times a job site/facility power source is preferred. However, it is recommended that extension cord length does not exceed 100', which means generators may be required on some job sites. Cut pieces of membrane to create test welds to ensure the settings of the robotic and hand-held welders are correctly configured to the current membrane and environmental conditions. Perform a 4' or 5' (1.22 m or 1.52 m) test weld before beginning each day's application and any time the hot air welder has been turned off for any length of time, to check peel strength, consistency, weld width, etc. Adjust the welder accordingly. Make sure the membrane is clean and dry on both sides of the membrane to be welded. If dirt and/or contaminants are not removed by wiping the membrane with a clean dry cotton cloth, a single Ply membrane cleaner may be used. If a cleaner is used, give an appropriate amount of time for the solvents to completely flash off, approximately 5 minutes.

Hand-Held Hot Air Welding:

After verifying the areas to be welded are clean and dry, seams are aligned with the minimum required overlap, and the welding equipment is set to the calibrated temperature setting; welding of the seam or flashing may begin.

1. Lift the top layer of membrane to insert the nozzle of the handheld welder underneath the end of the nozzle at a 45° angle to the seam.
2. Apply pressure with the 2" rubber/silicone roller, moving back and forth, parallel to the end of the nozzle, extending ½" past the nozzle in each direction.
3. Follow the hand-held hot air welder approximately ¼" – ½" behind the nozzle end as you continue down the weld in a smooth and consistent movement. If you must stop in the middle of a weld for any reason, make sure to pull on the last section of weld to release any cold or false welds. Then insert the nozzle back into the weld and continue as described above.

Robotic Hot Air Welding:

Robotic hot air welders provide many performance advantages over hand-held hot air welders, but their larger size and directionality do not make them applicable in all situations. Several advantages are consistent speed of weld, constant pressure on welded areas, higher powered heating elements, built-in air damn, and repeatability. Field seems to be completed by a robotic hot air welder. After verifying the areas to be welded are clean and dry, seams are aligned with the minimum required overlap, and the welding equipment is set to the calibrated temperature setting; welding of the seam or flashing may begin. To begin the welding process, align the drive wheel of the welder onto the edge of the top layer of membrane, move the rear guide wheel onto the same edge of the top layer of membrane, and insert the 2" nozzle into the lap to be welded. Fully seating the nozzle in the lap should activate the automatic movement function of the robotic hot air welder. **NOTE**: Use caution as the robotic hot air welder's direction of movement usually is in the backward walking direction for the operator. The assistance of a spotter and cord person is recommended. Surface irregularities can cause the pressure wheel to move slightly away from the seam. If this happens, apply light pressure on the machine's upper handle to maintain travel in a straight line and keep even pressure of the drive wheel on the welded seam area. As the hot air nozzle moves along the weld area, the wide drive wheel behind the nozzle (relative to the direction of movement) applies immediate and uniform pressure to the heated seam area. Check all robotic hot air welded seams for voids and repair with a hand-held hot air welder before the end of each working day.

T-Joints: T-joints occur where three layers of membrane intersect. Voids may occur along the edge of the middle layer of membrane between the upper and lower layers of membrane. After the lower and middle layer of membrane have been welded: In the case of hand welding:

1. To seal the void, gently lift the upper membrane sheet and apply sufficient hot air to heat both membrane surfaces.
2. Then, using the edge of a silicone rubber roller, roll and fuse the upper membrane surface into the lower membrane. A crease developed along the intersection of the two surfaces indicates a proper weld.

In the case of robotic welding:

1. To seal the void, when the robotic welder passes over the T-joint and the pressure wheel clears, use the edge of a silicone rubber roller to roll and fuse the upper membrane surface into the lower membrane. A crease developed along the intersection of the two surfaces indicates a proper weld.
2. Applying heat to the top side of the upper membrane sheet will not effectively fuse the two membranes together and will only damage the upper membrane sheet. It is recommended patching all T-joints — including base flashing — using a 4.5" (11.43 cm) rounded piece of detail membrane or PVC T-Joint Patch.

- **Repairing Scorched Membranes:** If a section of the membrane's surface is over-heated, the burned or discolored membrane must be patched, as a good weld cannot be achieved.
    - To repair a scorched section, cut a patch in a square or rectangular shape with rounded corners. Patches should be cut to extend at least 3" (7.62 cm) beyond all damaged areas. Allowing for a minimum of 1.5" (3.81cm) weld width on all sides.
    - Center the patch over the cut area and weld to the membrane, using normal hand-held hot air welder procedures. A reinforced membrane is to be used for patches on field membrane; non-reinforced membranes are to be utilized at areas requiring a tight contour or change in direction.
- **Probing Seams Test:** Test all welded seams for integrity and continuity before the end of each workday. Hot air welded seams may be tested as soon as the seams cool. Testing prior to the cooling of the seam will cause damage to the membrane and the weld. After the weld has cooled, carefully test every seam, t-joint, and patch along its entire length. Do this by running a blunted scratch awl, cotter key extractor or other round-tipped, blunted tool along the seam edge while applying firm, steady horizontal pressure. It is imperative to avoid scoring the membrane that has just been welded. Any penetration of the probe into the seam indicates a void in the weld, which must be repaired.
- Continuous seam probing will tend to sharpen the tip of the probe, so it is important to blunt the tip of the probe regularly.
- **Testing Seams:** In addition to probing, take seam samples to verify seam quality as necessary. Cut the samples across the seam 6" (15.24 cm) on each side of the seam and 1" (2.5 cm) wide. Peel these samples by hand to test seam strength. Good seams will be virtually impossible to peel and should delaminate the PVC film from the reinforcing scrim. Cut and test a sample at the beginning of each day. Take additional test cuts when weather conditions change or after work interruptions when the automatic hot air welder has been shut off.
- **Sealing Test Seams:** Not all manufacturers recommend the use of PVC Edge Sealant, only the ones that use wicking reinforcements. This prevents water from entering the welded area through wicking or capillary action. Weld and seal seams at all cut edges on the same day. Clean and dry any edges that stand overnight to ensure good sealant adhesion. Apply sealant with a squeeze bottle. Draw the tip smoothly along the cut edge of the membrane to produce a uniform 1/8" (3.18 mm) bead.

Installation of roof drain in a PVC roofing system

Installing a roof drain in a PVC (Polyvinyl Chloride) roofing system

requires careful sealing to maintain the membrane's watertight integrity. Because PVC is a thermoplastic, the most reliable method for sealing at a drain is hot-air welding a reinforced PVC flashing directly to a PVC-coated drain flange.

Installation Steps

1. **Preparation and Sumping**: Cut the insulation around the drain to create a "sump" (typically 36" x 36" or 48" x 48"). This ensures water flows toward the drain rather than pooling around it.
2. **Setting the Drain Body**: Secure the drain body to the roof deck using an underdeck clamp to prevent movement. Connect the outlet to the internal plumbing using a flexible rubber coupling.
3. **Applying Water Block**: Apply a thick bead of **water block sealant** (a non-curing butyl sealant) on the drain flange. This acts as a secondary gasket under the PVC membrane.
4. **Membrane Placement**: Lay the PVC membrane over the drain. Identify the drain bolt holes by pressing on the membrane, then cut small holes to expose them.
5. **Flashing and Welding**: For maximum security, use a **PVC-coated drain flange**. Hot-air weld the PVC roof membrane directly to the plastisol coating on the drain flange.
6. **Clamping Ring Installation**: Place the metal clamping ring over the membrane and tighten the bolts in a crossing pattern to ensure even pressure. This creates a mechanical seal against the water block sealant.
7. **Final Components**: Install the **dome strainer** (trash guard) to prevent debris from clogging the pipes.

Critical Considerations

- **Compatibility**: Ensure the drain flange is compatible with PVC. Standard cast iron drains require a "target patch" of PVC membrane and heavy-duty clamping.
- **Retrofit Options**: If replacing a drain on an existing roof, PVC RetroDrains allow you to install a new system without tearing up the entire deck.
- **Fastening**: Insulation around the drain must be independently fastened to the deck to prevent shifting that could tear the membrane.

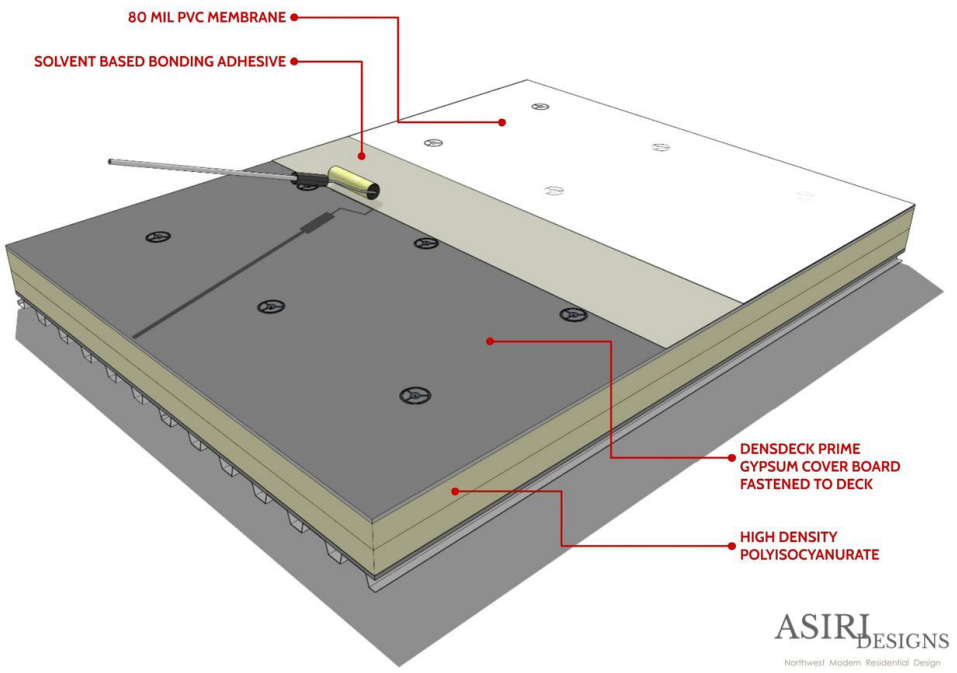
Are you installing this as a **new construction** project or as a **retrofit/repair** for an existing leak?

A Crash Course on Adhered PVC Roof Membranes

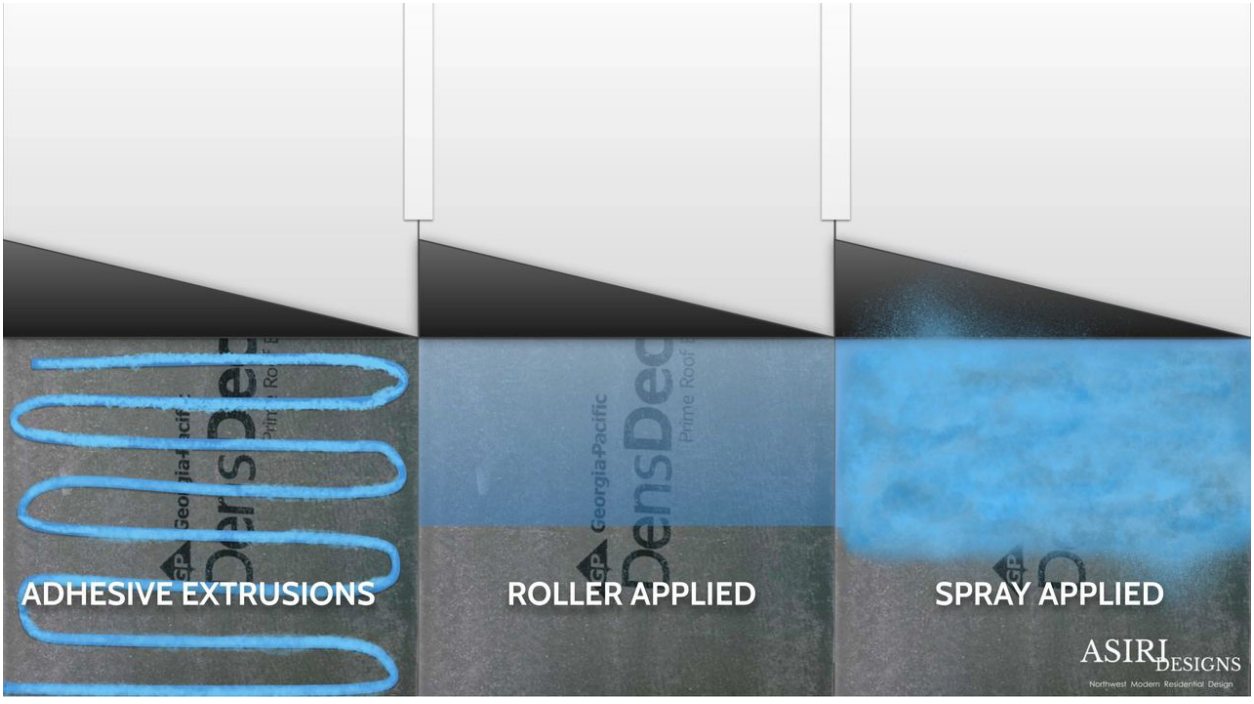
PVC roof membranes can be installed as either mechanically fastened or adhered systems. Rather than screwed to the roof's substrate at regular intervals, adhered PVC membranes are glued to the roof's substrate which provides the benefits of a robust water and air barrier, as water and air leakage cannot occur underneath the membrane, compared to mechanically fastened systems. Additionally, fully adhered PVC membranes are more resistant to wind uplift forces that can cause the membrane to "flap", impacting the integrity of the membrane and its ability to resist water entry, as these forces can weaken and even tear the membrane over time (Building Science, 2023).

Installing Adhered PVC Membranes

The PVC membrane is rolled out onto the roof's substrate and left to "relax" prior to applying any adhesives to the substrate or to the underside of the membrane. For standard PVC membranes without a fleece backer, a compatible bonding adhesive is applied to both the substrate and the underside of the membrane and rolled to ensure a strong bond. After the membrane has been adhered to the substrate, the seams and joints are hot air welded to complete the installation.



The adhesives that are applied to the substrate and/or the membrane must also be left to cure for a period of time specified by the manufacturer in order to obtain the ideal level of tackiness and consistency prior to the installation of the membrane. If the adhesives are too wet, proper adhesion to the deck cannot occur since the membrane will be “sliding” around, resulting in bubbling and blistering (most common in water-based adhesives). However, if the adhesives are too dry the membrane will not adequately bond to the substrate, and patterns left behind by the adhesives can also show through the membrane if the adhesives were gunned onto the substrate.



Adhesives can be installed as continuous extrusions with diameter and spacing depending on the adhesive used and the uplift requirements. The adhesives can also be rolled onto to the membrane and the substrate with a roller, or spray applied with a mechanized rig. Roller applied and spray applied applications are the only way to ensure a 100% coverage rate so that the membrane is truly “fully adhered”.

The adhesives are either sprayed, rolled, or gunned onto the surface of the roof, depending on the type of substrate, the type of PVC membrane specified, the type of adhesive specified, the ambient outdoor temperature, and the cost of the application. Full coverage of the roof’s substrate is preferable, as this will ensure that the roof membrane is truly a “fully” adhered system, providing the highest level of strength and resistance against water and air infiltration. The adhesives can also be applied in continuous undulating beads that expand and cure into foam-like extrusions.

Types of Adhesives

The glues used for adhered PVC membranes fall under the category of solvent-based adhesives and water-based adhesives. The types of adhesives that will need to be specified will vary depending on the system manufacturer and whether the PVC membrane has a fleece backer.

Solvent-Based Adhesives: Solvent-based adhesives, such as synthetic rubbers, tend to be the gold standard for most applications and substrates (including on concrete roof decks), as solvents cure quickly and are not typically impacted by the presence of moisture. Solvent-based adhesives can also be applied in much colder temperatures compared to water-based adhesives. However, solvent-based adhesives tend to be highly odorous and flammable, and great care must be taken to prevent the noxious off-gassing vapors from affecting the occupants of the existing structure, or people nearby. While low-VOC products are available on the market, the adhesives are still flammable. Fire extinguishers should be located nearby during the application of these types of adhesives.

Water-Based Adhesives: Water-based adhesives are typically specified when a low-odor/low-VOC or non-combustible product is desired, as water-based adhesives are significantly less dangerous to work with compared to solvent-based products. Use caution when specifying water-based adhesives or primers for flat roof substrates, especially on concrete roof decks that sequester moisture. Exposure to water turns water-based adhesives back into gloopy sludge, compromising the membrane’s adhesive bond to the substrate. While some water-based adhesives can be used successfully on flat roof assemblies with wood and steel framing, care should be taken by the roofer to ensure that the adhesives are not applied too thickly or pool in certain areas, as this can impact the drying time and adhesion. Additionally, water-based adhesives take longer to cure (72 hours is not uncommon).

Polymer-Based Adhesives: Polymer-based adhesives are another sub-category of adhesives designed for PVC membranes. These tend to be low-VOC products that are relatively flexible, allowing

the roof membrane to expand and contract with temperature changes and building movement. While polymer adhesives are flexible, they are typically limited to application temperatures of 40- or higher. Some polymer-based adhesive products may be specified with other types of single-ply membranes such as TPO or EPDM, however, it's important to verify the compatibility with the manufacturers.

Urethane Adhesives: Designed to bond membranes with fleece backers to a range of substrates, urethane adhesives for PVC membranes are composed of a two-part system, an "A" component and a "B" component that is combined using a mechanized rig that distributes and delivers the proper proportions of the chemicals at the right temperature to form the adhesive in the field - similar to rigs used for spray foam applications. The application temperature for urethane adhesives is also extremely important, especially in low-temperature installations. While spray-applied urethane adhesives can be installed in temperatures as low as 25- , the mixture must be heated to around 70- to ensure flexibility, as the adhesives can harden quickly when exposed to cold temperatures.

Cover Boards and Substrates for Adhered PVC Membranes

PVC roof membranes can be adhered directly to coated glass faced rigid insulation or to a moisture and rot-resistant cover board material that is compatible with the membrane adhesives.

Cover Boards That Are Compatible With Adhered PVC Membranes:

Adhered PVC membranes can be bonded to a number of substrates including primed gypsum cover boards, coated glass-faced high-density polyisocyanurate, and even some OSB products that are bonded to high-density polyiso.

- **Gypsum cover boards**, such as Densdeck Prime and Securock, are composed of a gypsum core similar to sheetrock, and a facer such as glass mat, coated glass, or glass-reinforced cellulose fibers. Gypsum cover boards provide impact resistance and fire resistance to the top side of the assembly, as well as a uniform substrate for the installation of adhered roof membranes. Gypsum cover boards with coated glass and glass mat facers are also mold-resistant and will not support biological growth. However, gypsum cover boards do not have a high hygric buffer capacity and will crumble if they get sufficiently wet. It is imperative that gypsum cover boards are dry during installation and remain right throughout the service life of the structure. Avoid gypsum coverboard products with cellulose fibers or paper facers, as these are the most sensitive products to moisture. If they get wet, they can sustain mold and biologic growth, and cause the membrane to delaminate from the substrate, compromising the integrity of the roof.
- **Rigid high-density polyisocyanurate** is also a common substrate for many adhered roof membranes, especially for PVC. While many manufacturers will recommend high density polyiso

products with reinforced fiber facers and even paper facers, only coated glass facers should be specified, as they do not experience any loss of bonding strength when exposed their moisture. The polyisocyanurate products specified for adhered PVC membranes must be high density, or otherwise an additional cover board layer should be installed over the medium density products, as the thermal stresses in the membrane must be transferred to the structural deck or framing. Some warranties require that the adhered PVC membrane is installed on a gypsum substrate over high-density coated glass faced polyiso in regions that must resist hail, as this can damage the polyiso below, increasing the potential for deformities in the membrane if it's bonded directly to the insulation.

- **OSB and ACX plywood substrates** have a higher hygric buffer capacity than the gypsum cover boards, will not crumble when exposed to small amounts of water, and are impact-resistant. However, because both OSB and plywood are composed of wood (and therefore cellulose), mold and other biological growth will consume it as a food source if the moisture is not able to dry out. Use caution when specifying moisture-sensitive substrates and avoid them completely in assemblies with concrete roof decks, as the concrete sequesters an enormous amount of moisture that will often be driven upwards.

However, fleece-backed PVC membranes are only compatible with coated glass gypsum and high-density polyisocyanurate with coated glass facers. Gypsum and polyiso cover board products with cellulose fiber facers should never be specified in fleece-backed PVC applications, as recommended by all manufacturers of fleece-backed PVC membrane products for the delamination risks mentioned above. OSB and plywood substrates should also be avoided.

How Thick Are Adhered PVC Roof Membranes?

Standard adhered PVC membranes typically come in the same standard sizes as their mechanically fastened counterparts, and are available at 50 mil, 60 mil, and 80 mil thicknesses. However, fleece backed PVC membranes are thicker than standard bareback PVC, as they have a 55-mil thick polyester fleece fabric bonded to the underside of the PVC membrane. These membranes come in 105 mil, 115 mil, and 135 mil thicknesses, impacting the types of adhesives that can be specified for these membranes, as well as the flashing details at roof to wall intersections such as parapets.

Most fleece backed PVC membranes are designed to be installed with two-component urethane adhesives rather than the contact bonding adhesive typically used for standard "bare backed" PVC membranes, increasing the total thickness of the membrane buildup.

PVC Membrane Induction Welding

The isoweld® induction fastening system is designed to fasten both insulation and roof membrane with a single plate/fastener combination. For 4' x 8' insulation boards, the fastening density is primarily determined by wind uplift requirements (FM Ratings), with typical field installation patterns ranging from 6 to 32 fasteners per board.

Typical Isoweld Fastening Patterns (4' x 8' Board)

The following are common patterns based on field, perimeter, and corner requirements:

- **6 Fasteners per Board (Minimum/Field):** Commonly used for general field attachment (1 per 5.33 sq ft).
- 8 Fasteners per Board (Standard Field): Commonly used for 1-90 wind ratings.
- **16 Fasteners per Board (Enhanced):** Used for higher wind loads, often with 2' x 2' spacing density.
- **20-32+ Fasteners per Board (High Wind):** Used in corner/perimeter zones to achieve higher FM ratings.

Fastener Spacing Layouts (4' x 8' Boards)

- **Standard (6-8 per board):** Usually placed in two rows, with 3 to 4 fasteners per row, spaced roughly 24" to 32" apart along the 8-foot length.
- **Enhanced (16 per board):** A common grid is 2 rows of 8 fasteners (approx. 12" o.c. along the 8-foot edge, and 24" o.c. along the 4-foot edge).

Key Installation Guidelines

- **System Components:** Use isoweld-coated plates (purple for PVC) with #15 fasteners.
- **Board Orientation:** Boards should be laid with long dimensions perpendicular to steel deck ribs.
- **Perimeter/Corner Zones:** Fastening density must be increased by 50% or more compared to the field, usually meaning 16–32 fasteners per 4' x 8' board.
- **Adhered Systems:** When using isoweld for insulation attachment in a fully adhered system, ensure the layout meets the specific manufacturer's wind uplift requirements.

Note*:* Always consult the specific roofing system manufacturer (e.g., SFS, Goliath) for the exact approved fastening pattern for your project's wind rating.

Isoweld fastening patterns for 4' x 8' insulation boards use specific numbers of fasteners per board, with common rates being 6 or 8 fasteners per board for standard field-of-roof applications, depending on the required wind uplift rating. The system is designed for use on the larger 4' x 8' boards, and the fastening

density for smaller section sizes (like 1' x 1' or 2' x 2') would need to meet or exceed these required square footage rates.

Standard Fastening Rates for 4′ x 8′ Boards

The required number of fasteners for a 4' x 8' board (32 sq. ft.) typically depends on the specified wind uplift rating (e.g., FM 1-90, FM 1-120, etc.).

- **1 fastener per 4 sq. ft.:** This results in **8 fasteners per 4' x 8' board**. This is a common rating for some FM 1-90 applications.
- **1 fastener per 5.33 sq. ft.:** This results in **6 fasteners per 4' x 8' board**. This is a common requirement for some standard field of roof applications and FM 1-90 ratings.
- **Higher wind uplifts:** Applications requiring higher wind uplift ratings (e.g., FM 1-150) may require more fasteners, such as **20 fasteners per 4' x 8' board** or even up to 30+ fasteners per board in certain scenarios.

Fastening Patterns for Smaller Sections

The Isoweld system uses a **grid-type pattern** to distribute securement evenly across the roof, with the plates positioned in-line on the substrate. The overall density per square foot dictates the pattern, which can be applied regardless of how the board itself is notionally divided.

- **For 1' x 1' sections:** To achieve a common fastening density (e.g., 1 fastener per 4 sq. ft.), you would need a fastener every 2 feet in a grid pattern. To meet higher densities (e.g., 1 fastener per 2 sq. ft.), the grid spacing would be tighter. A manufacturer recommendation for general adhesive application mentions a grid layout of **1 pin every 12" in each direction (1 pin per sq. ft.)** for certain applications, which is a very high density.
- **For 2' x 2' sections:** Using a 1 fastener per 4 sq. ft. rate, a single fastener would be placed within each 2' x 2' square (e.g., at the center).

Important Considerations

- **Consult Manufacturer Specifications:** Fastening patterns are highly dependent on the specific **deck type** (steel, concrete, wood), **insulation product**, **thickness**, and required **wind uplift rating** and building height. Always refer to the specific manufacturers (e.g., Carlisle, Johns Manville, SFS) most current design reference documents or contact their design services for the exact approved pattern for your specific project.
- **Perimeter and Corners:** The perimeter and corner zones of a roof require a significantly increased (often 50% or more) fastening density compared to the field of the roof.
- **Induction Welding Process:** The Isoweld system works by first mechanically attaching the plates to the deck in the specified pattern, laying the membrane over the top, and then induction-welding the membrane directly to the plate, creating a non-penetrating assembly.

The isoweld® induction fastening system is designed to fasten both insulation and roof membrane with a single plate/fastener combination. For 4' x 8' insulation boards, the fastening density is primarily determined by wind uplift requirements (FM Ratings), with typical field installation patterns ranging from 6 to 32 fasteners per board.

Typical Isoweld Fastening Patterns (4' x 8' Board)

The following are common patterns based on field, perimeter, and corner requirements:

- **6 Fasteners per Board (Minimum/Field):** Commonly used for general field attachment (1 per 5.33 sq ft).
- 8 Fasteners per Board (Standard Field): Commonly used for 1-90 wind ratings.
- **16 Fasteners per Board (Enhanced):** Used for higher wind loads, often with 2' x 2' spacing density.
- **20-32+ Fasteners per Board (High Wind):** Used in corner/perimeter zones to achieve higher FM ratings.

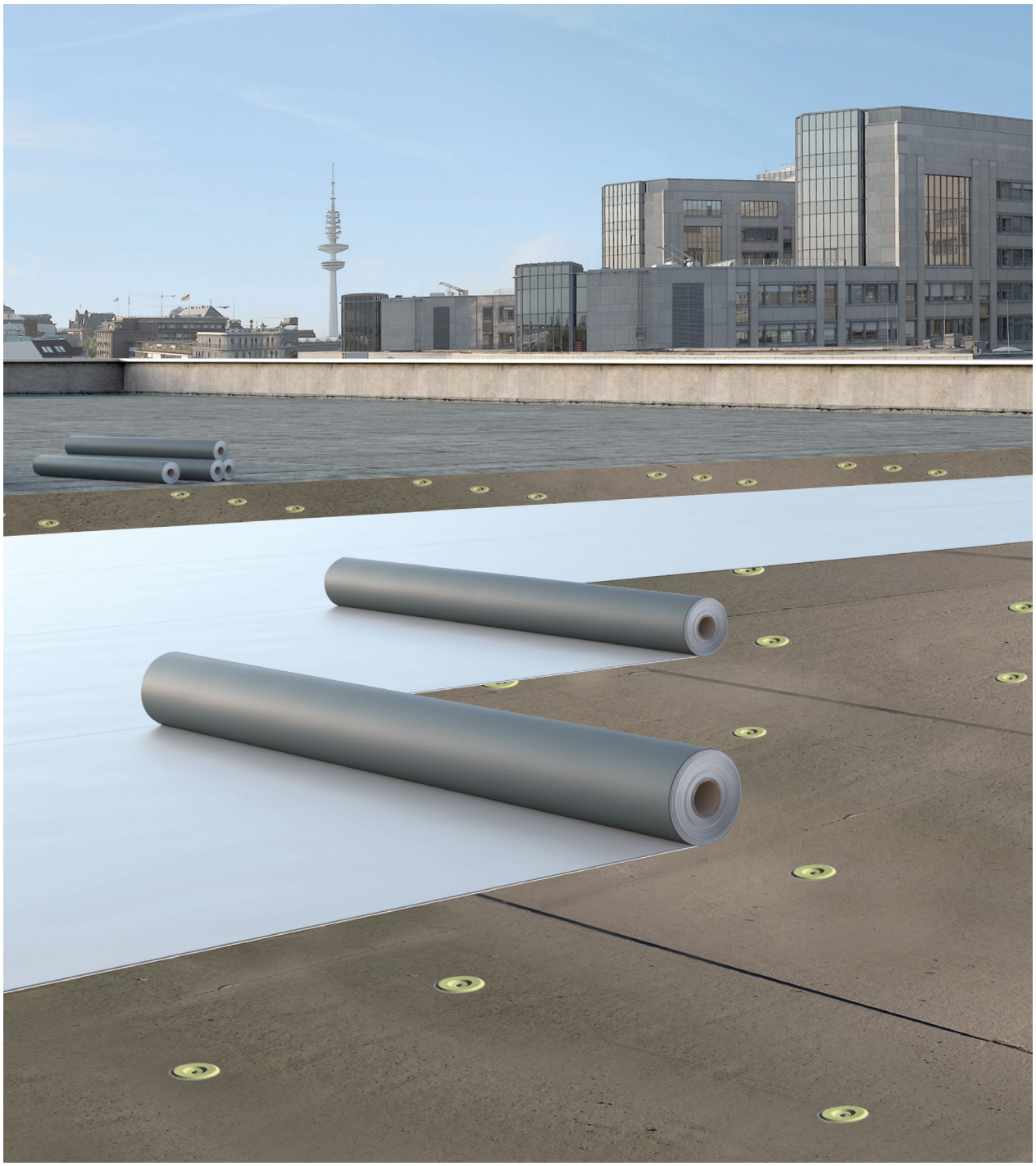
Fastener Spacing Layouts (4' x 8' Boards)

- **Standard (6-8 per board):** Usually placed in two rows, with 3 to 4 fasteners per row, spaced roughly 24" to 32" apart along the 8-foot length.
- **Enhanced (16 per board):** A common grid is 2 rows of 8 fasteners (approx. 12" on center along the 8-foot edge, and 24" on center along the 4-foot edge).

Key Installation Guidelines

- **System Components:** Use isoweld-coated plates (yellow for TPO, purple for PVC) with #15 fasteners.
- **Board Orientation:** Boards should be laid with long dimensions perpendicular to steel deck ribs.
- **Perimeter/Corner Zones:** Fastening density must be increased by 50% or more compared to the field, usually meaning 16–32 fasteners per 4' x 8' board.
- **Adhered Systems:** When using isoweld for insulation attachment in a fully adhered system, ensure the layout meets the specific manufacturer's wind uplift requirements.

Note: Always consult the specific roofing system manufacturer (e.g., SFS and Goliath) for the exact approved fastening pattern for your project's wind rating.



Goliath PVC Roof Inspection and Roof Maintenance Guide

Overview

The most important reason for establishing a program of regular roof maintenance is to protect the owner's investment. A properly executed maintenance program will add years to the life of the roof by detecting minor problems before they become major, as well as providing better protection for, and avoiding interruption of, the internal functions of the building.

A roof system is exposed to all manner of chemical and physical stress. The long-term effects of these forces are called "Normal Aging". In reality, small, isolated problems caused through abuse, stress concentration, inadequate ventilation, error, or other factors result in a shortened lifespan of the roofing system.

Small problems or defects, if not detected and repaired, inevitably become major problems affecting the performance of the whole roof system.

Roofs represent approximately 5 to 7% of capital building costs - but roofs cover 100% of the building and its contents.

Roof Types (Definitions)

Membrane Roofing

Conventional Uninsulated

Roof membrane is installed directly onto the deck (usually wood or concrete) and is exposed to the weather. There is no insulation directly below the membrane. In a wood deck of this type of insulation, if used, is typically installed in the supporting joist space, which must be cross-vented.

Conventional Insulated

Roof membrane is installed directly over insulation material, which is installed on the deck (wood, concrete or steel). The membrane is exposed to the weather.

Protected (or Inverted) Membrane

A roof membrane is installed directly on the deck (wood, concrete or overlaid steel). Extruded

polystyrene is installed over the membrane covered by filter fabric and appropriate ballast. Ballast is required to counteract insulation flotation and wind uplift, and to provide ultraviolet resistance for the insulation. A modified protected membrane includes insulation both above and below the membrane. It is often used to provide a slope for the membrane to improve drainage* or to move the dew point away from the membrane.

*The building code states that the roof structure must provide positive drainage.

Steep Roofing

In the context of this guide, steep roofing may be defined as roofs with asphalt shingles, cedar shakes or shingles or metal roofing on slopes that exceed 1:6 (2” in 12”).

Membrane Types (Most Common)

Built-Up Roofing (also called “Tar & Gravel” or “BUR”)

A continuous, relatively inflexible roof assembly consisting of plies (usually 3 or 4) of saturated felts or fabrics between which layers of bitumen (asphalt, pitch, or modified rubberized asphalt) is applied. The roof is usually surfaced with gravel to provide ultraviolet protection.

Flexible Membranes

Flexible membranes encompass a large number of unique membranes installed in single or multi-ply applications. The materials may be bituminous or non-bituminous and offer a wide choice of physical properties and performance.

The key point with these membranes — from a maintenance and repair standpoint — is that each type is unique. The building owner must be aware of the specific type and product in place in order to know what maintenance is required and what specialized repair materials and methods should be used.

Remember: “This Roof May Be Different”

Common Types of Flexible Membranes are:

Modified Bitumen

A generic description for pre-manufactured sheet membranes consisting of asphalt, modified with a polymer, which improves the physical properties of the asphalt and coated on a reinforcing mat or carrier. Different polymers offer different physical properties. Sheets may be installed either in hot asphalt or by heating with a propane torch, and in some cases they may be self-adhesive. Applications normally

consist of 2 plies but may be a single ply in certain well-slopped applications. Modified Bitumen Membranes are used in all roof types.

EPDM (Ethylene Propylene Diene Monomer)

A generic description for synthetic rubber sheet membranes. Applied only in single-ply applications on all roof types. Seams are accomplished with proprietary adhesives.

PVC (Polyvinyl Chloride and TPO (Thermoplastic Polyolefin)

Generic descriptions for a plastic sheet membrane. Applied in single-ply applications on all roof types. Seams are accomplished by fusion either with solvent or hot-air welding techniques.

Although these are the most commonly used generic flexible membranes, there are other types on the market (each of which, as mentioned, requires special knowledge and techniques). Make sure you know what you are dealing with.

Basic Preventive Maintenance

A preventive maintenance program is simply a program of scheduled inspections and subsequent corrective action. The purpose is to maximize the life expectancy of the roofing system, thus providing maximum protection to building and contents and minimizing overall costs.

The basic elements of a preventive maintenance program for roofs are:

- Regular visual inspections to determine the current condition of the roof membrane and flashings.
- Immediate repair of any defect before it allows moisture to enter the roof system or building interior.
- Non-destructive moisture detection to determine if moisture has infiltrated into the insulation of the roof system.

A vital part of the condition of the roof system is whether or not the insulation remains dry. A roof may appear to be in excellent condition from the surface, but may have areas of saturated insulation, which severely affect the thermal efficiency of the roof.

Non-destructive moisture detection of roof systems has developed into a sophisticated technique that can provide accurate analysis of roof insulation condition. Two commonly used systems are nuclear meter and infrared thermography. Both systems require trained skilled operators, specific weather conditions, specific roof types, and professional analysis. Visual inspection by a trained person is the key to a successful maintenance program.

Inspection

Roofs should be inspected at least twice a year — spring and fall — and after any significant weather or construction event.

The inspection should be preceded by the preparation of a detailed roof plan on which all defects or notes can be marked. If the inspection indicates that more than minor work is required, an inspection checklist is necessary to ensure thoroughness. Call your professional roofing contractor to perform the required maintenance work.

A typical roof plan and an inspection checklist are included in this guide for your convenience.

Begin the inspection by looking at the underside of the deck, if it is accessible, and also at the outside of the building. Look for cracks, stains, rusting, watermarks, efflorescence, wet spots, spalled mortar etc. or other signs of excessive moisture or deterioration. The observations may give clues to not only roofing problems but also other conditions affecting the performance of the building envelope.

The final and most important part is inspecting the roof itself. The keys to a competent roof inspection are thoroughness and attention to detail — be prepared to get dirty!

DO'S and DON'TS of Roof Maintenance

DO's:

- *Do* be aware that wise maintenance will prolong the life of any roof - even the best of them.
- *Do* perform inspections at least twice a year, preferably at the end of winter and right after summer, when roofs have passed through the periods of severest stress.
- *Do* conduct additional inspections immediately after unusual occurrences such as extremely heavy rains, high winds, hail, nearby fires, explosions, etc.
- *Do* check the building exterior for settlement or movement. Cracks in the wall are a warning of possible cracks in the roofing and flashing. Are overhangs, cornices, facias and edging in good condition? Are gutters and downspouts satisfactory? Breaks in roof edge elements can cause leaks and let wind get under the roofing membrane and cause blow-offs. Damaged or clogged gutters, roof drains, and downspouts can cause water back up on the roof.
- *Do* be certain that equipment servicemen going on the roof are warned against penetrating or dropping tools on the roof. They should be accompanied by your trained maintenance man to ensure no damage to the roof assembly occurs.
- *Do* ensure that your roof is kept clean and free from debris.
- *Do* recognize that exposure of roof felts (bare spots) on a gravel surfaced roof can lead to quick deterioration. This requires immediate attention by qualified personnel.
- *Do* be advised that flashings, gum pans, gravel stops and all other roof penetrations are the source of most leaks. Pay extreme and careful attention to these items.

DON'TS:

- *Don't* allow unqualified personnel to maintain your roofs.
- *Don't* allow traffic on your roof unless accompanied by your informed maintenance man.
- *Don't* allow equipment servicemen to penetrate your roof without being certain that qualified personnel flash the penetrations. If your roof is covered by a **Goliath warranty,** then a **Goliath Representative** should be notified prior to cutting the roof or altering it in any manner.

When It's Time to Reroof:

DON'TS:

- *Don't* permit products of unproven quality to be used on your roof.
- *Don't* be taken in by **"Cure-All"** products, which can be applied by anyone.
- *Don't* take bids on projects without adequate, uniform specifications.
- *Don't* reroof over an existing roof unless a careful evaluation is made, and a qualified consultant or standards authority gives prior approval
- *Don't* expect a guarantee to keep the water out of your buildings. Guarantees do not cover many of the problem areas of your roof.
- *Don't* think that the lowest price is always the best. Be certain you will not be faced with a few change order requests for extras after a project is awarded.
- *Don't* deal with firms who cannot stand behind their work and will not be available when you need them. Remember that no product is better than the applicator.

DO's:

- *Do* hire a professional roofer.
- *Do* call a **Goliath** approved contractor
- *Do* request the **Goliath Warranty**
- *Do* benefit from:
    - Independent Inspections
    - **Goliath** Approved Materials
    - **Goliath** Warranties and Installation Standards

Defects in Flexible Membranes

The most important thing to remember when dealing with maintenance or repair to any flexible membrane (be it TPO, PVC, EPDM or modified bitumen) is that you must understand and know the specific system, its components and required repair materials and techniques. Do not mix and match materials without specific instructions from the membrane manufacturer.

PVC Single Ply Membranes

- Referring to the checklist, report on the general appearance of the roof and the surface conditions of the membrane.
- General appearance is primarily a function of housekeeping. Debris, poor drainage, or ponding may be evidence of physical damage.
- Any discolouration, cracking or splitting, as well as punctures, should be noted and repaired.
- Seams should be observed and probed for open joints, fishmouthing or ridging.
- On fully adhered systems, it is important to note any unadhered areas.
- On mechanically fastened systems, a check should be made to be sure that there is no evidence of fasteners backing out or popping. On ballasted systems, the weight and depth of stone ballast should be checked against the design specifications.
- Any signs of scouring should be noted and all gravel redistributed evenly.
- If increased foot traffic becomes necessary, be sure to provide walkways.

The following troubleshooting guide for PVC membranes identifies some defects and the possible causes.

Defect Observed

- Discolouration of Membrane
- Cracking, crazing, or splitting of the membrane
- Fishmouthing or open joints
- Loss of adhesion in fully adhered system
- Loose fastening in mechanically fastened system
- Movement of ballast in loosely laid system
- Ridging or buckling of membrane at insulation joints

Possible Cause

- Chemical or atmospheric contamination
- Possible defective membrane. Call the manufacturer immediately.
- Improper seam welding or adhesive.
- Interlaminar separation between insulation and facing indicating failure of insulation. Separation between membrane and insulation indicating improper application of adhesive. Call the manufacturer immediately.
- Fasteners are not properly installed. Fasteners are too short. Buckling, warping, shifting or corrosive deterioration of deck or structure. Heavy foot traffic.
- Ballast is too small for wind uplift conditions. Foot traffic or vandalism.
- Movement of substrate due to moisture or thermal effects.

Maintenance for Steep Roofing

- Do keep drains and gutters clean.
- Foot traffic on steep roofs should be minimized both for safety reasons and to avoid physical damage.
- Granule erosion on asphalt shingles will lead to early deterioration of the shingle.
- Caulking of flashings must be regularly inspected and maintained.
- Improper ventilation of attic spaces may result in curling and blistering/buckling of asphalt shingles.
- Install zinc strips to prevent moss build-up. Power washing the roof removes moss and other debris but may erode granules on asphalt shingles and may also promote premature degradation of cedar roofing.
- If asphalt shingle tabs are loose, re-tab with a cement recommended by the shingle manufacturer.

Maintenance for Steep PVC Roofing Systems

- Do keep drains and gutters clean.
- Foot traffic on steep roofs should be minimized both for safety reasons and to avoid physical damage.
- Caulking of the metal flashings must be regularly inspected and maintained.

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The GOLIATH Warranty Programs

The **Goliath** warranty program may cover the workmanship and materials, including the flashing. Projects are required that the roof installation is:

Performed to **Goliath** Published Installation Standards

Applied by the manufacturers approved roofing contractor

Follow the printed **Goliath** PVC roofing specifications

Inspected by a **Goliath** representative or by an approved independent inspection firm

Only includes only **Goliath** approved materials and systems

Required Maintenance Items

To maintain the validity of a Goliath warranty, the building owner must properly maintain:

Drains, Gutters and Downspouts

Clear away any debris that may impede their function. In addition, if they are clogged and cannot be readily cleared, get professional help. Make sure that any drain screens installed are still in place and function as intended.

Reglets

These joints are designed to be the first line of defense against water penetration. Proper caulking should always be maintained in these reglets.

Caulking of Metal Flashing

Caulking of joints in metal flashings such as copings, counter flashing, roof top units, curbs, expansion joints etc., requires regular inspection, cleaning and recaulking, or replacement caulking. Always use a caulking material that you have checked out to be compatible with all components in contact with the caulking.

Gum Pans / Pitch Pockets

A potential source of trouble, these high maintenance items should always be filled and “crowned” with roofing cement or compatible sealant to shed water. Their waterproofing ability depends on keeping them full and free of cracks.

Plumbing Caps

Check to make sure plumbing caps on vents are in place. Replace all caps if necessary. Do not just hammer or bend lead stacks. Use the proper cap.

Insulation Boards

In a protected membrane assembly, the insulation and ballast system may be designed to “float” under heavy rainfall conditions. If, under these circumstances, some of the gravel ballast is displaced and the scrim sheet is exposed, ballast can be added or moved to prevent floatation and to provide cover. Cautionary Note: If ballast is added, ensure that the added weight does not compromise the integrity of the roof structure. If there is any doubt at all, contact a structural engineer for a professional opinion.

Roof Traffic

It is important to ensure that maintenance personnel who require access to roof-top equipment do not cause any damage while working on the roof. A roof should never be used as a patio or sun deck unless proper protection has been provided.

In addition, roof-top equipment and protrusions such as ventilators, plumbing stacks, etc., should never be used as anchors to tie down aerials, satellite dishes and the like.

Rooftop Alterations

Always contact your professional **Goliath,** approved roofer to seal and flash any new rooftop equipment or for any other alterations to the roof system. Any unauthorized alterations to the roof could result in voiding the manufacturer's warranty. Alterations must be inspected and reported for conformance to Goliath warranty conditions.

Roof Spills

Your professional roofer should clean any accidental spills of material to the roof system, such as oil-based products, as soon as possible. If there is an on-going potential for this kind of spill, such as around a vent from a kitchen exhaust, call your roofing professional to recommend a long-term solution.

Change in Use / Occupancy

If the use of a building has changed due to a change in the owner or tenant, consider its effect on the roof system. For example, an increased humidity condition beyond the limits of the roof system's vapour retardant could allow moisture transmission from within the building's interior into the roof system. This, in turn, could lead to premature problems and the possible failure of the roof system.

GOLIATH Warranty Inspections

Regular walk-over inspections should be made and documented at least twice a year - once in the Spring, and once in the Fall.

Spring inspections permit observation of possible winter damage and allow for maintenance to be scheduled and completed during the best possible weather.

Fall inspections can disclose requirements for preventative measures that should be taken in preparation for the oncoming winter.

Extra inspections should be made after major storms or after any construction activity that could affect the roofing system.

If you need help: CONTACT YOUR GOLIATH REPRESENTATIVE

Warranty Program Guidelines

To maintain the validity of the warranty the building owner must:

- **ENSURE** that the roof and its components are properly maintained. Items such as caulking of flashings, maintenance of gum pans, clearance of drains and debris, wind damage are considered maintenance items and are the building owner's responsibility.

- **ENSURE** that any modifications or repair work done on the roof during the warranty period is performed to industry Standards by an approved contractor of **Goliath** and inspected by a **Goliath** accepted representative or independent inspection firm. **Goliath** must be notified in writing of any modifications or repairs to the roof under warranty.
- **UNDERSTAND** that the warranty is not negotiable or transferable without the written consent of Goliath.
- **UNDERSTAND** that access to the roof must be granted to the **Goliath** representative or the accepted independent inspection firm to carry out the mandatory two-year re-inspection as per the conditions of the **Goliath** warranty.
- **UNDERSTAND** that if a claim under the warranty proves not to be within coverage, then the costs of inspection, investigation and subsequent repairs will be to the building owner's or roofing contractor's account.
- **UNDERSTAND** that "reused" materials (typically reused metal flashings) are specifically excluded from coverage by the **Goliath** warranty.
- **UNDERSTAND** that the guarantee may be voided if the building use changes to any other purpose than that for which it was originally designed.
- **UNDERSTAND** that the guarantors do not assume liability for any leakage resulting from usual and ordinary effects of wear and weather; fire; construction failures, distortions, settlement or faulty design; hail, lightning, earthquake, windstorms, or any other acts of God; nor does this guarantee include liability for damage to the building or contents therein.

Goliath PVC Membrane Codes and Approvals Requirements

The National Building Code of Canada (NBC)

It is a model technical code that sets out minimum requirements for the design and construction of new buildings, as well as the alteration and demolition of existing ones. It is developed by the Canadian Board for Harmonized Construction Codes and published by the **National Research Council of Canada (NRC).**

Key Versions and Access

- **Current Edition:** The National Building Code 2025 was published on December 22, 2025.
- **Previous Edition:** The National Building Code 2020 remains widely referenced as provinces transition to newer standards.
- **Free Access:** Electronic formats are available for free through the NRC Publications Archive. Printed copies can be purchased via the NRC Virtual Store.

Legal Status and Enforcement

The NBC is a **model code**, meaning it has no legal status on its own. It must be **adopted or adapted** by provincial or territorial governments to become law in their jurisdiction.

- **Provincial Codes:** Some provinces, like Ontario and Quebec, create their own codes based on the national model.
- **Federal Jurisdictions:** The NBC typically applies directly to federal lands, including military bases and airports.

Code Structure

The NBC is organized into nine parts covering essential building aspects:

- **Parts 1-2:** Scope, Definitions, and General Requirements.
- **Parts 3-6:** Fire Protection, Safety, Structural Design, and Environmental Separation.
- **Parts 7-8:** Plumbing and Construction Site Safety.
- **Part 9:** Housing and Small Buildings (crucial for residential projects).

Major Recent Updates (2025 Edition)

The 2025 edition (detailed here) highlights, as noted in, advancements in:

ASTM D4434 (formally ASTM D4434/D4434M)

It is the international standard specification for **Poly(Vinyl Chloride) (PVC) sheet roofing**. It defines the material requirements, physical properties, and testing methods for flexible PVC sheets used as single-ply roofing membranes exposed to weather.

Membrane Classifications

The standard currently categorizes PVC membranes into three primary types based on their reinforcement and physical performance:

- **Type II:** Reinforced with fibers (often as a carrier) incorporated during production. It provides dimensional stability, but the fibers do not significantly impact tensile strength or elongation.
- **Type III**: Internally reinforced with fabric and may also feature a fabric backing.
- **Type IV:** The highest performance grade, internally reinforced with fabric and requiring a minimum thickness of 0.91 mm (36 mils). Type IV membranes must meet significantly more rigorous standards than Type III, including **38% higher breaking strength and 100% greater tearing strength.**

Note: Type I, originally for unreinforced sheets, is no longer in use as it is no longer produced.

Key Physical Requirements

For a PVC membrane to comply with ASTM D4434, it must satisfy several minimum performance thresholds:

Property	Type II (Min)	Type III (Min)	Type IV (Min)
Overall Thickness	1.14 mm (45 mils)	1.14 mm (45 mils)	0.91 mm (36 mils)
Breaking Strength	245 N (55 lbf/in)	890 N (200 lbf/in)	1223 N (275 lbf/in)
Elongation at Break	250% (MD) / 220% (CD)	15%	25%
Seam Strength	75% of tensile	75% of breaking	75% of breaking
Tearing Strength	45 N (10 lbf)	200 N (45 lbf)	400 N (90 lbf)

Essential Testing Methods

The standard references several other ASTM tests to verify these properties:

- ASTM D751: Used for measuring breaking strength and elongation of coated fabrics.
- **ASTM D2136**: Low-temperature bend test (must pass at -40°C).
- **ASTM G154 / G155**: Accelerated weathering tests using UV light or Xenon-Arc exposure for 5,000 hours to check for cracking or crazing.
- **ASTM D5602 / D5635**: Static and dynamic puncture resistance tests to ensure durability against debris and foot traffic.

The current active version is **ASTM D4434/D4434M-21**, which was approved in January 2021.

ASTM D6754 (full designation ASTM D6754/D6754M)

It is the standard specification for **Ketone Ethylene Ester (KEE)** based sheet roofing. This standard provides a nationally recognized benchmark for evaluating the performance and composition of high-quality single-ply thermoplastic roofing membranes.

Key Requirements of ASTM D6754

The standard ensures that products labeled as “KEE membranes” meet specific criteria for durability and chemistry:

- **Minimum KEE Content:** To comply, the polymer content of the membrane must consist of at least 50% KEE by weight.
- **Fabric Reinforcement:** The specification requires that the flexible sheets be internally reinforced with fabric to ensure structural integrity.
- **Performance Testing:** Membranes are tested for several physical properties, including:
    - **Breaking and Tearing Strength:** Ensuring the material resists punctures and mechanical stress.
    - **Water Absorption:** Maintaining strict limits on how much moisture the material can absorb.
    - **Low-Temperature Flexibility:** Ensuring the sheet does not crack or become brittle in cold climates.
    - **Weather Resistance:** Evaluating how the membrane holds up under UV exposure and fungal growth.

Significance in the Roofing Industry

ASTM D6754 is often called the **“KEE Standard”**. It was developed to differentiate high-performance

KEE membranes from standard PVC sheets. KEE is a solid plasticizer (often branded as **DuPont™ Elvaloy®**) that does not migrate out of the membrane over time, allowing the roof to remain flexible and chemical-resistant for decades.

If a membrane contains KEE but less than the 50% required by D6754, it is generally classified under **ASTM D4434**, which is the standard for standard Poly(Vinyl Chloride) (PVC) sheet roofing.

CSA A123.21

It is the Canadian national standard for the **dynamic wind uplift resistance** of membrane-roofing systems. It is a mandatory requirement under the National Building Code of Canada (NBCC) for determining whether a roof assembly can withstand calculated wind loads.

Key Features of the Standard

- **Dynamic Testing Protocol:** Unlike static tests (such as FM 4474), CSA A123.21 uses oscillating pressure cycles that simulate actual wind gusts and “membrane flutter”.
- **Safety Factor:** The standard applies a 1.5 resistance factor to the tested maximum pressure to determine the factored resistance of a roofing assembly.
- **Applicability:** It applies to various membrane roofing systems, including:
    - **MARS**: Mechanically Attached Roofing Systems.
    - **AARS**: Adhesive-Applied Roofing Systems.
    - **PARS**: Partially Attached Roofing Systems.
- **Scope**: The latest 2020 edition covers systems on various substrates, including steel, wood, and concrete decks. It does **not** apply to ballasted roofs (e.g., gravel or pavers).

Compliance and Tools

To ensure a building is compliant, a registered professional must first calculate the project’s wind load. Resources like the NRC Wind-Roof Calculators (Wind-RCI) help determine these requirements. Designers then select a pre-tested assembly from manufacturers like Goliath that meets or exceeds those calculated loads.

ASTM D5602 (Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens)

It is a laboratory test measuring the maximum load a roofing membrane can withstand without leaking. It is used to evaluate bitumen, polymer-modified bitumen, rubber, and thermoplastic membranes, ensuring resistance to puncture from construction loads or roof traffic.

Key Details of ASTM D5602:

- **Purpose:** To determine the static puncture resistance of roofing membranes, often for quality control or performance classification.
- **Methodology:** A test specimen is clamped into a fixture and subjected to a static load, usually in a controlled temperature setting (often 25°C), to see if it sustains damage allowing water penetration.
- **Applicability:** Applies to various sheet membranes, including those with factory-applied granules, but not to aggregate-surfaced membranes.
- **Equipment:** A universal testing machine with a specific puncture probe is typically used to apply the load.
- **Significance:** It helps manufacturers and engineers determine how well a membrane protects against damage from objects underweight.

The standard is technically similar to tests ensuring waterproofing integrity in both commercial and bituminous systems. The current version is often designated as ASTM D5602/D5602M-18(2022).

ASTM D5635/D5635M is the standard test method used to evaluate the dynamic puncture resistance of roofing membrane specimens.

Purpose and Scope

This laboratory test determines the maximum dynamic impact energy a roofing membrane can withstand without allowing water to pass through. It is primarily used to assess how well roofing systems resist damage from sharp, rigid objects—such as dropped tools or wind-blown debris—under dynamic (impact) conditions.

Key Details of the Test

- **Applicable Materials:** The test is used for various membranes, including bituminous built-up, polymer-modified bitumen, vulcanized rubbers (like EPDM), and thermoplastic materials (like TPO and PVC).
- **Test Setup:** A specimen is placed over a thermal insulation substrate and struck by a falling puncture head. This head follows a quarter-circle trajectory, falling from a vertical to a horizontal position under gravitational acceleration.
- **Passing Criteria:** A “pass” is achieved if the membrane remains watertight after the impact.
- **Measurement:** Results are typically reported in Joules (J) or foot-poundals (ft·pdl), with standard increments of 2.5 J.

Significance in Industry

Manufacturers use this standard to compare the durability of different roofing assemblies. For example, testing often shows that **FleeceBACK** membranes or systems utilizing high-density cover boards (like **DensDeck Prime**) provide significantly higher puncture resistance than traditional two-ply modified bitumen systems.

The current active version is **ASTM D5635/D5635M-18(2022)**, which is available through the ASTM International website or other standards distributors like the ANSI Webstore.

ASTM D751 is a standard set of test methods for evaluating the physical, mechanical, and thermal properties

Rubber or plastic-coated fabrics, such as tarpaulins, rainwear, and covers. Key tests include thickness, breaking strength, bursting strength, and hydrostatic resistance, typically performed on a universal testing machine.

Key Aspects of ASTM D751:

- **Purpose:** Measures performance, durability, and quality of coated fabrics.
- **Common Tests:** Includes breaking strength (grab/strip method), tear strength, hydrostatic resistance, adhesion of coating, and thickness.
- **Scope:** Covers materials with at least one textile layer and one polymeric layer.
- **Applicability:** Essential for quality control of industrial textiles and protective clothing.
- **Key Parameters:** Often measures tensile strength and elongation to failure.

The standard focuses on ensuring the materials meet specifications for waterproofing and strength.

ASTM D7635/D7635M

It is the standard test method used to measure the thickness of coatings over fabric reinforcement (scrim), commonly used in quality assurance for single-ply roofing membranes like PVC. It ensures the top-performing layer above the scrim is thick enough for durability, often used for verifying thickness requirements in ASTM D4434 standards.

Key Aspects of ASTM D7635:

- **Purpose:** Measures the exact thickness of polymer coatings ***above*** reinforcing scrim/fabric, crucial for ensuring long-term weathering performance in membranes.
- **Application:** Primarily used in the roofing industry to verify the performance of PVC and TPO

single-ply roofing systems.

- **Reliability:** Considered a more accurate and reliable method for determining top-ply thickness compared to traditional optical methods.
- **Applicability:** The test method covers both SI (metric) and inch-pound units, which should be treated separately.

It is frequently cited in technical data sheets to ensure compliance with minimum thickness requirements for commercial roofing membranes, often focusing on top-ply thickness over scrim (e.g., 16 mil minimum).

ASTM D570

It is the standard test method for determining the water absorption rate of plastics by measuring the weight gain of samples after immersion in water. It assesses how moisture impacts material properties, such as dimensions, weight, or appearance, crucial for plastics in plumbing, electrical, and outdoor applications.

Key Aspects of ASTM D570:

- **Procedure:** Samples are weighed, immersed (commonly for 24 hours at 23°C or in boiling water), and then reweighed to determine the percentage of water absorbed.
- **Purpose:** Evaluates material suitability for high-humidity environments and checks for product consistency.
- **Applicability:** Covers cast, hot-molded, and cold-molded resinous products, including rods, tubes, and sheets.
- **Key Data Points:** Results are reported as a percentage of moisture absorbed, crucial for evaluating dimensional stability.
- **Equivalent Standard:** This test method is technically equivalent to ISO 62.

This test is widely used for material selection and product validation in automotive and electrical sectors.

ASTM D2136

It is the **Standard Test Method for Coated Fabrics—Low-Temperature Bend Test.**

It is a simple **pass/fail procedure** used to determine if a fabric coated with rubber or similar polymeric materials remains flexible and resistant to cracking when bent at a specific low temperature.

Key Aspects of the Standard

- **Purpose**: To evaluate a material's ability to withstand a prescribed bend without damage in extremely cold conditions.
- **Methodology**: A specimen is placed in a specialized bending jig, cooled to a target temperature (often as low as for heavy-duty gear) and then bent around a 1/8-inch (3 mm) radius hinge pin.
- **Applications**: This standard is critical for materials used in:
    - **Protective Clothing:** Waterproof garments for extremely cold environments, like those used by Natpro.
    - **Geomembranes:** Used for liners in reservoirs or embankments where winter installation flexibility is necessary.
    - **Industrial Goods:** Roofing membranes, HVAC ductwork, and specialized gaskets.

Testing Equipment

Testing requires a specialized **Low-Temperature Bending Jig**. These fixtures are typically made of stainless steel and aluminum to withstand environmental chambers and ensure the bending action is consistent and not influenced by the operator. You can find technical specifications and drawings for these jigs through ASTM International or equipment manufacturers like Retrofitmach

ASTM D3045

ASTM D3045 is the standard practice for the **heat aging of plastics without load**. It defines the conditions for exposing plastic materials to hot air over extended periods to evaluate their thermal endurance and predict how they might degrade or oxidize over time in real-world service conditions.

Key Aspects of the Standard

- **Purpose**: It is used as a guide to compare the thermal aging characteristics of different materials or to estimate the endurance time of a material until a specific property change occurs at a lower temperature, often using the **Arrhenius relation** for predictions.
- **Scope**: The standard only specifies the **procedure for heat exposure** (e.g., oven type and air flow); it does not specify the particular property to be tested or the exact test specimen to be used.
- **Aging Conditions**: Specimens are typically placed in a controlled, forced-convection air oven at temperatures usually ranging from 70°C to 150°C
- **Post-Aging Testing**: After aging, specimens are allowed to cool and are then tested for changes in mechanical, physical, or chemical properties—such as **tensile strength**, **elongation**, or **impact resistance**—compared to unaged specimens.

Technical Definitions

- **Continuous Use Temperature (CUT)**: The temperature at which a plastic maintains a specific level of property retention (typically 50%) for a defined period.
- **Temperature Index (TI)**: A specific CUT value where the endurance time is fixed at **20,000 hours**.

This standard is commonly utilized in industries like automotive, aerospace, and electronics to ensure material safety and longevity. It is technically equivalent to the international standard **ISO 2578**.

ASTM D1204

It is a standard test method for measuring linear dimensional changes (shrinkage or expansion) in non-rigid thermoplastic sheeting or film (less than 0.51 mm or 0.020 in

thick) when exposed to elevated temperatures. It is commonly used to determine the thermal stability of products such as plastics, geomembranes, and sheets, often after manufacturing, by measuring samples before and after heating.

Key Details of ASTM D1204:

- **Scope:** Applies to nonrigid thermoplastic film/sheeting, typically used to measure dimensional stability at elevated temperatures.
- **Procedure:** Samples are marked and measured, placed between talc-dusted papers to prevent sticking, and exposed to heat in an oven.
- **Measurement:** After heating, samples are reconditioned for at least one hour at room temperature before final measurements are taken.
- **Test Conditions:** The temperature and time are specified by the material specification.
- **Significance:** Ensures that materials remain stable and do not deform excessively under heat, which is critical for packaging and industrial applications.

ASTM E96

It is the standard test method for determining the water vapor transmission (WVT) rate and permeance of thin materials, such as paper, plastic films, coatings, and building materials (gypsum, wood). It uses gravimetric methods (dry cup or wet cup) to measure how moisture moves through a material under controlled conditions, crucial for moisture control in building construction.

Key Aspects of ASTM E96 Testing

- **Purpose:** Measures the rate at which water vapor passes through a material, helping to determine the water vapor permeance (permeability).
- **Methods:** Includes the **Desiccant Method** (dry cup, measuring inflow) and the **Water Method** (wet cup, measuring outflow), often at 73°F.
- **Key Metrics:** Provides results in perms or permeability ratings.
- **Materials Tested:** Primarily used for permeable to semi-permeable materials, including plastics, laminates, and building envelopes.
- **Limitations:** Specimens must not exceed 1-1/4 in. (32mm) in thickness.

Difference Between Methods

- Dry Cup Method: A desiccant inside the cup is covered by the specimen, placed in a high-humidity chamber to measure water moving into the dry environment.
- Wet Cup Method: The cup contains water, and the specimen is placed in a lower-humidity chamber to measure water moving out.

ASTM D1004

It is the standard test method for determining the **initial tear resistance** (often called the **Graves Tear**) of flexible plastic film and sheeting. It is primarily used for quality control and material comparison by measuring the force required to initiate a tear in a specific specimen geometry.

Key Specifications of the Test

- **Target Materials:** Flexible plastic films and sheeting, typically with a thickness of **less than 0.25 mm (0.010 in.).**
- **Test Speed:** Performed at a very low, constant rate of **51 mm/min (2 in/min).**
- **Specimen Geometry:** The specimen is die-cut into a specific “crescent” or “mustache” shape with a **90-degree notch** to create a stress concentration point.
- **Measured Values:** The test records the **maximum force** (in Newtons or pounds-force) and the **maximum extension** (in millimeters or inches) until complete failure.

Equipment Requirements

To perform this test, labs typically use a **Universal Testing Machine (UTM)** equipped with specific accessories:

- **Grips**: Self-tightening roller grips or pneumatic side-action grips are recommended to prevent specimen slippage.

- **Load Cell**: Since the forces involved are often low, high-precision load cells (e.g., 5N or 50N) are used to ensure accuracy within 1% of the reading.
- **Die Cutter**: A precision die is required to ensure specimens meet the exact dimensions defined in the standard.

Important Limitations

- **Brittle Materials**: The method is **not applicable** to materials that exhibit brittle failure.
- **High Elongation**: It is not suitable for materials that elongate more than **200%** or beyond **101.6 mm (4 in.)** during the test.
- **Real-World Correlation**: While excellent for comparing materials, the results may not directly correlate with real-world tearing performance due to the low-test speed.

ASTM E108 (often referenced in relation to UL 790)

It is the standard test method for measuring the fire performance of roof coverings against external fire sources. It classifies materials into Class A (severe), B (moderate), or C (light) fire exposure based on resistance to flame spread, intermittent flames, and burning brands.

Key Aspects of ASTM E108:

- **Purpose:** Evaluates roof systems (materials, underlayments, decking) to determine their ability to withstand fire, such as from flying embers during a wildfire.
- **Test Methods:**
  - Intermittent Flame Test: Measures resistance to flames that cycle on and off.
  - Spread of Flame Test: Evaluates how far flames travel across the surface.
  - Burning Brand Test: Assesses safety when a burning item lands on the roof.
  - Flying Brand Test: Determines if the roof creates flaming debris.
- **Roof Classifications:**
  - **Class A:** Highest resistance (e.g., concrete, clay, slate, specialized metal/asphalt).
  - **Class B:** Moderate resistance.
  - **Class C:** Light resistance.
- **Applicability:** Applies to various materials, including asphalt shingles, metal roofing, and treated wood shakes.

This standard is essential for building code compliance, particularly in wildfire-prone areas. For detailed testing requirements, you can access the full standard on the ASTM website.

UL 790 (also known as ASTM E-108)

It is the standard test method for evaluating the fire resistance of roof covering materials against external fire exposure. It classifies roofing systems as Class A, B, or C—with Class A offering the highest protection—by testing for spread of flame, intermittent flame, and burning brands.

Key Aspects of UL 790:

- **Purpose:** Measures the ability of roof assemblies to resist ignition and fire spread when exposed to fire from outside the building.
- **Test Methods:** Includes tests for Spread of Flame, Intermittent Flame, Burning Brand, and Flying Brand.
- **Roof Classes:**
    - **Class A:** Effective against severe fire exposure.
    - **Class B:** Effective against moderate fire exposure.
    - **Class C:** Effective against light fire exposure.
- **Performance Requirements:** During tests, materials must not produce heavy flying, flaming, or glowing particles that fall from the roof deck.
- **Application:** Applies to various roofing materials, including shingles, metal panels, and membranes installed on either combustible or noncombustible decks.

These tests are essential for complying with building codes, particularly in wildfire-prone areas, and are often required for insurance purposes.

CAN/ULC-S107 (Standard Methods of Fire Tests of Roof Coverings)

It is the primary Canadian benchmark for evaluating how roofing systems perform when exposed to fires originating **outside** a building.

Key Functions and Scope

- **Measurement:** It measures the relative fire-performance characteristics of roof coverings, including their ability to slow flame spread and protect the underlying roof deck.
- **Application:** The standard applies to entire roof assemblies—from the deck to the finishing membrane—installed on both combustible and non-combustible surfaces.
- **Tests Included:** To earn a rating, assemblies undergo several rigorous assessments:
- **Intermittent-Flame Test:** Subjects the roof to repeated flame exposure.
- **Spread-of-Flame Test:** Measures how far flames travel across the surface.

- **Burning-Brand Test**: Places a burning wooden block ("brand") on the roof to test for penetration.
- **Flying-Brand Test:** Checks if the material produces dangerous flaming embers.

Fire Resistance Classifications

Based on test performance, roof coverings are assigned one of three classes:

Class	Level of Protection	Typical Use Case
Class A	Maximum	Effective against severe fire exposures; highest protection for the deck.
Class B	Moderate	Effective against moderate fire exposures; moderate deck protection.
Class C	Minimum	Effective against light fire exposures; measurable deck protection.

Regulatory Context

- **National Building Code**: This standard is frequently cited in the **National Building Code of Canada** (NBC) and provincial codes as a requirement for roofing materials.
- **ASTM Equivalent:** It is technically similar to the U.S. standard **ASTM E108** (or UL 790), though Canadian authorities often specifically require the CAN/ULC version for compliance.
- **Vs. CAN/ULC-S126**: While S107 handles **external** fire exposure, CAN/ULC-S126 is used to test fire spread from **inside** the building, underneath the roof deck.

CAN/ULC-S126

It is the Canadian national standard for measuring how fire spreads along the **underside** of a roof-deck assembly. It is specifically used to assess potential fire hazards originating from ***inside*** a building rather than external sources.

Core Purpose and Scope

- **Flame Spread Assessment**: It measures the contribution of roof-deck components—such as adhesives, vapour barriers, and insulation—to fire spread beneath the deck.
- **Assembly Testing**: The test evaluates the entire "sandwich" of materials, not just individual components.
- **Degradation Monitoring**: It also assesses the extent of thermal degradation and charring of the assembly.

Test Methodology

- **Equipment:** The test uses a **7.6 m Steiner Tunnel** apparatus, similar to the one used for CAN/ULC-S102 (surface burning characteristics).
- **Exposure:** The underside of the assembly is subjected to a gas flame from below for **30 minutes**.
- **Pass/Fail Criteria:**
    - Flame spread must not exceed **10 feet** within the first 10 minutes.
    - Flame spread must not exceed **14 feet** for the total 30-minute duration.

Regulatory Context

- **National Building Code (NBC)**: The NBC often requires roof-deck assemblies to meet CAN/ULC-S126 if they contain combustible materials above the deck in non-combustible construction.
- **Exemptions**: According to some building codes, this test may not be required if the combustible material is protected by at least **12.7 mm thick gypsum board** beneath the deck or if the building is fully sprinklered.
- **Comparison to S107**: While S126 deals with **interior** fire spread under the deck, CAN/ULC-S107 evaluates how the top of a roof assembly reacts to **exterior** fires (like sparks or flying brands).

The current version of the standard is CAN/ULC-S126-14 (R2024), which was recently reaffirmed in 2024.

FM Global (Factory Mutual)

It is a major commercial property insurance company specializing in risk management and loss prevention for large, industrial, and commercial businesses. It utilizes a research-driven, engineering-focused approach to protect clients from fire, natural hazards, and other risks, offering insurance and the “FM Approved” certification for products.

Key Aspects of FM (Factory Mutual):

- FM Global **Insurance**: A mutual insurance company providing coverage for high-value assets and property, focusing on reducing the likelihood of incidents through risk engineering.
- FM Approvals: A testing laboratory that certifies products (over 50,000 to date), including fire protection systems, electrical equipment, and building materials, ensuring they meet strict loss-prevention standards.
- **Engineering Focus**: Unlike traditional insurers, FM utilizes nearly 2,000 “boots-on-the-ground” engineers to assess risk directly at client sites.
- **Research Center:** The FM Global Research Campus is a state-of-the-art facility featuring

laboratories for fire, natural hazards, hydraulics, and electrical hazards, which informs their standards.

- **History:** Founded in 1835 by mill owners in Rhode Island seeking to improve fire safety through shared risk.

FM Approved vs. UL (Underwriters Laboratories):

- Factory Mutual (FM) focuses heavily on property loss prevention, particularly for industrial, commercial, and fire-related equipment.
- UL has a broader scope that includes consumer electronics, personal safety equipment, and general building materials.

Commonly Approved Products:

- Roofing systems (Static wind testing and fire)
- Fire suppression/sprinkler systems
- Insulated metal panels
- Hazardous location electrical equipment

Specifications

Please visit our website or download the specifications from the link below: https://goliathroofingsystems.com/resources/

Canada - Specifications

- CA - Goliath Fully Adhered PVC Roofing (Conventional)
- CA - Goliath - Mechanically Fastened PVC Roofing (Conventional)
- CA - Goliath - Induction Welded PVC Roofing (Conventional)
- CA - Goliath - Loose Laid Ballasted PVC Roofing
- CA - Goliath - Polyvinyl-Chloride (PVC) Protected Membrane Roofing – Adhered
- CA - Goliath - Polyvinyl-Chloride (PVC) Protected Membrane Roofing - Loose Laid

U.S. - Specifications

- US - Goliath Fully Adhered PVC Roofing (Conventional)
- US - Goliath - Mechanically Fastened PVC Roofing (Conventional)
- US - Goliath - Induction Welded PVC Roofing (Conventional)
- US - Goliath - Loose Laid Ballasted PVC Roofing
- US - Goliath - Polyvinyl-Chloride (PVC) Protected Membrane Roofing – Adhered
- US - Goliath - Polyvinyl-Chloride (PVC) Protected Membrane Roofing - Loose Laid

GLOSSARY OF COMMON ROOFING TERMS

Alligatoring: Shrinkage cracking of the bituminous surface of built-up roofing or the exposed surface of smooth-surface roofing, producing a pattern of deep cracks with the scaly look of an alligator's hide.

Asphalt: A highly viscous hydrocarbon produced from the residuum left after the distillation of petroleum used as the waterproofing agent of a built-up roof.

Ballast: An anchoring material (such as rounded river rock, gravel, or pre-cast concrete pavers), which is used to resist wind, uplift forces and hold roof membranes in place.

Bitumen: A generic term for either the asphalt or coal tar pitch used in the roofing industry.

Blister: A spongy, raised portion of roofing membrane, ranging in size from 25 mm (1") in diameter and barely detectable to as much as 4.6 m_2 (50 ft_2) in area and 300 mm (12") high. Blisters result from the pressure of entrapped air or water vapour.

Built-up Roofing (BUR): A continuous, semi-flexible roof covering, consisting of laminations or plies of saturated or coated felts alternated with layers of bitumen.

Surfaced with bitumen, and in some cases covered with aggregate.

Cant Strip: A continuous strip of triangular cross-section, fitted into the angle formed by a structural deck and a wall or other vertical surface. Used to provide a gradual transition for base flashing and horizontal roof membrane.

Emulsion: An intimate mixture of bitumen and water, with uniform dispersion of the bitumen globules, achieved through a chemical of clay emulsifying agent.

EPDM (Ethylene Propylene Diene Monomer): A synthetic rubber sheet used in single-play roof membranes.

Felt: A fabric made by the interlocking of fibers. Roofing felts are manufactured from cellulosic fibers (organic felts), asbestos fibers (asbestos felts), or glass fibres (glass-fibre felts). Felts are either saturated, or saturated and coated with bitumen.

Fishmouth: An opening formed by an edge wrinkle in a felt where it overlaps another felt in a built-up roofing membrane.

Flashing: Connecting devices that seal membrane joints, drains, gravel stops and other places where the membrane is interrupted. Base flashing forms the upturned edges of the watertight membrane. Cap or counterflashing shields the exposed edges and joints of the base flashing.

Flood Coat: The top layer of bitumen in an aggregate-surfaced built-up roofing membrane.

Gravel: Coarse granular aggregate, having rounded edges, resulting from the natural erosion of rock.

Gravel Stop: Flanged device, normally metallic, designed to prevent loose aggregate from washing off the roof; it also provides a finished edge detail for the built-up roofing assembly.

Gum Pan (or Pitch pocket): A flanged, metal container placed around a column or other roof penetrating element and filled with bitumen or flashing cement to seal the joint.

Loosely Laid Membrane: Membranes, which are not attached to the substrate except at the perimeter of the roof. They are held in place with appropriate and adequate ballast.

Modified Bitumen: Asphalt enhanced by the addition of polymer modifiers to increase cold temperature flexibility and warm temperature flow resistance and stability. The most common modifiers are SBS (styrene butadiene styrene) and APP (atactic polypropylene).

Parapet: The part of any wall entirely above the roof.

Ply: A layer of roofing membrane. A four-ply membrane has at least four plies of felt at any vertical cross section cut through the membrane.

Primer: A liquid bituminous material applied to the surface to improve the adhesion of heavier application of subsequently applied bituminous materials.

PVC (Poly Vinyl Chloride): A thermoplastic sheet material used for single ply roofing membranes.

Reglet: A groove in a wall or other vertical surface adjoining a roof surface for the embedment of counterflashing.

Single Ply Membrane: Roofing membranes that are field applied using a pre-manufactured sheet of single-layer membrane materials (either homogenous or composite) rather than multiple layers.

Slope: The ratio between the measure of the rise and the horizontal span.

Smooth-Surfaced A built-up roofing membrane surfaced with a coating of hot asphalt,

Roof: asphalt emulsion or asphalt cutback.

Square: A roof area of one hundred square feet.

Substrate: The surface upon which the roofing membrane is placed — structural deck or insulation.

Vapour Retarder: A material designed to restrict the passage of water vapour through a wall or roof assembly.

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