EverGuard® TPO/PVC Mechanically Attached Retrofit Roofing Systems Over Metal Roof Panels on Metal Buildings
A Guide to Metal Roof Retrofit in Commercial Low-slope Roof Assemblies

Prepared by GAF Technical Services
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Note: Refer to www.gaf.com for a complete list of Product Data Sheets and Chemical Resistance Guides.
Introduction

Thank you for consulting the EverGuard® TPO/PVC Mechanically Attached Retrofit Roofing Systems Over Metal Roof Panels on Metal Buildings. You can find further information at www.gaf.com, or contact GAF Technical Services at 1-800-ROOF-411 (1-800-766-3411).

This Guide serves as a supplement to the EverGuard® TPO/PVC Mechanically Attached and Drill-Tec™ RhinoBond® Roofing System Overview & General Requirements Manuals.

About GAF

Founded in 1886, GAF is the largest roofing manufacturer in North America.

As the industry leader, GAF proudly offers a comprehensive portfolio of award-winning, innovative roofing products for both steep-slope and commercial properties. Supported by an extensive national network of factory-certified contractors, GAF has built its reputation – and its success – on its steadfast commitment to Advanced Quality, Industry Expertise, and Solutions Made Simple.

GAF offers all major low-slope roofing technologies, including repair and maintenance products and roof restoration systems, as well as new roofing systems (BUR, modified bitumen, TPO, PVC, and liquid-applied roofing). GAF has developed single-ply, asphaltic and liquid-applied membranes with excellent durability to meet the most rigorous industry standards.

For more information, visit www.gaf.com.

Important Considerations

The purpose of this Guide is to provide fundamental information on mechanically attached metal roof retrofits and recommendations on addressing mechanically attached metal roof retrofits in low-slope roof assemblies.

- This Guide contains the latest information relating to the application of GAF’s EverGuard® TPO/PVC Mechanically Attached Retrofit Roofing Systems Over Metal Roof Panels on Metal Buildings and is based on our years of experience in the commercial roofing field. It has been prepared as a general guide to assist architects, engineers, roofing contractors, and owners in the use of our roofing systems.
- GAF manufactures and sells roofing materials and does not practice architecture or engineering. GAF is not responsible for the performance of its products when damage to its products is caused by such things as improper building design, construction flaws, or defects in workmanship.
- The design responsibility remains with the architect, engineer, roofing contractor or owner, and construction details illustrated and described herein are furnished solely for guidance purposes. These guidelines should not be construed as being all-inclusive, nor should they be considered as a substitute for good application practices. Please consult your design professional for more information.
- Under no circumstances shall GAF have any liability for expenses arising out of or associated with the pre-existing presence of asbestos-containing materials or any other allegedly hazardous
substances or materials upon the roof to which the new GAF roofing materials are being applied.

- Information contained in this Manual is presented in good faith and, to the best of GAF’s knowledge, does not infringe upon any patents, foreign or domestic.
- As a part of its continuing efforts to improve the performance of its products, GAF periodically makes changes to its products and application specifications. The Company reserves the right to change or modify, at its discretion, any of the information, requirements, specifications, or policies contained herein. This Guide supersedes all catalogs and previous manuals.
- This Guide serves as a supplement to the EverGuard® TPO/PVC Mechanically Attached and Drill-Tec™ RhinoBond® Roofing System Overview & General Requirements Manuals.

Guarantee Program

GAF offers roof guarantees for a fee for all roofing system specifications published in this Guide when installed by GAF Factory-Certified Low-Slope Roofing Contractors in accordance with the terms and conditions set forth in this Manual, and provided that all procedures for obtaining a guarantee are followed.

All guaranteed roofing systems must be flashed in accordance with published GAF flashing requirements and details. All GAF insulation, fasteners, pre-flashed details, expansion joint covers, cements, coatings, and accessory products as job appropriate are required for guarantees unless otherwise approved in writing by a Field Services Manager or Director prior to installation.

GAF will be the sole judge as to whether a guarantee will be issued to cover any proposed or completed roof. The issuance of a guarantee and its effectiveness or the continued liability thereunder is contingent upon payment of GAF’s guarantee fee and payment in full to contractors and materials suppliers.

GAF has no obligation to issue a roofing guarantee on any roof. Any inspection prior to issuance is solely for the benefit of GAF and does not constitute a waiver of any terms or conditions in the guarantee. In the event that a roof system does not conform to GAF’s standards and a guarantee is not issued, no portion of the guarantee fee is refundable.

GAF will not accept Notices of Award of Contract that indicate that the owner or architect has the option to accept or reject the guarantee upon completion of the roof.

Specifications not listed in this Guide may also be eligible for GAF guarantees. For further information on guarantee requirements and for approval of modifications to published specifications, consult with GAF at 800-766-3411.

GAF is not responsible for consequential damages in case of roof system failure. GAF has no control over a building’s contents, type, quantity, positioning, or protection.

Some GAF guarantees may be eligible for GAF WellRoof® guarantee extension. See guarantee for terms and conditions.
Guarantees Lengths

GAF offers an extensive selection of roof guarantees to meet the needs of most building owners. The following guarantees are available for use with selected EverGuard® TPO/PVC Mechanically Attached Retrofit Roofing Systems Over Metal Roof Panels on Metal Buildings when installed by an eligible GAF factory-certified contractor. GAF EverGuard® roof membranes must be used in roofing systems to be guaranteed by GAF. **The maximum guarantee length for any metal retrofit system is 20 years.**

**Mechanically Attached Retrofit**

The following is a list of eligible membranes:

1. EverGuard® PVC **12-year guarantee**
   a. EverGuard® PVC 50 mil membrane (smooth)
   b. EverGuard® PVC 50 mil XK membrane (smooth)

2. EverGuard® PVC **15-year guarantee**
   a. EverGuard® PVC 50 mil membrane (smooth)

3. EverGuard® PVC **15-year guarantee**
   a. EverGuard® PVC 60 mil membrane (smooth)
   b. EverGuard® PVC 60 mil XK membrane (smooth)

4. EverGuard® TPO **20-year guarantee**
   a. EverGuard® TPO 60 or 80 mil membrane (smooth)
   b. EverGuard Extreme® TPO 50, 60, 70 or 80 mil membrane (smooth)

5. EverGuard® PVC **20-year guarantee**
   a. EverGuard® TPO 60 mil membrane (smooth)

6. EverGuard® PVC **20-year guarantee**
   a. EverGuard® PVC 80 mil membrane (smooth)
   b. EverGuard® PVC 80 mil XK membrane (smooth)

*(Excludes colored membrane and the state of Florida)*
***(Includes colored membrane and the state of Florida)*

**Drill-Tec™ RhinoBond® Retrofit**

The following is a list of eligible membranes:

1. EverGuard® PVC **12-year guarantee**
   a. EverGuard® PVC 50 mil membrane (smooth)
   b. EverGuard® PVC 50 mil XK membrane (smooth)

2. EverGuard® PVC **15-year guarantee**
   a. EverGuard® PVC 50 mil membrane (smooth)

3. EverGuard® PVC **15-year guarantee**
   a. EverGuard® PVC 60 mil membrane (smooth)
   b. EverGuard® PVC 60 mil XK membrane (smooth)
4. EverGuard® TPO 20-year guarantee
   a. EverGuard® TPO 45, 60 or 80 mil membrane (smooth)
   b. EverGuard Extreme® TPO 50, 60, 70 or 80 mil membrane (smooth)

5. EverGuard® PVC 20-year guarantee*
   a. EverGuard® TPO 60 mil membrane (smooth)

6. EverGuard® PVC 20-year guarantee**
   a. EverGuard® PVC 80 mil membrane (smooth)
   b. EverGuard® PVC 80 mil XK membrane (smooth)

* (Excludes colored membrane and the state of Florida)
** (Includes colored membrane and the state of Florida)

Roof Design

GAF does not practice architecture or engineering. This section is provided for guidance purposes only based on GAF’s experiences in the roofing industry. However, there are many factors that may affect roof design, including specific job site conditions, local building codes, building use, etc., which must be taken into account. GAF recommends consultation with a design professional to determine specific roofing needs and requirements for each particular project.

Proper roofing system design and selection requires the consideration of many factors. Although GAF’s expertise is in materials manufacturing, and not in engineering, architecture, or specialized roof consulting, our company has decades of extensive experience in the practical aspects of roofing. Our experience suggests that careful consideration of the following will provide a fundamentally sound basis for design and selection of EverGuard® mechanically attached single-ply roofing systems.

Re-Cover

The basis for any re-cover project is to eliminate defects in the existing roof assembly so that their effect on the new roofing system is minimized. At a minimum, attention to the following considerations is recommended:

- Raise all perimeter flashings, penetrations, and equipment to provide required flashing heights;
- Address drainage deficiencies to provide positive drainage; and
- Concentrate on thorough surface preparation.

Existing Metal Roof System As The Substrate

It is the responsibility of the engineer, architect, building owner, or roofing contractor to determine the fitness of an existing metal panel roof system that will be serving as a substrate for a specific roofing system installation. Additionally, GAF is not responsible for moisture related problems associated with any deck or substrate materials.
Fire Resistance

Resistance by the roofing system to fire applied to the exterior roof surface is important. Typically, a UL Class A or B rating is required by building code. Occasionally, depending on the use of the building, special resistance to fire applied from within the building is required. This is normally expressed in the form of hourly ratings, and usually requires the use of a specialized roof assembly. Refer to current EverGuard® listings in the appropriate UL directory or Factory Mutual Approval Listing to verify roof assembly requirements for specific fire ratings.

Wind Performance

Ideally, roofing systems should be capable of resisting the forces generated by the maximum anticipated wind speed for a specific building. One widely accepted method for specifying wind performance is to require the appropriate FM 1-60, 1-90, or other rated system as appropriate for a specific building based upon location, exposure, and other factors.

The following are common standards and approvals typically used in conjunction with wind performance of EverGuard® roofing systems:

- Factory Mutual Approvals
  - Testing based on method described in Approval Standards 4450 and 4470.
  - Measures resistance to upward pressure applied to the roof system.

- American Society of Civil Engineers (ASCE) document ASCE 7, “Minimum Design Loads for Buildings and Other Structures”
  - A comprehensive analysis of wind forces acting on buildings.
  - Requires detailed calculations to determine actual wind pressures at different regions of the roof.
  - Referenced by building codes.

Refer to Factory Mutual Loss Prevention Data Sheets 1-28 and 1-29 for specific installation guidelines.

GAF provides the following thermoplastic Perimeter Half Sheet Table to use as a guide for mechanically attached systems because wind pressures are increased in the corners of the roof, with somewhat lower increased pressures acting along the remaining roof perimeter. The remaining field area of the roof normally experiences significantly lower wind pressures than either the corner or perimeter areas.
Perimeter Half Sheet Table

<table>
<thead>
<tr>
<th>Building Width</th>
<th>Building Height</th>
<th>Number of EverGuard® TPO 60” (1.5 m) Half Sheets</th>
<th>Number of EverGuard® PVC 60” (1.5 m) Half Sheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200’ (61 m)</td>
<td>0-34’ (0-10 m)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>35-60’ (10-20 m)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>≥200’ (61 m)</td>
<td>0-60’ (0-20 m)</td>
<td>Install half sheet throughout the perimeter and corner region. The width of this region is defined as the least of the following two measurements: 0.1 x building width or 0.4 x building height. <strong>Note:</strong> The minimum width is 4’ (1.2 m). The width is defined as the narrowest dimension.</td>
<td></td>
</tr>
</tbody>
</table>

Refer to the sheet lay-up details in the Mechanically Attached Systems section for requirements on the installation of these half sheets. Note: When designing for wind loads, ensure that the proper building classification (closed, partially closed, or open) is used if the building has large openings (i.e., docks with large loading bays, etc.). Improper classifications can result in roof attachment failure caused by designing to lower loads than actually exist for the building in question.

**Structural Performance**

There are design considerations when installing a TPO or PVC mechanically attached retrofit roofing system over existing metal roof panels on a metal building, such as:

- **Wind Load:** TPO and PVC mechanically attached retrofit roofing systems over metal panels on metal buildings should be attached to existing purlins, not the metal panels, to ensure a proper wind-uplift load path. See Figure 1. For conventional mechanically attached roofing systems, they may be fastened into every purlin (e.g., every 5 feet [1.52 m]) or fastened into every other purlin (e.g., every 10 feet [3.05 m]). For Drill-Tec™ RhinoBond® attached roofing systems, they should be fastened into every purlin.

  Additional purlins may need to be installed in corners and perimeters to provide appropriate attachment locations for fasteners in order to achieve desired wind uplift resistance.
Wind Load Testing: The UL 580 test method is commonly used to determine the wind resistance (i.e., uplift) of roofing systems. The test evaluates the roofing system and the roof deck attachment to the supports. Some aspects of a roof deck system are not evaluated by UL 580. For example, secondary supports such as beams, purlins and joists, and the connections from secondary supports to the main structural system, are not evaluated.

It is imperative that the attachment capacity of the purlins to the secondary structure is greater than the attachment capacity of the metal panels to the purlins.

Dead load: Additional dead load comes from two sources:
- Added weight of the new roof (albeit minimal), and
- Added loads during winter from a lack of melted snow due to reduced heat loss from the insulation upgrade in the retrofit roof system.

Drag Load: Drag load is a load that runs parallel to a sloped roof surface. With low-slope roof systems (i.e., 2:12 or less), the effect of drag load typically is insignificant. However, drag loads can pull metal roof panels down the slope of a roof. Factors that contribute to drag load are the weight of the roof system itself, and the additional weight of snow and ice. Drag load increases as roof slope increases. With a single-ply membrane retrofit system, drag loads are resisted by:
  - Attachment of the metal roofing panels to the structural purlins; Drag loads may be large enough to cause structural purlins to “roll.”
  - Lateral loading on the membrane fasteners. The greater the insulation depth, the greater the bending load on the fasteners.
# TPO & PVC ATTACHMENT TABLE

**MECHANICALLY ATTACHED SYSTEMS**

Maximum roof slope = 2:12  
Maximum building height = 60 feet (18.3 m)  
Maximum wind speed = 72 mph

<table>
<thead>
<tr>
<th>Max. Purlin &amp; Fastener Row Spacing</th>
<th>Purlin Type</th>
<th>Min. Pull-out Value (lbs/fastener)</th>
<th>Max. Fastener Spacing Field of Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 6 ft. (1.83 m) [every purlin]</td>
<td>Min. 16 ga.</td>
<td>800</td>
<td>12” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 14 ga.</td>
<td>1000</td>
<td>12” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 12 ga.</td>
<td>1000</td>
<td>12” o.c.</td>
</tr>
<tr>
<td>Up to 10 ft. (3.05 m) [every other purlin]</td>
<td>Min. 16 ga.</td>
<td>800</td>
<td>6” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 14 ga.</td>
<td>1000</td>
<td>6” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 12 ga.</td>
<td>1000</td>
<td>6” o.c.</td>
</tr>
</tbody>
</table>

1. Consult FM Approvals, ROOFNAV listings, and FM LPDS 1-28 and 1-29 for detailed installation requirements.
2. The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
3. Fastener pull-out testing must be conducted. Minimum 1” (25 mm) Drill-Tec™ Purlin Fastener embedment is required.
4. Perimeter and corner zones require different fastening rates, refer to Detail 101F.

**Fastener Pullout Testing**

Fastener pullout tests shall be conducted on the purlins with approved fasteners. A minimum of 15 pullouts shall be performed for up to 50,000 square feet (4,650 square meters) of which eight (8) are to be in perimeter and corner zones. Seven (7) additional pullouts shall be performed for each additional 50,000 square feet (4,650 square meters). A report indicating each pullout value with a roof plan noting locations of the pullouts shall be submitted to GAF. Roof sections with low pullout results will require additional pullout tests or additional purlins.
TPO & PVC ATTACHMENT TABLE
DRILL-TEC™ RHINO BOND® ATTACHED SYSTEMS

Maximum roof slope = 2:12
Maximum building height = 60 feet (18.3 m)
Maximum wind speed = 72 mph

<table>
<thead>
<tr>
<th>Max. Purlin &amp; Fastener Row Spacing</th>
<th>Purlin Type</th>
<th>Min. Pull-out Value (lbs/fastener)</th>
<th>Max. Fastener Spacing Field of Roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 6 ft. (1.83 m) [every purlin]</td>
<td>Min. 16 ga.</td>
<td>800</td>
<td>24” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 14 ga.</td>
<td>1000</td>
<td>24” o.c.</td>
</tr>
<tr>
<td></td>
<td>Min. 12 ga.</td>
<td>1000</td>
<td>24” o.c.</td>
</tr>
</tbody>
</table>

1. Consult FM Approvals, ROOFNAV listings, and FM LPDS 1-28 and 1-29 for detailed installation requirements.
2. Membrane must be attached to the Drill-Tec™ RhinoBond® Plates that are installed directly into structural purlins with appropriate Drill-Tec™ Purlin Fastener. The special TPO coating on the plates allows for EverGuard® TPO membrane to be welded to each plate using the RhinoBond® magnetic induction welding tool. Drill-Tec™ RhinoBond® Plates are different in type and color: TPO plates are a yellow/green, while the PVC plates are black in color. The appropriate plate must be used with the appropriate membrane type.
3. The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
4. Fastener pull-out testing must be conducted. Minimum 1” (25 mm) Drill-Tec™ Purlin Fastener embedment is required.
5. Fasteners should be offset 12” (610 mm) between rows.
6. Perimeter and corner zones require different fastening rates, refer to Detail 101F.

Fastener Pullout Testing

Fastener pullout tests shall be conducted on the purlins with approved fasteners. A minimum of 15 pullouts shall be performed for up to 50,000 square feet (4,650 square meters) of which eight (8) are to be in perimeter and corner zones. Seven (7) additional pullouts shall be performed for each additional 50,000 square feet (4,650 square meters). A report indicating each pullout value with a roof plan noting locations of the pullouts shall be submitted to GAF. Roof sections with low pullout results will require additional pullout tests or additional purlins.
### TPO Mechanically Attached Systems (Every Purlin) Specification Plate

**MEMBRANE TYPE**
- T = TPO

**CONSTRUCTION TYPE**
- R = RECOVER

**INSULATION**
- I = INSULATED

**MEMBRANE ATTACHMENT**
- MA = MECHANICALLY ATTACHED

**MEMBRANE (THICKNESS AND TYPE)**

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>45 MIL SMOOTH</td>
</tr>
<tr>
<td>60</td>
<td>60 MIL SMOOTH</td>
</tr>
<tr>
<td>90</td>
<td>90 MIL SMOOTH</td>
</tr>
<tr>
<td>50EX</td>
<td>50 MIL EXTREME</td>
</tr>
<tr>
<td>60EX</td>
<td>60 MIL EXTREME</td>
</tr>
<tr>
<td>70EX</td>
<td>70 MIL EXTREME</td>
</tr>
<tr>
<td>90EX</td>
<td>90 MIL EXTREME</td>
</tr>
</tbody>
</table>

**GUARANTEE LENGTH UP TO 20 YEARS**

<table>
<thead>
<tr>
<th>T</th>
<th>MA</th>
<th>R</th>
<th>I</th>
</tr>
</thead>
</table>

1. The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
TPO MECHANICALLY ATTACHED SYSTEMS (EVERY OTHER PURLIN) SPECIFICATION PLATE

EverGuard® TPO Flashing Strip, Min. 6" Width

EverGuard® TPO Membrane

EnergyGuard® Insulation

EnergyGuard® Insulation Flute Filler

Drill-Tec® Purlin Fasteners and Plates, Spaced 6" O.C.

Existing Metal Panel Roof

Structural Purlin

EnergyGuard® TPO Membrane

MEMBRANE TYPE
T = TPO

CONSTRUCTION TYPE
R = RECOVER

INSULATION
I = INSULATED

T
MA
R
I
60

MEMBRANE ATTACHMENT
MA = MECHANICALLY ATTACHED

MEMBRANE (THICKNESS AND TYPE)

45 = 45 MIL SMOOTH
60 = 60 MIL SMOOTH
80 = 80 MIL SMOOTH
50EX = 50 MIL EXTREME
60EX = 60 MIL EXTREME
70EX = 70 MIL EXTREME
80EX = 80 MIL EXTREME

MEMBRANE TYPE
T

MEMBRANE ATTACHMENT
MA

CONSTRUCTION TYPE
R

INSULATION
I

GUARANTEE LENGTH UP TO 20 YEARS

1 The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
PVC MECHANICALLY ATTACHED SYSTEMS (EVERY OTHER PURLIN) SPECIFICATION PLATE

<table>
<thead>
<tr>
<th>MEMBRANE TYPE</th>
<th>CONSTRUCTION TYPE</th>
<th>INSULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>P = PVC</td>
<td>R = RECOVER</td>
<td>I = INSULATED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEMBRANE ATTACHMENT</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA = MECHANICALLY ATTACHED</td>
<td></td>
</tr>
</tbody>
</table>

MEMBRANE (THICKNESS AND TYPE):
- 50 = 50 MIL SMOOTH
- 60 = 60 MIL SMOOTH
- 80 = 80 MIL SMOOTH
- 50K = 50 MIL SMOOTH
- 60K = 60 MIL SMOOTH
- 80K = 80 MIL SMOOTH

<table>
<thead>
<tr>
<th>MEMBRANE TYPE</th>
<th>MEMBRANE ATTACHMENT</th>
<th>CONSTRUCTION TYPE</th>
<th>INSULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>MA</td>
<td>R</td>
<td>I</td>
</tr>
</tbody>
</table>

GUARANTEE LENGTH UP TO 20 YEARS

---

1 The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
TPO DRILL-TEC™ RHINOBOND® ATTACHMENT SYSTEM SPECIFICATION PLATE

MEMBRANE TYPE
T = TPO

CONSTRUCTION TYPE
R = RECOVER
I = INSULATED

INSULATION

MEMBRANE ATTACHMENT
RB = RHINOBOND®

MEMBRANE (THICKNESS AND TYPE)

45 = 45 MIL SMOOTH
60 = 60 MIL SMOOTH
80 = 80 MIL SMOOTH
50EX = 50 MIL EXTREME
60EX = 60 MIL EXTREME
70EX = 70 MIL EXTREME
80EX = 80 MIL EXTREME

MEMBRANE TYPE
T

MEMBRANE ATTACHMENT
RB

CONSTRUCTION TYPE
R

INSULATION
I

GUARANTEE LENGTH UP TO 20 YEARS

1 The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
The attachment capacity of the purlins to the secondary structure must be greater than the attachment capacity of the metal panels to the purlins.
Design Considerations & Application Guidelines
Mechanically Attached And Drill-Tec™ RhinoBond® Roofing Systems

The following are additional guidelines for roofing professionals on projects involving metal retrofit assemblies.

Substrate Surface Preparation & Site Conditions

1. Substrates must be inspected and accepted by the contractor as suitable to receive and hold roof membrane materials. Substrate preparation is the sole responsibility of the building owner or roofing contractor. All defects in the substrate must be corrected before roofing work commences.

2. Confirm the adequacy of the new roofing system to provide positive slope to drains. Eliminate ponding areas by the addition of drainage locations or by providing additional pitch to the roof surface.

3. Obtain verification that the building structure can accommodate the added weight of the new roofing system.

4. The existing metal panel roof system must be free of visible moisture, such as ponding water, ice, or snow.

5. Prepare substrate surfaces thoroughly prior to application of new roofing materials. This is particularly important for re-cover and reroofing applications. Providing a smooth, even, sound, clean, and dry substrate minimizes the likelihood that underlying deficiencies will cause premature deterioration or even failure of the new roofing system.

6. Preparation includes, but is not limited to, removal of existing flashings, replacement of wet/damaged existing roofing materials, removal of loose aggregate, removal of abandoned equipment, supports and penetrations, securement and replacement of damaged and deteriorated metal decking, etc.

7. All defects in the existing metal panel roof system must be corrected before new roofing work commences. Verify that the deck surface is dry, sound, clean, and smooth, and free of depressions, waves, or projections.

8. Confirm quality and condition of existing metal panel roof system by visual inspection and by fastener pull-out testing. GAF recommends that these test results be kept on file as part as part of the acceptability of the substrate surface for a Diamond Pledge Guarantee.

9. Remove all existing flashings and clean substrate surfaces of all adhesive contaminants. If the wall/curb flashings are in good condition and tightly adhered to the substrate, new TPO or PVC flashing materials may be installed over existing flashings to a height of 24" (610 mm) without adhesives.
10. Remove abandoned equipment and equipment supports. Raise equipment supports to allow the installation of full-height flashings.

11. Protect building surfaces against damage and contamination from roofing work.

12. Where work must continue over completed roof areas, protect the finished roofing system from damage.

Fasteners & Plates

1. Drill-Tec™ Purlin Fasteners. Refer to the appropriate Attachment Tables in this Guide for fastener spacing and pull-out requirements.

2. Drill-Tec™ RhinoBond® Fastening Plates. Refer to the Drill-Tec™ RhinoBond® Attachment Table for fastener spacing and pull-out requirements.

3. Drill-Tec™ “flat” plates (without the countersunk screw holes protruding from the bottom of the plates) are required when plates are installed over hard surfaces such as DensDeck®, SECURock® or other hard cover boards to allow the plates to rest flush on the surface.

4. Drill-Tec™ XHD Fasteners can be used for supplemental insulation attachment.

5. Use fasteners that are suitable for the purlin type, and ensure that purlins are of the required condition to ensure reliable installation and performance.

6. Fasteners used in flashings should be dictated by the substrate.

7. Special care should be taken when fastening plates, so as not to overdrive or underdrive the fasteners into the purlins. Overdriving the fasteners will result in a deformation or “cupping” of the plate and will result in an uneven or inadequate bond to the membrane when welded. Under-driving the fastener will result in a loose plate with insufficient clamping force and a protruding fastener head that could cause damage to the membrane during welding and through normal roof traffic.

Insulation & Flute Filler

1. The selection of insulation type, thickness, and configuration is the responsibility of the architect, engineer, owner, or roof consultant. GAF reserves the right to accept or reject any roof insulation as an acceptable substrate for GAF roof systems. GAF EnergyGuard™ insulations must be used in roofing systems for which GAF guarantees are sought. Refer to the specific EverGuard® System Manual you are working with for a complete list of approved insulation boards.

2. EnergyGuard™ Flute Filler Insulation: EPS, XPS, or polyiso insulation may be used to fill in flutes of existing metal roof panels, and should fit snugly between seams of the existing metal panels. Flute filler insulation thickness should be equivalent to the height of the metal panel seams.
   a. EnergyGuard™ Polyisocyanurate insulation with glass-based facer meeting or exceeding the requirements of ASTM C1289, min. 16 psi (110 kPa) compressive strength.
b. EnergyGuard™ Extruded Polystyrene insulation meeting or exceeding the requirements of ASTM C578, Type II nominal 1.5 pound (42 gram/cubic cm) density and minimum 15 psi (110 kPa) compressive strength.

c. EnergyGuard™ Expanded Polystyrene insulation with plastic facer meeting or exceeding the requirements for ASTM C578, Type II nominal 1.5 pound (42 gram/cubic cm) density and minimum 15 psi (110 kPa) compressive strength.

3. Use the minimum number of fasteners necessary (1 fastener every 4 sq. ft. (1.22 m)) to hold insulation boards in place prior to membrane attachment.

Membrane Installation – Mechanically Attached Roofing System into Purlins

Membrane Placement

1. Place roof membrane so that wrinkles and buckles are not formed. Remove any wrinkles or buckles from the sheet prior to permanent securement. Roof membrane must be mechanically fastened after it is rolled out, followed by welding to adjacent sheets.

2. Full-width rolls must be installed in the field of the roof.

3. Half-width rolls must be installed in the perimeter region of the roof. Width of the roof perimeter region must be determined in accordance with the Perimeter Half Sheet Table in this Guide.

4. Overlap roof membrane a minimum of 6" (152 mm) for side laps of mechanically attached systems, and a minimum of 3" (76 mm) for end laps. Membranes are provided with lap lines along the side laps; the inside line is for mechanically attached system overlaps, which are 6" (152 mm) for TPO membranes. For PVC membranes, the solid line (overlap line) is marked on the top ply 5" (127 mm) from the sheet edge. The fastener line is a nominal 2" (51 mm) from the sheet edge, and an "X" is placed between the sheet edge and the field seam overlap line with spacing every 6" (152 mm). TPO fastener spacing marks should resemble a "pyramid" pattern.

5. Best practice is to install membrane so that the flow of water is parallel or over the side laps toward drainage points.

Membrane Securement

1. The Mechanically Attached Metal Retrofit System secures the membrane by mechanically fastening into purlins with Drill-Tec™ Purlin Fasteners as required by the Attachment Tables in this Guide.

2. Purlins of 18 gauge weight or heavier require Drill-Tec™ Purlin Fasteners. The fasteners are installed into the purlins for maximum uplift resistance.

3. Depending on sheet orientation and placement of the fasteners into the purlins, fasteners may be located in the seams of the membrane or in the field of the sheet. Fasteners not located in the seams should be covered by an 8" (203 mm) wide flashing strip hot air welded to the membrane.
4. Fasteners must be installed to achieve the proper embedment depth. Install fasteners vertical to the substrate/deck, without lean or tilt. Do not over- or under-drive fasteners. Install fasteners so that the plate is drawn down tightly to the membrane surface. Properly installed fasteners will not allow the plate/termination bar to move (underdriving), but will not cause wrinkling of the membrane (overdriving).

5. In the corner areas, additional fasteners must be installed through the perimeter half-width membrane rolls to form a grid pattern, with an 8" (203 mm) wide reinforced membrane flashing strip heat-welded over the additional fasteners. "Corners" include both outside and inside corners that measure 75°-105°. Perimeter cap sheets may overlap one another in the corner areas.

6. For perimeter and corners, refer to the Perimeter Half Sheet Table in this Guide for complete requirements.

7. Fastener pullout tests shall be conducted on the purlins with approved fasteners. Refer to the TPO & PVC Attachment Table for Mechanically Attached Systems in the Guide for complete requirements.

8. Mechanically attach membrane with screws and plates to the substrate at locations of deck slope changes in excess of 1:12.

9. Membrane may be heat-welded to EverGuard® coated metal flanges.
   a. Membrane must be secured to the substrate within 6" (152 mm) of the base of walls and curbs, at the perimeter and at all penetrations with Drill-Tec™ Fasteners of a type and spacing in accordance with in-lap attachment requirements, with a 12" (305 mm) o.c. maximum spacing.
   b. Alternatively, membrane may be extended vertically 3" up walls and curbs and secured to the wall/curb substrate within 2" (51 mm) of the plane of the roof. Use Drill-Tec™ Fasteners and inverted termination bar of type and spacing in accordance with in-lap attachment requirements, with a 12" (305 mm) o.c. maximum spacing. Vertical attachment with seam plates and fasteners may also be used. This alternative detail, including termination bar, is required to be used for pressurized buildings.

Membrane Installation – Drill-Tec™ RhinoBond® Roofing System into Purlins

Membrane Placement

1. Place roof membrane so that wrinkles and buckles are not formed. Remove any wrinkles or buckles from the sheet prior to permanent securement.

2. Full-width rolls can be installed throughout the field and perimeter of the roof. Half sheets are not necessary.
3. Overlap roof membrane a minimum of 3” (76 mm) for end laps of EverGuard® PVC and TPO membranes. Membranes are provided with lap lines along the side laps; the red line is for the Drill-Tec™ RhinoBond® Attachment System. PVC does not have an adhered line.

4. Best practice is to install membrane so that the flow of water is parallel or over the side laps toward drainage points

**Membrane Securement**

1. The RhinoBond® Purlin Attachment Metal Retrofit System secures the membrane to the purlins without penetrating the roofing material.

2. The Drill-Tec™ Purlin Fasteners are installed into the purlins for maximum uplift resistance without being placed in the seams of the membrane. Once the fasteners are in place, unroll the membrane and weld the membrane to the specially coated RhinoBond® plates using the Drill-Tec™ RhinoBond® induction welding tool. Then, hot air weld the membrane seams.

3. Purlins of 18 gauge weight or heavier require Drill-Tec™ Purlin Fasteners. The fasteners are installed into the purlins for maximum uplift resistance.

4. Fastener pullout tests shall be conducted on the purlins with approved fasteners. Refer to the TPO & PVC Attachment Table for Drill-Tec™ RhinoBond® Systems in the Guide for complete requirements.

5. Since fastening patterns are different in the field, perimeter and corner areas, treat each as a separate zone and weld each zone separately. This helps ensure that all plates are welded as you move from zone to zone. Refer to the TPO & PVC Attachment Table for Drill-Tec™ RhinoBond® Attached Systems in this Guide.

6. Roof membrane must be mechanically secured at the perimeter, at the base of internal walls and curbs, and at all penetrations with Drill-Tec™ RhinoBond® Plates and Fasteners at 12” (305 mm) o.c. maximum spacing. Membrane may be heat-welded to coated metal flanges. A minimum of 4 fasteners per penetration is required. Note: This assembly must be placed no closer than 4.5” (113 mm) from vertical flashings and a maximum of 6” (152 mm) away to facilitate the proper placement of the RhinoBond® induction welder. Specific details are available for these conditions in this Guide. Alternatively, standard mechanical base attachment can be used 12” (305 mm) o.c.

7. Fasteners must be installed to achieve the proper embedment depth. Install fasteners vertical to the substrate/deck, without lean or tilt. Do not over- or under-drive fasteners. Install fasteners so that the plate is drawn down tightly to the substrate surface.
1. REFER TO THE DRILL-TEC™ RHINOBOND® ATTACHMENT TABLE FOR ADDITIONAL INFORMATION.
NOTE
1. SEE EVERGUARD® SYSTEM GUIDELINES IN SPEC MANUAL TO DETERMINE PERIMETER AND CORNER ZONES AND REFER TO ATTACHMENT TABLES FOR FASTENER SPACING.
2. DEFAULTS TO PERIMETER FASTENING RATE.
3. DEFAULTS TO CORNER FASTENING RATE.
NOTE:
1. REFER TO THE DRILL-TEC® RHINOBOND® ATTACHMENT TABLES FOR DETAILED INSTALLATION REQUIREMENTS.
REINFORCED EVERGUARD® MEMBRANE

ENERGYGUARD™ ROOF INSULATION

HEAT-WELDED LAP

EVERGUARD® HEAT-WELDABLE COVER TAPE (SEE NOTE #2)

WOOD NAILER WITH APPROVED FASTENERS.

PEEL-N-STICK ADHESIVE

ENERGYGUARD™ INSULATION-FLUTE FILLER

EXISTING METAL ROOF PANEL

COATED FASCIA CLADDING WITH CONTINUOUS CLEAT

NOTE:

1. REFER TO THE ATTACHMENT TABLES FOR DETAILED INSTALLATION REQUIREMENTS.
2. USE STRIPPING DETAIL APPROPRIATE TO THE METAL TYPE AND GUARANTEE PERIOD. REFER TO EVERGUARD® 200 SERIES DETAILS