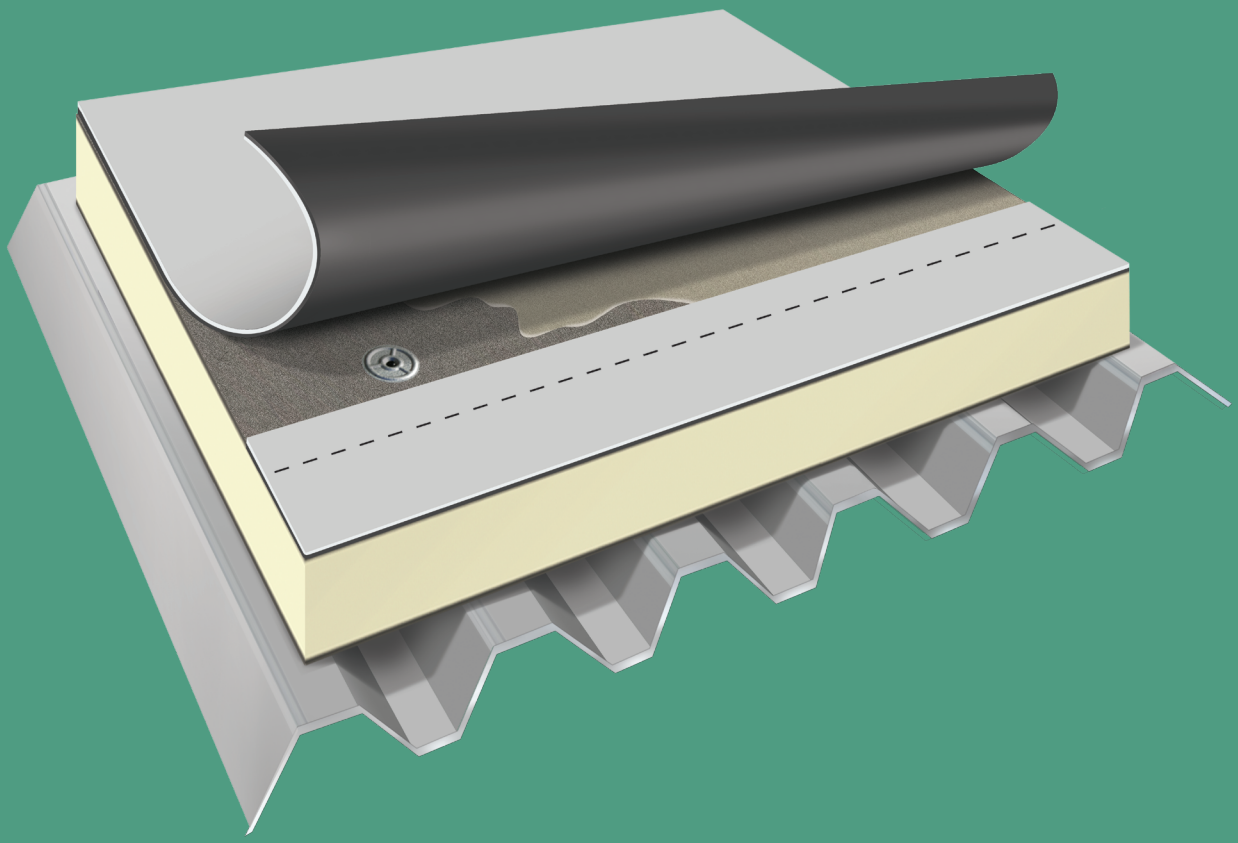
GAF

We protect what matters most™

Version 2.0

EVERGUARD® TPO/PVC ADHERED

Roofing System Overview & General Requirements Manual



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WELCOME

Thank you for consulting Version 2.0 of the EverGuard® TPO/PVC Adhered Roofing System Overview & General Requirements Manual. You can find further information at www.gaf.com, or call 800-766-3411.

WHO IS GAF?

Founded in 1886, GAF has grown to become North America's largest manufacturer of commercial and residential roofing with plants strategically located across the U.S. As a member of the the Standard Industries family of companies, GAF is the largest roofing and waterproofing business in the world.

WHAT IS IN THIS MANUAL?

This Manual contains the following sections:

- Welcome
- Guarantee Program
- Roof Design Considerations
- Design Considerations & Application Guidelines: Adhered Roofing Systems

WHAT ARE OUR PRODUCTS AND SERVICES?

No one offers a wider range of reliable, proven, cost-effective roofing solutions:

COMMERCIAL PRODUCTS

- EnergyGuard™ Insulation
- EverGuard Extreme® TPO Single-Ply Roofing Systems
- EverGuard® TPO and PVC Single-Ply Roofing Systems
- EverGuard® Freedom™ TPO Self-Adhering Roofing Systems
- RUBEROID® SBS and APP Modified Bitumen
- Liberty™ SBS Self-Adhering Roofing Systems
- GAFGLAS® Fiberglass Built-up Roofing Systems
- GAF Liquid-Applied Roof Coatings
- HYDROSTOP® Liquid-Applied Roof Membrane
- GAF Pavement Coatings
- GAF LiveRoof® Garden Roofing System

RESIDENTIAL PRODUCTS

- Lifetime Designer Shingles... Camelot II®, Slateline®, Grand Canyon®, Grand Sequoia®, Grand Sequoia® ArmorShield™, Grand Sequoia® Reflector Series, and Woodland® Shingles.
- Timberline® Lifetime Shingles... Timberline UHD®, Timberline® UHD with Dual Shadow Line, Timberline® Natural Shadow®, Timberline® American Harvest®, Timberline® HDZ™, Timberline HDZ™ Reflector Series™ & Reflector Series™ Plus, Timberline® CS Cool Series®, and Timberline® ArmorShield™ II
- 3-Tab Shingles... Marquis® WeatherMax® and Royal Sovereign®
- ThermaCal® Nail Base Roof Insulation Panels

ACCESSORY PRODUCTS

- We offer an extensive line of accessory products for our roof systems, including: EverGuard® TPO and PVC Prefabricated Accessories; Single-Ply Adhesives, Primers & Sealants; Matrix™ Coatings and Cements; Drill-Tec™ Fasteners; M-WELD® Preflashed Accessories; Metalastic® Expansion Joint Covers; Lexsuco® Roof System Accessories; Cobra® and Master Flow® Ventilation Products; Timbertex® Premium Ridge Cap Shingles; WeatherWatch® and StormGuard® Leak Barriers; Shingle-Mate®, Deck-Armor®, Tiger Paw™ and RoofPro™ Roof Deck Protection, among others. See www.gaf.com for complete product offerings.

SERVICES

- GAF has a network of field representatives and distributors to supply and service its quality roofing systems throughout North America.
- Our GAF Technical Support Services is an assistance service that allows you to contact us directly to speak with a representative about specifications, applications, code approvals, and product information. The GAF Technical Support Services number is 800-766-3411.
- Our CARE (Center for the Advancement of Roofing Excellence) program trains industry professionals in safe roofing techniques. Professional, educational programs geared specifically to the roofing industry – given by experts in the roofing industry.
- Architectural Information Services (AIS) is a specification service that helps you to specify an approved GAF roofing system based on your specific roofing needs and will send you a general specification for that roofing system, as well as application methods, product description, and detail drawings. The phone number for AIS is 800-522-9224.
- Our Tapered Design Group (TDG) is one of the many services available to our customers to help reduce their hassles. We provide tapered insulation take-offs for architects, contractors, and distributors nationwide. Just send your roof plans and specifications to tdg@gaf.com.
- Visit GAF on the web at www.gaf.com for extensive product information, specifications, and technical literature.

A FEW THINGS TO CONSIDER...

- This Manual contains the latest information relating to the application of GAF's Adhered Single-Ply Roofing Systems 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, or construction flaws.
- The design responsibility remains with the architect, engineer, roofing contractor, or owner. GAF's general guidelines 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.
- Under no circumstances does 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 in 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. GAF reserves the right to change or modify, at its discretion, any of the information, requirements, specifications, or policies contained herein. This Manual supersedes all catalogs and previous Manuals.

GUARANTEE PROGRAM

GENERAL

GAF offers roof guarantees for a fee for all roofing system specifications published in this Manual when installed by contractors certified with GAF at the appropriate certification level in accordance with the terms and conditions set forth in this Manual, and the 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 determine, in its sole discretion, whether a roofing guarantee will be issued to cover any proposed or completed roof. The issuance of a guarantee and/or its effectiveness is contingent upon payment of GAF's guarantee fee and payment in full to roofing contractors and materials suppliers.

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.

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 under any circumstances. Building owners may make reasonable and customary temporary repairs at their own expense to minimize damage to the building or its contents in an emergency.

A GAF guarantee may be cancelled subsequently by GAF for violation of its terms and conditions.

Certain GAF guarantees may be eligible for GAF WellRoof® guarantee extension. Consult with GAF at 800-766-3411 for eligibility requirements.

GAF CERTIFIED CONTRACTOR PROGRAM

GAF does not install roofing systems. GAF does not own roof contracting companies, or have any interest in companies installing roofing systems. Accordingly, GAF shall not be responsible for any roofing contractor's workmanship except as specifically covered under the terms and conditions of the GAF roofing guarantee issued for a particular project.

References to GAF certified contractors only identify a contractor eligible to apply for a GAF roofing guarantee and is not intended to convey any other meaning. GAF certified contractors are not employees, agents, or representatives of GAF.

GAF will issue a roofing system guarantee only for roofs applied by a GAF certified contractor that meet GAF's requirements for guarantee issuance. The responsibility for proper application of the roof lies with the GAF certified contractor alone. It is the responsibility of the building owner and his designated representatives to enforce the compliance with contractual requirements, specifications and good workmanship practices, and such enforcement is not an obligation of GAF.

INSPECTIONS

GAF will inspect only those roofs where a guarantee is to be issued or where special inspection services have been purchased, and the current charge for the guarantee or inspection services has been paid. If an inspection is requested and the job is not ready or the owner's representative is not available when GAF arrives onsite, GAF reserves the right to charge for such visit.

GAF reserves the right to waive inspection of guaranteed roofs when, in its opinion, inspection is not necessary. In such cases, the owner or designer may request a special inspection for which an additional charge may be made.

Any inspections made by GAF are for its sole use only and do not constitute a waiver modification, or expansion of any of the terms and conditions of the guarantee.

Should a GAF Field Services Representative observe conditions on the job site that do not conform to our requirements or standard good roofing practices, such conditions will be brought to the attention of the roofing contractor. GAF, at its sole discretion, has the right to require corrective action as it deems necessary to conform to standard requirements for the issuance of the GAF roofing system guarantee.

SPECIAL CONDITIONS

A guarantee will not be issued to cover less than the entire roof area of a single building.

GAF will not issue a roofing system guarantee for the following without prior written approval from the Field Services Manager or Director:

- Over any surface or deck not covered in this Manual
- On storage silos, heated tanks, or domed structures
- On structures having conduit or piping between the roof deck and roofing membrane, unless the conduit or piping is installed in channels below the top deck surface
- On roofs that have an inadequate number and spacing of expansion joints or curbs
- On systems constructed with insulation not approved by GAF
- On any structure where there is limited or no access to the roof
- On a roof designed for or used as a water-insulated or spray roof
- On promenade or parking roofs
- On any structure where high-heat or humidity conditions exist such as, but not limited to, breweries, creameries, laundries, textile mills, pulp and paper plants, swimming pools, shower rooms, and canneries
- When roofing over an existing roof system that contains

moisture, that is not fully adhered to the substrate or roof deck, and/or provides an improperly prepared surface

- On plywood/OSB decks not conforming to APA requirements
- On roofs containing sprayed-in-place polyurethane foam
- Any unusual condition not specifically approved by GAF
- On any high-temperature condition that allows the roof membrane temperature to exceed 160°F (71°C); or 195°F (90°C) for EverGuard Extreme® roofing systems
- On any other installations that deviate from GAF's specifications.

GUARANTEE PROGRAM

GAF ROOF GUARANTEE PROGRAM

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® adhered roofing system when installed by an eligible GAF certified contractor. Please call 800-766-3411 for additional information and specific guarantee requirements.

EverGuard® Roofing System Guarantees	Length of Coverage
Diamond Pledge™ NDL Roof Guarantee	10 years
	15 years
	20 years
	25 years
	30 years
	35 years
System Pledge™ Roof Guarantee	10 years
	15 years
	20 years
Weather Stopper® Integrated System Limited Warranty	Up to 20 years
WellRoof® Guarantee Extension* • **Coverage: Up to 25% longer guarantee term**	Up to 35 years

* *When certain additional annual maintenance requirements are met, GAF will extend the term of its Diamond Pledge™ NDL Roof Guarantee by up to 25% for a maximum of 35 years. Please call 800-766-3411 for qualifying specifications and detailed information concerning additional requirements. All maintenance work must be completed by a GAF Certified Maintenance Professional (CMP). See WellRoof® Guarantee Extension for complete coverage and restrictions.*

Note: Refer to the TPO/PVC Guarantee Requirements for maximum guarantee lengths and additional requirements. See pages 7-8.

TPO SYSTEM GUARANTEE REQUIREMENTS

EverGuard® TPO Roofing Systems – Adhered 20-, 25-, 30- and 35- Year Diamond Pledge™ NDL Roof Guarantee Requirements

The following is a summary of the assembly requirements for the installation of an EverGuard® TPO adhered roofing system in order to be eligible to receive an NDL roof guarantee. The selection of membrane type, thickness, and attachment is the responsibility of the architect, engineer, owner, or roof consultant. GAF EverGuard® roof membranes must be used in roofing systems to be guaranteed by GAF.

TPO GUARANTEE CHART

Attachment Method	Maximum Guarantee Length	EverGuard Extreme® TPO Membrane	EverGuard® TPO Membrane	Insulation Requirements
Adhered	20 Years	50-80 mil	45-80 mil	As required by Insulation Attachment Table(s)
	25 Years	50-80 mil	60-80 mil	Minimum of 2 layers of approved insulation[1]
	30 Years[3]	60-80 mil	80 mil	Minimum of 2 layers of approved insulation[1]; top layer must be an approved cover board[2]
	35 Years[3]	80 mil	n/a	

[1]May be one layer when using a minimum 1/4: 12 tapered polyiso insulation system from GAF over concrete, gypsum or cementious wood fiber (cwf) decks.

[2]Approved Cover Boards:

a. EnergyGuard™ HD Polyiso
b. EnergyGuard™ HD Plus Polyiso
c. EnergyGuard™ NH HD Polyiso
d. EnergyGuard™ NH HD Plus Polyiso
e. SECUROCK® Gypsum-Fiber Roof Board
f. DensDeck® Prime Roof Board
g. Blue Ridge STRUCTODEK® High Density Fiberboard

[3] Exclusively for Master Select Contractors

Additional Requirements For Extended-Length (25-, 30- and 35- Years) EverGuard® Diamond Pledge™ NDL Roof Guarantees	
Building Height Limitations	Buildings greater than 100' (30.5 m) in height must have a minimum 3' (1 m) parapet wall to be eligible for an extended-length guarantee.
Construction Type	Extended-length guarantees are available only for new construction or a complete tear-off to the deck. Extended-length guarantees are not eligible for re-cover applications.
Air/Vapor Retarders	An air/vapor retarder is required where large wall openings greater than 10% of a total wall area can be open during a wind storm, including opening due to storm damage. An air/vapor retarder is required on all 10' (3 m) wide or greater membranes with side laps mechanical attachment that exceed 6" (152 mm) o.c.
WellRoof® Guarantee Extension	Any Issued guarantees up to 30 years in length may be eligible for a GAF WellRoof® extension; provided certain additional annual maintenance requirements are met. maximum guarantee length, including WellRoof® Guarantee Extension, is 35 years. All maintenance work must be completed by a GAF Certified Maintenance Professional (CMP).
Roof Flashings	For extended-length guarantees, separate counter flashing or cap flashing is required; exposed termination bars are not acceptable.
Flashing Accessories	For extended-length guarantees, regardless of the membrane type, EverGuard Extreme® pre-formed flashing accessories are required. When EverGuard Extreme® pre-formed flashing accessories are not available, unreinforced EverGuard Extreme® membrane must be used.
Roof Edges	EverGuard Extreme® Cover Tape HW, EverGuard Extreme® TPO Coated Metal in conjunction with EverGuard Extreme® Flashing Strip or any of the other EverGuard® pre-fabricated extruded aluminum fascia systems are required.

GUARANTEE PROGRAM

PVC SYSTEM GUARANTEE REQUIREMENTS

EverGuard® PVC Roofing Systems – Adhered Systems 15-, 20-, 25 and 30-Year Diamond Pledge™ NDL Roof Guarantee Requirements

The following is a summary of the assembly requirements for the installation of an EverGuard® PVC roofing system in order to be eligible to receive an NDL roof guarantee. The selection of membrane type, thickness, and attachment is the responsibility of the architect, engineer, owner, or roof consultant. GAF EverGuard® roof membranes must be used in roofing systems to be guaranteed by GAF.

PVC GUARANTEE CHART

Attachment Method	Maximum Guarantee Length	EverGuard® PVC EverGuard® PVC Fleece-Back	EverGuard® PVC XK EverGuard® PVC XK Fleece-Back	Insulation Requirements
Adhered	15 Years	50-80 mil	50-80 mil	As required by Insulation Attachment Table(s)
	20 Years	60-80 mil	50-80 mil	
	25 Years	80 mil	60-80 mil	Minimum of 2 layers of approved insulation[1]
	30 Years[3]	N/A	80 mil	Minimum of 2 layers of approved insulation[1]; top layer must be an approved cover board[2]

[1]May be one layer when using a minimum 1/4:12 tapered polyiso insulation system from GAF over concrete, gypsum or cementious wood fiber (cwf) decks.

[2]Approved Cover Boards:

a. EnergyGuard™ HD Polyiso
b. EnergyGuard™ HD Plus Polyiso
c. EnergyGuard™ NH HD Polyiso
d. EnergyGuard™ NH HD Plus Polyiso
e. SECUROCK® Gypsum-Fiber Roof Board
f. DensDeck® Prime Roof Board
g. Blue Ridge STRUCTODEK® High Density Fiberboard

[3]Exclusively for Master Select Contractors

Additional Requirements For Extended-Length (25- & 30- Year) EverGuard® Diamond Pledge™ NDL Roof Guarantees	
Building Height Limitations	Buildings greater than 100' (30.5 m) in height must have a minimum 3' (1 m) parapet wall to be eligible for an extended-length guarantee.
Construction Type	Extended-length guarantees are available only for new construction or a complete tear-off to the deck. Extended-length guarantees are not eligible for re-cover applications.
Air/Vapor Retarders	An air/vapor retarder is required where large wall openings greater than 10% of a total wall area can be open during a wind storm, including opening due to storm damage.
WellRoof® Guarantee Extension	Any Issued guarantees up to 30 years in length may be eligible for a GAF WellRoof® extension; provided certain additional annual maintenance requirements are met. maximum guarantee length, including WellRoof® Guarantee Extension, is 35 years. All maintenance work must be completed by a GAF Certified Maintenance Professional (CMP).
Roof Flashings	For extended-length guarantees, separate counter flashing or cap flashing is required; exposed termination bars are not acceptable.

ROOF DESIGN CONSIDERATIONS

PROVIDES A QUICK REFERENCE OF TECHNICAL REQUIREMENTS FOR EVERGUARD® ADHERED ROOFING SYSTEMS

General	10
Sustainable Design	10
Building Utilization	10
Tear-off or Re-cover	11
Roof Decks	12
Parapet Walls	14
Roof Drainage	14
Expansion Joints	14
Area Dividers	15
Equipment Mountings	15
Fire Resistance	15
Wind Performance	15
Energy Efficiency	15
Water Vapor Transfer	16
Air Barriers	17

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.

ROOF DESIGN CONSIDERATIONS

GENERAL

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, we have decades of extensive experience in the practical aspects of roofing.

Our experience suggests that careful consideration of the following will help provide a fundamentally sound basis for design and selection of EverGuard® single-ply roofing systems.

SUSTAINABLE DESIGN

Whether you're aiming for LEED®, Living Building Challenge or Green Globes certification, GAF can help. The dynamic tools listed below give you at-a-glance information on how GAF products can contribute towards meeting criteria for several of the most popular green building rating systems. Visit the Green Architects & Specifiers page for further information at www.gaf.com.

The LEED® (Leadership in Energy and Environmental Design) Green Building Rating System is a voluntary standard for developing High-performance, energy-efficient sustainable buildings. The LEED® Certification System is a program that awards building points for satisfying specified green-building criteria and requirements.

The GAF LEED® Playbook and Spec Advisor gives you at-a-glance information on how GAF products can contribute towards meeting criteria for several of the most popular green building rating systems.

Sustainable Minds® is a cloud-based product transparency application and service to help manufacturers design and market greener products. See ALL of our products, with all the associated disclosures including Environmental Product Disclosures (EPDs), Health Product Declarations (HPDs), and Declare organized by MasterFormat® division and section on one page.

EcoScorecard™ is a web based tool that helps architects and designers to measure the environmental impact of specific products and materials. EcoScorecard™ will quickly provide detailed information you need about how our products perform in all green building design and construction rating systems.

Mindful Materials is a freely searchable platform where users can access product data, certifications, declarations and test reports, in a standard format, effectively and efficiently.

CREST is the industry's first self-serve cool roof energy conductor that preloads utility cost information based on your zip code, finds rebates available in your local market, allows you to compare multiple roof designs, and generates a proposal quality report!

BIMsmith® is a completely free platform for building professionals to research, configure, and download building product data and BIM models to use in your Revit projects.

Note: GAF is not responsible for ensuring the accuracy and currentness of the data contained in these third party databases.

GAF's EverGuard® TPO is the first to be certified by NSF International for the NSF/ANSI 347: Sustainability Assessment for Single-Ply Roofing Membranes. The Standard includes criteria across the product life cycle from raw material extraction through manufacturing, use, and end-of-life management.

GAF's EverGuard Extreme® TPO is also the first TPO membrane to be tested and certified as an approved membrane for rainwater catchment that complies with NSF/ANSI P151: Certification of Rainwater Catchment System Components requirements. Go to www.nsf.org for details.

BUILDING UTILIZATION

Building utilization can have a significant impact on roofing system selection and design. The most common building utilization considerations are as follows: PV (solar applications), extremes in internal temperature/humidity; positive internal pressure; rooftop traffic/abuse; rooftop-exhausted contaminants; and the use of the roof as living space.

PV (Solar Applications)

- Please review Photovoltaic Installations on GAF Guaranteed Roofing Systems, available at www.gaf.com, before installing a PV System on a GAF Guaranteed Roof.

Internal Temperature/Humidity

Extremes in internal temperature/humidity are most often associated with cold storage/freezer buildings, swimming pool facilities, drying kilns, food processing plants, paper/pulp mills, and smelting/blast furnace facilities. 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. GAF's guarantees and warranties specifically exclude from coverage leaks or other damage resulting from condensation.

Relevant design considerations include:

- Incorporation of a vapor retarder at deck level to control vapor flow into and through the roof assembly for high humidity interior conditions;
- Attention to a vapor-tight seal between the roof and side walls/penetrations;
- Utilization of closed-cell foam insulation and stainless steel fasteners to minimize potential for condensation-related degradation of the roof system;
- Limitation of penetrations through the roof deck;
- Avoidance of roof system attachment that will puncture the vapor retarder;
- Cold/freezer storage. Refer to GAF's *A Guide to Cold Storage Roof Systems Design*.
- Visit www.gaf.com for further information.

Positive Internal Pressure

Positive internal pressure is most often associated with manufacturing/clean-room facilities, mechanical air-handling rooms, aircraft hangars, distribution centers with multiple overhead doors, and high-rise office/residential towers. In all these instances, positive internal pressures can adversely act on the underside of the roof system. Leaks or other damage resulting from positive internal pressures are not covered under GAF's guarantees or warranties.

Conditions where the positive internal pressure is constant, as in the case of clean-room facilities and high-rise towers, may cause the roof

system to billow up in a mechanically attached system, i.e., form a mattress effect, and may reduce the overall uplift resistance of the roofing system.

This effect can cause attachment concerns with other types of roof system installations including adhered systems. Conditions where the positive internal pressure is applied suddenly, as in the case of aircraft hangars and distribution centers, may cause failure of the roofing system due to pressure impact.

Relevant design considerations include:

- Use of air-impermeable deck construction, such as a poured-in-place concrete or insulating cellular concrete over a steel pan;
- Alternatively, installation of an air barrier, such as polyethylene sheeting, at deck level beneath mechanically attached insulation with attachment sufficient to balance positive pressure;
- Attention to an air-tight seal between roof and side walls/penetrations.

Rooftop Traffic/Physical Abuse

Roofing installations that can be expected to experience a high degree of roof traffic due to equipment maintenance, vandalism or other unauthorized access, frequent hailstorms or high winds, and prolonged periods of temperature extremes or rapid fluctuations in temperature will require a more durable roofing system, especially because guarantee and warranty coverage for these items may be limited.

Relevant design considerations include:

- Use of thicker membrane or multiple-ply system;
- Installation of EverGuard® TPO or PVC Walkway Roll at high-traffic areas;
- Use of a higher compressive strength insulation substrate;
- Application of a concrete paver or insulated paver overlay for extreme conditions.

Contamination

Many roofing installations are exposed to oil, grease, and chemical contamination in excess of normal airborne contaminants. These conditions are most often associated with restaurants, food processing plants, chemical and pharmaceutical plants, refineries, machining and manufacturing facilities, and airports. Most roofing materials are degraded by certain families of contaminants, and will become brittle, swell and soften, or dissolve, depending on the material formulation and contaminant type. GAF's warranties and guarantees do not cover leaks or other damage resulting from exposure of the roofing materials to chemicals, grease, oils and the like.

Relevant design/maintenance considerations include:

- Isolation of contaminated roof area with expectation of more frequent roof membrane replacement;
- Periodic power washing of roofing membrane with moderate pressure;
- Limitation of rooftop spillage/exhaust of contaminating materials through the use of containment, i.e., grease traps.

Refer to www.gaf.com for chemical–resistance information.

TEAR-OFF OR RE-COVER

The decision to tear-off or to re-cover an existing roofing system is not always clear.

Although not an exhaustive list, the following additional design elements typically require consideration for any reroofing project:

- Replacement of damaged roof decking or structural components;
- Improvement of roof access;
- Removal of unused rooftop equipment and associated equipment mountings;
- Remounting of rooftop equipment to allow proper roofing and flashing technique;
- Matching of architectural elements such as special perimeter metalwork;
- Repair of deteriorated parapet and penthouse walls;
- Protection of roofing membrane by means of concrete paver overlay or walkway pad system.

Tear-off/Replace

Factors that support the tear-off approach include:

- Two or more existing roofs (building code restriction);
- Structural weight limitation;
- More than 25% of existing roof area is wet;
- Flashing height limitations;
- Need to maximize long-term performance.

The basis for any tear-off project is to provide a sound substrate for the installation of a new roofing system and minimize potential damage from tear-off activities. At a minimum, attention to the following considerations is recommended:

- Thoroughly inspect decking, flashing substrates, and wood nailers before installing new materials;
- Plan a tear-off strategy so that roof drainage patterns are never blocked, and so that construction traffic is directed away from new roof areas;
- Protect new roof areas adjacent to tear-off areas from dirt, debris, and damage.

Re-cover

Factors that support the re-cover approach include:

- Need to minimize cost;
- Disposal restrictions;
- Difficult access to the roof;
- Only one roofing system in place.

The requirement 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:

ROOF DESIGN CONSIDERATIONS

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

Re-covering Over Coal Tar Pitch Roofing

Coal tar pitch has oils and vapors that can be harmful to various roofing membranes and may discolor white thermoplastic membranes. Coal tar pitch may also "cold flow" through fastener holes into the building. For these reasons, extra care must be taken when re-covering over an existing coal tar pitch roof. Typically, additional insulation and a white surface help to first separate the membrane from the existing coal tar pitch roof and reduce the temperature of the finished assembly, which minimizes the potential for cold flow.

ROOF DECKS

It is the responsibility of the engineer, architect, building owner, or roofing contractor to determine the fitness of a deck for a specific roofing system installation. Additionally, GAF is not responsible for moisture-related problems associated with any deck materials.

Most common structural roof deck types are suitable substrates for the installation of an EverGuard® roofing system.

Structural Steel

- Min. 22 gauge (standard FM-approved steel decking is 22 gauge in thickness).
- 24-26 gauge decks require a GAF Field Services Manager's or Director's approval. Thinner-gauge steel decks usually require additional mechanical fasteners to achieve comparable roof attachment performance.
- 18 gauge, 20 gauge, and 22 gauge Grade E high-strength steel decks usually require fewer mechanical fasteners to achieve comparable roof attachment performance.

Structural Concrete (Pre-cast, Pre-stressed, and Poured Concrete)

- Minimum 2,500 psi (17,237 kPa) compressive strength.
- Min. 2" (51 mm) thickness (pre-cast), min. 4" (102 mm) thickness (poured-in-place).
- Cannot be wet or frozen. If the deck is determined to be wet, it must be allowed to dry.
- For insulated decks, wood nailers of equivalent thickness to the roof insulation must be provided at perimeters and projection openings to act as an insulation stop and to provide for the nailing of the flanges of metal flashing.
- Ridges and other irregularities require grinding to provide a smooth and even substrate surface.
- For non-insulated decks, nailers must be flush with deck surfaces.
- When applying insulation directly to the deck in hot asphalt, prime with asphalt/concrete primer, meeting ASTM D41, at a rate of 1 gal/square (4.08 L/10 m^2) and allow the primer to dry prior to the application of the roofing system.

Pre-cast Concrete

- These decks are usually manufactured as planks or slabs and constructed of steel-reinforced Portland cement and solid aggregate; often they are made with hollow cores to minimize their weight.
- All deformed panels must be replaced.
- Joints must be filled with a masonry grout to correct imperfections between slabs and feathered to provide a slope not greater than 1/8:12 for adhered insulated assemblies.
- If the joints cannot be grouted and finished smooth, then a leveling course of lightweight insulating concrete (minimum 2" (51 mm) thickness) must be applied. Do not seal joints between the slabs; leave open to permit venting and drying of the roof fill from below.

Pre-stressed Concrete

- GAF recommends a minimum 2" (51 mm) cellular lightweight concrete fill be installed over all pre-stressed concrete decks prior to installation of the roof system and/or insulation because variations in camber and thickness of pre-stressed concrete members may make securement of the roof system difficult.
- Provisions must be made for the curing or drying of the fill installed over the top of the pre-stressed deck members. Do not seal joints between the slabs/leave open to permit venting and drying of the roof fill from below.

Poured Concrete

- Should be properly cured prior to application of the roofing system. Check curing agents for compatibility with roofing materials. Prior to the installation of the roof assemblies, GAF recommends the evaluation of surface moisture and deck's dryness through the use of ASTM D4263 or a hot bitumen test.
- Should be poured over removable forms or must provide for bottom side drying. Poured-in-place structural concrete decks that are poured over non-vented metal decks or pans that remain in place can trap moisture in the deck under the roof system.
- The underside of the concrete decks, either the vented metal forms or exposed concrete, should remain unobstructed to allow the escape of water vapor. Materials that retard the flow of vapor should not be installed directly below the deck. Foil-faced insulation secured to the bottom of the deck, spray-on fireproofing, or paint, which obstruct the venting of the concrete, are just three examples of things that can trap moisture in the concrete deck below the roof.
- GAF recommends that a vapor retarder be used directly over any poured structural concrete installed over non-removable form decks or any impermeable substrate and **requires** the use of a vapor retarder for lightweight aggregate structural concrete decks in this configuration.
- Roofing professionals must take care with lightweight structural concrete decks. due to the amount of water that the aggregate absorbs during mixing.
- The selection of the deck material and its suitability for use is the responsibility of the designer of record, who must make appropriate design accommodations to address high moisture content that may be encountered in structural concrete.
- GAF is not responsible for moisture-related problems associated with any deck materials.

ROOF DESIGN CONSIDERATIONS

Wood Planking

- Min. 1" (25 mm) nominal thickness.
- Tongue and groove or splined edges required.
- All boards must have a bearing on rafters at each end and be securely fastened.
- Lumber should be kiln dried.
- Check compatibility of preservatives or fire retardants used to treat decking with roofing materials.
- Decking should be kept dry and roofed promptly after installation.

Plywood

- Min. 15/32" (12 mm) thickness.
- Deck must be attached with approved fasteners at required spacing.
- Plywood sheathing must comply with roof deck design requirements and local codes for roof deck construction.
- The panels must be secured in accordance with APA- The Engineered Wood Association Construction Guide recommendations.
- Tongue and groove edges or full blocking required.
- Plywood sheathing must be C-D Exposure 1 APA Rated, minimum 4 ply.
- Plywood sheathing must comply with Structural 1 performance rating.
- Panels must be installed with a 1/8" to 1/4" (3 mm – 6 mm) gap between panels and must match vertically at joints to within 1/8" (3 mm).
- Moisture content not to exceed 16%
- Decking should be kept dry and roofed promptly after installation.
- Must be installed over joists not greater than 24" (610 mm) o.c.
- Insulation above the wood deck may be necessary to prevent condensation from adversely affecting the deck.
- Must meet minimum pull out values
- Minimum 5 test pulls per 1,000 sq. ft. (93 sq. m.)

Oriented Strand Board (OSB)

- Min. 15/32" (12 mm) thickness.
- Deck must be attached with approved fasteners at required spacing. Consult local building codes for specific requirements.
- OSB must comply with roof deck design requirements and local codes for roof deck construction.
- The panels must be secured in accordance with APA- The Engineered Wood Association Construction Guide recommendations.
- Tongue and groove edges or full blocking required.
- OSB must comply with Structural 1 performance rating.
- Oriented strand board (OSB) must be C-D Exposure 1 APA Rated.
- Must be installed over joists not greater than 24" (610 mm) o.c.
- Insulation above the wood deck may be necessary to prevent condensation from adversely affecting the deck.
- Must meet minimum pull out values
- Minimum 5 test pulls per 1,000 sq. ft. (93 sq. m.)
- Panels must be installed with a 1/8" to 1/4" (3 mm – 6 mm) gap between panels and must match vertically at joints to within 1/8" (3 mm).
- Moisture content not to exceed 16%
- Decking should be kept dry and roofed promptly after installation.

Note: OSB values vary greatly by manufacturer and with exposure to moisture. OSB exposed to daily condensation or nightly dew has seen significant loss of pull out values. GAF will not accept any liability for substandard or moisture-damaged OSB.

Gypsum Concrete

- Min. 2" (51 mm) thickness.
- Steel reinforcing mesh and permanent form boards required for poured-in-place monolithic decks.
- Steel reinforced edges required for pre-cast decking units.
- An average fastener withdrawal resistance as recommended by the fastener manufacturer must be obtained. If proper mechanical attachment cannot be achieved, please call 800-766-3411 for assistance with installation recommendations.
- If surface is either wet or frozen, a poured gypsum deck is not suitable to receive a roof.

Cementitious Wood Fiber

- Min. 2" (51 mm) thickness.
- Tongue and groove panel edges required.
- Should not be installed over high humidity occupancies.
- All structural wood fiber deck panels must be anchored against uplift and lateral movement.
- OSB or insulation composite decks for use with adhered systems require a GAF Field Service Manager's or Director's approval.

Lightweight Insulating Concrete (LWIC)

- Min. 2" (51 mm) thickness.
- Cellular lightweight insulating concrete decks can be installed over non-slotted, galvanized metal decking designed for cellular lightweight insulating concrete or structural concrete.
- Aggregate lightweight insulating concrete decks must be installed over permanent venting steel forms.
- Insulating concrete installed over structural concrete or existing roof membrane substrates requires a GAF Field Services Manager's or Director's approval.
- Lightweight insulating concrete decks are required to have a minimum compressive strength of 125 psi (9 kg/cm) and a density of 22 pcf (208 grams/cubic meter). Individual deck manufacturers' standards apply when their specifications exceed these GAF minimum thicknesses, compressive strengths, and density requirements.
- Where the Mean January Temperature (reference current ASHRAE Fundamentals Handbook) is below 40°F (4.4°C), lightweight insulating concrete decks must be poured and roofed between April 1st and October 31st; this type of deck is unacceptable in Alaska.

ROOF DESIGN CONSIDERATIONS

- Lightweight insulating concrete should not be poured during rainy periods; deck areas that have frozen before they have cured must be removed and replaced. Check decks for moisture content and dryness if exposed to precipitation prior to installation of roof membrane.
- Adhering an EverGuard® fleece-back membrane directly to LWIC is acceptable only when the deck has less than 15% moisture content. Please call 800-766-3411 for additional requirements.
- Maximum guarantee length available when mechanically attaching an approved base sheet to a LWIC deck is 20 years.

Loadmaster Decks

- Roof deck must be installed by a Loadmaster approved contractor according to Loadmaster specifications.
- Min. 25 gauge steel decking, 15/16" (22 mm) deep with 1/2" thick (13 mm) mineral board top panel.
- Polystyrene or polyisocyanurate insulation is optional.
- Install only white or light colored membranes on Loadmaster decks.
- Consult a GAF Field Services Manager or Director for reroofing and re-covering requirements.

Non-Acceptable Substrates

The following are some examples of non-acceptable roof substrates, but should not be considered a complete list. Please call 800-766-3411 or consult with a GAF Field Services Manager or Director regarding the suitability of unusual deck substrates:

- Metal roof panels
- Transite roof panels
- Fiberglass roof panels

PARAPET WALLS

Most common structural wall types are suitable substrates for the installation of EverGuard® membrane flashing.

Brick/Block Masonry

- Standard-finish brick and concrete block with standard tooled mortar joints.
- Split-face block, textured block and brick, and deeply tooled mortar joints require a cementitious coating or plywood facing to provide a smooth and even substrate surface.

Structural Concrete

- Steel trowel, wood float, or removable form finish.
- Ridges and other irregularities require grinding to provide a smooth and even substrate surface.

Stucco/EIFS

- Stucco finish and EIFS systems must be removed to the underlying substrate surface.

Plywood/Oriented Strand Board (OSB)

- Plywood must be exterior grade, minimum 4 ply, and not less than 15/32" (12 mm) thick. Must comply with Structural 1 rating.
- OSB must comply with Structural 1 rating and be at least 7/16" (11 mm) thick.
- Tongue and groove edges.
- Adhesives should only be used with untreated plywood/OSB.
- Surface of plywood/OSB should be dry to the touch with no visible liquid, snow or ice at the time roofing is installed.
- Moisture content not to exceed 16%.

Sheet Metal

- Min. 24 gauge steel.
- Min. .032" (8 mm) aluminum.
- Corrugated panels require overlay of 15/32" (12 mm) plywood/oriented strand board or silicone-impregnated gypsum panel.

Gypsum Panel

- Min. 1/2" (13 mm) thickness.
- Underlying substrate must allow securement of flashing at prescribed spacing. Mechanical attachment to gypsum panels is not acceptable.
- Use of gypsum panel requires GAF Field Services Area Manager's or Director's approval.

ROOF DRAINAGE

Providing positive roof drainage is important. Standing water can result in deck deflection and possible structural damage. In addition, in the event of an opening through the roofing membrane, standing water can significantly worsen damage to the roof system, the building itself, and interior contents by providing a reservoir of water ready to gravitate through the membrane opening. Providing structural slope in the deck assembly, installing a tapered lightweight cellular concrete overlay, installing a tapered insulation system, or adding additional drains are the most common methods of achieving positive drainage.

Applicable building codes generally require a minimum 1/4 : 12 slope to drain in order to provide positive drainage and accommodate deck irregularities. Although existing buildings may or may not be required by code to achieve this degree of roof slope, providing positive slope to drain remains an important design consideration.

In situations where roof edge conditions, window/door height above the roof surface, parapet wall height, weep hole locations, rooftop equipment mountings, or other factors prevent the installation of a full slope-to-drain system, a combination of additional drain locations, tapered saddles, and crickets to direct drainage to drain points should be considered.

Design and installation of roof drainage systems should comply with the International Energy Conservation Code (IECC) and the International Plumbing Code (IPC).

ROOF DESIGN CONSIDERATIONS

EXPANSION JOINTS

The function of a structural expansion joint is to minimize the effect of stresses and movements on building components and to prevent these stresses from adversely affecting the roof. The design, location, and use of building structural expansion joints must be considered at the time of original building design and are the responsibility of the architect, engineer, and building owner.

Expansion Joints

- Must be continuous along the break in the structure and not terminated short of the end of the roof deck.
- Should never be bridged with insulation.
- Construction ties must be removed in order for expansion joints to function properly.
- Extend expansion joints at least 8" (203 mm) above the roof surface on curbs and use either EverGuard® Prefabricated Expansion Joint Covers or metal expansion joint covers. Alternately, a low-profile expansion joint can be used; see EverGuard® details for construction specifics.
- Design drainage flow patterns so they are not blocked by any structural expansion joints.
- Where possible, position walkways on roof access points to limit roof traffic over expansion joints; provide protective coverings for expansion joints at locations of anticipated roof traffic.
- All expansion joints should have wood nailers.
- EverGuard® Pre-Fab Expansion Joint Covers are available.

AREA DIVIDERS

Area dividers are not structural expansion joints. They can be installed to separate different roof areas, or be used for stress relief and can be either a curb or low-profile type. Please call 800-766-3411 for recommendations regarding area dividers.

EQUIPMENT MOUNTINGS

Proper mounting of equipment is an important consideration. In general, rooftop equipment should be mounted in such a way as to provide adequate flashing height for both new and anticipated re-cover roof system applications; sufficient clearance around and beneath the equipment to facilitate roof system installation; and compatibility with roofing and flashing materials so that standard flashing methods can be readily applied.

Alternatively, lightweight equipment and gas/conduit lines can be installed on wood blocking or other prefabricated devices that do not penetrate the roofing system. Do NOT use this type of application for heavy equipment or heavy gas/conduit lines, or where movement can damage the substrate or membrane.

FIRE RESISTANCE

Resistance by the roofing system to fire applied to the exterior roof surface is important. Typically, an ANSI/UL 790 or ASTM-E108 Class A, B or C roof fire 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 suitable for a specific building based upon location and exposure.

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

Note: Regardless of the wind rating achieved by any particular system, GAF system guarantees cover leaks resulting from wind speeds up to 55 mph only, unless additional high-speed wind coverage is purchased for eligible systems. Please contact GAF at 800-766-3411 for more information.

Factory Mutual Approvals (FM)

- Testing based on methods described in Approval Standards 4450 and 4470.
- Measures resistance to upward pressure applied to the roof system.
- Factory Mutual Loss Prevention Data Sheets 1-28 and 1-29 provide specific installation guidelines.

DORA (Directory Of Roofing Assemblies) The Directory of Roof Assemblies (DORA) is a web application database of roof systems tested in accordance with standards referenced in Chapter 15 of the International Building Code (IBC). This service lists wind uplift load capacity on single-ply and modified bitumen roof systems.

- Listed in MasterSpec.
- Sponsored by SPRI and administered by InterTek.
- Available at https://www.dora-directory.com/.

Note: GAF is not responsible for ensuring the accuracy/correctness of the data contained in this database.

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.
- Required for wind load determination by building codes. Check with local code agency as to the latest version that has been adopted.

ENERGY EFFICIENCY

Thermal transmission standards have been established by building codes for most buildings. Roof insulation installed above the roof deck is a practical means of achieving the necessary energy efficiencies. In addition, the use of white-colored reflective membranes can reduce the heat load on air conditioning equipment, as well as provide a moderating effect on the temperature in proximity to the building.

ROOF DESIGN CONSIDERATIONS

U-Value

- Thermal Transmittance: The number of BTUs (energy) that pass through a 1-square-foot (0.1 sq. m) sample of a total material assembly in one hour with a temperature difference between the two surfaces of 1 degree F (-17°C).
- Thermal Transmittance applies to an actual total material assembly, and as such is a quantitative physical property that can be used to represent the overall thermal performance of a system.

R-Value

- Thermal Resistance: The number of degrees difference between two surfaces (energy difference) that is required to obtain an energy flow of 1 BTU through a 1-square-foot (0.1 sq. m) sample of a given material thickness in one hour.
- The R-value is the reciprocal of the C-value. The C-value represents thermal conductance and depends on the thickness of the material.
- Thermal Resistance applies to an actual thickness of a material, and as such is a quantitative physical property that can be used for determining insulation requirements.

Reflectance

- A measure of the % of solar energy that is reflected away from a surface.
- Dark materials absorb more heat from the sun and can be up to 70°F (21°C) hotter than a reflective white surface given the same outside temperature and conditions such as wind speed, location, etc.

Emittance

- A measure of the infrared radiation emitted from a roof surface. Unlike reflectance, infrared emissivity may not be affected by dirt or discoloration of the surface of a material.

The following references provide useful information regarding energy efficiency:

ASHRAE Fundamentals Handbook

- Provides detailed design calculations and material energy transfer information utilized by mechanical engineers in the design of heating, ventilation, and air-conditioning systems.
- Suitable for complex energy evaluation considerations such as solar heat gain, exterior shading, total building envelope, building usage, and lighting.

NRCA Roofing Manual: Architectural Metal Flashing Condensation and Air Leakage Control, and Reroofing

- Provides a simplified method for determining the amount of insulation necessary to construct an energy-efficient low-slope roof system.
- Provides a simplified method for determining the energy cost savings resulting from the installation of additional roof insulation.
- Suitable for most roofing-related energy evaluations.

The NRCA Energy Wise Roof Calculator

- Provides a simplified method for determining the amount of insulation necessary to construct an energy-efficient low-slope roof system.
- Provides a simplified method for determining the energy cost savings resulting from the installation of additional roof insulation.
- Suitable for most roofing-related energy evaluations.
- Go to www.energywise.nrca.net

GAF CREST

- GAF CREST (Cool Roof Energy and Sustainability Tool) is a unique tool designed to help contractors, consultants and building owners compare potential energy cost savings of different roofing systems options.

WATER VAPOR TRANSFER

Typical single-ply roof assemblies do not include vapor retarders as a standard assembly component. For these applications, there is a natural transfer of water vapor into the roof assembly during a portion of the year, followed by a natural transfer of water vapor out of the roof assembly during the balance of the year. Under normal conditions, this type of cyclical water vapor flow does not cause a significant deterioration of the roof insulation or reduction in insulation thermal performance.

For projects where there is a significant difference in vapor pressure between building interior and exterior, the volume of water vapor flow is much greater, and control of water vapor transfer into and through a roof system becomes an important consideration. Without adequate control provisions such as a vapor retarder, the roof insulation can become saturated with water, with a corresponding reduction in insulation thermal performance. Structural deck damage and/or condensation into the building interior may also occur.

Vapor flow is referenced in various ways. The following are common terminologies:

Permeance

- The time rate of vapor transmission through a flat material or construction induced by vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.
- Units of permeance are expressed as: (gr)/(h) (sq. ft.) (in. Hg).
- The permeance, or perm rating, of a material is a performance evaluation specific to a sample of material, and not a specific property of the material.
- In general, the perm rating of a vapor retarder should be < 0.1 perms (Class 1).

Relative Humidity

- Relative humidity is the ratio of the pressure of water vapor present in air to the pressure of fully saturated water vapor at the same temperature.
- Relative humidity is expressed as a percentage.

ROOF DESIGN CONSIDERATIONS

Dew Point Temperature

- The temperature at which air becomes saturated with vapor (100% relative humidity) and condensation begins to form.
- Dew Point Temperature is expressed as °F or °C.

Temperature and Relative Humidity

- Vapor flows based upon a difference in vapor pressure between two locations, and flows from higher to lower pressure regions.
- Normally, the higher the temperature difference, the higher the vapor pressure.
- In determining the need for a vapor retarder for most typical conditions, the exterior winter temperature and the interior winter relative humidity are the most critical factors.
- Design temperature information is available in the ASHRAE Fundamentals Handbook.
- Relative humidity information is typically available from the building HVAC design professional or the building operations manager. Relative humidity can also be field-measured.

Vapor Retarder Location

- Vapor retarders are intended to be installed as close to the warm side of the roof assembly as possible. Normally, this places the vapor retarder directly on the structural deck or directly over a minimal layer of insulation.
- A sufficient amount of insulation must be installed over the vapor retarder to place the dew point location above the level of the vapor retarder (keeping the vapor retarder on the warm side).
- A number of basic considerations factor into the need and location of a vapor retarder. Determining the need and location of the vapor retarder is the responsibility of the design professional.

Sealing At Perimeter And Penetrations

- Vapor retarders must be completely sealed at all perimeter and penetration locations.
- Sealing methods must be selected in accordance with the type of vapor retarder being installed.
- Air leakage into the roof system at perimeters and penetrations will significantly reduce the effectiveness of the vapor retarder by allowing moist air to penetrate into the roof assembly, where it can condense and cause roof deterioration.

Building Usage

- Building usage such as swimming pools, food processing, paper manufacturing, foundries, etc., that result in increased internal temperatures and humidity conditions will likely require the use of a vapor retarder.
- These generalizations are not intended to substitute for actual vapor flow calculations based upon specific building and climatic conditions.

The Case For The Use Of A Vapor Retarder

- A vapor retarder can protect the long-term thermal resistance of insulation sandwiched between the vapor retarder and the membrane.
- A vapor retarder provides a good safeguard against vapor migration in case a building's use changes from a "dry" use to a "wet" use.
- A vapor retarder can reduce or eliminate condensation inside the roofing system.

The Case Against The Use Of A Vapor Retarder

- The vapor retarder, together with the roofing membrane, may seal within the roof system entrapped moisture that can eventually destroy the insulation, help split or wrinkle the membrane, or, in gaseous form, blister it.
- In the event of a roof leak through the membrane, the vapor retarder will trap the water in the insulation and only appear as a leak when there is a disruption in the vapor retarder. A large area of insulation may be saturated before the punctured roof membrane is discovered and repaired.
- A vapor retarder is a disadvantage in the summer, when vapor migration is generally downward through the roof. Hot, humid air can infiltrate the roofing system through any interruption in the membrane and moisture can condense and then collect on the vapor retarder.

The following resources may provide useful information regarding vapor retarders:

- NRCA Guidelines for Condensation and Air Leakage Control
- ASHRAE Fundamentals Handbook

AIR BARRIERS

1. Designers should consider requiring an air barrier:
   a. On all air porous decks, with openings in the walls or area directly below the roof deck that exceeds 10% of the total wall area.
   b. When the internal pressurization of the building is in excess of 5 lbs. per sq. ft. (239 Pa).
   c. When the building height exceeds 50 ft. (30.5 m).
   d. When buildings have large openings or overhangs.
   e. In conditions where positive internal pressure is applied suddenly, as may be the case at aircraft hangers or distribution centers, where the roofing system may fail due to pressure impact.
2. Refer to FM Global Loss Prevention Data Sheets 1-28 and 1-29 for specific installation procedures for all roofs with large openings.
3. For roofs to be guaranteed by GAF:
   a. Air barriers are required for all extended-length guarantees on buildings where large wall openings greater than 10% of the total wall area can be open during a windstorm, including opening due to storm damage.
   b. All 10' (3 m) wide or greater membranes with side laps mechanically attached with a spacing greater than 6" (152 mm) o.c.

TPO DESIGN TABLE - NEW CONSTRUCTION OR TEAR-OFF - ADHERED SYSTEMS

Deck	Insulation/Substrate Attachment			Insulation/Substrate					Membrane Attachment		Membrane Type	
	Mech. Attached	Adhesive[1]	Hot Asphalt[3]	ISO	Gypsum Board	Wood Fiber/ Perlite	EPS[7]/ XPS[7]	None	Adhered		Smooth	Fleece (FB)
									Adhesive	Hot Asphalt		
Steel	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes[6]	Yes		Yes		Yes	
	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes[6]	Yes					Yes[9]
	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes	Yes			Yes		Yes
Wood	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes	Yes		Yes	
	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes				Yes[9]
	Yes	Yes	Yes[4]	Yes	Yes	Yes		Yes[4]		Yes		Yes
Structural Concrete & Gypsum	Yes	Yes	Yes[5]	Yes	Yes	Yes[6]	Yes		Yes		Yes	
	Yes	Yes	Yes[5]	Yes	Yes	Yes[6]	Yes	Yes				Yes[9]
	Yes	Yes	Yes[5]	Yes	Yes	Yes		Yes[5]		Yes		Yes
Lightweight Insulating Concrete	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes[6]	Yes		Yes		Yes	
	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes[8]				Yes[9]
	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes	Yes	Yes[4]		Yes		Yes
Cementitious Wood Fiber	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes		Yes		Yes	
	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes				Yes[9]
	Yes	Yes	Yes[4]	Yes	Yes	Yes	Yes	Yes[4]		Yes		Yes

1. *Includes OlyBond500® and LRF Adhesive M*
2. *Moisture content must be less than 15%. Otherwise a base sheet is required prior to attach ment to the deck.*
3. *No hot attachment of XPS or EPS.*
4. *Insulation/membrane can be installed in hot asphalt only when mopping to mechanically attached base sheet in lieu of direct mopping to the deck.*
5. *Prime with MATRIX™ 307 Premium Asphalt Primer.*
6. *Wood fiber only with bonding adhesives.*
7. *Cover board required. Cover board cannot be attached with hot asphalt. If the membrane is attached using hot asphalt or solvent based adhesive, the cover board must either have all joints taped prior to installation of the roofing membrane, or a layer of red rosin sheathing paper must be installed between the layers of insulation.*
8. *Attachment of membrane must be with water-based adhesive.*
9. *Includes OlyBond500® Canister, LRF Adhesive O and LRF Adhesive M.*
10. *Not acceptable for attachment to deck.*

TPO DESIGN TABLE - RE-COVER - ADHERED SYSTEMS

Existing Roofing System	Insulationa/Substrate Attachment			Insulation/Substrate					Membrane Attachment		Membrane Type	
	Mech. Attached	Adhesive[1]	Hot Asphalt[2]	ISO	Gypsum Board	Wood Fiber/ Perlite[4]	EPS[6]/ XPS[6]	None	Adhered		Smooth	Fleece (FB)
									Adhesive	Hot Asphalt		
Smooth BUR/MB	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes		Yes		Yes	
	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes					Yes[8]
	Yes	Yes	Yes[3]	Yes	Yes	Yes	Yes	Yes[3]		Yes		Yes
Single-Ply Membrane	Yes			Yes	Yes	Yes[5]	Yes		Yes		Yes	
	Yes			Yes	Yes	Yes[5]	Yes	Yes[9]				Yes[8]
	Yes			Yes	Yes	Yes	Yes			Yes		Yes
Granule Surfaced BUR/MB	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes		Yes		Yes	
	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes					Yes[8]
	Yes	Yes	Yes[3]	Yes	Yes	Yes	Yes	Yes[3]		Yes		Yes
Gravel Surfaced BUR/MB	Yes	Yes		Yes	Yes	Yes[5]	Yes[7]		Yes		Yes	
	Yes	Yes		Yes	Yes	Yes[5]	Yes[7]					Yes[8]
	Yes	Yes		Yes	Yes	Yes	Yes			Yes		Yes

1. Includes OlyBond500® and LRF Adhesive M
2. No hot attachment of XPS or EPS.
3. Prime with MATRIX™ 307 Premium Asphalt Primer.
4. Roof moisture scan required for use of perlite/wood fiber in re-cover roof systems.
5. Wood fiber only with bonding adhesives.
6. Cover board required. Cover board cannot be attached with hot asphalt. If the membrane is attached using hot asphalt or solvent based adhesive, the cover board must either have all joints taped prior to installation of the roofing membrane, or a layer of red rosin sheathing paper must be installed between the layers of insulation.
7. Fanfold is not acceptable.
8. Includes OlyBond500® Canister, LRF Adhesive O and LRF Adhesive M.
9. Refer to section 3.03.N for requirements.

PVC DESIGN TABLE - NEW CONSTRUCTION OR TEAR-OFF - ADHERED SYSTEMS

Deck	Insulation/Substrate Attachment			Insulation/Substrate					Membrane Attachment		Membrane Type	
									Adhered			
	Mech. Attached	Adhesive[1]	Hot Asphalt[3]	ISO	Gypsum Board	Wood Fiber/ Perlite	EPS[7]/ XPS[7]	None	Adhesive	Hot Asphalt	Smooth	Fleece (FB)
Steel	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes[6]			Yes		Yes	
	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes[6]	Yes					Yes[8,9]
	Yes	Yes[10]	Yes[10]	Yes	Yes	Yes	Yes			Yes		Yes
Wood	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]		Yes	Yes		Yes	
	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes				Yes[8,9]
	Yes	Yes	Yes[4]	Yes	Yes	Yes		Yes[4]		Yes		Yes
Structural Concrete & Gypsum	Yes	Yes	Yes[5]	Yes	Yes	Yes[6]			Yes		Yes	
	Yes	Yes	Yes[5]	Yes	Yes	Yes[5]	Yes	Yes				Yes[8,9]
	Yes	Yes	Yes[5]	Yes	Yes	Yes		Yes[5]		Yes		Yes
Lightweight Insulating Concrete	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes[6]			Yes		Yes	
	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes[8]				Yes[8,9]
	Yes	Yes[2]	Yes[4]	Yes	Yes	Yes	Yes	Yes[4]		Yes		Yes
Cementitious Wood Fiber	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]			Yes		Yes	
	Yes	Yes	Yes[4]	Yes	Yes	Yes[6]	Yes	Yes				Yes[8,9]
	Yes	Yes	Yes[4]	Yes	Yes	Yes	Yes	Yes[4]		Yes		Yes

1. *Includes OlyBond500® and LRF Adhesive M*
2. *Moisture content must be less than 15%. Otherwise a base sheet is required prior to attachment to the deck..*
3. *No hot attachment of XPS or EPS.*
4. *Insulation/membrane can be installed in hot asphalt only when mopping to mechanically attached base sheet in lieu of direct mopping to the deck.*
5. *Prime with MATRIX™ 307 Premium Asphalt Primer.*
6. *Wood fiber insulation only.*
7. *Cover board required. Cover board cannot be attached with hot asphalt. If the membrane is attached using hot asphalt or solvent based adhesive, the cover board must either have all joints taped prior to installation of the roofing membrane, or a layer of red rosin sheathing paper must be installed between the layers of insulation.*
8. *Membrane attachment must be with water-based adhesive.*
9. *Includes OlyBond500® Canister, LRF Adhesive O and LRF Adhesive M.*
10. *Not acceptable for attachment to deck.*

PVC DESIGN TABLE - RE-COVER - ADHERED SYSTEMS

Existing Roofing System	Insulation/Substrate Attachment			Insulation/Substrate					Membrane Attachment		Membrane Type	
									Adhered			
	Mech. Attached	Adhesive[1]	Hot Asphalt[2]	ISO	Gypsum Board	Wood Fiber[4]/ Perlite[4]	EPS[6]/ XPS[6]	None	Adhesive	Hot Asphalt	Smooth	Fleece (FB)
Smooth BUR/MB	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]			Yes		Yes	
	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes					Yes[8,9]
	Yes	Yes	Yes[3]	Yes	Yes	Yes	Yes	Yes[3]		Yes		Yes
Single-Ply Membrane	Yes			Yes	Yes	Yes[5]			Yes		Yes	
	Yes			Yes	Yes	Yes[5]	Yes	Yes[10]				Yes[8,9]
	Yes			Yes	Yes	Yes	Yes			Yes		Yes
Granule Surfaced BUR/MB	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]			Yes		Yes	
	Yes	Yes	Yes[3]	Yes	Yes	Yes[5]	Yes					Yes[8,9]
	Yes	Yes	Yes[3]	Yes	Yes	Yes	Yes	Yes[3]		Yes		Yes
Gravel Surfaced BUR/MB	Yes	Yes		Yes	Yes	Yes[5]			Yes		Yes	
	Yes	Yes		Yes	Yes	Yes[5]	Yes[7]					Yes[8,9]
	Yes	Yes		Yes	Yes	Yes	Yes[7]			Yes		Yes

1. Includes OlyBond500® and LRF Adhesive M.
2. No hot attachment of XPS or EPS.
3. Prime with MATRIX™ 307 Premium Asphalt Primer.
4. Roof moisture scan required for use of perlite/wood fiber in re-cover roofing systems.
5. Wood fiber insulation only.
6. Cover board required. Cover board cannot be attached with hot asphalt. If the membrane is attached using hot asphalt or solvent based adhesive, the cover board must either have all joints taped prior to installation of the roofing membrane, or a layer of red rosin sheathing paper must be installed between the layers of insulation.
7. Fanfold is not acceptable.
8. Includes OlyBond500® Canister, LRF Adhesive O and LRF Adhesive M.
9. Attachment of membrane must be with water-based adhesive.
10. Refer to section 3.03.N for requirements.

TPO/PVC INSTALLATION SPECIFICATIONS

TABLE 1 - INSULATION FASTENER & PLATE (TABLE 1 OF 3)

For insulation attachment, use Table 1 to determine the proper fastener and plate and Tables 2 & 3 to determine the number of fasteners per board.

Deck Type	Drill-Tec™ Fastener Type	Drill-Tec™ Plate Type	Penetration (min.)
Steel[1] (Min. 22 gauge)	#12	3" (76 mm) Steel	3/4" (19 mm) through the deck
	HD #14		
Wood (Plywood, OSB and Plank)	#12	3" (76 mm) Steel	3/4" (19 mm) through the deck (plywood or OSB) and 1" (25 mm) thread into the deck (plank)
	HD #14		
	XHD #15		
Structural Concrete (Min. 2,500 psi)	HD #14	3" (76 mm) Steel	1" (25 mm) thread into the deck
	CD-10		1" (25 mm) shank into the deck
Gypsum Concrete and Cementitious Wood Fiber (Tectum)	Polymer GypTec™	3" (76 mm) GypTec™	1 1/2" (38 mm) thread into the deck
	LD (Lite Deck)	3" (76 mm) LD (Lite Deck)	

[1] 24-26 gauge decks require a GAF Field Services Manager's or Director's approval. Refer to GAF's A Guide to Metal Roof Retrofit in Commercial Low-slope Roof Assemblies for installations over existing metal roofs.

TABLE 2 - INSULATION ATTACHMENT (TABLE 2 OF 3)

STANDARD ATTACHMENT FOR APPROVED STEEL, CONCRETE, WOOD, GYPSUM & CEMENTITIOUS WOOD FIBER DECKS

For insulation attachment, use Table 1 to determine the proper fastener and plate and Tables 2 & 3 to determine the number of fasteners per board.

Insulation Type	Board Size	Thickness	Standard Attachment Fasteners per Board		
			Field	Perimeter	Corner
EnergyGuard™ Polyiso	4′ x 4′ (1.2 m x 1.2 m)	.5″ - 1.4″ (13 - 35 mm)	8	12	16
	4′ x 4′ (1.2 m x 1.2 m)	1.5″ - 1.9″ (38 - 48 mm)	5	8	10
	4′ x 4′ (1.2 m x 1.2 m)	2″ (51 mm) minimum	4	6	8
	4′ x 8′ (1.2 m x 2.4 m)	.5″ - 1.4″ (12 - 35 mm)	16	24	32
	4′ x 8′ (1.2 m x 2.4 m)	1.5″ - 1.9″ (38 - 48 mm)	10	15	20
	4′ x 8′ (1.2 m x 2.4 m)	2″ (51 mm) minimum	8	12	16
EnergyGuard™ HD Polyiso	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (12 mm) minimum	8	12	16
EnergyGuard™ Barrier Polyiso	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (13 mm) minimum	8	12	16
USG SECUROCK® Brand Gypsum-Fiber Roof Board	4′ x 8′ (1.2 m x 2.4 m)	1/4″ (6 mm) minimum	8	12	16
	4′ x 8′ (1.2 m x 2.4 m)	5/8″ (15 mm) minimum	6	9	12
DensDeck® Prime Roof Board	4′ x 8′ (1.2 m x 2.4 m)	1/4″ (6 mm) minimum	8	12	16
Blue Ridge STRUCTODEK® HD Fiberboard	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (13 mm) minimum	16	24	32

TPO/PVC INSTALLATION SPECIFICATIONS

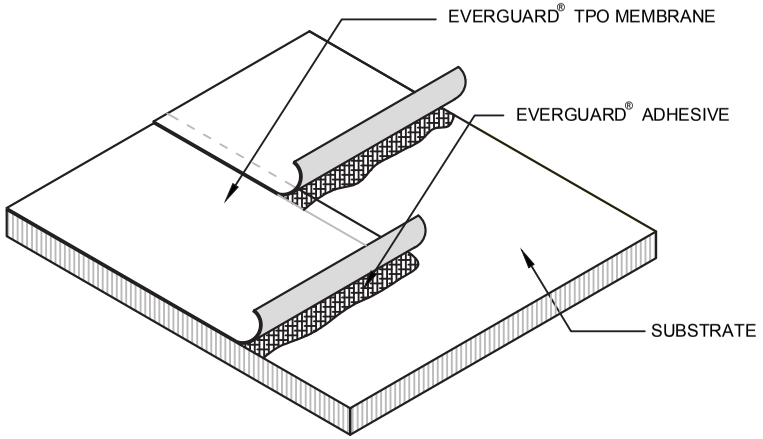
TABLE 3 - INSULATION ATTACHMENT (TABLE 3 OF 3)

90 PSF UPLIFT RESISTANCE FOR APPROVED STEEL & CONCRETE DECKS

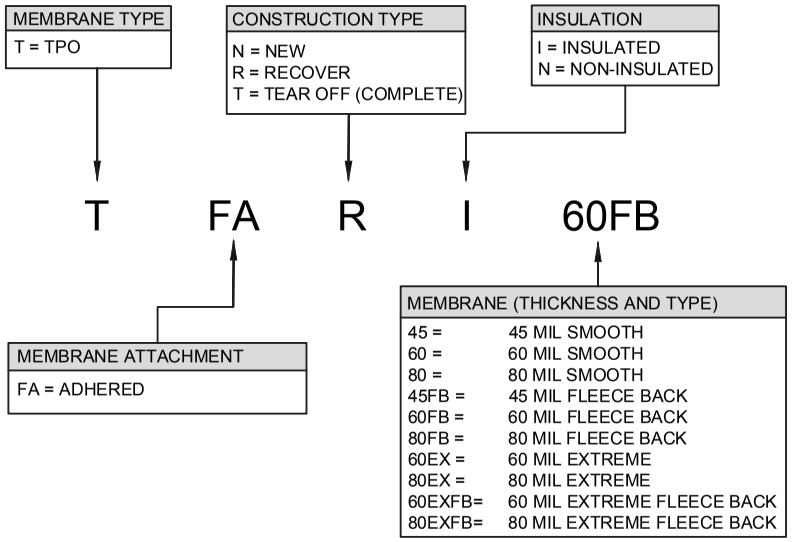
For insulation attachment, use Table 1 to determine the proper fastener and plate and Tables 2 & 3 to determine the number of fasteners per board.

Insulation Type	Board Size	Thickness	Attachment Fasteners/Board (For 90 psf Uplift Resistance)		
			Field	Perimeter	Corner
EnergyGuard™ Polyiso	4′ x 4′ (1.2 m x 1.2 m)	1.5″ - 1.9″ (38 - 48 mm)	8	12	16
	4′ x 4′ (1.2 m x 1.2 m)	2″ (51 mm) minimum	4	6	8
	4′ x 8′ (1.2 m x 2.4 m)	1.5″ - 1.9″ (38 - 48 mm)	16	24	32
	4′ x 8′ (1.2 m x 2.4 m)	2″ (51 mm) minimum	8	12	16
EnergyGuard™ HD Polyiso	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (13 mm) minimum	16	24	32
EnergyGuard™ Barrier Polyiso	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (13 mm) minimum	16	24	32
USG SECUROCK® Brand Gypsum-Fiber Roof Board	4′ x 8′ (1.2 m x 2.4 m)	1/4″ (6 mm) minimum	10	15	20
	4′ x 8′ (1.2 m x 2.4 m)	5/8″ (15 mm) minimum	6	9	12
DensDeck® Prime Roof Board	4′ x 8′ (1.2 m x 2.4 m)	1/4″ (6 mm) minimum	10	15	20
	4′ x 8′ (1.2 m x 2.4 m)	1/2″ (13 mm) minimum	8	12	16

INSULATED & NON-INSULATED TPO ADHERED SYSTEMS SPECIFICATION PLATE



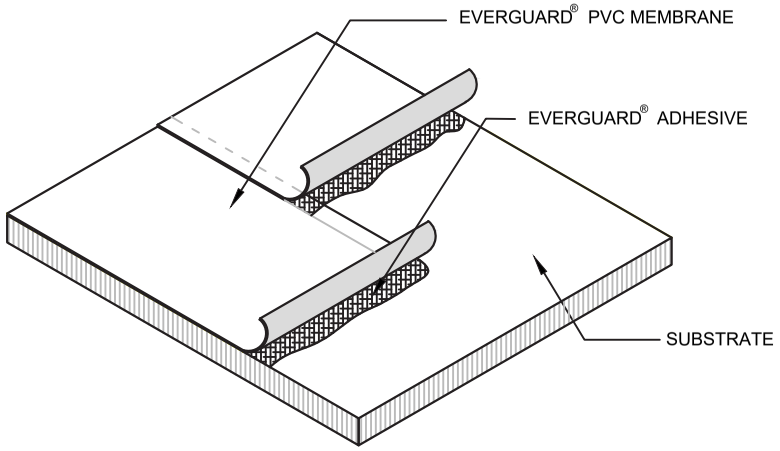
GAF

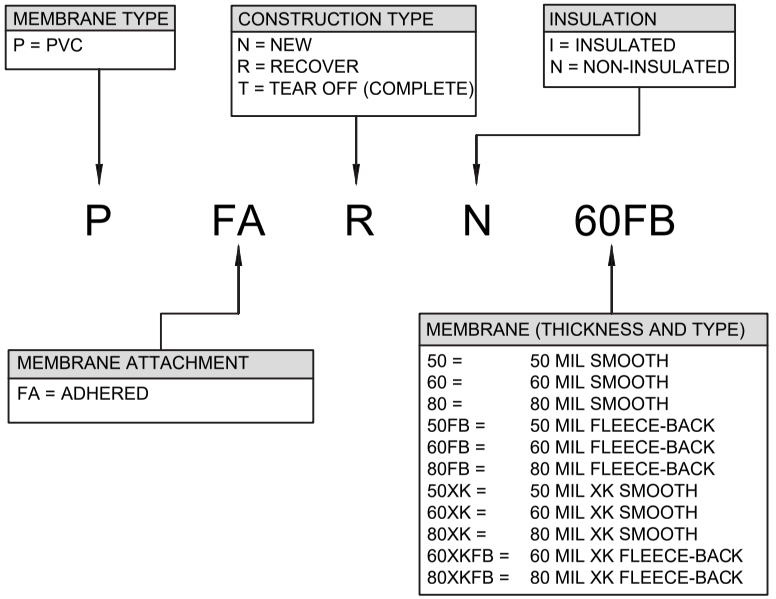


MEMBRANE TYPE	MEMBRANE ATTACHMENT	CONSTRUCTION TYPE	INSULATION	GUARANTEE LENGTH UP TO (YEARS)			
				20	25[1]	30[1]	35[1]
T	FA	N R T	I N	45 45FB	60 60FB 50EX 50EXFB	80 80FB 60EX 60EXFB 70EX 70 EXFB	80EX 80EXFB
				MINIMUM MEMBRANE REQUIREMENTS			

1. New & Tear-off only. Minimum 2 layers of insulation. Refer to the Guarantee Requirements Table for additional requirements on extended-length guarantees.

INSULATED & NON-INSULATED PVC ADHERED SYSTEMS SPECIFICATION PLATE





MEMBRANE TYPE	MEMBRANE ATTACHMENT	CONSTRUCTION TYPE	INSULATION	GUARANTEE LENGTH UP TO (YEARS)			
				15	20	25[2]	30[2]
P	FA	N[1] R T	I N	50 50FB 50XK	60 60FB 50XK	80 80FB 60XK 60XKFB	80XK 80XKFB
				MINIMUM MEMBRANE REQUIREMENTS			

1. For a non-insulated recover with smooth membrane only: Slip sheet or fire barrier required; 3 or 6 oz./sq. yd. (102 or 203 g./sq.m.) polymat or VersaShield® Solo™ Fire-Resistant Slip Sheet.
2. New & Tear-off only. Refer to the Guarantee Requirements Table for additional requirements on extended length guarantees.

TPO/PVC INSTALLATION SPECIFICATIONS

LOW-RISE FOAM (LRF) ADHESIVE SECUREMENT TABLE

Direct Adhesion To Deck With Fleece-Back Membranes ONLY	Yes/ No	Notes
Structural Concrete (New)	Yes[1]	28-day minimum cure time.
Structural Concrete – Reroof (structural concrete deck that had an existing roof and contains residual asphalt)	Yes[1]	
Lightweight Structural Concrete	Yes[1]	28-day minimum cure on new poured decks.
Lightweight Insulating Concrete	Yes[1]	Less than 15% moisture content.
Plywood (CDX) Or Oriented Strand Board (OSB)	Yes[1]	
Wood Planking	No	
Poured Gypsum	Yes[1]	
Pre-Cast Gypsum	Yes[1]	
Cementitious Wood Fiber (Tectum)	Yes[1]	
Steel	No	
Asphaltic Base Sheet		
Unmodified Fiberglass / Asphalt Sand / Smooth Surface Base Sheet	Yes[1]	
SBS Modified Asphalt Sand / Smooth Surface Base Sheets	Yes[1]	
APP Modified Asphalt Sand / Smooth Surface Base Sheets	Yes[1]	
Approved Insulations (May be adhered to subsequent layers or decks listed above)		
Polyisocyanurate (flat / tapered)	Yes[1]	Max. 4′ x 4′ (1.2 m x 1.2 m) boards[4]
High-Density Polyiso Cover Board	Yes[1]	Max. 4′ x 4′ (1.2 m x 1.2 m) boards[4]
High-Density Wood Fiber	Yes[1]	
DensDeck® Prime	Yes[1]	
SECUROCK® Gypsum-Fiber Roof Board	Yes[1]	
Perlite Insulation	Yes[1]	¾″ (18 mm) minimum
Extruded Polystyrene (XPS)	Yes[1]	Cover board required
Expanded Polystyrene (EPS)	Yes[1]	Cover board required
Direct Re-cover		
Existing Asphaltic Built-Up Roofs (Gravel must be removed)		
Smooth Surface Built-Up Roof (with no coating)	Yes[1]	
Smooth Surface Built-Up Roof (with new asphalt glaze coat)	Yes[1]	
Smooth Surface Built-Up Roof (with any type of coating)	Yes[1]	Excludes silicone coatings
Gravel-Surfaced Built-Up Roof (over existing insulation)	Yes[1]	Excludes silicone coatings
Mineral-Surfaced Built-Up Roof	Yes[1]	

Continued on next page.

TPO/PVC INSTALLATION SPECIFICATIONS

LOW-RISE FOAM (LRF) ADHESIVE SECUREMENT TABLE

Existing SBS Modified Asphaltic Roofs		
Smooth SBS Ply – Sheet (with no granules or coating)	Yes[1]	
Smooth SBS Ply – Sheet (with new asphalt glaze coat)	Yes[1]	
SBS Modified Bitumen Roofs (with any type of coating)	Yes[1]	Excludes silicone coatings
Mineral-Surfaced SBS Modified Bitumen Roofs	Yes[1]	
Existing APP Modified Asphaltic Roofs		
Smooth APP Ply – Sheet (with no granules or coating)	Yes[1]	
APP Modified Bitumen Roofs (with any type of coating)	Yes[1]	Excludes silicone coatings
Mineral-Surfaced APP Modified Bitumen Roofs	Yes[1]	
Existing Coal Tar Built-Up Roof		
Gravel-Surfaced Coal Tar Pitch Roof	Yes[1]	• Loose gravel removed & new insulation. • 1" ISO min. required for TPO • 1.5" ISO min. required for PVC
Existing Single-Ply Roof[4]		**Spatter pattern only**
EPDM Roof	Yes[1, 2]	Requires Supplemental Fastening[3]
TPO Roof	No[3]	
PVC Roof	No[3]	
Insulation (after removal of existing single-ply roof)	Yes[1, 3]	Must be an approved insulation that is secured and not wet or damaged.[4]

1. *An adhesion test is required to ensure substrate and adhesion quality. Refer to Appendix A in the back of this manual for adhesion testing guidelines.*
2. *Refer to Section 3.03 N for further requirements.*
3. *The use of low-rise foam adhesives directly over an existing single-ply membrane is not acceptable by GAF. The use of LRF Adhesive M, OlyBond500® Canister and TPO LRF Adhesive M Low Temp can be utilized to attach new insulation/cover board to existing adhered polyiso insulation that has had its facer removed during the removal of an adhered single-ply roof system.*
4. *4' x 8' (1.2 m x 2.4 m) polyiso boards may be installed using LRF if the following requirements are followed:*
   - *6" o.c. bead spacing only*
   - *Insulation boards must be flat, dry, and clean. Installation of any boards that are cupped or warped is not acceptable.*
   - *Lay insulation boards in place and walk-in to ensure complete adhesion. Once the board is set in place, apply adequate weight to the boards until the adhesive is cured to ensure proper securement between the insulation and substrate.*
   - *Does not qualify for enhanced wind coverage; GAF standard NDL Guarantee coverage only.*
   - *Not approved for use with any roofing system that requires the support of 3rd party testing (e.g. FM.). If 3rd party testing is utilized to support the wind uplift resistance of a roofing system, maximum 4'x4' boards are required.*

Note: *Refer to the Low-Rise Foam Insulation Adhesive Coverage Rates Table within this Manual for further information.*

PERIMETER SECUREMENT TABLE

Minimum Requirements for GAF Diamond Pledge™ NDL Roof Guarantees

Building Width	Building Height	Minimum Area Width	Minimum Bead Spacing
<200' (61 m)	0-34' (0-10 m)	4' (1.2 m)	6" (152 mm)
	35'-100' (10-30 m)	8' (2.4 m)	6" (152 mm)
	>100' (30 m)	**Formula:** Perimeter area width is 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 **Note:** The minimum width is 4' (1.2 m)	
≥200' (61 m)	any height		

General Comments/Requirements

1. *When installing insulation/cover boards, if a portion of a board extends into another zone, it must defer to the zone of the greater fastening/securement pattern.*
2. *Based on ASCE 7-05 (2009 IBC) and ASCE 7-10 (2012 & 2015 IBC), the perimeter and corner dimensions for buildings less that 60 ft. in height would be equal to the smaller of the following:*
   - *0.1 times the building width, or*
   - *0.4 times the building eave height*
3. *Based on the ASCE 7-16 (2018 IBC), the perimeter and corner dimensions for buildings less than 60 ft. in height are as follows:*
   - *Perimeter: width dimension is equal to 0.6 times the building eave height*
   - *Corners: length dimension is equal to 0.6 times the building eave height and the width dimension is equal to 0.2 times the building eave height*
4. *For buildings greater than 60 ft. in height:*
   - *Perimeter: 10% of the least horizontal dimension*
   - *Corners: Length of the corner is 2 times 10% of the least horizontal dimension and the width is 10% of the least horizontal dimension*

EVERGUARD® MEMBRANE ADHESION GUIDANCE TABLE

Adhesive Type[1]	Preferred Application Method[2]	EverGuard® TPO		EverGuard Extreme® TPO		EverGuard® PVC		EverGuard® PVC XK	
		Smooth	Fleece-Back	Smooth	Fleece-Back	Smooth	Fleece-Back	Smooth	Fleece-Back
EverGuard® WB 181 Bonding Adhesive	Roller	Yes[4]	Yes[3]	Yes[4]	Yes[3]	No	Yes[3]	No	Yes[3]
EverGuard® Low VOC TPO Bonding Adhesive	Roller	Yes[4]	No	Yes[4]	No	No	No	No	No
EverGuard® #1121 TPO Bonding Adhesive	Roller	Yes[4]	No	Yes[4]	No	No	No	No	No
EverGuard® #2331 PVC Bonding Adhesive	Roller	No	No	No	No	Yes[4]	No	Yes[4]	No
EverGuard® TPO 3 Square Low VOC Bonding Adhesive	Roller	Yes[4]	No	Yes[4]	No	No	No	No	No
EverGuard® TPO Quick Spray Adhesive (including LV50)	Spray	Yes[4]	No	Yes[4]	No	No	No	No	No
EverGuard® PVC Quick Lay Adhesive	Roller	No	No	No	No	Yes[3]	No	No	No
LRF Adhesive M	Ribbon	No	Yes[3]	No	Yes[3]	No	Yes[3]	No	Yes[3]
TPO LRF Adhesive M Low Temp	Ribbon	No	Yes[3]	No	Yes[3]	No	No	No	No

1. *It is critical that the proper adhesive be used with each membrane type to prevent failure. Substitution of adhesives for different products and non-GAF branded adhesives is discouraged. Performance/adhesion failures due to adhesive substitutions will not be covered by GAF warranties and guarantees.*
2. *Refer to the specific adhesive product label for detailed application rates and instructions or contact GAF at 800-766-3411.*
3. *One-sided application: adhesive applied to top of substrate only.*
4. *Two-sided application: adhesive applied to both top of substrate and bottom of membrane.*

Note: *Refer to the EverGuard® Membrane Coverage Rates Table for further information on adhesion coverage and application rates.*

TPO/PVC INSTALLATION SPECIFICATIONS

EVERGUARD® MEMBRANE ADHESIVE COVERAGE RATES TABLE

COVERAGE RATE[3]					
Adhesive Type[1]	**Container**	**Minimum Application Temperature**	**Application[2]**	**Installed Coverage Per Container**	**Installed Membrane Per Gallon (Liter/ Canister)**
EverGuard® #1121 TPO Bonding Adhesive	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply adhesive equally to both the substrate and underside of membrane	300 sq. ft. (27.87 sq. m)	50-70 sq. ft. (1.23 - 1.75 sq. m)
EverGuard® Low VOC TPO Bonding Adhesive	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply adhesive equally to both the substrate and underside of membrane	600 sq. ft. (55.74 sq. m)	100-120 sq. ft. (2.45 – 2.94 sq. m)
EverGuard® TPO 3 Square Low VOC Bonding Adhesive	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply adhesive equally to both the substrate and underside of membrane	300 sq. ft. (27.87 sq. m)	50-70 sq. ft. (1.23 - 1.75 sq. m)
EverGuard® WB 181 Bonding Adhesive	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply adhesive equally to both the substrate and underside of membrane	600 sq. ft. (55.74 sq. m)	100-120 sq. ft. (2.45 – 2.94 sq. m)
	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For fleece-back membrane - Apply to the roof substrate surface ONLY	600 sq. ft. (55.74 sq. m)	100-120 sq. ft. (2.45 – 2.94 sq. m)
EverGuard® TPO Quick Spray Adhesive (includes LV50)	Canister	20° F (-6.7° C)	For smooth membrane - Apply adhesive equally to both the substrate and the underside of the membrane	600 sq. ft. (55.74 sq. m)	1,000 sq. ft. per canister (93 sq. m)
EverGuard® #2331 PVC Bonding Adhesive	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply adhesive equally to both the substrate and underside of membrane	300 sq. ft. (27.87 sq. m)	50-70 sq. ft. (1.23 - 1.75 sq. m)
EverGuard® PVC Quick-Lay Adhesive[3]	5 Gallon (55.74 L) Pail	40°F (4.4°C)	For smooth membrane - Apply to the roof substrate surface ONLY	600 sq. ft. (55.74 sq. m)	100-120 sq. ft. (2.45 – 2.94 sq. m)

[1] It is critical that the proper adhesive be used with each membrane type to prevent failure. Substitution of adhesives for different products and use of non-GAF branded adhesives is discouraged. Performance/adhesion failures due to adhesive substitutions will not be covered by GAF warranties and guarantees.

[2] Refer to the specific adhesive product label for detailed application rates and instructions or contact GAF at 800-766-3411.

[3] Not for use with EverGuard® PVC XK membranes.

Note: *This Table is not a substitute for adhesion testing and verification that the adhesive selected is appropriate for the substrate being used.*

TPO/PVC INSTALLATION SPECIFICATIONS

LOW-RISE FOAM INSULATION ADHESIVE COVERAGE RATES TABLE

Adhesive Type[1]	Container	Minimum Application Temperature	Application	Application Type[3] and Rate[5]	Installed Coverage Per Container[2]
OlyBond500® Equipment-Free Canister	Canister	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	.75"-1" (19-25 mm) foam bead - 12" (305 mm) o.c. spacing	3500 sq. ft. (35 sqs)
OlyBond500® Insulation Adhesive	Cartridge	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	.75"-1" (19-25 mm) wet bead - 12" (305 mm) o.c. spacing	400-600 sq. ft. (4-6 sqs)
	Bag-In-A-Box	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	.75"-1" (19-25 mm) wet bead - 12" (305 mm) o.c. spacing	1700-2000 sq. ft. (17-20 sqs)
	15 Gallon (56.78 L) Drum	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	.75"-1" (19-25 mm) wet bead - 12" (305 mm) o.c. spacing	6,000 - 7,000 sq. ft. (60-70 sqs)
LRF M Adhesive	Cartridge	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	1" (25 mm) wet bead - 12" (305 mm) o.c. spacing	400-600 sq. ft. (4-6 sqs)
	Bag-In-A-Box	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	1" (25 mm) wet bead - 12" (305 mm) o.c. spacing	1800-2000 sq. ft. (18-20 sqs)
	15 Gallon (56.78 L) Drum	40°F (4.4°C)	Insulation/Cover board - Apply to the board or roof substrate	1" (25 mm) wet bead - 12" (305 mm) o.c. spacing	6,000 - 7,000 sq. ft. (60-70 sqs)
LRF M Adhesive Low Temp[4]	Cartridge	25° F (-3.8° C)	Insulation/Cover board - Apply to the board or roof substrate	1" (25 mm) wet bead - 12" (305 mm) o.c. spacing	400-600 sq. ft. (4-6 sqs)

[1] Substitution of adhesives for different products and use of non-GAF branded adhesives is discouraged. Performance/adhesion failures due to adhesive substitutions will not be covered by GAF warranties and guarantees.

[2] Coverage may vary depending on the porosity of the roof substrate surface or if spacing is reduced.

[3] Refer to the Low-Rise Foam Perimeter Securement Table within this Manual for further perimeter bead spacing requirements.

[4] TPO LRF Adhesive M Low Temp cannot be used for adhering fleece-back PVC membranes.

[5] Application spacing may be less for specific uplift resistance performance. Refer to listed system requirements from the applicable testing agency.

***Note**: This Table is not a substitute for adhesion testing and verification that the adhesive selected is appropriate for the substrate being used.*

DESIGN CONSIDERATIONS & APPLICATION GUIDELINES:
ADHERED ROOFING SYSTEMS

Contents: TPO/PVC Installation Specifications

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PART 1 – GENERAL

1.01 System Description

A. Adhered heat-welded thermoplastic sheet roof membrane system.

B. EverGuard® TPO and EverGuard® PVC materials are not compatible with one another. DO NOT mix EverGuard® TPO or PVC membranes, flashings, and flashing accessories together in the same roofing system.

C. Hybrid systems are a great option when you need the added strength of a multi-ply asphalt system as well as the value of a single-ply membrane. Hybrid systems can be used in a variety of types of asphaltic systems including self-adhered and hot-mopped.

1.02 Specification Designations

A. See Specification Plates in TPO/PVC Installation Specifications Section.

1.03 Regulatory Requirements & Pre-Job Conference

A. Conform to all applicable building and jurisdictional codes, including roof assembly wind uplift and fire resistance requirements and slope limitations. GAF recommends at least 1/4:12 of slope with proper grading and placement of drainage outlets.

B. Follow local, state and federal guidelines for disposing of used or expired adhesives, sealants and other products subject to disposal regulations.

C. Potential problems in roofing applications, as well as potential conditions that may be detrimental to installation and performance of the roof system, should be resolved prior to the start of the application. This can best be accomplished by a pre-job meeting with the architect; roofing contractor; general contractor; all other subcontractors whose work will involve the roof system/related systems; and a GAF representative.

D. The following are common items of discussion at a pre-job conference:

1. Submittals of materials, drawings, and project documents.
2. Roof deck conditions.
3. Flashing and expansion joint details.
4. Insurance underwriters or building code requirements.
5. Unusual project conditions.
6. Protection of the roof, building, building occupants, and contents during and after application.
7. Application techniques.
8. Coordination and scheduling of other trades that will be working on the project.
9. Designation by the roofing contractor of a qualified person responsible for quality control. This person should be on the project full time during application of the roof system.
10. Scheduling of material shipments, material storage, and rooftop loading.

1.04 Delivery, Storage & Protection

A. Deliver products to site in original containers with seals unbroken and labeled with manufacturers' names, product brand names and types.

B. Store materials in a weather-protected environment, clear of the ground and moisture, in accordance with GAF instructions. Store all adhesives, coatings, and sealants/caulks to protect them from freezing. Frozen material must be discarded and replaced. Properly seal all liquid material containers after use.

C. Outside storage of roofing materials:

1. All materials stored outside must be raised above ground or roof level on pallets and covered with a tarpaulin or other waterproof and "breathable" material. Insulation products should be properly stored and secured to avoid weather and wind damage.
2. Factory-installed plastic shipping shrouds are not designed for rooftop storage. Use "breathable" type covers, such as waterproof tarpaulins, to protect from weather and moisture. To reduce condensate during job site storage, remove the plastic shipping shroud or cut the plastic shroud to allow for venting.
3. Cover and protect materials at the end of each day's work.
4. Do not remove any protective tarpaulins until immediately before material will be installed. Extreme heat or cold conditions may require special storage. Reference product data sheets for specific product storage requirements.

E. Follow GAF directions and requirements for protection of roofing materials prior to and during installation.

F. Do NOT use materials that are wet or damaged to the extent that they will no longer serve their intended purposes. Remove all damaged materials from the job site.

G. When staging materials on the roof during application, ensure the deck and structure are not temporarily overloaded by the weight of construction materials.

H. At the job site, no more material should be stored than will be used within two weeks. For periods longer than two weeks, the materials should be properly warehoused, i.e., dry ventilated, on pallets, etc. No more material should be stored on the rooftop than can be used within five days. When prolonged inclement weather threatens, i.e., rainy seasons, no more roofing materials should be supplied to the rooftop than can be used within two days.

1.05 Environmental Requirements & Restrictions

A. Do not apply roofing materials during inclement or threatening weather.

B. Do not expose materials vulnerable to water or sun damage in quantities greater than can be covered with membrane during the same day.

C. Be aware that high or gusting winds make the installation of some materials more difficult.

D. Material installation during periods of high ambient temperature and/or humidity levels (typically above 90°F (32°C) and/or 90% relative humidity) can result in poor installation quality due to condensation on the membrane surface, or excessively fast adhesive drying rates in hot, dry weather. Do not install materials when moisture, such as liquid water, dew, condensate, snow or ice, is present on the roof deck or substrate to which the materials are to be applied.

E. Material installation during periods of low ambient temperatures, typically below 40°F (4.4°C), can result in poor installation quality. To avoid these problems:

1. Store accessory materials in a warming box.
2. Use as soon as possible after removal from warming box.
3. Allow adhesives to properly cure.
4. Adjust welder settings to ensure proper welds for applicable ambient conditions.

1.06 Working Environment

A. Work should only begin when the contractor has decided to his/her satisfaction that all specifications are workable as specified, and that the contractor can meet project and code requirements.

B. The contractor should only begin roofing work when the substrates have been prepared as necessary, and are ready to accept the roofing materials installed as specified.

C. Provide a safe working environment, including, but not limited to, adequate fall protection, restriction of unauthorized access to the work area, and protection of the building and its occupants.

D. Safe work practices should be followed, including, but not limited to, keeping tools in good operating order; providing adequate ventilation if adhesives are used; and daily housekeeping to remove debris and other hazards. See section 1.07 for further details on safety.

E. Protect the building, contents, surrounding area, building occupants and contractor personnel during work. Coordinate all work operations with the building owner and building occupants so that adequate interior protection, as necessary, is provided and disruption to normal building operations is minimized.

F. Where heavy wheeled or other traffic over the partially completed roofing is unavoidable, provide and use adequate plank or plywood, set over a minimum thickness of rigid board insulation, to protect the newly installed roof.

G. Provide temporary water cut-offs and tie-ins at the end of each work day. Remove all temporary work at the beginning of the next work day.

H. When tearing off an existing membrane, limit removal to the area that will be completely reroofed that day with the new roofing system.

I. If conditions are uncovered or created that would be detrimental to the proper execution of specified work, immediately notify the building owner and the designer of record of these conditions for consultation on acceptable remedy or resolution of the problem.

1.07 Safety Considerations & Warnings

A. As with any construction process, safety is a key element. All applicable safety standards and good roofing practices must be followed. Read and understand GAF's Design Considerations & Application Guidelines before starting application. Follow all precautions and directions.

B. Only properly trained and professionally equipped roofing contractors experienced in the installation of each TPO and PVC roofing application should install these systems. Never allow contact between the heated surface of a hot welder or other tool and the applicator's hair, skin, or clothing. Always wear protective gear, including but not limited to: hardhats, eye protection, heavy-duty gloves, and snug-fitting clothing.

C. Solvent-containing accessories may be combustible and should always be kept from heat, flame or any source of ignition. Empty containers must be disposed in accordance with local, state, and federal regulations.

D. Thoroughly train all personnel in first aid procedures, and always comply with all OSHA safety standards and fire codes. Also, use extreme caution when working around equipment, such as gas lines or HVAC units, which have electrical or gas connections.

E. EverGuard® TPO or PVC roof membranes may be slippery when wet. Exercise caution when walking on the TPO or PVC membranes during or after a rain shower, or if moisture is present in the form of dew, frost or ice. Pay attention while walking on light-colored surfaces as ice or frost build-up may not be as visible as on a dark surface.

PART 2 – PRODUCTS

2.01 Membrane

A. EverGuard® TPO

B. EverGuard Extreme® TPO

C. EverGuard® TPO FB

D. EverGuard Extreme® TPO FB

E. EverGuard® PVC

F. EverGuard® PVC Fleece-Back

Note: EverGuard Extreme® has a light gray backer sheet to distinguish it from regular TPO membrane. It is the contractor's responsibility to install EverGuard Extreme® where specified on the roof, i.e., under highly reflective glass or metal, or wherever sustained exposure to high temperatures requires.

2.02 Flashing - Wall & Curb

A. EverGuard® membrane flashing should be of the same type and thickness as the roofing membrane. EverGuard® Freedom™ TPO can be used with EverGuard® TPO membrane for flashing in the same thickness as the field membrane.

B. The use of EverGuard Extreme® TPO flashings is required on EverGuard Extreme® systems for extended-length guarantees.

C. Because colored TPO membranes may exhibit different welding characteristics, please call 800-766-3411 before attempting to weld different-colored TPO membranes with white membranes or flashings.

D. EverGuard® TPO and PVC fleece-back membranes are optional flashing membranes for all EverGuard® TPO and PVC roofing systems, respectively. These membranes may be a solution when a contaminated substrate is encountered.

2.03 Flashing Accessories

A. EverGuard® preformed flashing accessories must be of the same type as the roofing membrane.

B. For a full listing and descriptions of the latest EverGuard® preformed flashing accessories, see the appropriate Product Data Sheet(s) for the specific accessory(s) being used.

C. The use of EverGuard® TPO flashing accessories is required on EverGuard Extreme® systems and extended length guarantees.

D. Unreinforced EverGuard Extreme® flashing membrane is available and required on areas where prefabricated accessories cannot be used or are unavailable.

E. All EverGuard® accessories must be stored properly and protected from moisture and extreme temperatures. See specific instructions on packaging for further details

2.04 Fasteners

A. Refer to the Insulation Attachment Table and the appropriate Membrane Attachment Table in this Manual for the correct type, length, and diameter of fastener.

B. Use fasteners that are suitable for the deck type, and ensure the deck is of the required thickness and condition to ensure reliable installation and performance.

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

D. Drill-Tec™ "flat" plates (without the countersunk fastener holes protruding from the bottom of the plates) are required when plates are installed over hard surfaces such as wood decks, EnergyGuard™ HD Polyiso Insulations, DensDeck®, SECUROCK® or other hard cover boards to allow the plates to rest flush on the surface.

2.05 Adhesives, Sealants, Primers, & Cleaners

A. Adhesives

1. Solvent-Based
   a. EverGuard® #1121 TPO Bonding Adhesive
   b. EverGuard® TPO Low VOC Bonding Adhesive
   c. EverGuard® TPO Quick Spray Adhesive
   d. EverGuard® TPO Quick Spray Adhesive LV50
   e. EverGuard® PVC #2331 Bonding Adhesive

2. Water-Based
   a. EverGuard® WB 181 Bonding Adhesive (Smooth TPO only)
   b. EverGuard® PVC Quick-Lay Adhesive

3. Low-Rise Foam (LRF)
   a. LRF Adhesive M
   b. LRF Adhesive M Low Temp
   c OlyBond500® Insulation Adhesive
   d. OlyBond500® Canister

B. Sealants

1. EverGuard® One-Part Pourable Sealant (urethane based)
2. FlexSeal™ Caulk Grade Sealant
3. FlexSeal™ LV Caulk Grade Sealant (low-viscosity)
4. EverGuard® Water-Block
5. EverGuard® TPO Cut Edge Sealant

C. Primers

1. EverGuard® TPO Primer
2. EverGuard® Low VOC Primer

D. Cleaners

1. EverGuard® CleanWeld™ Conditioner (low-VOC)
2. EverGuard® TPO Seam Cleaner
3. EverGuard® PVC Membrane Conditioner

2.06 Traffic Protection

A. EverGuard® TPO Walkway Roll

1. This product is designed to be heat-welded to the top of GAF TPO roofing membranes.
2. The Walkway Roll is available in standard gray or "safety" yellow color with a "diamond tread" pattern, and comes in 34.25" x 50" (870 mm x 15.2 m) rolls.
3. The EverGuard® TPO Walkway Roll features a 2" (51 mm) welding strip (smooth border) along each longitudinal edge that is compatible with hand or automatic welders.

B. EverGuard® PVC Walkway Roll

1. This product heat-welds directly to GAF EverGuard® PVC roofing membranes.
2. The Walkway Roll is available in standard gray with a "herringbone" traction surface, and comes in 30" x 50' (762 mm x 15.24 m) rolls.
3. The EverGuard® PVC Walkway Roll features a 2" (51 mm) welding strip (smooth border) along each longitudinal edge that is compatible with hand or automatic welders.

2.07 Insulation

A. 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 insulation must be used in roofing systems to be guaranteed by GAF.

B. Insulation boards of the types listed below are acceptable for use in roofing systems guaranteed by GAF. The actual minimum thickness of insulation will depend on flute spacing. Refer to specific Product Data Sheets for further information. Board size can be 4' x 4' or 4' x 8' (1.2 m x 1.2 m or 1.2 m x 2.4 m) panels for mechanical attachment.

1. EnergyGuard™ Polyiso Insulation is made of glass fiber-reinforced cellulosic felt facers bonded to a core of polyisocyanurate foam. Meets or exceeds the requirements of ASTM C1289 Type II, Class 1, Grade 2 (20 psi), and available in Grade 3 (25 psi).

2. EnergyGuard™ Tapered Polyiso Insulation is made of glass fiber-reinforced cellulosic felt facers bonded to a core of polyisocyanurate foam. It is readily available in various slopes such as the most popular and efficient tapers, 1/8:12 (1%), 1/4:12 (2%), and 1/2:12 (4%). Meets or exceeds the requirements of ASTM C1289 Type II, Class 1, Grade 2 (20 psi), and available in Grade 3 (25 psi). Maximum board size is 4' x 4' (1.21 m x 1.21 m).

3. EnergyGuard™ Ultra Polyiso Insulation is made of coated glass-fiber mat facer laminated to a closed-cell polyisocyanurate foam core. Meets or exceeds the requirements of ASTM C1289 Type II, Class 2, Grade 2 (20 psi), and available in Grade 3 (25 psi).

4. EnergyGuard™ Ultra Tapered Polyiso Insulation is made of coated glass-fiber mat facer laminated to a closed-cell polyisocyanurate foam core. It is readily available in various slopes such as the most popular and efficient tapers, 1/8:12 (1%), 1/4:12 (2%), and 1/2:12 (4%). Meets or exceeds the requirements of ASTM C1289 Type II, Class 2, Grade 2 (20 psi), and available in Grade 3 (25 psi). Maximum board size is 4' x 4' (1.21 m x 1.21 m).

5. EnergyGuard™ NH Polyiso Insulation is made of glass-reinforced cellulosic felt facers bonded to a core of non-halogenated polyisocyanurate foam. Meets or exceeds the requirements of ASTM C1289 Type II, Class 1, Grade 2 (20 psi), and available in Grade 3 (25 psi).

6. EnergyGuard™ NH Tapered Polyiso Insulation is made of glass-reinforced cellulosic felt facers bonded to a core of non-halogenated polyisocyanurate foam. It is readily available in various slopes such as the most popular and efficient tapers, 1/8:12 (1%), 1/4:12 (2%), and 1/2:12 (4%). Meets or exceeds the requirements of ASTM C1289 Type II, Class 1, Grade 2 (20 psi), and available in Grade 3 (25 psi). Maximum board size is 4' x 4' (1.21 m x 1.21 m).

7. EnergyGuard™ NH Ultra Polyiso Insulation is made of coated glass facers bonded to a core of non-halogenated polyisocyanurate foam. Meets or exceeds the requirements of ASTM C1289 Type II, Class 2, Grade 2 (20 psi), and available in Grade 3 (25 psi).

8. EnergyGuard™ NH Ultra Tapered Polyiso Insulation is made of coated glass facers bonded to a core of non-halogenated polyisocyanurate foam. It is readily available in various slopes such as the most popular and efficient tapers, 1/8:12 (1%), 1/4:12 (2%), and 1/2:12 (4%). Meets or exceeds the requirements of ASTM C1289 Type II, Class 2, Grade 2 (20 psi), and available in Grade 3 (25 psi). Maximum board size is 4' x 4' (1.21 m x 1.21 m).

9. Expanded Polystyrene Insulation (EPS) with plastic facer meets or exceeds the requirements of ASTM C578, Type II nominal 1.5 lb. (42 g/cm3) density and minimum 15 psi (110 kPa) compressive strength. Min. 25 psi (173 kPa) compressive strength is available for high traffic applications.

10. Extruded Polystyrene Insulation (XPS) meets or exceeds the requirements of ASTM C578, Type II nominal 1.5 lb. (42 g/cm^3) density and minimum 15 psi (110 kPa) compressive strength. Min. 25 psi (173 kPa) compressive strength is available for high traffic applications.

C. Insulation or cover/re-cover boards with a higher compressive strength should be considered in high traffic areas.

2.08 Cover/Re-cover Boards

A. Cover/Re-cover boards of the following types listed below are acceptable for use in roofing systems guaranteed by GAF. Board size can be 4' x 4' or 4' x 8' (1.21 m x 1.21 m or 1.21 m x 2.4 m) panels for mechanical attachment and 4' x 4' or 4' x 8' (1.21 m x 1.21 m or 1.21 m x 2.4 m) for adhered attachment and tapered systems, except for fanfold re-cover board, which comes in 2' (610 mm) x 4' (1.21 m) sections with a 50' (15.2 m) total length.

1. EnergyGuard™ HD Polyiso Insulation is a ½" (12.7 mm) thick high-density polyiso cover board made of coated glass-fiber mat facers bonded to high-density closed cell polyisocyanurate foam cores. Meets or exceeds the requirements of ASTM C1289 Type II, Class 4, Grade 1 (80 psi).

2. EnergyGuard™ NH HD Polyiso Insulation is a ½" (12.7 mm) thick high-density polyiso cover board made of coated glass facers bonded to a core of non-halogenated polyisocyanurate foam. Meets or exceeds the requirements of ASTM C1289 Type II, Class 4, Grade 1 (80 psi).

3. EnergyGuard™ HD PLUS Polyiso Insulation is a ½" (12.7 mm) thick high-density polyiso cover board made of coated glass-fiber mat facers bonded to high-density closed cell polyisocyanurate foam cores. Meets or exceeds the requirements of ASTM C1289 Type II, Class 4, Grade 2 (110 psi).

4. EnergyGuard™ NH HD PLUS Polyiso Insulation is a ½" (12.7 mm) thick high-density polyiso cover board made of coated glass facers bonded to a core of non-halogenated polyisocyanurate foam. Meets or exceeds the requirements of ASTM C1289 Type II, Class 4, Grade 2 (110psi).

5. EnergyGuard™ Barrier Polyiso Insulation consists of coated glass-fiber and a special coated glass-fiber laminated to a closed-cell polyisocyanurate foam core. Meets or exceeds the requirements of ASTM C1289 Type II, Class 4, Grade 2 (110 psi).

6. EnergyGuard™ NH Barrier Polyiso Insulation consists of coated glass-fiber and a special coated glass-fiber laminated to a closed-cell polyisocyanurate foam core. Meets or exceeds the requirements of ASTM C1289 Type II, Class 2, Grade 2 (20 psi), and available in Grade 3 (25 psi).

7. USG SECUROCK® Brand Gypsum-Fiber Roof Board is a high-performance, non-combustible, moisture and mold resistant roof board that meets the requirements of ASTM C1278.

8. DensDeck® Prime Roof Board is made of glass mat facings front and back that are embedded into a water-resistant and moisture-resistant treated gypsum core. Meets the requirements of ASTM C1177

9. Blue Ridge STRUCTODEK® High Density Fiberboard Roof Insulation Cover Board with Primed Red Coating incorporates a non-asphaltic Primed Red Coating integrated on the surface board that meets the requirements of ASTM C208, Type II, Grade 1 and Grade 2.

2.09 Base Sheets

The use of the following base sheets may also be appropriate with hot-asphalt applications of fleece-back membranes:

A. GAFGLAS® Stratavent® Nailable Base Sheet
B. GAFGLAS® #80 Ultima™ Base Sheet
C. GAFGLAS® #75 Base Sheet
D. GAFGLAS® Stratavent® Perforated Venting Base Sheet

2.10 Interply Sheets (Hybrid Systems)

A. RUBEROID® 20 Smooth
B. RUBEROID® Mop Smooth 1.5
C. GAFGLAS® FlexPly™ 6

2.11 Air/Vapor Retarders

A. GAF SA Vapor Retarder

2.12 Other Accessories

A. The following items may also be required, depending on the project:
   1. Wood Nailers: New wood nailers must be #2 or better quality lumber. Do NOT use asphaltic or creosote-treated lumber.
   2. Roofing Nails: Galvanized or non-ferrous type and size as required to suit application.
   3. Temporary Sealant: Polyurethane foam sealant or similar as required to provide temporary watertight sealing of roofing.
   4. Air/Vapor Barrier: Polyethylene sheeting, min. 6 mil for TPO only when covered with mechanically attached insulation.
   5. Fire Barrier: 1/2" (13 mm) EnergyGuard™ Barrier Polyiso Insulation or Gypsum panels, min. 1/4" (6.3 mm) thick (DensDeck®, DensDeck® Prime or SECUROCK® Roof Board), or GAF FireOut™ Fire Barrier Coating. Please refer to listed fire classified assemblies for fire performance/classifications.

PART 3 – EXECUTION

3.01 Site Conditions

A. Obtain verification that the building structure can accommodate the added weight of the new roofing system.
B. Confirm the adequacy of the new roofing system to provide positive slope to drain. Eliminate ponding areas by the addition of drainage locations or by providing additional pitch to the roof surface.
C. 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.
D. Deck preparation is the sole responsibility of the building owner or roofing contractor. All defects in the roof deck or substrate must be corrected by the responsible parties before new roofing work commences. Verify that the deck surface is dry, sound, clean and smooth, free of depressions, waves, or projections.
E. Protect building surfaces against damage and contamination from roofing work.
F. Where work must continue over completed roof areas, protect the finished roofing system from damage.
G. Refer to GAF Roof Guarantee Program for specific requirements for extended-length guarantees.

3.02 Preparation of Roofing Area – New & Tear-off Applications

A. For tear-offs, remove all existing roofing materials to the roof decking, including flashings, metal edgings, drain leads, pipe boots, and pitch pockets, and clean substrate surfaces of all asphalt and adhesive contaminants.
B. Confirm quality and condition of roof decking by visual inspection and by fastener pull-out testing by an individual trained by the roof fastener manufacturer. GAF recommends these test results to be kept on file as part of the acceptability of the substrate surface for a Diamond Pledge™ NDL Roof Guarantee. Submission of results to GAF is generally not required.
C. Secure all loose decking. Remove and replace all deteriorated decking.
D. Remove abandoned equipment and equipment supports.
E. Confirm that height of equipment supports will allow the installation of minimum 8" (203 mm) flashing heights.
F. Refer to Section 3.06 for air/vapor retarder requirements.

3.03 Preparation of Roofing Area – Re-cover Applications

A. Remove all surfacing and debris from the roof surface.
B. Remove blisters and ridges from the roof membrane.
C. When re-covering over an existing single-ply roof, that roof must be first cut into maximum 10' x 10' (3 m x 3 m) areas first, before the application of new slip sheet and/or membrane.
   1. PVC must be separated from existing PVC roofs and other types of single-ply membranes and asphaltic membranes that have active sealants, including asphalt cement, single-ply adhesives, or other non-compatible materials. This can be accomplished by installing a polymat slip sheet, insulation, cover board, or fleece-back PVC membrane.
   2. Installation over an existing mechanically attached membrane is only acceptable if all existing fasteners are flush and do not cause ridging/tenting at the existing membrane.
D. Remove all existing flashings, including metal edgings, drain leads, pipe boots, and pitch pockets, and clean substrate surfaces of all asphalt and adhesive contaminants.
E. The existing roof surface must be free of visible moisture, such as ponding water, ice, or snow.

F. It is strongly recommended that the building owner have a moisture survey performed to ascertain the condition and suitability of the existing roofing materials to receive a re-cover system. A survey is required if perlite or wood fiber insulation is used in a re-cover system. GAF will not be responsible for damage to the roofing system resulting from moisture in the existing roofing system. Remove and replace all existing roofing materials that contain moisture.

G. Confirm quality and condition of roof decking by visual inspection if possible, and by fastener pull-out testing. Remove and replace all deteriorated decking.

H. Test cuts

1. Take test cuts to verify the existing roof construction and condition. Generally three test cuts should be made for roofs under 100 squares (929 sq. m) and one test cut per 100 squares (929 sq. m) above the minimum amount.

2. Test cuts must be representative of the roofing system(s).

I. Remove abandoned equipment and equipment supports.

J. Raise equipment supports to allow the installation of minimum 8" (203 mm) flashing heights.

K. Re-cover installations over coal tar pitch roofs are not recommended. However, if the designer of record chooses to re-cover over an existing coal tar pitch roof, GAF requires the following:

1. Existing loose gravel must be broomed or vacuumed (do not spud).

2. If high spots remain, a thicker insulation board must be used to provide a smooth substrate for the EverGuard® membrane.

3. A minimum 1" (25 mm) re-cover board is required for TPO applications.

4. A minimum 1.5" (38 mm) re-cover board is required for PVC applications.

5. Do not use a EPS/XPS re-cover board over coal tar pitch roofs.

L. Surface preparation over Coal Tar Pitch (CTP)

1. CTP must be cleaned mechanically (not by hand) with vacuuming, power washing or power brooming equipment.

2. When using LRF Adhesive M or OlyBond500®, an adhesion test must be completed and the adhesive bead spacing pattern must be approved by a GAF Field Services Manager Director. Please call 800-766-3411 for compatibility and surface preparation instructions over CTP or gravel-surfaced BUR.

M. Surface preparation over smooth-surface BUR

1. When adhering EverGuard® fleece-back membrane to a smooth-surface built-up roof (BUR) – with or without coatings – an adhesion test must be completed first. When using low rise foam adhesives, contact the appropriate low rise foam adhesive manufacturer for adhesion tests and submit the results to GAF Field Services.

2. All asphaltic surfaces must be clean, dry, and primed with GAF Asphalt Primer when insulation or fleece-back membrane is being installed in hot asphalt.

N. Surface preparation for fleece-back membrane directly to EPDM

1. Peel test required

a. Insulation facer must remain bonded to the existing EPDM membrane.

2. Building limitations

a. <100 squares (929 m^2) or

b. <15' (4.57 m) high without a parapet or

c. <40' (7.62 m) high with a parapet

3. GAF CleanAct Rinsable Primer Only

a The existing EPDM membrane must be power-washed and properly cleaned with GAF CleanAct Rinsable Primer prior to the installation of the EverGuard® membrane.

4. Required supplemental perimeter fastening through the EPDM membrane prior to the installation of the EverGuard® fleece-back membrane.

a. Fastened 18" (457 mm) o.c. in two staggered rows. Rows are spaced 2.5' (762 mm) and 5' (1.52 m) from the roof edge.

b. Fastening is required in both directions in all corners

5. Full Coverage (Spatter Pattern) application with OlyBond500® Equipment-Free Canister System.

Note: See Appendix A for Adhesion Test Guidelines.

3.04 Wood Nailer Installation

A. General

1. GAF recommends perimeter blocking and flashing be installed in accordance with the most current version of ANSI/SPRI ES-1 and FM Global Property Loss Prevention Data Sheet 1-49.

2. Additionally, GAF does not guarantee the attachment of the wood nailers, nor the performance of the wood nailers or any leaks that may be caused by nailer installation.

3. Use untreated wood blocking and nailers in all GAF roof systems unless required otherwise by code or insurance carrier.

4. If pressure treated wood is required, use fasteners and separators as recommended by the specifier, code or insurance carrier.

5. GAF does not recommend the use of ACQ or CA treated lumber and assumes no responsibility for corrosion problems resulting from its use.

3.05 Gypsum Board Installation

A. General

1. Gypsum fire barrier boards must typically be installed when required by the design professional or code authority to address code or approval requirements. For EverGuard® adhered systems, SECUROCK® Gypsum-Fiber Roof Board or DensDeck® Prime Roof Boards must be used for a GAF guarantee.

B. Placement

1. Butt gypsum boards together with a 1/4" (6.3 mm) maximum space between adjoining boards. Fit gypsum boards around penetrations and perimeter with a 1/4" (6.3 mm) maximum space between board and penetration.
2. Install gypsum boards in pieces a minimum of 2' x 2' (610 mm x 610 mm) in size. Every piece must be properly secured to the substrate.
3. Gypsum boards installed in multiple layers must have the joints between boards staggered in all directions a minimum of 6" (152 mm) between layers.
4. Gypsum boards installed over steel decking must have boards placed perpendicular to deck flutes with edges over the flute surface for bearing support.
5. Do NOT use gypsum boards that are wet, warped, or buckled; they must be discarded. Boards that are broken, cracked, or crushed must not be installed unless the damaged area is first removed and discarded.
6. Remove and replace gypsum boards that become wet or damaged after installation.
7. Install no more gypsum board than can be properly covered with roofing membrane by the end of each day.

C. Securement

1. Refer to Section 3.08 Insulation & Re-cover Board Installation for gypsum board securement options.

3.06 Air/Vapor Retarder Installation

A. General

1. Air/Vapor retarder components must typically be installed when required by the design professional to address internal building air pressure or humidity conditions.

B. Application – Loose-Applied

1. Install the air/vapor retarder components loose-applied to the deck or fire-barrier board so that wrinkles and buckles are not formed.
2. Overlap air/vapor retarder components per applicable installation recommendations of the manufacturer. If minimum 6 mil polyethylene is used, overlap a minimum of 6" (152 mm).
3. Seal perimeter and penetration areas with foam sealant.
4. Seal all perimeter nailers with adhered roof membrane placed over the nailer and covering the exterior face of the nailer by 1" (25 mm).
5. Install insulation boards over the air/vapor retarder and mechanically attach the boards to the deck.

C. Application – Adhered

1. Apply compatible adhesive to the structural deck or fire barrier board per air/vapor retarder manufacturers' recommendations.
2. Install the air/vapor retarder components loose applied to the deck or fire barrier board so that wrinkles and buckles are not formed. Broom air/vapor barrier components to ensure embedment into the adhesive.
3. Overlap air/vapor retarder components a minimum of 6" (152 mm) for side and end laps. Adhere laps together with compatible adhesive.
4. Seal perimeter and penetration areas with foam sealant.
5. Install insulation boards over the air/vapor barrier and mechanically attach the boards to the deck or adhere the boards to the air/vapor retarder with compatible adhesive to achieve the desired roof system uplift resistance.

D. Application – Self-Adhered

1. GAF SA Vapor Retarder can be applied at temperatures as low as 25°F (-3.9°C) with rising temperatures as long as the vapor retarder has been stored in a heated area to ensure the GAF SA Vapor Retarder is between 50°F - 100°F (10°C – 37.7°C) at time of installation. GAF SA Primer must be mixed thoroughly prior to application. GAF SA Primer can be applied at temperatures as low as 25°F (-3.9°C) with rising temperatures as long as the primer has been stored in a heated area to ensure the GAF SA Primer is between 50°F - 100°F (10°C – 37.7°C) at time of installation.
2. Roll out the GAF SA Vapor Retarder over clean, dry deck and allow to relax. For metal decks, the width of the membrane is designed for proper alignment of the long edge with the flutes as it is installed over the roof deck.
3. GAF SA Primer is not required for metal decks. Metal decks must be clean, dry, and free from oil or other contaminants that can interfere with adhesion of the GAF SA Vapor Retarder. Other acceptable substrates (plywood, gypsum, or concrete) must be primed prior to application.
4. Apply GAF SA Primer using brush, roller, or sprayer at approximately 0.5-0.66 gallons per 100 square feet (0.2-0.27 L/m^2). Lightly prime for uniform coverage. Do not apply primer in heavy or thick coats.
5. Place GAF SA Vapor Retarder in desired position. Once the membrane is in place, while holding the membrane tight, peel off the silicone release film by pulling diagonally from the underside of the sheet.
6. Install subsequent rolls of membrane in the same way, taking care to overlap the longitudinal side laps a minimum of 3" (76 mm) and end laps a minimum of 6" (152 mm).
7. For metal decks, install a 6" x 42" (152 mm x 1.07 m) metal plate at the end of the roll to support the membrane end lap between the metal flutes, ensuring a complete end lap seal. Overlap end laps a minimum of 6" (152 mm).
8. Once installed, pressure must be applied over the whole surface using a weighted roller to ensure adequate adhesion to the substrate.

9. Seal perimeter and penetration areas with closed-cell foam sealant. The GAF SA Vapor Retarder must be tied into the building's air/vapor retarder system as appropriate with compatible SBS asphaltic materials.

10. Because the water resistance characteristics of vapor retarders can be compromised by storms, physical damage and installation issues, vapor retarders should be covered by a primary roof covering as soon as possible after installation.

11. If GAF SA Vapor Retarder is not immediately covered, particular attention should be paid to implementation of details to ensure a temporary seal. GAF will have no responsibility for any moisture infiltration that results from improper seals or phasing.

12. All T-joints and 90 degree transitions must be sealed with Matrix™ 201 SBS Flashing Cement. If fishmouths or other openings are created at overlap, they must be repaired and sealed with Matrix™ 201 SBS Flashing Cement. All wet and damaged materials or leaks through the GAF SA Vapor Retarder must be repaired before installing the finished roof.

13. GAF SA Vapor Retarder is UV resistant up to 90 days. The 90-day UV resistance refers to standardized testing conducted to ensure the product will not physically degrade when exposed to UV. GAF SA Vapor Retarder is NOT waterproof. DO NOT USE GAF SA Vapor Retarder as a temporary roof to protect property or possessions.

3.07 Base Sheet Installation

A. General

1. Fiberglass base sheet should typically be installed over all nailable substrates other than gravel-surfaced built-up roofing whenever insulation, re-cover board, or fire barrier board is installed in hot asphalt.

2. Nailable base sheet must be applied over substrates that are not suitable for asphalt adhesion.

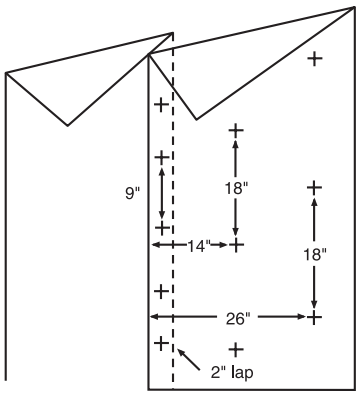
3. Install base sheet so that wrinkles or buckles are not formed.

4. Overlap the base sheet a minimum of 2" (51 mm) for side laps and 6" (152 mm) for end laps.

B. Mechanical Securement - Nailable Base Sheet

1. Secure nailable base sheet through existing substrate to the deck. Use appropriate type and length of fastener for structural deck type, and install required number of fasteners in accordance with Figure 1.

Figure 1



2. Fastening rate must be enhanced in the perimeter and corner areas. Fastening enhancements vary by deck type, contact GAF at 800-766-3411 for deck specific fastening enhancement requirements.

3. Pre-drilling is required for concrete decks, and may be required for gypsum concrete and cementitious wood fiber decks.

4. Install fasteners such that the fastener plate is pulled flush with the nailable base sheet surface and lies flat to the deck surface.

5. Maximum guarantee lengths available when mechanically attaching an approved base sheet to a LWIC deck is 20 years.

C. Loose-Laid Securement - Venting Base Sheet

1. This application is for use in hybrid systems only installed over polyisocyanurate insulation.

2. Install GAFGLAS® Stratavent® Perforated Venting Base Sheet (granule side down) loose-laid over the polyisocyanurate insulation so that wrinkles and buckles are not formed.

3. Overlap venting base sheet a minimum of 2" (51 mm) for side laps and 6" (152 mm) for end laps.

4. Install the subsequent system ply/plies in hot asphalt over the GAFGLAS® Stratavent® Perforated Venting Base Sheet. The hot asphalt used to install the subsequent ply/plies mopped over the surface of the base sheet flows through the perforations to attach the base sheet and membrane system to the insulation.

3.08 Insulation & Re-cover Board Installation

A. General

1. Refer to section 2.08 of this Manual for specific GAF requirements on cover/re-cover boards.

2. Install insulation board and re-cover board as required in accordance with the Design Tables in this Manual.

3. The use of an overlay board is required for all membrane applications adhered in hot asphalt over polystyrene insulations. The overlay board must either have all joints taped prior to installation of the roofing membrane, or a layer of red rosin sheathing paper must be installed between the insulation and the coverboard. Roof tape, if required over insulation joints, shall be laid evenly, smoothly, and embedded in a uniform coating of hot steep asphalt with 4" (102 mm) end laps. Care must be taken to ensure smooth application of tape, and full embedment of the tape in the asphalt.

   a. Perlite is only acceptable as a re-cover board when the membrane is installed in hot asphalt.

   b. Application of the asphalt and tape may be made by either "back mopping" the tape and pressing the tape into place, or by using a taping machine (small felt layer), which will apply asphalt to the tape in a continuous operation.

B. Placement

1. Butt insulation boards together with a ¼" (6.3 mm) maximum space between adjoining boards. Fit insulation boards around penetrations and perimeter with a ¼" (6.3 mm) size maximum space between board and penetration. Do not kick insulation boards into place.

2. Install insulation boards in pieces a minimum of 2' x 2' (610 mm x 610 mm) in size. Every piece must be properly secured to the substrate.

3. Insulation boards installed in multiple layers must have the joints between boards staggered in all directions a minimum of 6" (152 mm) between layers.

4. Insulation boards installed over steel decking must have boards placed perpendicular to deck flutes with edges over flute surface for bearing support.

5. Install tapered insulation to provide a sump area with a minimum area of 36" x 36" (914 mm x 914 mm) where applicable.

6. Do NOT install insulation boards that are wet, warped, or buckled; they must be discarded. Insulation boards that are broken, cracked, or crushed must not be installed unless the damaged area is first removed and discarded.

7. Remove and replace insulation boards that become wet or damaged after installation.

8. Install no more insulation than can be properly covered with roofing membrane by the end of each day.

9. EPS, XPS or polyiso insulation may be used to fill in flutes of steel decking when used in conjunction with a cover board.

C. Securement

1. Mechanical Attachment

a. Use appropriate number, type, and length of Drill-Tec™ fastener for structural deck type. See Insulation Attachment Tables within this Manual.

b. Drill-Tec™ "flat" plates (without the countersunk fastener holes protruding from the bottom of the plates) are required when plates are installed over hard surfaces such as EnergyGuard™ HD Polyiso Insulation(s), DensDeck®, SECUROCK® or other hard cover boards to allow the plates to rest flush on the surface.

c. Pre-drilling is required for concrete decks, and may be required for gypsum concrete and cementitious wood fiber decks.

d. Install fastener so as to firmly fix the plate to the insulation surface without over-driving.

e. Additional fasteners must be installed in corner/perimeter roof areas for all EverGuard® systems. Refer to the Perimeter Securement Table within this Manual to determine the width of the perimeter area.

2. Hot Asphalt

a. Use ASTM D-312, Type III or Type IV asphalt.

b. Hot asphalt application requires priming of concrete and gypsum decks and existing asphaltic roofing systems.

c. Apply asphalt at the rate of 25 lbs. (11.3 kg) per 100 sq. ft. (9.2 sq. m) over the entire surface to which the board is to be adhered.

d. Asphalt application rates of up to 60 lbs. (27 kg) per 100 sq.ft. (9.2 sq. m) may be required if the substrate surface is rough or porous, such as an existing flood coat and gravel surfacing. Ensure existing gravel and dirt is vacuumed, power-broomed, or power-washed away.

e. Apply asphalt at its EVT temperature (+/- 25°F, 13.9°C) to obtain a proper bond, typically within the range of 425 °F (218°C) to 475°F (246°C).

f. Walk in the boards after installation to ensure a proper bond.

g. Maximum board size is 4' x 4' (1.2 m x 1.2 m).

3. Foam Adhesive

a. Ribbon-adhere insulation with LRF adhesive in ribbons spaced 12" (305 mm) o.c. maximum for the field of the roof, and 6" (152 mm) o.c. maximum for perimeters and corners for all standard GAF guarantees. To determine the width of the perimeter, refer to the Perimeter Securement Table within this Manual.

b. For bead width requirements, installation temperatures and further details, refer to GAF's Low-Rise Foam (LRF) Insulation Adhesive Coverage Rate Table within this Manual.

c. Adhesive ribbons must be evenly spaced.

d. Walk in the insulation boards after installation to ensure complete adhesion. Once the board is set in place, apply adequate weight to the boards until the adhesive is cured to ensure proper securement of the insulation to the substrate.

e. Maximum board size is 4' x 4' (1.2 m x 1.2 m) for polyisocyanurate unless the following requirements are met:

- Bead spacing of 6" (152 mm) o.c. only.
- Insulation boards must be flat, dry, and clean. Installation of any boards that are cupped or warped is not acceptable.
- Lay insulation boards in place and walk-in to ensure complete adhesion. Once the board is set in place, apply adequate weight to the boards until the adhesive is cured to ensure proper securement between the insulation and substrate.
- Does not qualify for enhanced wind coverage; GAF standard NDL Guarantee coverage only.
- Not approved for use with any roofing system that requires the support of 3rd party testing (e.g. FM.). If 3rd party testing is utilized to support the wind uplift resistance of a roofing system, maximum 4'x4' boards are required.

D. Crickets and Saddles

1. When installing crickets, saddles, or cut tapered insulation panels, it may be advantageous to use an approved lowrise foam adhesive in lieu of mechanical attachment. See Section 3.08 C 3 Foam Adhesive for more information.

3.09 Interply Sheet Installation - Hybrid Systems Only

A. General

1. Interply sheets must be installed over the base sheet, fire barrier board, or insulation as appropriate for the roof assembly.
2. Install interply sheets so that wrinkles and buckles are not formed.
3. Refer to the current RUBEROID® SBS Hot-Mopped or Heat-Welded Roofing Systems Application & Specifications Manuals for the proper overlap placement, which changes depending on the total number of plies being installed.
4. Hybrid systems require the use of EverGuard® TPO/PVC fleece-back membranes as the capsheet. Refer to section 3.10 within this Manual for membrane installation.

B. Application - Hot Asphalt

1. Adhere interply sheets shingle fashion (overlapping starting at the low point) in hot asphalt at the rate of 25 lbs +/- 20% per 100 sq. ft. of roof area (1.2 kg/m^2).
2. Use either ASTM D312 Type III or Type IV asphalt up to 1/2:12 slope.
3. Broom interply sheets to ensure complete bonding between asphalt and interply sheets.
4. Refer to the current RUBEROID® SBS Hot-Mopped Roofing Systems Application & Specifications Manual for additional hot asphalt installation instructions.

C. Application - Heat-Weld

1. When Heat-Welding interply sheets, all safety precautions must be taken. Refer to the RUBEROID® SBS Heat-Welded Roofing Systems Application & Specifications Manual for further information regarding torch safety.
2. Measure and cut RUBEROID® SBS Heat-Welded membrane into the required lengths.
3. Apply the propane torch flame uniformly across the back surface of the membrane and lap areas until the compound reaches the proper application temperature and exhibits a slight sheen.
4. The membrane is slowly unrolled as heat is applied to ensure proper adhesion. Avoid overheating which may result in damage to or improper adhesion of the membrane.
5. Laps must be rolled or pressed to ensure proper seaming with a minimum 1/16" (2 mm) bead of bitumen at all seams.
6. Refer to the current RUBEROID® SBS Heat-Welded Roofing Systems Application & Specifications Manual for additional Heat-Weld installation instructions.

3.10 Membrane Installation

Substrates must be inspected and accepted by the contractor as suitable to receive and support the roof membrane materials.

A. Substrate Surface Preparation

1. Prepare substrate surfaces thoroughly prior to application of new roofing materials. This is particularly important for re-cover and reroofing applications.
2. 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, replacement of damaged decking, etc.
3. 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.

B. Placement

1. Place roof membrane so that wrinkles and buckles are not formed. Any wrinkles or buckles must be removed 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 side and end laps of adhered systems that utilize smooth reinforced membrane. Membranes are provided with lap lines along the side laps; the red line is for adhered and ballasted systems overlap.
4. Install membrane so that the side laps run across the roof slope lapped toward drainage points. Butt ends of the fleece-back membrane.
5. All exposed sheet corners must be rounded a minimum of 1" (25 mm).
6. Cut edges of reinforced TPO membrane can be sealed with EverGuard® TPO Cut Edge Sealant.

C. Supplemental Securement

1. Roof membrane must be mechanically secured at the perimeter, at the base of internal walls and curbs, and at all penetrations with Drill-Tec™ Membrane Fasteners and Plates at a 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.
2. Membrane may be extended vertically 3" (76 mm) up walls and curbs and secured to the wall/curb substrate within 2" (51 mm) of the plane of the roof with Drill-Tec™ Membrane Fasteners and inverted Termination Bar at a 12" (305 mm) o.c. maximum spacing. This detail is required to be used for all pressurized buildings.
3. Mechanically fasten the membrane with fasteners and plates to the roof deck at locations of deck angle changes in excess of 1:12.
4. Fasteners must be installed to achieve the proper embedment depth. Install fasteners vertical to the deck, or horizontal to the wall/curb without lean or tilt.
5. 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 (under-driving), and will not cause wrinkling of the membrane (over-driving).

6. Utilization of Roof Transition Anchor (R.T.A.) Strip may be installed as the method of supplemental securement for a non-penetrating base attachment present on adhered TPO systems.

7. Low-rise foam adhesive may also be used for supplemental attachment for EverGuard® TPO and PVC fleece-back membranes only. Install two .75" - 1" (19 - 25 mm) ribbons a minimum of 2" (50 mm) from the wall and 4"-6" (102-152 mm) apart.

D. Bonding Adhesive – Smooth Reinforced Membrane

1. When using EverGuard® TPO and PVC bonding adhesives with smooth reinforced membranes, use any of the following substrates: polyisocyanurate insulation (w/o foil facer), high density fiberboard, approved gypsum board, untreated OSB, untreated CDX plywood.

2. Unroll the membrane sheet in place and fold back the sheet in the long dimension (to expose the underside) to allow adhering of the membrane, one half of a sheet at atime. Do not crease.

3. For best results use a 3/8" (9.5 mm) solvent-resistant nap roller, brush, or squeegee. When using a roller, avoid taking the roller head out of the bucket, dropping it in one place, and beginning to roll. Instead, remove the roller filled with adhesive and drop the roller on three areas to be glued, and then connect the adhesive drop areas. This will avoid an excess amount of adhesive in one place, and it will flash off faster and more uniformly. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.

4. For application rates and temperatures, refer to the EverGuard® Membrane Adhesive Coverage Rates Guidance Table within this Manual.

5. Coverage may vary depending on the porosity of the substrate surface.

6. Refer to the EverGuard® Membrane Adhesion Table within this Manual to determine membrane and adhesive compatibility.

7. Solvent-based adhesive must be allowed to dry until tacky to the touch before mating membrane. Water-based adhesive must be allowed to flash off completely. Typically, the sheet must be installed within one hour of applying the water-based adhesive. However, this may vary depending on ambient temperature conditions.

8. Bond the membrane to the substrate and apply pressure by means of a roller or push broom to ensure complete bonding. Avoid trapping air between the membrane and the substrate.

9. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.

E. Spray Bonding Adhesive – Smooth Reinforced Membrane

1. EverGuard® TPO Quick Spray Adhesive and Everguard® TPO Quick Spray LV 50 adhesive is for use with smooth reinforced membranes over any of the following substrates: polyisocyanurate insulation (w/o foil facer), high density fiberboard, approved gypsum board untreated OSB, untreated CDX plywood.

2. Spraying the adhesive will require the following materials and equipment: EverGuard® TPO Quick Spray Adhesive Hose & Gun Cleaner, EverGuard® TPO Quick Spray Adhesive Hose & Gun Kit, EverGuard® TPO Quick Spray Adhesive LV50 Hose & Gun Kit. These kits include Spray Gun with 24" (610 mm) extension and the hose measures 12' (3.6 m). The recommended gun tip is Unijet 11002.

3. For application rates and temperatures, refer to the EverGuard® Membrane Adhesive Coverage Rates Table within this Manual.

4. Coverage may vary depending on the porosity of the substrate surface.

5. Unroll the membrane sheet in place and fold back the sheet in the long dimension (to expose the underside) to allow adhering of the membrane, one half of a sheet at a time. Do not crease.

6. Application of spray bonding adhesive:

   a. Remove the EverGuard® Quick Spray Hose And Gun Kit. Before initial use, rotate the gun thumbwheel closed so that the trigger can't be pulled. Securely attach the gun to the hose and the hose to the canister. Fully open canister valve. Do not close until the canister is empty. A small adjustable wrench is all that is needed.

   b. When not spraying, leave the tank and safety on with the line charged. When spraying is resumed, use EverGuard® TPO Quick Spray Adhesive Hose & Gun Cleaner on a clean rag to clean the nozzle tip.

   c. Spray only on an approved substrate that is clean, dry and free of foreign matter.

   d. Spraying from 8 to 12 inches (203 to 305 mm) away, apply adhesive uniformly to both the substrate and membrane without overlap. Keep the gun perpendicular to the surface.

   e. Spray pattern should be approximately 8 to 12 inches (203 to 305 mm) wide when using the recommended Unijet 11002 gun tip.

   f. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.

   g. Allow adhesive to partially dry (approximately 2-5 minutes). Adhesive should feel tacky before bonding the membrane to substrate.

7. Bond the membrane to the substrate and apply pressure by means of a roller or push broom to ensure complete bonding. Avoid trapping air between the membrane and the substrate.

8. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.

9. In order to maintain the gun and hose once finished, lock the trigger and leave the canister valve OPEN. Keep the spray gun thumbwheel CLOSED when not in use. (Maximum 3 days.) Keep canisters covered when not in use. To use adhesive after storage, clean with EverGuard® TPO Quick Spray Adhesive Hose & Gun Cleaner.

10. To dispose of an empty tank, turn on the valve at the tank with the nozzle pointing away from you. Let all vapors evacuate the tank. On top of the tank is a recessed round metal plug. With the tank empty, knock out the plug and dispose of the empty tank.

F. Water-Based Bonding Adhesive – Fleece-Back Membrane

1. When using EverGuard® WB 181 bonding adhesives with fleece-back membranes, use any of the following substrates: polyisocyanurate insulation (w/o foil facer); high density fiberboard; approved gypsum board; cured structural concrete (with no curing and sealing compound present); untreated OSB; untreated CDX plywood; poured or plank gypsum and dry, sound masonry (with no curing and sealing compound present).
2. Unroll the membrane sheet in place and fold back the sheet in the long dimension (to expose the underside) to allow adhering of the membrane, one half of a sheet at a time. Do not crease.
3. For best results use a 3/8" (9.5 mm) solvent-resistant nap roller, brush, or squeegee. When using a roller, avoid taking the roller head out of the bucket, dropping it in one place, and beginning to roll. Instead, remove the roller filled with adhesive and drop the roller on three areas to be glued, and then connect the adhesive drop areas. This will avoid an excess amount of adhesive in one place, and it will flash off faster and more uniformly. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.
4. For application rates and temperatures, refer to the EverGuard® Membrane Adhesive Coverage Rates Table within this Manual.
5. Coverage may vary depending on the porosity of the substrate surface.
6. Water-based adhesives are approved for use with smooth and fleeceback TPO membranes and fleece-back PVC membranes only.
7. For fleece-back membranes, all of the adhesive is applied to the substrate and the sheet is installed in the wet adhesive.
8. Water-based adhesive must be allowed to flash off completely. Roll membrane into adhesive as soon as practical. Typically, the sheet must be installed within one hour of applying the water-based adhesive. However, this may vary depending on ambient temperature conditions. Do not allow adhesive to dry or string.
9. Bond the membrane to the substrate and apply pressure by means of a roller or push broom to ensure complete bonding. Avoid trapping air between the membrane and the substrate.
10. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.
    a. For selvage edge laps of EverGuard® PVC and TPO membranes, overlap the roof membrane a minimum of 3" (76 mm) and heat weld the laps.
    b. Non-selvage edge laps of EverGuard® PVC and TPO Fleece-back membranes are made by butting adjacent sheets, and welding an 8" (203 mm) wide flashing strip cut out of smooth PVC or TPO membrane of the same thickness as the field sheet and using as the flashing strip.

G. Low Rise Foam (LRF) Adhesive - Fleece-Back Membrane

1. When using an LRF adhesives with fleece-back membranes, use any of the following substrates: polyisocyanurate insulation (w/o foil facer), high density fiberboard, approved gypsum board, cured structural concrete (with no curing and sealing compound present), untreated OSB, untreated CDX plywood, poured or plank gypsum, and dry, sound masonry (with no curing and sealing compound present). Adhering fleece-back membranes directly to perlite is not recommended. However, perlite can be used as a base/fill layer underneath an appropriate substrate in fleece-back applications.
2. Use LRF adhesives for fleece-back membrane attachments at the prescribed bead spacing:
    a. LRF adhesive packaged in cartridges can be applied using a Manual hand applicator; battery powered applicator; or pneumatic powered applicator.
    b. LRF adhesive packaged in five-gallon (20 liter) box sets (parts A and B) must be applied using Cyclone or Cyclone II cart for LRF Adhesive M. An OMG PaceCart® or PaceCart 2® must be used for LRF Adhesive O.
    c. OlyBond500® canisters can be used in a spatter application in conjunction with fleece-back membranes only. For more information on LRF application equipment, contact LRF foam manufacturers.
3. For application rates and temperatures, refer to the Low-Rise Foam (LRF) Membrane Adhesive Coverage Rates Table within this Manual.
4. Coverage may vary depending on the porosity of the substrate surface.
5. Unroll the membrane sheet in place and fold back the sheet in the long dimension (to expose the underside) to allow adhering of the membrane, one half of a sheet at a time. Do not crease.
6. Apply adhesive to the substrate at the prescribed rate and ALLOW TO FOAM. Lay one half of the membrane sheet into the wet adhesive and roll into place with a segmented, 150 lb. (68 kg) roller. Avoid trapping air between the membrane and the substrate. Repeat for the other half of the sheet.
    a. If adhesive contaminates the weld area, immediately clean the area with EverGuard® TPO Cleaner or acetone for PVC membrane. See Section 3.10 J for more detailed instructions on cleaning.
7. Alternatively, align a full roll of membrane with the factory-applied red line on the previously installed sheet. Roll out the sheet approximately 20' (6.1 m) checking to see that the edge of the new roll is straight with the red marked line. Fold back the sheet in the long dimension (to expose the underside). Do not crease. Install the LRF to the substrate per application specification. Pull the sheet back to its original position, and roll into place. Ensure that the red line is followed when re-installing the sheet.

8. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.
   a. For selvage edge laps of EverGuard® PVC and TPO membranes, overlap the roof membrane a minimum of 3" (76 mm) and heat weld the laps.
   b. Non-selvage edge laps of EverGuard® PVC and TPO Fleece-back membranes are made by butting adjacent sheets, and welding an 8" (203 mm) wide flashing strip cut out of smooth PVC or TPO membrane of the same thickness as the field sheet and using as the flashing strip.

H. Hot Asphalt - Fleece-Back Membrane

1. When using hot asphalt with fleece-back membranes, use any of the following substrates: high density fiberboard; perlite, approved gypsum board; cured structural concrete (with no curing and sealing compound present); dry, sound masonry (with no curing and sealing compound present).
   a. When applying fleece-back membrane directly to the deck or an existing asphaltic surface in hot asphalt, prime with asphalt/concrete primer, meeting ASTM D41, at a rate of 1 gal/square (4.08 L/10 m^2) and allow the primer to dry prior to the application of the roofing system.
2. Use appropriate asphalt grade for deck slope, either Type III or Type IV.
3. Adhere membrane sheets with hot asphalt at the rate of 25 lbs. (11.3 kg) per 100 sq. ft. (9.2 sq. m).
   a. Apply asphalt to substrate surface only.
   b. A greater quantity of asphalt may be required based upon the substrate surface condition.
   c. Prevent seam contamination by keeping the asphalt application 4" (102 mm) back from the seam area.
4. Unroll the membrane sheet in place and fold back the sheet in the long dimension (to expose the underside) to allow adhering of the membrane, one half of a sheet at a time. Do not crease.
5. Roll membrane into asphalt immediately and apply pressure by means of a roller or push broom to ensure complete bonding. Avoid trapping air between the membrane and the substrate.
6. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.
   a. For selvage edge laps of EverGuard® PVC and TPO membranes, overlap the roof membrane a minimum of 3" (76 mm) and heat weld the laps.
   b. Non-selvage edge laps of EverGuard® PVC and TPO fleece-back membranes are made by butting adjacent sheets, and welding an 8" (203 mm) wide flashing strip cut out of smooth PVC or TPO membrane of the same thickness as the field sheet and using as the flashing strip.
7. For roofs with a slope over 1.5:12, contact your GAF Field Services Manager for review prior to installation.

I. Membrane Surface Preparation for Seaming

1. 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 these two discreet pieces together, the materials must be clean and dry; if not clean and dry, contaminants will interfere with the weld and, generally, the result is a poor or false weld.
2. Satisfactory heat welding requires that the membrane be clean of dirt and contaminates, and free from dew, rain, and other sources of moisture.
3. Factory-fresh membrane typically will not require cleaning prior to welding, provided that welding is performed immediately after placement of the membrane. Membrane that has been exposed for a longer period of time will require additional cleaning methods, depending on the type of contamination present.
   a. Any material rolled out and put into place needs to be welded the same day, including welding of any detail work.
   b. Membrane that has been exposed overnight or for more than 12 hours or has otherwise become contaminated, will require cleaning.

J. Seam Cleaning

1. **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 EverGuard® TPO Seam Cleaner or EverGuard® CleanWeld™ Conditioner (low VOC) for TPO membranes. For PVC membranes, EverGuard® PVC Membrane Cleaner, MEK (methyl ethyl ketone) or acetone can be used. Be sure to wait for cleaner to dry/flash-off prior to welding.
2. **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 to dry. This must be followed by cleaning with a cloth moistened with EverGuard® TPO Seam Cleaner or EverGuard® CleanWeld™ Conditioner (low VOC) for TPO, or EverGuard® PVC Membrane Cleaner, MEK (methyl ethyl ketone) or acetone for PVC. Be sure to wait for cleaner to dry/flash-off prior to welding.
3. **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 weathered/oxidized top surface layer. This must be followed by cleaning with a cloth moistened with EverGuard® TPO Seam Cleaner or EverGuard® CleanWeld™ Conditioner (low VOC) for TPO, or EverGuard® PVC Membrane Cleaner, MEK (methyl ethyl ketone) or acetone for PVC. Be sure to wait for cleaner to dry/flash-off prior to welding.

4. **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 required in these situations.

5. If low-rise foam adhesive is accidentally spilled on the surface of the finished roof, use the following procedure to clean the roof:

   a. Carefully scrape off the adhesive without rupturing the underlying roof membrane.

   b. After removal of adhesive, cover the affected area with either EverGuard® smooth or fleece-back membrane.

K. Heat Welding Equipment

1. 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.

2. 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.

   a. Current generation automatic hot-air welder (recommended)

      i. Minimum Power Supply: 220 volts, 30 amps, 10,000 watt continuous

   b. Current generation hand-held hot-air welder (recommended)

      i. Minimum Power Supply: 110 volts, 15 amps, 2500 watt continuous

   c Commercial Grade 10,000-watt voltage-controlled generator (minimum)

      i. THD (Total Harmonic Distortion) rating should be six (6) or less for quality welds

      ii. 240v & 120v Outlets

      iii. GFCI Line Cords

      iv. Volt Meters

   d. Extension Cords

      i. Automatic Welders - #10 wire with a standard plug configuration. Maximum 100' (30.5 m) in length.

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

      iii. For longer lengths, consult an electrician for line voltage drop. Heavier-gauge extension cords are likely to be required.

3. Stable power supply- 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. House-supplied power is acceptable for hand welders only. Do not connect to a power source that is:

   a. Used for other equipment that cycles on and off.

   b. Is subject to momentary disruptions or power surges.

   c. Incapable of providing sufficient power.

      i. THD greater than six (6) may lead to fluctuations which may impact welding.

4. Silicone Hand Roller (used in conjunction with hand-held welders)

   a. Ensure that the roller is in good condition. Rollers with rounded edges should be replaced.

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

L. Equipment Maintenance

1. 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.

   a. Follow the equipment manufacturer's recommendations regarding other aspects of equipment maintenance and repair (i.e., motor brushes, switches, belts, etc.).

   b. Store welding equipment in weather tight tool boxes. Tool boxes for automatic welders in particular should be fitted with cushioning foam material to protect the welder during transit and hoisting operations.

   c. Clean welding nozzles on a daily basis with a wire brush. Nozzles have a tendency to retain membrane residue on their surfaces. This buildup of residue can interfere with welding if not removed.

   d. 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.

   e. 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.

M. Equipment Settings

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

2. Test welds should be performed at the beginning of every work period.
   a. Just before welding in the morning,
   b. Upon returning from lunch in the afternoon, and
   c. When there's been a significant change in weather (e.g., air temperature, wind speed, cloud cover, etc.).
3. 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. This is called a "film tearing bond." A deficient weld fails by separating between the two layers of the membrane.
4. 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 settings, use the formula below:
   a. Speed Formula: Start at (ambient temp/10) + 2 = FPM (Feet Per Minute)
   b. Example: 70/10 + 2 = 9 FPM

Note: This formula serves as an initial starting point. Adjustments may need to be made accordingly from there. New equipment may run faster and hotter. Remember, settings required for a good weld will change based on equipment type, weather conditions and membrane thickness.

Cautions & 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.
- Any attempt to run a robotic welder at a speed greater than 16 ft. (9.6 m)/min. 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).

N. Test Welds

1. Take 2 pieces of "bag fresh" EverGuard® membrane approximately 18" (457 mm) long.
2. Set your automatic welder's speed and heat. For full size welders, such as the BAK LarOn, GAF suggests starting at the following settings:
   a. Temperature between 600˚F (315˚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.
   b. For an initial setting, use the formula below as a general-guideline:

Speed Formula: Start at (ambient temp/10) + 2 = FPM (Feet Per Minute)

Example Scenario: Start out by setting the speed at 10 FPM and the temperature at 600°F (315˚C) and do a test weld. Bump temperature up 100°F (38˚C) to 700°F (371˚C) keeping same 10 FPM. Perform another test weld. Continue doing this in 100°F (38˚C) 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.

3. 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 stress causing the seam to peel apart.
4. An acceptable weld will fail by exposing the scrim reinforcement. This is called a "film tearing bond" or "FTB". The film tearing bond will be between 1" (25 mm) and 1.5" (38 mm) wide.
5. A partial weld will fail by partially separating between the two layers of the membrane.
6. An unacceptable weld will fail by separating between the two layers of the membrane. This is also known as a "cold weld" or "false weld".
7. 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.).
8. Hand welding during colder temperatures also needs to be adjusted.
   a. Perform test welds on membrane you will be using that day.
   b. Do not use scrap material to create test welds.
   c. Perform daily quality control including probing and checking seams at the end of the day.

O. Adjustments to the Hot Air Robotic Welder Settings

1. 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.
2. The correct speed and temperature settings for automatic welders are determined by preparing test welds at various speed and heat settings.
3. Only make one change at a time and avoid changing heat and speed together.

4. 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.

5. 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.

6. 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.

P. Automatic Hot Air Welding of Field Seams

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

2. Membrane MUST be cleaned and free from all dirt and debris prior to hot air welding of seams.

3. Verify correct power supply voltage with a voltmeter.

4. Determine proper welder speed and temperature settings by performing the test weld procedure.

5. 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.

6. The weld must provide a maximum film-tearing bond of 1.5" (38 mm) and a minimum 1" (25 mm) film-tearing bond.

7. Membrane laps must be heat-welded together. All welds must be continuous, without voids or partial welds. Welds must be free of burns or scorch marks; however, seaming of PVC membrane should exhibit bleed-out when properly welded.

8. All reinforced membrane TPO and PVC field seams should be made using an automatic hot air welder.

9. 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.

   a. 60, 70 & 80 mil TPO membrane T-joints require the installation of a heat-welded membrane cover patch.

   b. 80 mil PVC membrane T-joints require the installation of a heat-welded membrane cover patch.

10. Cut edges of reinforced TPO membrane can be sealed with EverGuard® TPO Cut Edge Sealant.

Q. Hand-Welding of Seams

1. 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.

2. Membrane MUST be cleaned and free from all dirt and debris prior to hand-welding.

3. 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.

4. 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.

5. 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.

6. All welds must be continuous, without voids or partial welds. Welds must be free of burns or scorch marks. PVC welds should show bleed out and TPO welds should not have bleed out.

7. 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.

8. The weld must provide a maximum film-tearing bond of 1.5" (38 mm) and a minimum 1" (25 mm) film-tearing bond.

9. Depending on the type of welding being performed, the temperature setting will vary, as will the width of the welding nozzle.

   a. Welding Seams, Prefabricated Flashings and Repair Patches – Use the highest temperature setting that the roofer is comfortable with.

   b. Welding Field-Fabricated Pipe and Corner Flashings – Use the highest temperature setting that the roofer is comfortable with.

R. Seam Probing

1. 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.

2. 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).

3. Contractors are responsible for initial probing of their welds. Do NOT wait for a GAF Field Services 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 GAF.

4. Probing MUST be conducted daily.

5. Initial probing should be done on hands and knees.

6. Subsequent probing may be completed with a cotter key hand tool that can be affixed to a standard extension handle, which allows the tool to be used from a standing position.

7. Exercise care when handling and walking with the seam probe to avoid injuries from the point end.

8. Continuous use of the probe will cause it to become sharper. Ensure that the point is blunted/rounded off at all times.

9. 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.

10. 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.

11. 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.

12. Mark all voids, open welds or cold-welds using a water-soluble marker or crayon so repairs can be made.

13. 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.

14. 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.

15. 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.

16. 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.

17. Cut edges of reinforced TPO membrane can be sealed with EverGuard® TPO Cut Edge Sealant.

3.11 Flashing Installation

Refer to the construction details in the Architectural Roofing Details Manual, available at www.gaf.com, which depict flashing requirements for typically encountered conditions. Install flashing materials as shown in the construction details.

A. General

1. Flash all perimeter, curb, and penetration conditions with EverGuard® coated metal, membrane flashing, and flashing accessories as appropriate to the site condition.

2. All EverGuard® coated metal and membrane flashing corners must be reinforced with pre-formed corners or non-reinforced membrane.

3. All flashing membranes and accessories are to be heat-welded using a hand welder. Refer to Section 3.10 Q.

4. Cut edges of reinforced TPO membrane can be sealed with EverGuard® TPO Cut Edge Sealant.

5. When using bonding adhesive, be sure to use adhesive specific to membrane and ambient weather conditions.

6. Maximum flashing height without intermediate fastening:
   - 30" (762 mm) – Loose-Applied
   - 66" (1.7 m) – Adhered

   Note: EverGuard® TPO Quick Spray Adhesive and EverGuard® TPO Quick Spray LV50 can be applied to walls without any height limitations. Supplemental fastening is not required. The wall flashing must be separate from the roof membrane. The roof membrane cannot extend continuously from the field of the roof up the wall. The roof membrane must be mechanically attached along the base of the wall(s) and the wall flashing must be mechanically attached at the top of the wall(s).

7. Minimum flashing height is 8" (203 mm).

8. The maximum distance from the wall that horizontal mechanical attachment should be installed is 6" (152 mm). When you must go past 6" (152 mm), move the attachment to the vertical substrate.

9. Installation of EverGuard® PVC flashing membrane over asphalt-based substrates must have a polymat slip sheet or approved insulation boards, metal, wood, etc., under the PVC flashing membrane.

10. EverGuard® membrane flashings should be of same type, thickness, and color as the roofing membrane.

11. For TPO or PVC membranes installed over granulated modified bitumen flashings, a polymat separator sheet must be installed for loose-applied flashings. In adhered applications, a barrier board must be installed.

12. When using EverGuard® TPO or PVC adhesives, use any of the following substrates: polyisocyanurate insulation (w/o foil facer); high density fiberboard; approved gypsum board; cured structural concrete (with no curing and sealing compound present); untreated OSB; untreated CDX plywood; poured or plank gypsum and dry, sound masonry (with no curing and sealing compound present).

13. DensGlass® Gold gypsum board is NOT to be used as a substrate for adhered attachment on parapet walls, according to the manufacturer.

14. Fire-treated plywood/wood used as a parapet wall substrate is only acceptable if covered with an approved gypsum board for adhered EverGuard® flashing membranes.

15. Corner Curb Wraps consist of a pre-formed combination corner and flashing pieces that are 12" (305 mm) in height and can be ordered in various lengths. These flashings may be loose applied or adhered in place. For adhered flashing applications, apply adhesive to both the underside of the substrate and the flashing membrane to adhere the membrane.

B. EverGuard® Coated Metal Flashing

1. EverGuard® coated metal flashing allows much of the metal-work used in typical roofing applications to benefit from the security of heat-welded membrane seaming, with a corresponding reduction in required metalwork maintenance during the life of the roofing system.

2. EverGuard® coated metal must be formed in accordance with construction details. Where required, EverGuard® coated metal should be designed for wind resistance in accordance with the applicable building code and tested for capacity in accordance with ANSI/ SPRI/FM 4435/ES-1, "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

3. The use of EverGuard Extreme® TPO Coated Metal Flashing is required on EverGuard Extreme® Systems and extended length guarantees.

4. EverGuard® coated metal sections used for roof edging, base flashing, and coping must be butted together with a 1/4" (6 mm) gap to allow for expansion and contraction. Heat weld a 6" (152 mm) wide non-reinforced membrane strip to both sides of the joint. A 2" (51 mm) wide aluminum tape can be installed over the joint as a bond-breaker, to prevent welding in this area.

5. EverGuard® coated metal used for sealant pans and scupper inserts, and corners of roof edging, base flashing, and coping, must be overlapped or provided with separate metal pieces to create a continuous flange condition, and pop-riveted securely. PVC and TPO coated metal flashings must be stripped in using 6" (152 mm) membranes.

6. EverGuard® coated metal base flashings must be provided with min. 4" (102 mm) wide flanges fastened to wood nailers. EverGuard® coated metal base flashings must be formed with a 1" (25 mm) cant.

7. Provide a 1/2" (13 mm) hem for all exposed metal edges to provide corrosion protection and edge reinforcement for improved durability.

8. EverGuard® coated metal flashings should be attached to wood nailers or otherwise mechanically attached to the roof deck, or to the wall or curb substrate, in accordance with construction detail requirements.

9. When installing EverGuard® coated metal on walls or curbs that completely cover the existing flashing, the flashing does not need to be removed provided that it is in good condition and tightly adhered.

C. Adhered Reinforced Membrane Flashing - Smooth Surface

1. The type and thickness of the flashing membrane must be the same as the thickness and type of the roofing membrane.

2. For application rates and temperatures, refer to the EverGuard® Membrane Adhesive Coverage Rates Table within this Manual.

3. Coverage may vary depending on the porosity of the substrate surface.

4. Carefully position the membrane flashing prior to application to avoid wrinkles and buckles.

5. Solvent-based adhesive must be allowed to dry until tacky to the touch before mating membrane. Water-based adhesive must be allowed to dry completely. Typically, the sheet must be installed within one hour of applying the water-based adhesive. However, this may vary depending on ambient conditions including temperature, relative humidity, sunlight, etc.

6. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.

   a. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.

7. Only use the adhesive you are working with to prime the wall substrate.

8. For extended-length guarantees, a counter flashing must be used. Exposed termination bars are not acceptable.

D. Adhered Reinforced Membrane Flashing - Fleece-Back

1. For bonding adhesive or LRF application rates and temperatures, refer to the EverGuard® Membrane Adhesive Coverage Rates Table or the Low-Rise Foam (LRF) Membrane Adhesive Coverage Rates Table within this Manual.

2. The bonding adhesive must remain wet to the touch for one-surface applications. The use of solvent-based adhesive is not recommended.

3. When installing fleece-back membranes to a vertical surface, the material should be rolled in with hand rollers and should have top edge fastening and termination installed immediately to avoid slippage. For best results, flashings may need to be rolled in several times with a hand-held, silicone roller.

4. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.

   a. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.

   b. For selvage edge laps of EverGuard® PVC and TPO membranes, overlap the roof membrane a minimum of 3" (76 mm) and heat weld the laps.

   c. Non-selvage edge laps of EverGuard® PVC and TPO Fleece-back membranes are made by butting adjacent sheets, and welding an 8" (203 mm) wide flashing strip cut out of smooth PVC or TPO membrane of the same thickness as the field sheet and using as the flashing strip.

5. Only use the adhesive you are working with to prime the wall substrate.

6. For extended-length guarantees, a counter flashing must be used. Exposed termination bars are not acceptable.

E. Loose Reinforced Membrane Flashing

1. Carefully position the EverGuard® smooth or fleece-back reinforced flashing membrane prior to application to avoid wrinkles and buckles.

2. Heat-weld all EverGuard® reinforced membrane seams in accordance with heat-welding guidelines.

   a. For selvage edge laps of EverGuard® PVC and TPO membranes, overlap the roof membrane a minimum of 3" (76 mm) and heat weld the laps.

b. Non-selvage edge laps of EverGuard® PVC and TPO Fleeceback membranes are made by butting adjacent sheets, and welding an 8" (203 mm) wide flashing strip cut out of smooth PVC or TPO membrane of the same thickness as the field sheet and using as the flashing strip.

3. For extended-length guarantees, a counter flashing must be used. Exposed termination bars are not acceptable.

F. Non-Reinforced Membrane Flashing

1. Non-reinforced membrane must be used as a field-fabricated penetration/reinforcement flashing only where pre-formed corners and pipe boots cannot be properly installed.

2. Penetration flashing constructed of non-reinforced membrane is typically installed in two sections, a vertical piece that extends up the penetration and a horizontal piece that extends onto the roofing membrane. The two pieces are overlapped and heat welded together.

3. The non-reinforced vertical membrane flashing may be adhered to the penetration surface. Refer to section 3.11 C for application instructions.

4. All round and square pipe type flashings require EverGuard® FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block between the penetration and the membrane. Add and tighten stainless steel band and seal top of membrane with EverGuard® FlexSeal™ Caulk Grade Sealant.

5. T-joint Patches

a. T-joint patches are to be a minimum 4" (102 mm) in size and made of non-reinforced material. They must be completely hot-air welded over the T-joint at the intersection of the three pieces of reinforced membrane. During installation, care must be taken to "crease-in" the unsupported membrane at the three step-off locations.

b. Pre-fabricated or field-fabricated non-reinforced membranes that match the membrane being used in the field of the roof are acceptable for T-joints.

c. T-joint patches are required on 60, 70 and 80 mil TPO and 80 mil PVC only.

G. Roof Edging

1. TPO roof edge flashing is applicable for both gravel stop/drip edge conditions, as well as exterior edges of parapet walls.

a. For guarantees up to 20 years, use EverGuard® Cover Tape HW, or EverGuard® Cover Tape with all edges sealed with EverGuard® Cut Edge Sealant, EverGuard® TPO Coated Metal, or any of the other EverGuard® pre-fabricated extruded aluminum fascia systems.

b. For extended-length guarantees (greater than 20 years), use weldable metal, pre-fabricated extruded aluminum fascia systems, or EverGuard Extreme® Cover Tape HW only.

2. Where required, metal roof edging should be designed for wind resistance in accordance with the applicable building code and tested for capacity in accordance with ANSI/SPRI/FM 4435/ES-1, "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems." When not required, refer to Items 3 and 4.

3. Flash roof edges with EverGuard® coated metal flanged edging with minimum 3" (76 mm) wide flange nailed 4" (102 mm) o.c. or Drill-Tec™ fasteners 12" (305 mm) o.c. into wood nailers with a reinforced flashing strip welded to the coated metal and to the field of the roof.

a. For TPO coated metal, heat weld an 8" (203 mm) TPO reinforced flashing strip.

b. For EverGuard® PVC membranes, an 8" (203 mm) reinforced heat-weldable flashing strip must be used. Cover tape products are not acceptable for use with PVC membranes.

4. Metal roof edging must be provided with a continuous metal hook strip to secure the lower fascia edge. Secure the continuous hook strip to the building a maximum of 4" (102 mm) o.c.

5. Alternatively, flash roof edges with a two-piece snap-on fascia system, adhering roof membrane to metal cant with bonding adhesive and face-nailing the membrane 8" (203 mm) o.c. prior to installing the snap-on fascia.

6. For TPO roofs with guarantee lengths up to 20 years, metal edging may be flashed using EverGuard® TPO Cover Tape after priming both the metal and the TPO membrane.

a. EverGuard® TPO Cover Tape is a 6" (152 mm) wide, non-reinforced TPO membrane backed with a butyl tape adhesive. Clean the entire surface to be covered, both metal and roof membrane, with soap and water, and dry entire area. Wipe area to be primed with a damp wipe of EverGuard® TPO Cleaner.

b. Prime surfaces mating with the butyl tape with EverGuard® TPO Primer, keeping primer only on the surface receiving the tape. After primer has flashed off, pull release paper on the back of the tape, exposing the butyl adhesive, and mate the two surfaces. Roll the tape portion of the cover strip at a 45-degree angle to ensure a good bond. Seal all end laps, miters, and T-joint intersections with EverGuard® TPO Cut Edge Sealant 6" (152 mm) past the intersection in all directions.

7. For TPO roofs with extended-length guarantees, use EverGuard Extreme® TPO Cover Tape Heat Weld. This is a hybrid cover tape consisting of 6" (152 mm) of .045 reinforced TPO membrane with 3" (76 mm) butyl tape on half of the back surface. Refer to Step 6 (above) and follow procedures for the butyl tape preparation and installation. Then heat weld the cover tape to the field membrane with a 2" (51 mm) hand welder or automatic heat welder, to all membrane-to-membrane surfaces.

Note: Any overlap ends must be stripped in with flashing detail membrane and welded completely to finish the detail. EverGuard® TPO Cut Edge Sealant must be installed on all edges of the HW Flashing Strip.

8. Flash roof edge scuppers with a scupper insert of EverGuard® coated metal or an EverGuard® pre-fabricated coated metal scupper that is mechanically attached to the roof edge and integrated as part of the metal edging. Refer to section 3.11.O for more information on scuppers.

H. Parapet and Building Walls

1. Flash wall with either adhered membrane flashings, metal flashings, or loose-applied flashings.

2. Secure membrane flashing at the top horizontal edge with a termination bar. Apply FlexSeal™ Caulk Grade Sealant between the wall surface and membrane flashing underneath all termination bars. Exposed termination bars must be mechanically fastened 6" (152 mm) o.c. (20-year max. guarantee); termination bars that are counter flashed must be fastened 12" (305 mm) o.c. for extended-length guarantees.

3. Roof membrane must be mechanically attached along the base of walls that are flashed with membrane flashing. Attach with fasteners and plates/termination bar. Use a fastener spacing in accordance with in-lap attachment requirements, with a maximum 12" (305 mm) o.c. spacing.

4. Metal counter flashings with adhered or loose-applied membrane wall flashings are required on 20-year guarantees or longer. (They are not required for guarantees of less than 20 years.) All termination bars, either exposed or covered, must be sealed with FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block.

5. Flash wall scuppers with a scupper insert of EverGuard® coated metal that is mechanically attached to the wall and integrated as part of the wall flashing. Refer to Scupper section for other detail options.

6. Where required, metal cap flashings should be designed for wind resistance in accordance with the applicable building code and tested for capacity in accordance with ANSI/SPRI/FM 4435/ES-1, "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

7. Maximum flashing height without intermediate fastening:
   - 30" (762 mm) – Loose-Applied
   - 66" (1.7 m) – Adhered

Note: EverGuard® TPO Quick Spray Adhesive and EverGuard® TPO Quick Spray LV50 can be applied to walls without any height limitations. Supplemental fastening is not required. The wall flashing must be separate from the roof membrane. The roof membrane cannot extend continuously from the field of the roof up the wall. The roof membrane must be mechanically attached along the base of the wall(s) and the wall flashing must be mechanically attached at the top of the wall(s).

8. Metal cap flashings must have continuous cleats or be face-fastened 12" (305 mm) o.c. on both the inside and outside of the walls.

I. Round and Square Tube Penetrations

1. Four options are available for penetration flashings: stepped pipe boots; split pipe boots; square tube wraps; and field fabrication with unsupported membrane and target.

2. All flashings require the installation of a stainless steel draw band around the top of the flashing. Install EverGuard® Water-Block on the inside top of the flashing and add the draw band with FlexSeal™ Caulk Grade Sealant around the top of the flashing.

3. Roof membrane must be mechanically attached at the base of each penetration with fasteners and plates a maximum of 12" (305 mm) o.c., with a minimum of four fasteners per penetration.

J. Irregularly Shaped Penetrations

1. Metal Sealant Pans/Pre-formed TPO or PVC Accessories

   a. Flash irregularly shaped penetrations with flanged sealant pans formed of EverGuard® coated metal, secured to the deck through the roof membrane with fasteners 6" (152 mm) o.c., a minimum of two per side.

   b. Strip in metal flanges with 8" (203 mm) wide membrane-flashing strips and vertical pop riveted seams with 4" (102 mm) unsupported membrane.

   c. Surface should be clean, dry, and free of any loose materials. Remove all previously applied caulk, mastic, cement, and other contaminants from penetrations with a cleaner. All roof deck voids are to be filled with FlexSeal™ Sealant.

   d Prime all surfaces of pre-formed TPO accessories with EverGuard® TPO Primer. Primer not required when using PVC pre-formed accessories. Allow primer to dry prior to applying EverGuard® OnePart Pourable Sealant. Fill the EverGuard® Pourable Sealer Pocket with EverGuard® One-Part Pourable Sealant to the top of the pocket, ensuring that all voids are filled.

   e. Installation of pre-formed PVC sealant pans requires the flange of the PVC sealant pan to be fastened with a minimum of 4 fasteners per penetration. A PVC membrane target is installed around the base of the sealant pan over the flanges of the PVC sealant pan and heat welded to the flanges. Install the fasteners near the outside edge of the flanges to allow for proper heat welding of the target. The outside edge of the target membrane is heat welded to the field membrane.

   f. Installation of pre-formed TPO sealant pans requires field membrane securement around the penetration. A minimum of four (4) system-appropriate fasteners and plates are required around the penetration. A membrane target must be installed prior to the installation of the TPO sealant pan if the location of the plates does not allow for a continuous 2" (51 mm) weld of the TPO sealant pan flange. Properly heat weld the flange of TPO sealant pan to the field/target membrane.

   g. If the sealant pan is cut to install around the penetration, the cut must be stripped in with a minimum 4" (102 mm) wide non-reinforced membrane. The non-reinforced strip-in membrane must extend a minimum of 2" (51 mm) beyond the outside edge of the sealant pan flange and be fully welded.

   h. EverGuard® TPO reinforced targets may be sealed with EverGuard® TPO Cut Edge Sealant.

2. MajorSeal™ Liquid Flashing is only to be used when MajorSeal™ TPO flashing accessories and standard details cannot be used. You must contact your GAF Field Services Area Manager to assess suitability prior to use.

a. MajorSeal™ Liquid Flashing is not suitable for areas around drains or scuppers, or areas that pond water.

b. MajorSeal™ Liquid Flashing is eligible for a 20-year maximum guarantee and is not eligible for extended-length guarantee coverage.

c. MajorSeal™ Liquid Flashing cannot be used with PVC.

K. Curbs

1. Flashing can be done two different ways, either with adhesive applied to the membrane and substrate, or loose-applied up to 30" (762 mm) high.

2. Secure membrane flashing at the top edge with a termination bar, flat stock, or counter flashing. Apply FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block between the curb surface and membrane flashing. Exposed termination bars must be mechanically fastened 6" (152 mm) o.c.; termination bars that are counter flashed must be fastened 12" (305 mm) o.c. If wood is present at the top of the curb, install ring shank nails 12" (305 mm) o.c. after wrapping the membrane to the inside of the curb. This can be used in lieu of the termination bar if nailed on the top or preferably, the inside of the curb.

3. The roofing membrane must be mechanically attached along the base of curbs and ducts that are flashed with membrane flashing with fasteners and plates/termination bar at 12" (305 mm) o.c. and then covered with the base flashing.

4. Metal counter flashing must be used for extended guarantee lengths. All termination bars must be sealed with FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block.

L. Expansion Joints

1. Install expansion joint covers at all flat type and raised curb-type expansion joints. There are currently three types of expansion joints approved for EverGuard® Systems. There are two prefabricated expansion joints, one for TPO and one for PVC. TPO and PVC can also be field fabricated to meet expansion joint needs.

2. The roofing membrane must be mechanically attached along the base of raised curb expansion joints with fasteners and plates a minimum of 12" (305 mm) o.c.

3. Expansion joint bellows must be twice the width of the expansion joint opening to allow for proper expansion/contraction.

4. Metal fastening strip on prefabricated expansion joints must be set in FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block and secured with EverGuard® Drill-Tec™ fasteners and neoprene washers fastened 6" (152 mm) o.c.

M. Roof Drains

1. Roof drains must be fitted with compression clamping rings and strainer baskets. Both traditional cast iron and aluminum drains, as well as retrofit-type cast aluminum and molded plastic drains, are acceptable.

2. Roof drains must be provided with a min. 36" x 36" (914 mm x 914 mm) sumped area if possible. Slope of tapered insulation within the sumped area must not exceed 4:12.

3. Extend the roofing membrane over the drain opening. Locate the drain and cut a hole in the roofing membrane directly over the drain opening. Provide a 1/2" (13 mm) membrane flap extending past the drain flange into the drain opening. Punch holes through the roofing membrane at drain bolt locations.

4. For cast iron and aluminum drains, the roofing membrane must be set in a full bed of FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block on the drain flange prior to securing with the compression clamping ring.

5. For fleece-back roof membrane applications, the fleece-back membrane is cut just short of the drain flange. A separate smooth reinforced membrane drain flashing sheet is heat welded to the roofing membrane and set into the drain above in a full bed of FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block and secured as above. EverGuard® TPO Cut Edge Sealant should be used on TPO drain targets.

6. Do NOT locate lap seams within the sump area. Where lap seams must be located within the sump area, a separate smooth reinforced membrane drain flashing a minimum of 9" (229 mm) larger than the sump area must be installed. The membrane flashing must be heat welded to the roof membrane. Alternatively, if the seam does not run under the clamping ring, it can be covered with a 6" (152 mm) wide reinforced membrane strip heat welded to the membrane.

7. Tighten the drain compression clamping ring in place.

8. All drains must be provided with a strainer basket.

9. Roof drains must be open and functioning.

N. Retrofit Drain Inserts

1. Drain inserts must only be used in the event the original drain is damaged and cannot be repaired without complete replacement of the drain. Drain inserts will reduce water flow. Consult the design professional to ensure adequate drainage is maintained.

2. Clean the drain lines a minimum of 24" (610 mm) where the drain insert is to be installed. Failure to clear this section of drain line can prevent the sealing of the drain and degrade the performance of the drain seal.

3. All drains must be provided with a drain sump of 36" (914 mm) x 36" (914 mm) minimum dimension, if possible. Fasteners must be installed 12" (305 mm) o.c. or a minimum of 4 per penetration.

4. The drain insert is installed on top of the roofing membrane and is secured to the roof deck with Drill-Tec™ fasteners with a minimum of 4 fasteners per penetration.

5. A separate reinforced membrane drain flashing sheet is heat welded to the roofing membrane. The drain flashing sheet is heat welded to a compatible drain flange.

6. Install the drain clamping ring if applicable.

7. All drains must be provided with a strainer basket.

8. Roof drains must be open and functioning.

O. Scuppers

1. EverGuard® coated metal roof edge scuppers must be provided with a min. 4" (102 mm) wide flange nailed to wood nailers, with hemmed edges and secured with continuous clips in accordance with the gravel stop assembly.

2. EverGuard® coated metal wall scuppers must be provided with 4" (102 mm) wide flanges, with additional corner pieces pop-riveted to the flanges to create a continuous flange. All flange corners must be rounded.

3. Install wall scuppers over the roof and flashing membrane and secure to the roof deck/wall with Drill-Tec™ fasteners 6" (152 mm) o.c., a minimum of 2 fasteners per side.

4. All corners must be reinforced with EverGuard® PVC or EverGuard® TPO Universal Corners or field fabricated from EverGuard® non-reinforced materials.

5. Strip in scupper with flashing membrane target sheet.

6. Alternatively, a wall scupper box may be field flashed using non-reinforced flashing membrane heat welded to membrane on the wall face and roof deck. Be sure that all corners are reinforced with universal corners or non-reinforced EverGuard® material. Fully adhere to the scupper box and terminate on the outside wall face with a termination bar and FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block.

7. EverGuard® TPO has prefabricated scuppers in standard and custom sizes available. Consult your Territory Manager or local distributor for details.

8. Scuppers may be set in a bed of FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block for additional resistance to movement.

P. Heater Stacks

1. The temperature of any heater stack that comes into contact with the EverGuard® membrane or flashing should not exceed 160°F (71°C) for EverGuard® TPO membrane, 190°F (88°C) for Everguard Extreme® TPO or 140°F (60 °C) for EverGuard® PVC membrane.

2. Field-fabricated two-piece membrane flashings of EverGuard® non-reinforced flashing are typically installed at heater stacks. EverGuard® TPO and PVC have cone-type prefabricated pipe flashing that may work in these applications.

3. Heat stacks must be equipped with either cone-shaped or vertical tube-type flashing sleeves so that the membrane flashing is not directly in contact with the heater stack.

4. Mechanically attach the roof membrane to the structural deck with Drill-Tec™ fasteners and plates around the penetration base prior to flashing installation. Minimum of 4 fasteners per penetration.

5. All stack flashings must be secured at their top edge by a stainless-steel clamping band over FlexSeal™ Caulk Grade Sealant or EverGuard® Water-Block. Seal the detail with FlexSeal™ Caulk Grade Sealant.

6. Field-fabricated membrane flashings may be adhered to the flashing sleeve with EverGuard® adhesives. Be sure to use the correct bonding adhesive with the membrane being installed.

Q. Wood Support Blocking

1. Wood support blocking, typically 4" (102 mm) x 4" (102 mm), is usually installed under light-duty or temporary roof-mounted equipment, such as electrical conduit, gas lines, and condensation and drain lines.

2. Install wood support blocking over a protective layer of EverGuard® TPO walkway rolls or PVC walkway pads. Set wood blocking in FlexSeal™ Caulk Grade Sealant.

3. If using pre-fabricated pipe stands with rubber-like bases, no slip sheet is required on TPO membranes. Do not use on PVC membranes.

R. Satellite Dish Support Bases

1. Install non-penetrating satellite dish support bases over a protective layer of TPO/PVC membrane.

S. Lightning Suppression

1. Secure lightning suppression cable to the roof surface by means of 2" (51 mm) wide EverGuard® PVC or EverGuard® TPO Flashing membrane strips heat-welded to the roof membrane.

2. Secure lightning rod to reinforced EverGuard® membrane patch that is heat welded in place. Securement should not penetrate the roof membrane.

3.12 Traffic Protection

A. Walkway rolls or pads should be installed at all roof access locations, including ladders, hatchways, stairs, and doors. Install walkway rolls or pads at other designated locations, including roof-mounted equipment work locations and areas of repeated rooftop traffic.

B. Walkway rolls or pads must be spaced 6" (152 mm) to allow for drainage. Edges of walkway rolls or pads must be placed 6" (152 mm) from any seam.

C. Heat-weld walkway rolls or pads to the roof membrane surface continuously around the walkway roll or pad perimeter.

3.13 Temporary Closures

A. The roofing installation must be made watertight at the end of each day's activity to prevent water infiltration into the completed roofing system installation.

B. Complete all flashings and terminations as the roofing installation progresses.

C. At the edge of the completed roofing system installation, extend

the roofing membrane a minimum of 6" (152 mm) beyond the edge. Seal the roofing membrane to the surrounding deck or substrate surface with foam sealant, hot asphalt, or other temporary waterproofing measure.

D. Remove all temporary night seal materials prior to continuing with the roof installation and dispose of properly.

3.14 Field Quality Control

A. Field quality control should be performed in accordance with NRCA's Quality Control and Quality-assurance Guidelines for the Application of Membrane Roof Systems.

B. Inspect completed roof sections on a daily basis. It is the contractor's responsibility to probe all heat-welded seams and perform an adequate number of seam cuts to ascertain seam consistency.

C. Immediately correct all defects, irregularities, and deficiencies identified during inspections. All voids that are found must be patched over per specifications. Do NOT re-weld seam voids more than 24 hours after initial welding of the seam.

D. Remedial work must be performed with like materials and in a manner consistent with the balance of the roofing installation so as to minimize the number of repair patches.

3.15 Clean-Up

A. In areas of the roof where bonding adhesive, bituminous markings and other contaminants from finished surfaces can not be removed by standard GAF cleaning procedures, repairs may be necessary.

B. To repair a contaminated area, cut out and remove any sheet membrane where contaminants cannot be removed.

C. Repair sheet damage by cleaning the area with an all-purpose-Cleaner and then rinse off soapy residue.

D. Reactivate the membrane using EverGuard® TPO Seam Cleaneror EverGuard® CleanWeld™ Conditioner for TPO membrane and PVC Cleaner, MEK or Acetone for PVC membrane. Refer to Section 3.10 J.

E. Complete the repair by installing a patch of like material to specific system requirements

3.16 Maintenance

A. Upon completion of the roofing system, the owner should establish a semi-yearly inspection and maintenance program in accordance with standard good roofing practice and guarantee requirements.

B. Repair of any damage or defect should follow GAF recommendations. For further information, contact GAF.

APPENDIX A

ADHESION TEST GUIDELINES

PURPOSE

- Testing is required to ensure foam adhesive will bond to a given substrate.
- GAF requires roofing contractors (or a qualified third party) to conduct an adhesion test prior to registering a GAF Diamond Pledge™ NDL Roof Guarantee.

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.
- GAF recommends that contractors keep test results on file, to be submitted to GAF upon request. Submission of results to GAF is not required in the ordinary course; however, GAF 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 a GAF Diamond Pledge™ NDL Roof Guarantee.
- GAF may, at its sole discretion, require additional testing prior to the job start or prior to issuance of a GAF Diamond Pledge™ NDL Roof Guarantee in accordance with ANSI/SPRI IA-1 2015 Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates.

PROCEDURES

ACCEPTABLE ADHESION TEST METHODS ARE OUTLINED BELOW:

1. GAF Preferred Test Method: "Shovel Test" Materials:
   - GAF approved insulation adhesive(s)
   - Square edge shovel or similar
   - Minimum 12" x 12" (305 mm x 305 mm) piece(s) of minimum 1 ½" (38 mm) EnergyGuard™ polyiso roof insulation or minimum 15/32" (25 mm) plywood

Frequency:

- Minimum of 4 tests for the first 50,000 square feet [500 sqs.] (4,650 square meters) of roof surface area.
- 2 additional tests for each additional 50,000 [500 sqs.] square feet (4,650 square meters) of roof surface area.
- 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 GAF or other GAF approved manufacturer's requirements.
- Place a minimum 12" x 12" (305 mm x 305 mm) 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 or 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, GAF 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, foam adhesive should not be used to bond the new roof to this substrate.
- When testing adhesion to a deck, if the failure occurs in the deck, the deck is not suitable for using foam adhesive to bond the roof to the deck.

Record mode of failure and place in project file.

- Photographs
- Date, time & air temperature

OTHER ACCEPTABLE TEST METHODS:

2. ANSI/SPRI IA-1 2015 Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates.

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