1. SECTION 075423
Thermoplastic-Polyolefin ROOFING (TPO) - GAF

Cold storage projects require careful coordination and attention to detailing, specifications, and workmanship. Incorrect design and poor installation can cause air leakage, resulting in frost and ice formation at the interior of the building and within the roof assembly, energy loss, and expensive repairs. A continuous and uninterrupted air/vapor seal is required at the roof perimeter, at dividing walls where there are interior spaces of differing temperature, and at penetrations to prevent warm, humid air from infiltrating the roof assembly.

Specification language, selection options and specifier notes that assist the specifier in selecting cold storage design requirements have been highlighted in cyan. Contact GAF Design Services (designservices@gaf.com) for additional information and assistance.

This specification is provided as a general guide for use of GAF products based on typical building conditions and standard roofing practices. This guide specification is not a substitute for professional design services. The information in this guide specification must be reviewed and approved by a design professional and modified as necessary and appropriate for each project. Each project has unique requirements, and GAF recommends that the Owner's representative independently verify the accuracy and appropriateness of the specification provided for a particular project. Each selection or deletion made to this guide specification should be carefully considered. Users of this guide specification assume sole responsibility for its use. Always check [www.gaf.com](http://www.gaf.com) for updates before using guide specifications to ensure you are working with the current version.

To view non-printing specifier notes, turn on Hidden Text display option. Additional information may be accessed on the GAF website at [www.gaf.com](http://www.gaf.com) or one of the following websites:

**Build Your Roof:** Assemble your own commercial roof. You can’t get it wrong! Prompts and layer information help you choose attachments and adhesives that suit your selected layers. Get relevant product documents and connect with a regional design specialist. <https://www.gaf.com/en-us/for-pros/commercial-build-your-roof>

**Sustainability Content in UL SPOT:**

[<click to view products with UL Environment certifications>](https://spot.ul.com/main-app/products/catalog/?keywords=GAF)

**Product Transparency Content in the Sustainable Minds Transparency Catalog:**

[< click to view products with environmental product declarations (EPDs) and material ingredient disclosures>](https://www.transparencycatalog.com/company/gaf)

**HPD Content on HPD Public Repository:**

[< click to view product health product declarations (HPDs) on HPD Public Repository>](https://hpdrepository.hpd-collaborative.org/Pages/Results.aspx#k=GAF)

**Sustainability Content in Ecomedes:**

[<click to view products on Ecomedes>](https://gaf.ecomedes.com/)

**BIM Content on BIMsmith Market:**

[<click to view products on BIMsmith Market>](https://market.bimsmith.com/GAF?regionId=93)

* 1. PART 1  GENERAL
		1. SECTION INCLUDES
			1. TPO roofing membrane for [**new construction**] [**tear-off**] [**recover**] [**partial tear-off**] <**Insert requirement**> cold storage applications.
			2. Cover boards.
			3. Insulation.
			4. Vapor retarder.
			5. Deck sheathing.
			6. Roof pavers.
		2. RELATED REQUIREMENTS
			1. Section 013329 - Sustainability Design Reporting.
			2. Section 061000 - Rough Carpentry:  Wood nailers, curbs, and blocking.
			3. Section 075563 – Vegetative Roofing.
			4. Section ​ 077100 - Roof Specialties​:  Manufactured copings, fascias, gravel stops, and other flashing-related items.
			5. Section ​ 077600 - Roof Pavers​:  Roof mounted pavers and pedestals.
		3. REFERENCE STANDARDS
			1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
			2. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
			3. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
			4. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.
			5. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
			6. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
			7. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel.
			8. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
			9. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
			10. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing.
			11. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.
			12. ASTM D7877 - Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes.
			13. ASTM D8231 - Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes.
			14. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
			15. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
			16. ASTM E1186 – Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
			17. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
			18. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials.
			19. FM (AG) - FM Approval Guide.
			20. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.
			21. FM 4474 - American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures.
			22. FM DS 1-28 - Wind Design.
			23. NRCA (RM) - The NRCA Roofing Manual.
			24. NRCA (WM) - The NRCA Waterproofing Manual.
			25. UL (DIR) – Online Certifications Directory.
			26. UL (FRD) - Fire Resistance Directory.
			27. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.
			28. UL 1897 - Uplift Tests for Roof-Covering Systems; Underwriters Laboratories Inc.
		4. ADMINISTRATIVE REQUIREMENTS
			1. Preinstallation Meeting:  Convene one week before starting work of this section.
				1. Attendees:  Owner, Contractor, Architect, Installer, roofing manufacturer's technical representative, and installers whose work interfaces with or affects the work of this section.
				2. Review project requirements, including the following:

Preparation and acceptance of substrates.

Sequencing and coordination between trades and acceptance of substrates for roofing installation.

Approved materials, details and sequencing for transitions, tie-ins, flashings, drainage, penetrations, and curbs.

Protection of installed materials.

Repair procedures.

* + 1. SUBMITTALS
			1. See Section 013000 - Administrative Requirements for submittal procedures.
			2. Product Data:  Provide data for roofing system materials, components, and accessories.
			3. Shop Drawings:  Include roof plans and details showing terminations, flashings, penetrations, attachment methods, tie-ins, and interface with adjacent work.
				1. Indicate insulation thicknesses and slopes.
				2. Include project-specific tapered insulation layout prepared by roofing manufacturer.
				3. Roof plan indicating orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
			4. Samples for Verification:  Submit [**two**] <**Insert number**> samples [**6 by 6**] inches([**150 by 150**] mm) in size of [**roof membrane**] [**insulation**] [**and**] <**Insert requirement**>.
			5. Samples of Pavers:  Submit **[two]** <**Insert number**> units.
			6. Manufacturer's Letter:  Certify products meet or exceed specified requirements.
			7. Wind Uplift Resistance Submittal:  Indicate compliance with wind uplift performance requirements.

Retain testing if Architect should receive a copy of field testing defined in Part 3, Field Quality Control. The results of weld tests are typically required by the manufacturer but are not always required to be sent to the Architect.

* + - 1. Field Quality Control Submittals:  Field[ **testing and**] inspection reports.
			2. Manufacturer's qualification statement.
			3. Installer's qualification statement.
			4. Testing firm's qualification statement.

Edit sustainable design submittals list below to conform with applicable sustainability program requirements.

* + - 1. Sustainable Design Information:
				1. Environmental product declaration (EPD) documentation.
				2. Health product declaration (HPD) documentation.
				3. Test report showing solar reflectance index (SRI) of membrane.
				4. Recycled content certificates.
				5. VOC content of adhesives, sealants, and coatings.
				6. Materials transparency documentation.
			2. Specimen Warranty[ **or Guarantee**]: For approval.
			3. Executed Warranty[ **or Guarantee**].
		1. QUALITY ASSURANCE
			1. Manufacturer Qualifications:  Company specializing in manufacturing products specified in this section with minimum five years of documented experience[ **and listed in FM Approvals RoofNAV for specified roofing system**].
			2. Installer Qualifications:  Company specializing in performing work of this section with at least three years of documented experience and approved by manufacturer for specified warranty.
			3. Testing Firm Qualifications:  Company specializing in performing work of the type specified and approved by manufacturer.
		2. DELIVERY, STORAGE, AND HANDLING
			1. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.
			2. Deliver materials in manufacturer's original containers, dry and undamaged, with seals unbroken and labels intact, unless otherwise indicated.
			3. Store materials in weather protected environment, clear of ground and moisture, and within temperature range required by manufacturer.
			4. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
			5. Protect liquids and foam insulation from direct exposure to sunlight.
		3. FIELD CONDITIONS

Contact GAF Design Services (designservices@gaf.com) for additional information on special applications, such as high humidity, solar PV systems, and other applications.

* + - 1. Contact roofing manufacturer to confirm acceptable assemblies for special applications. Conform with manufacturer's instructions.
			2. Do not apply roofing membrane during unsuitable weather.

Contact GAF Design Services (designservices@gaf.com) for information on adhesives when roofing system installation occurs in conditions between 20 degrees F and 40 degrees F.

* + - 1. Do not apply roofing materials when ambient temperature is below [**40 degrees F (5 degrees C)**] <**Insert temperature**> unless otherwise permitted by manufacturer in writing.
			2. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
			3. Do not expose materials vulnerable to water or sun damage in quantities greater than can be covered the same day.
			4. Schedule applications so no partially completed sections of roof are left exposed at end of workday.
		1. WARRANTY[ or guarantee]
			1. See Section 017800 - Closeout Submittals for additional warranty[ **or guarantee**] requirements.

Select one of three warranty or guarantee options below.

* + - 1. Material Warranty:  Provide membrane manufacturer's limited warranty agreeing to replace material that leaks due to manufacturing defects within [**15**] [**20**] [**25**] [**30**] years.
				1. Warranty: GAF Limited Warranty on GAF Single-Ply Roofing Materials.
			2. Enhanced Material Warranty: Provide membrane manufacturer’s limited warranty agreeing to replace material that leaks due to manufacturing defects and cost of labor to correct leaks within [**15**] [**20**] [**25**] [**30**] years.
				1. Warranty: GAF Integrated System Limited Warranty.

Cold storage systems must be installed by a GAF GoldElite*™* or PlatinumElite*™* contractor. Select coverage options below as applicable to project.

* + - 1. System Guarantee:  Provide manufacturer's system guarantee.
				1. Guarantee: GAF EverGuard™ Diamond Pledge NDL Roof Guarantee.
				2. Term:  [**15**] [**20**] years.
				3. Liability Limit: No dollar limit on covered repairs.
				4. Scope of Coverage:

Repair of covered leaks resulting from manufacturing defects, ordinary wear and tear, or workmanship in applying the covering materials, subject to certain exclusions.

Standard wind speed limitation is maximum of 55 mph (88 km/hr). For higher wind specified wind speeds, manufacturer needs to evaluate eligibility. Contact GAF for more information.

Leaks due to winds up to [**55 mph (88 km/hr)**] [**72 mph (116 km/hr)**] [**80 mph (129 km/hr)**] [**90 mph (145 km/hr)**] [**100 mph (160 km/hr)**] <**Insert value**>, excluding hurricanes and tornados.

Hail coverage is not included in standard coverage and only applies to eligible systems as determined by manufacturer. Additional materials and requirements may apply. Contact GAF for more information.

Hail up to [**2 inches (50 mm)**] <**Insert number**> in diameter.

With regular inspections and maintenance program, the original owner may be eligible for a roof extension up to 25 percent of the original specified term. Contact GAF for more information and sample maintenance contract.

Provide GAF Well Roof Extension for a term up to 25 percent of the original guarantee duration (up to maximum duration of 25 years) when roofing system is inspected and maintained in accordance with manufacturer’s terms and conditions.

Retain paragraph below to extend the installer’s correction period beyond one year.

* + - 1. Extended Correction Period: Correct defective work within [**2-year**] [**3-year**] [**5-year**] period commencing on date of Substantial Completion.

Retain paragraph below for projects requiring tie-ins and alterations to existing roofing where new and existing materials are manufactured by GAF. Delete for new construction.

* + - 1. Existing Roofing Alterations: Submit statement from existing roof membrane manufacturer that existing roof warranty has not been affected by work performed under this section.
	1. PART 2 PRODUCTS
		1. MANUFACTURERS
			1. Basis of Design:
				1. GAF; 1 Campus Drive; Parsippany, NJ 07054; Toll Free Tel: 877-423-7663; Email: designservices@gaf.com:  www.gaf.com.

Alternate manufacturers for EverGuard™ Extreme are limited. It is recommended to list approved alternate products by name or close spec to selected products. Contact GAF Design Services (designservices@gaf.com) for additional information.

* + - * 1. Substitutions: ​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​.
			1. Source Limitations:  Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
		1. ROOFING SYSTEM
			1. Roofing System Description:  Listed from top of roof down.
				1. Single Ply Membrane: ​​[**Adhered**] [**Mechanically attached**] [**Induction welded**] [**Self-adhering**]​​.
				2. Cover Board:  [**Glass-mat faced gypsum board**] [**Fiber-reinforced gypsum board**] [**Coated wood fiberboard**] [**High density polyisocyanurate board**]; [**mechanically fastened**] [**loose-laid, no attachment**] [**adhered**] [**asphalt attached**].

Higher insulation R-values are typically required for cold storage projects. Refer to minimum code requirements and ASHRAE Handbook – Refrigeration. Contact GAF Design Services (designservices@gaf.com) for additional information.

* + - * 1. Insulation:  Minimum two layers, having maximum board thickness of [**1.5 inches (38 mm)**] [**2 inches (50 mm)**] [**2.5 inches (63 mm)**] [**3 inches (75 mm)**] <**Insert thickness**>.

Total System R-value (RSI-value)​:  Minimum R-<**Insert number**> [**value as indicated in drawings**].

Slope:  Provide minimum slope of [**1/16 inch per foot (1:192)**] [**1/8 inch per foot (1:96)**] [**3/16 inch per foot (1:72)**] [**1/4 inch per foot (1:48)**] [**3/8 inch per foot (1:36)**] [**1/2 inch per foot (1:24)**] <**Insert slope**> by means of tapered insulation.

Adhering the top layer of insulation reduces thermal bridging of insulation fasteners, if any, and increases the effective R-value for the assembly.

Top Layers:  Polyisocyanurate foam board; [**loose-laid, no attachment**] [**mechanically fastened**] [**adhered**] [**asphalt attached**].

Minimum Thickness: 2 inches (50 mm).

Bottom Layer:  Polyisocyanurate foam board; [**loose-laid, no attachment**] [**mechanically fastened**] [**adhered**] [**asphalt attached**].

Crickets:  Tapered insulation; minimum slope of [**1/16 inch per foot (1:192)**] [**1/8 inch per foot (1:96)**] [**3/16 inch per foot (1:72)**] [**1/4 inch per foot (1:48)**] [**3/8 inch per foot (1:36)**] [**1/2 inch per foot (1:24)**] <**Insert slope**> unless otherwise indicated in drawings.

* + - * 1. Vapor Retarder:  [**Self-adhering membrane**].
				2. Deck Sheathing: [**Glass-mat faced gypsum board**] [**Fiber-reinforced gypsum board**]; mechanically fastened.
			1. Performance Requirements:
				1. General:  Roofing system to withstand specified uplift pressures, thermally induced movement, and exposure to ordinary weather conditions.
				2. Material Compatibility:  Provide roofing materials and accessories compatible with one another under conditions of service and application, as demonstrated by roof membrane manufacturer based on testing and field experience.
				3. Wind Uplift Resistance:  Design to withstand wind uplift forces in accordance with applicable local building code requirements as demonstrated by roofing manufacturer’s independent testing.

Roofing System: Tested in accordance with FM 4474, UL 580, or UL 1897.

Design Pressures:  **​[As indicated in Structural Drawings**] [**As follows**].

Zone 1’ (Center Roof Area Field):  <**Insert**> lbf/sq. ft. (<**Insert**> kPa/sq m).

Zone 1 (Roof Area Field):  <**Insert**> lbf/sq. ft. (<**Insert**> kPa/sq m).

Zone 2 (Roof Area Perimeter):  <**Insert**> lbf/sq. ft. (<**Insert**> kPa/sq m).

Location:  From roof edge to [**10 feet (3.05 mm)**] <**Insert distance**> inside roof edge.

Zone 3 (Roof Area Corners):  <**Insert**> lbf/sq. ft. (<**Insert**> kPa/sq m).

Location:  [**10 feet (3.05 mm)**] <**Insert distance**> in each direction from building corner.

Coordinate SRI value with project requirements and sustainability goals.  Consider the 3-year aged SRI values to evaluate actual service conditions throughout the life of the building versus new installation SRI values. Refer to manufacturer's literature for SRI values, which are based on membrane type and color.

* + - * 1. Solar Reflectance Index (SRI):  [**Three-year-aged** ]SRI not less than ​​[**64**] ​​[**78**] ​​[**82**] [**90**] <**Insert number**>​​​, when calculated in accordance with ASTM E1980.

Roof assembly fire rating is usually regulated by code, and it can also affect the Owner's insurance rates significantly.  In addition to including this statement, it is necessary to specify only those materials that will meet those classification requirements. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - * 1. Roof Covering External Fire Resistance Classification:  ​Class ​[**A**] [**B**] [**C**] when tested per ANSI/UL 790.

Retain FM Classification paragraph if project is FM Global Insured or if project is to be designed per FM Global requirements. FM Approvals RoofNav does not include listings for cementitious wood fiber, wood, or wood panel decks. Consult FM Approvals with any questions. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - * 1. Factory Mutual Classification:  Provide roofing system listed in FM Approvals RoofNav, and having membrane, base flashings, and component materials complying with FM Approval Standard 4470.

The paragraph below applies to metal deck assemblies only; and only to Factory Mutual required ratings. Visit  www.fmglobal.com for free information or to purchase a copy of this document.

Fire and Windstorm Classification:  Class 1A and windstorm resistance of [**1-60**] [**1-75**] [**1-90**] [**1-120**] <**Insert value**>, in accordance with FM DS 1-28.

Hail Resistance Rating:  FM Global Property Loss Prevention Data Sheet 1-34 [**MH**][**SH**] [**VSH**].

Coordinate requirements with applicable sustainability programs. For GAF’s sustainable credit and certification documentation, see links above to UL Spot, Sustainable Minds, HPD Public Repository, Ecomedes, and BIMsmith.

* + - 1. Sustainable Credit and Certification Reporting Requirements:
				1. LEED [**v4**] [**v4.1**] Performance Requirements: See Section [**013329- Sustainability Design Reporting**] <**Insert Section**>​.

Credit SSc5 - Heat Island Reduction: High-reflectance roofs with low-sloped roof less than or equal to 2:12 ratio shall have a minimum initial SRI value of 82 or 3-year aged SRI value of 64. High-reflectance roofs with steep-sloped roof greater than 2:12 ratio, shall have a minimum initial SRI value of 39 or a 3-year aged SRI value of 32.

Credit MRc2 - Environmental Product Declarations: Provide third-party verified Environmental Product Declaration (EPD) documentation, complying with ISO 14044 and either ISO 14025 and EN 15804 or ISO 21930.

Credit MRc3 - Sourcing of Raw Materials: For products having raw material sourcing information, including recycled content or local sourcing to site, provide self-reported or third-party verified documentation.

Recycled Content: Third party verified postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert value**> percent.

Credit MRc4 - Material Ingredients: Provide roofing products with a publicly available material ingredient report that demonstrates chemical inventory to at least 1,000 ppm or 0.1%. Manufacturer and product name must be recognized as a participant.

Credit IEQc2 - Low-emitting Materials: Provide general emissions testing documentation for adhesive and sealants showing compliance with CDPH Standard Method v1.1-2010 or comply with the inherently nonemitting sources requirements.

* + - * 1. LEED v5 Performance Requirements: See Section [**013329- Sustainability Design Reporting**] <**Insert Section**>​.

Credit SSc4 - Heat Island Reduction: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index (SRI) requirements. For high-reflectance roof with low-sloped roof less than or equal to 2:12 ratio, shall have a minimum initial SRI value of 82 or 3-year aged SRI value of 64. For high-reflectance roofs with steep-sloped roof greater than 2:12 ratio, shall have a minimum initial SRI value of 39 or a 3-year aged SRI value of 32.

Prerequisite MRp2 - Assess Embodied Carbon: For roof membrane products provide the life cycle assessment or Environmental Product Declaration reporting for a cradle to gate scope, which includes modules A1-A3 at a minimum.

Credit MRc4 - Building Product Disclosure and Optimization: For permanently installed products, provide one of the following Multi-Attribute and Single-Attribute documentation.

Multi-Attribute Documentation:

Cradle to Cradle Bronze/Silver/Gold/Platinum.

BIFMA e3/level.

Living Product Challenge and Living Product Challenge with MHI.

Single-Attribute Documentation:

Product-Specific/ Optimized Environmental Product Declaration (EPD).

Health Product Declaration (HPD)- third party verified.

Optimized Health Product Declaration (HPD)- third party verified.

Declare- third party verified.

Product Lens.

Green Circle Closed Loop Certified.

TRUE Zero Waste Manufacturer.

Recycled Content- third party verified.

Credit MRc3 - Low-emitting Materials: Provide general emissions testing documentation for adhesive and sealants showing compliance with CDPH Standard Method v1.2-2017 or comply with the inherently nonemitting sources requirements.

* + - * 1. Well v2 Performance Requirements: See Section [**013329- Sustainability Design Reporting**] <**Insert Section**>​.

Credit X01: Comply with requirements surrounding the use of the below listed substances:

Asbestos.

Mercury.

Lead.

Credit X07: Provide one of the following certifications:

Declare Label.

Health Product Declaration (HPD).

Cradle-to-Cradle Certified.

Product Lens Certification.

Product Health Declaration.

BIFMA e3-2019 Scorecard.

* + - * 1. Living Building Challenge Performance Requirements: See Section [**013329- Sustainability Design Reporting**] <**Insert Section**>​.

Comply with requirements for Living Building Challenge compliance, including:

I12- Responsible Materials: Where applicable, provide a DECLARE label for the product. Where a DECLARE label does not exist, provide proof of correspondence with the manufacturer requesting disclosure of material ingredients.

I13- Red List: Provide product documentation that verifies the absence of Red List materials within the product.

I14- Responsible Sourcing.

I15- Living Economy Sourcing.

* + - * 1. Green Globes v1.4 Performance Requirements: See Section [**013329- Sustainability Design Reporting**] <**Insert Section**>​.

Credit Construction Impacts - Mitigating Heat Island Effect: High-reflectance roof with low-sloped roof less than or equal to 2:12 ratio shall have a minimum initial SRI value of 78 or 3-year aged SRI value of 60 or greater. High-reflectance roof with steep-sloped roof greater than 2:12 ratio shall have a minimum initial SRI value of 29 or aged SRI value of 25.

Credit Construction Impacts - Product Life Cycle: Provide third-party verified Environmental Product Declaration (EPD) documentation, complying with ISO 14044 and either ISO 14025 and EN 15804 or ISO 21930, and having a minimum scope of cradle-to-gate.

* + - * 1. IGCC 2021 / ASHRAE 189.1- 2020 Performance Requirements:

Product Recycled Content and Salvaged Material Content:

Recycled Content: Provide documentation showing the overall recycled content is equal or greater than 10% by cost of the product.

Regional Materials:

Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.

Multiple-attribute Product Declaration or Certification:

Environmental Product Declaration (EPD): Provide third-party verified Environmental Product Declaration (EPD) documentation, complying with ISO 14044 and either ISO 14025 and EN 15804 or ISO 21930, and having a minimum scope of cradle-to-gate.

* + - * 1. CAL Green Performance Requirements:

Provide thermal insulation product data that shows compliance with California Department of Public Health (CDPH), current adopted version.

Provide membrane adhesive product data demonstrating compliance with VOC limits.

Provide membrane sealant product data demonstrating compliance with VOC limits.

* + 1. MEMBRANE MATERIALS

**GAF EverGuard**™ **TPO** membrane provides proven performance for a great value and may be mechanically attached, adhered, or induction welded. **GAF EverGuard**™ **TPO Fleece-Back** membrane is an ideal option for new construction, tear-off, and re-cover applications where added puncture resistance is required. Fleece-backed membranes may be mechanically attached or adhered. **GAF EverGuard**™ **Extreme TPO** membrane, an enhanced weathering membrane, outperforms standard TPO in heat-aging and UV testing with high 3-year aged reflectance values that help reduce rooftop surface temperatures. Enhanced weathering membranes may be mechanically attached, adhered, or induction welded and also come as a fleece-back membrane. **GAF EverGuard**™ **SA TPO Self-Adhered** membrane is ready-to-install direct from the factory with a hot melt, pressure sensitive adhesive that may be installed at temperatures as low as 20 degrees Fahrenheit.

* + - 1. Membrane:
				1. TPO Membrane:  Thermoplastic polyolefin sheet complying with ASTM D6878/D6878M with internally reinforced scrim.

Smooth Membrane:  [**45 mil, 0.045 inch (1.1 mm)**] [**60 mil, 0.060 inch (1.5 mm)**] [**80 mil, 0.080 inch (2.0 mm)**] [**nominal**] [**minimum**] TPO thickness.

Fleece-Back Membrane:  [**45 mil, 0.045 inch (1.1 mm)**] [**60 mil, 0.060 inch (1.5 mm)**] [**80 mil, 0.080 inch (2.0 mm)**] [**nominal**] [**minimum**] TPO thickness.

Thicker Fleece-Back Membrane:  [**45 mil, 0.045 inch (1.1 mm) TPO thickness with a thicker fleece backing (100)**] [**60 mil, 0.060 inch (1.5 mm) TPO thickness with a with a thicker fleece backing (115)**] [**80 mil, 0.080 inch (2.0 mm) TPO thickness with a with a thicker fleece backing (135)**], [**nominal**] [**minimum**].

Enhanced Weathering Smooth Membrane: [**50 mil, 0.050 inch (1.3 mm)**] [**60 mil, 0.060 inch (1.5 mm)**] [**70 mil, 0.070 inch (1.8 mm)**] [**80 mil, 0.080 inch (2.0 mm)**] [**nominal**] [**minimum**] TPO thickness.

Enhanced Weathering Fleece-Back Membrane:  [**50 mil, 0.050 inch (1.3 mm)**] [**60 mil, 0.060 inch (1.5 mm)**] [**70 mil, 0.070 inch (1.8 mm)**] [**80 mil, 0.080 inch (2.0 mm)**] [**nominal**] [**minimum**] TPO thickness.

Self-Adhered Membrane:  [**60 mil, 0.060 inch (1.5 mm)**] [**80 mil, 0.080 inch (2.0 mm)**] [**nominal**] [**minimum**] TPO thickness.

* + - * 1. Impact Resistance:  Membrane to resist impact damage when tested in accordance with the "Resistance to Foot Traffic Test" in FM 4470.

Retain section option below for higher hours of exposure for EverGuard™ Extreme membranes.

* + - * 1. Accelerated Weathering:  Roof to withstand [**2000**] [**3600**] hours of exposure when tested in accordance with ASTM G155.
				2. Color:  [**White**] [**Gray**] [**Tan**] <**Insert color**>.
				3. Products:

GAF EverGuard™ TPO Membrane​​: www.gaf.com.

GAF EverGuard™ TPO Fleece-Back Membrane​​​​: www.gaf.com.

GAF EverGuard™ Extreme TPO Membrane​​: www.gaf.com.

GAF EverGuard™ Extreme TPO Fleece-Back Membrane​​​: www.gaf.com.

GAF​ EverGuard™ SA TPO Self-Adhered Membrane​​: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

For adhered attachment, select one of four options below. Bonding adhesive, low rise foam, and quick spray bonding adhesives are low VOC.

* + - 1. Membrane Attachment:  [**Bonding adhesive**] [**Spray bonding adhesive**] [**Low rise foam**] [**Hot asphalt**] in accordance with roofing manufacturer’s requirements.

Delete subparagraph below if there are no VOC restrictions for membrane adhesives or edit per project requirements.

* + - * 1. VOC Content: [**Maximum 90 g/L**] <**Insert requirement**>.
			1. Membrane Fasteners:  Membrane manufacturer’s recommended[ **induction welded**] type.
			2. Flexible Flashing:  Manufacturer's standard TPO sheet flashing matching primary membrane in type and color, minimum 55 mil, 0.055 inch (1.4 mm) thickness.

Protection sheets may be required under paver and pedestal systems that do not have protection mats under each pedestal and where solar panels are installed. Confirm material, installation, and membrane thickness requirements with GAF. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - 1. Protection Sheet:  [**Loose-laid**] [**Adhered and welded**] TPO membrane, minimum [**45 mil, 0.045 inch (1.1 mm)**] [**60 mil, 0.060 inch (1.5 mm)**].

Retain first option in paragraph below to protect from sharp edges beneath lightweight interlocking concrete pavers. Retain second option in paragraph below for non-interlocking heavyweight concrete pavers. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - 1. Separation Mat: [**Loose-laid**] Non-woven, UV stabilized polyester mat, [**3 oz/yd**] [**6 oz/yd**].
		1. COVER BOARDS

Cover boards may be used over existing roof systems or for new installations over insulation. Install with adhesives or mechanical fasteners with plates according to manufacturer’s recommendations. High-density polyiso insulation cover boards contribute higher R-value to the roof assembly than roof cover boards made with wood fiber or gypsum.

* + - 1. Cover Board:  High-density polyisocyanurate (ISO) insulation board,[ **non-halogenated, TCPP-free,**] complying with ASTM C1289, and the following characteristics:
				1. Classification:  Type II, Class 4 - faced with coated glass-fiber-mat facers on both major surfaces of core foam.

Select Grade 1 for **EnergyGuard**™ **HD,** **HD-MA**, **NH HD**, **HD Barrier**, and **NH HD Barrier**. Select Grade 2 for **EnergyGuard**™ **HD Plus** and **NH HD Plus**.

* + - * 1. Compressive Strength:  [**Grade 1, 80 psi (Grade 1, 550 kPa)**] [**Grade 2, 110 psi (Grade 2, 758 kPa)**].
				2. Thickness:  1/2 inch (12.7 mm).
				3. Insulation Thermal Resistance, R-value (RSI-value):   2.5 (0.44), nominal.

**EnergyGuard**™ **NH** (non-halogenated and TCPP-free) cover boards can contribute towards sustainability certifications. **EnergyGuard**™ **Barrier** cover boards provide increased fire resistance and achieve ANSI UL790 roof rating over combustible wood decks without the use of a slip sheet. **EnergyGuard**™ **HD-MA** cover boards can only be used where roofing membranes are mechanically attached. **EnergyGuard**™ **HD Plus** cover boards have increased compressive strength.

* + - * 1. Products:

GAF EnergyGuard™ HD Polyiso Cover Board: www.gaf.com.

GAF EnergyGuard™ HD-MA Polyiso Cover Board: www.gaf.com.

GAF EnergyGuard™ NH HD Polyiso Cover Board: www.gaf.com.

GAF EnergyGuard™ HD Barrier Polyiso Cover Board:  www.gaf.com.

GAF EnergyGuard™ NH HD Barrier Polyiso Cover Board:  www.gaf.com.

GAF EnergyGuard™ HD Plus Polyiso Cover Board: www.gaf.com.

GAF EnergyGuard™ NH HD Plus Polyiso Cover Board: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Cover Board:  Glass-mat faced gypsum board complying with ASTM C1177/C1177M.
				1. Thickness:  [**Type X, 5/8 inch (15.9 mm)**] [**1/2 inch (12.7 mm)**] [**1/4 inch (6.4 mm)**].
				2. Surface Finish:  [**Factory Primed**] [**Unprimed**].
				3. Products:

Georgia-Pacific; DensDeck®:  www.buildgp.com.

Georgia-Pacific; DensDeck® Prime with EONIC™ Technology: www. buildgp.com.

Georgia-Pacific; DensDeck® StormX™ Prime: www. buildgp.com.

Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® Glass Mat Roof Board: www.goldbondbuilding.com.

Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® FA Glass Mat Roof Board: www.goldbondbuilding.com.

Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® FA VSH Glass Mat Roof Board: www.goldbondbuilding.com.

USG Corporation; Securock® Ultralight Glass-Mat Roof Board: www.usg.com.

USG Corporation; Securock® Ultralight Coated Glass-Mat Roof Board: www.usg.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Cover Board:  Fiber-reinforced gypsum board, ASTM C1278/C1278M.
				1. Thickness:  [**Type X, 5/8 inch (15.9 mm)**] [**1/2 inch (12.7 mm)**] [**3/8 inch (9.5 mm)**] [**1/4 inch (6.4 mm)**].
				2. Products:

USG Corporation; Securock® Gypsum-Fiber Roof Board: www.usg.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Adhesive Attachment:  [**Low rise foam**] [**Hot asphalt**] in accordance with roofing manufacturer’s requirements.
			2. Fasteners:  As recommended and approved by roofing manufacturer.
		1. INSULATION

ASTM C1289 defines minimum compressive strength, dimensional stability, flexural strength, tensile strength, water absorption, water vapor permeance, and thermal resistance for various thicknesses.

* + - 1. Polyisocyanurate (ISO) Board Insulation:  Rigid cellular foam,[ **non-halogenated, TCPP-free,**] complying with ASTM C1289.
				1. Classification:  Type II, [**Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam**] [**Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam**].

Retain paragraph below for mold growth resistance if Class 2 classification is selected above.

* + - * 1. Mold Growth Resistance: Passing ASTM D3273.

Retain paragraph below for non-halogenated products.

* + - * 1. Low Temperature Stability: Maintains R-value at 75 degrees F (21 degrees C) and 40 degrees F (5 degrees C) mean temperature when tested in accordance with ASTM C518.
				2. Compressive Strength:  [**Grade 2, 20 psi (138 kPa)**] [**Grade 3, 25 psi (172 kPa)**] minimum.
				3. Board Size:  [**48 by 96 inches (1220 by 2440 mm)**] [**48 by 48 inches (1220 by 1220 mm)**].
				4. Tapered Board:  Same type as primary roof insulation.

**GAF EnergyGuard**™ **Polyiso** is made of glass fiber-reinforced cellulosic felt facers bonded to a core of polyisocyanurate foam. **EnergyGuard**™ **Barrier Polyiso** may be used directly over a combustible deck to achieve ANSI UL 790 Class A fire rating requirements and consists of a coated glass-fiber mat facer laminated to a polyisocyanurate foam core. **EnergyGuard**™ **Ultra Polyiso** may be utilized for enhanced moisture and mold resistance and consists of a coated glass-fiber mat facer laminated to polyisocyanurate foam core. GAF also offers TCPP free, low-temperature-stable R-value, non-halogenated options for projects requiring sustainability credits or certifications, which is designated as “NH” polyiso.

* + - * 1. Products:

GAF; EnergyGuard™ Polyiso Insulation: www.gaf.com.

GAF; EnergyGuard™ Barrier Polyiso Insulation: www.gaf.com.

GAF​; EnergyGuard™ Ultra Polyiso Insulation: www.gaf.com.

GAF​; EnergyGuard™ NH Polyiso Insulation: www.gaf.com.

GAF; EnergyGuard™ NH Barrier Polyiso Insulation: www.gaf.com.

GAF; EnergyGuard™ NH Ultra Polyiso Insulation: www.gaf.com.

Substitutions:  [**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Composite Polyisocyanurate Insulation with High Density Polyisocyanurate Cover Board: High-density polyisocyanurate cover board with coated glass facers laminated to closed-cell polyisocyanurate foam, complying with ASTM C1289.
				1. Classification, Top Layer: Type IV, Class 4.
				2. Compressive Strength, Top Layer:  Grade 1, 80 psi (Grade 1, 550 kPa).
				3. Board Size:  [**48 by 96 inches (1220 by 2440 mm)**] [**48 by 48 inches (1220 by 1220 mm)**].
				4. Products:

GAF; EnergyGuard™ Ultra HD Composite Insulation: www.gaf.com.

Substitutions:  [**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Adhesive Attachment:  [**Low rise foam**] [**Hot asphalt**] in accordance with roofing manufacturer’s requirements.
			2. Fasteners:  Appropriate for purpose intended and approved by roofing manufacturer.

A mechanically fastened slip sheet is required when adhesive or hot asphalt is used as a means of attaching roof insulation. Verify with the manufacturer for other conditions requiring use of a slip sheet over wood, wood panel, or cementitious wood fiber decking.

* + - 1. Slip Sheet: Asphalt-impregnated, glass-fiber-mat base sheet, complying with ASTM D4601, Type II.
				1. Products:

GAF​​; [**GAFGLAS® #75 Base Sheet**] [**GAFGLAS® #80 Ultima Base Sheet**]​​: www.gaf.com.

Substitutions:  [**See Section 016000 - Product Requirements**] [**Not permitted**].

* + 1. VAPOR RETARDER

Verify, with the roof membrane manufacturer, if a vapor retarder is required over lightweight structural concrete roof decks, normal weight concrete roof decks, or under any other circumstances. A vapor retarder is recommended over new concrete roof decks, for high-humidity interior environments, and according to NRCA’s recommendations at the discretion of the design professional. Coordinate vapor retarder material and installation method with wind uplift requirements. Note that if the product is also required to function as an air barrier, loosely laid polyethylene does not qualify as an air barrier and detailing to connect the vapor retarder to the wall air barrier is required. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - 1. Self-Adhering Vapor Retarder Membrane:  Material approved by roof manufacturer complying with requirements of fire rating classification and compatible with adjacent materials.
				1. Water Vapor Permeance:  ​0.04 perm (2.5 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
				2. Water Penetration Resistance around Nails:  Pass, when tested in accordance with ASTM D1970/D1970M.

**GAF SA Vapor Retarder XL** is a self-adhered vapor retarder membrane with a nominal 30 mil thickness and can be used in a direct-to-metal deck application to achieve Class 1 fire rating without a separate thermal barrier. **GAF SA Vapor Retarder XL 40** is a self-adhered vapor retarder membrane with a nominal 40 mil thickness and should be installed over a thermal barrier. Use of a primer is not required for installation of GAF vapor retarders.

* + - * 1. Products:

GAF​; GAF SA Vapor Retarder XL: www.gaf.com.

GAF; GAF SA Vapor Retarder XL 40: www.gaf.com.

Substitutions:  [**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + 1. DECK SHEATHING

Deck sheathing is required on fluted metal deck unless board insulation is installed under the membrane. Deck sheathing may also be required in fire resistance rating applications and where continuous substrate is required to support a vapor retarder.

Select one of the deck sheathing options below. Glass-mat faced gypsum board generally offers better moisture resistance and is often considered the more suitable option due to its ability to withstand outdoor conditions and potential water exposure, while fiber-reinforced gypsum board might be better suited for applications requiring high impact resistance, depending on the specific fiber composition.

* + - 1. Deck Sheathing:  Glass-mat faced gypsum board complying with ASTM C1177/C1177M.
				1. Thickness:  [**Type X, 5/8 inch (15.9 mm)**] [**1/2 inch (12.7 mm)**] [**1/4 inch (6.4 mm)**].
				2. Surface Finish:  [**Factory Primed**] [**Unprimed**].
				3. Products:

Georgia-Pacific; DensDeck®:  www. buildgp.com.

Georgia-Pacific; DensDeck® Prime with EONIC™ Technology: www. buildgp.com.

Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® Glass Mat Roof Board: www.goldbondbuilding.com.

Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® FA Glass Mat Roof Board: www.goldbondbuilding.com.

USG Corporation; Securock® Ultralight Glass-Mat Roof Board: www.usg.com.

USG Corporation; Securock® Ultralight Coated Glass-Mat Roof Board: www.usg.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Deck Sheathing:  Fiber-reinforced gypsum board, ASTM C1278/C1278M.
				1. Thickness:  [**Type X, 5/8 inch (15.9 mm)**] [**1/2 inch (12.7 mm)**] [**3/8 inch (9.5 mm)**] [**1/4 inch (6.4 mm)**].
				2. Products:

USG Corporation; Securock® Gypsum-Fiber Roof Board: www.usg.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Fasteners:  As recommended by roofing manufacturer.
		1. ROOF PAVERS
			1. Pavers and Pedestals:  See Section 077600.
			2. Lightweight Interlocking Concrete Roof Pavers:
				1. Comply with local wind load resistance requirements of ASCE 7.
				2. Compressive Strength: [**2500 psi (17 MPa)**] [**5000 psi (34 MPa)**] minimum, when tested in accordance with ASTM C140/C140M.
				3. Size:  <**Insert size**>​, nominal.
				4. Weight: ​[**12 lb per sq ft (58 kg/sq m)**] <**Insert weight**>​, nominal.
				5. Color and Texture:  ​[**As selected by Architect**] [**As indicated on drawings**] <**Insert requirements**>​​.
			3. Heavyweight Precast Concrete Roof Pavers:  Extruded or Autoclaved concrete units.
				1. Comply with local wind load resistance requirements of ASCE 7.
				2. Compressive Strength: [**7500 psi (52 MPa)**] [**6500 psi (45 Mpa)**] minimum, when tested in accordance with ASTM C140/C140M.
				3. Water Absorption:  5 percent, maximum, when tested in accordance with ASTM C140/C140M.
				4. Freeze-Thaw Resistance:  Maximum 1 percent loss of dry weight, when tested in accordance with ASTM C67.
				5. Size:  [**23-7/8 by 23-7/8 inches (606 by 606 mm)**] <**Insert size**>​, nominal.
				6. Thickness:  [**2 inches (51 mm)**] <**Insert thickness**>​, nominal.
				7. Weight: ​[**25 lb per sq ft (122 kg/sq m)**] <**Insert weight**>​, nominal.
				8. Color and Texture:  ​[**As selected by Architect**] [**As indicated on drawings**] <**Insert requirements**>​​.
		2. vegetative roofing
			1. See Section 075563.
		3. ACCESSORIES
			1. Miscellaneous Accessories:  Provide pourable sealers, primers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

Verify with roofing manufacturer that conductive primer may be included in an approved roofing assembly.

* + - 1. Conductive Primer for Electronic Leak Detection (ELD):  Conductive medium which enables ELD testing of conventional roofing assemblies by providing required conductive substrate directly below roofing membrane.
				1. Apply primer directly under roofing membrane on nonconductive surface in accordance with manufacturer's requirements.
				2. Products:

Detec Systems; TruGround® Conductive Primer: www.detecsystems.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Asphalt-Coated, Glass-Fiber-Mat, Venting Base Sheet:  ASTM D4897/D4897M, Type II; nonperforated, asphalt-impregnated fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.
				1. Products:

GAF​​; GAFGLAS® Stratavent Nailable Venting Base Sheet​​: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Prefabricated Roofing Expansion Joint:  Type approved by roofing manufacturer. See Section 077100.
			2. Prefabricated Flashing Accessories: Same material as membrane in manufacturer's standard thicknesses, including:
				1. Inside corners, outside corners, universal corners, and fluted corners.
				2. Square tube wraps.
				3. Conical pipe boots and split pipe boots.
				4. Pourable sealer pockets.
				5. T-Joint cover patches.
			3. Spray Polyurethane Flashing Foam: Two-component, closed-cell, solvent-free, HFC-free, polyurethane foam spray, Class A when tested in accordance with ASTM E84.
				1. Products:

GAF​​; SPF Flashing Foam​​: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Wood Nailers, Curbs, and Blocking:  See Section 061000.
			2. Fasteners:  Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

Show locations of termination bars in drawings and details. Delete paragraph below if not required.

* + - 1. Termination Bars:  Manufacturer’s standard aluminum bars [**with integral caulk ledge**].
			2. Sealants: As recommended by membrane manufacturer for each application.

Refer to GAF Cold Storage details for air-sealing applications and products. Contact GAF Design Services (designservices@gaf.com) for assistance.

* + - 1. Detailing Sealant for Air Infiltration: Caulk-grade, solvent-based synthetic elastomeric sealant.
				1. Products:

GAF​​; FlexSeal™​​Caulk-Grade Sealant: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Thinners and Cleaners:  As recommended by adhesive manufacturer, compatible with membrane.
			2. Welded Flexible Walkways:  Heavy-duty, slip-resistant, textured TPO walkway roll, suitable for maintenance traffic and visually distinctive from roof membrane.
				1. Roll Width:   34 inches (860 mm).
				2. Surface Color:  [**Gray**] [**Yellow**].
				3. Products:

GAF EverGuard™ TPO Walkway Roll: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* + - 1. Loose-Laid Walkways: Heavy-duty, slip-resistant, cross-directional textured TPO walkway roll, suitable for maintenance traffic and visually distinctive from roof membrane.
				1. Roll Width: 36 inches (914 mm).
				2. Surface Color: [**Gray**] [**White**] [**Yellow**].
				3. Products:

GAF Crossgrip™ TPO: www.gaf.com.

Substitutions: ​​​​​​[**See Section 016000 - Product Requirements**] [**Not permitted**]​​​​​​.

* 1. PART 3  EXECUTION
		1. EXAMINATION
			1. Verify surfaces and site conditions are ready to receive work.
			2. Verify deck is supported and secure.
			3. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
			4. Verify deck surfaces are dry and free of moisture, snow or ice.
			5. Verify roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

Delete paragraph below if project is not a recover scope. Modify list of tests and reports as required.

* + - 1. Preinstallation Testing: For recover roofing installations, provide the following:
				1. Testing or confirmation of adequate existing roof drainage.
				2. Core cut.
				3. Roof deck fastener pullout testing.
				4. Bonded pull testing.
				5. Third-party, non-destructive moisture testing using [**infrared thermography**] [**or**] [**nuclear backscatter]** method.
			2. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

Retain applicable articles below for project deck conditions.

* + 1. PREPARATION - WOOD DECK
			1. Verify wood deck conforms with manufacturer's minimum requirements.
				1. Minimum Thickness: 15/32-inch (12 mm) for wood sheathing or nominal 1 x 4-inch (25 x 100-mm) for wood planks.
				2. Oriented Strand Board (OSB): Structural 1 rated.
				3. Wood Joist Spacing: Not exceeding 24 inches (609 mm) on center.
				4. Sheathing: Installed with all four sides bearing on and secured to joists and cross blocking. “H” clips are not acceptable.
			2. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.
			3. Confirm dry deck by moisture meter with [**12**] <**Insert number**>​ percent moisture maximum.
			4. Proceed with installation only after unsatisfactory conditions have been corrected.
		2. PREPARATION - CONCRETE DECK
			1. Cure concrete until specified compressive strength is achieved.
			2. Grout joints in precast concrete roof decks flush with top of concrete.
			3. Clean concrete of curing compounds that would impair adhesion of roofing components.
			4. Verify concrete is visibly dry and free of moisture.
			5. Fill surface honeycomb and variations with latex filler.
			6. Proceed with installation only after unsatisfactory conditions have been corrected.
		3. PREPARATION - METAL DECK
			1. Verify metal deck conforms with manufacturer's minimum requirements.
				1. Minimum Uncoated Thickness: 22 gauge (0.8) mm, grade 33/230 structural steel.
				2. Galvanized Coating: Minimum G90/Z275.
				3. Meeting the gauge and span requirements in the current Factory Mutual FM Approval Guide and installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
				4. Re-roofing Over Existing Metal Decks: Remove surface corrosion and repair severely corroded areas. Fasten loose or inadequately secured decking and replace defective decking.
			2. Verify surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100.

For Acoustical steel decking, ensure that the decking selected (including, but not necessarily limited to, gauge and profile) meets all requirements for the project, including any applicable third-party assembly listings discussed elsewhere herein. Contact GAF Design Services (designservices@gaf.com) for assistance. Delete paragraph below where acoustical steel decking is not required.

* + - 1. Acoustical Decking: Install sound-absorbing insulation strips in accordance with acoustical roof deck manufacturer's instructions.
			2. Cold Storage Metal Decking:
				1. Roof Perimeter: Fill first two decking flutes parallel with exterior wall with closed-cell spray foam. Fill decking flutes perpendicular to exterior wall with spray foam a minimum of 12 inches (300 mm) from face of wall.
				2. Penetrations: Fill decking flutes a minimum of 12 inches (300 mm) in diameter around penetrations.
				3. Environmental Separation Walls: At cold storage walls that separate interior spaces of differing temperatures, perform the following:

Fill decking flutes on both sides of wall with closed-cell spray foam for a minimum of 12 inches (300 mm) from face of wall at walls that protrude above the deck.

Fill decking flutes on both sides of wall with closed-cell spray foam for a minimum of 6 inches (150 mm) from centerline of wall at walls that terminate below the deck.

* + - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
		1. PREPARATION - CEMENTITIOUS WOOD-FIBER
			1. Verify damaged sections of cementitious wood-fiber decks have been repaired or replaced.
			2. Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch (3.2 mm) at top surface.
			3. Proceed with installation only after unsatisfactory conditions have been corrected.
		2. INSTALLATION, GENERAL
			1. Perform work in accordance with manufacturer's instructions[ **and FM Approvals RoofNav**]**.**
			2. Do not apply roofing components during cold or wet weather conditions outside of manufacturer’s approved conditions.
			3. Do not apply roofing membrane when ambient temperature is outside of manufacturer’s required temperature range.
			4. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
			5. Do not expose materials vulnerable to water or sun damage in quantities greater than can be covered the same day.
			6. Coordinate this work with installation of associated counterflashings installed by other sections as work of this section proceeds.
			7. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition[ **and to not void warranty or guarantee for existing roofing system**].

Retain paragraph when air barriers are part of Project. Drawing details should specifically illustrate transition between different air barrier components, as required by IECC codes.

* + - 1. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section [**072700 - Air Barriers**] <**Insert Section**>​.
			2. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
			3. Install night seal at end of each workday or when rain is forecast. Provide temporary seals to prevent water from entering completed sections of roofing system. Ensure stagger and offset of underlying insulation to prevent thermal breaks. Remove and discard temporary seals before beginning work on adjoining roofing.
		1. INSTALLATION - DECK SHEATHING
			1. Install deck sheathing with long joints in continuous straight lines and end joints staggered not less than 24 inches (610 mm) in adjacent rows.
			2. At metal decks, install deck sheathing at right angle to flutes of deck. Locate end joints over crests of steel roof deck.
			3. Install boards with edges loosely abutted together. Cut neatly around penetrations and projections.
			4. Mechanical Attachment:  Fasten deck sheathing to top flanges of steel deck in accordance with manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].
		2. INSTALLATION - VAPOR RETARDER
			1. Install vapor retarder to substrate in accordance with manufacturer's instructions.
			2. Self-Adhering Vapor Retarder Membrane:  Install self-adhering vapor retarder membrane in accordance with manufacturer’s instructions, side and end lapping each sheet 3 inches (75 mm) minimum and terminating a minimum 2 inches (50 mm) onto exterior walls. Seal laps by rolling with a weighted roller.
			3. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.
			4. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
		3. INSTALLATION - INSULATION
			1. Installation Over Metal Deck:  Attach insulation in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**]. Where insulation is installed directly over metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

Coordinate installation requirements with selections made in ROOFING SYSTEM article in Part 2.

* + - * 1. Base Layer:  Mechanically fasten base layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to metal decks.
				2. Base Layer:  Embed base layer of insulation into ribbons of insulation adhesive.
				3. Base Layer:  Loosely lay base layer of insulation units over substrate.
				4. Upper Layers:  Adhere upper layers of insulation using insulation adhesive.
				5. Upper Layers:  Set upper layers of insulation in solid mopping of hot roofing asphalt.
				6. Upper Layers:  Loosely lay upper layers of insulation units over substrate.
				7. Upper Layers:  Mechanically fasten upper layers of insulation using fasteners specifically designed and sized for fastening specified roof insulation to metal decks.
			1. Installation Over Wood and Wood Panel Decking:  Attach insulation in accordance with roofing manufacturer's instructions.

A mechanically fastened slip sheet is required when adhesive or hot asphalt is used as a means of attaching roof insulation. Verify with manufacturer for other conditions requiring use of a slip sheet over wood or wood panel decking.

* + - * 1. Slip Sheet: Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet wood decks.

Coordinate installation requirements with selections made in ROOFING SYSTEM article in Part 2.

* + - * 1. Base Layer:  Mechanically fasten base layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to wood decks.
				2. Base Layer:  Embed base layer of insulation into ribbons of insulation adhesive.
				3. Base Layer:  Loosely lay base layer of insulation units over substrate.
				4. Upper Layers:  Adhere upper layers of insulation using insulation adhesive.
				5. Upper Layers:  Loosely lay upper layers of insulation units over substrate.
				6. Upper Layers:  Mechanically fasten upper layers of insulation using fasteners specifically designed and sized for fastening specified roof insulation to wood decks.
			1. Installation over Concrete Decks:  Attach insulation in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].

Coordinate installation requirements with selections made in ROOFING SYSTEM article in Part 2.

* + - * 1. Base Layer:  Embed base layer of insulation into ribbons of insulation adhesive.
				2. Base Layer:  Set base layer of insulation in solid mopping of hot roofing asphalt.
				3. Base Layer:  Loosely lay base layer of insulation units over substrate.
				4. Upper Layers:  Adhere upper layers of insulation using insulation adhesive.
				5. Upper Layers:  Set upper layers of insulation in solid mopping of hot roofing asphalt.
				6. Upper Layers:  Loosely lay upper layers of insulation units over substrate.
			1. Installation Over Cementitious Wood Fiber Decks:  Attach insulation in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].

NRCA recommends a mechanically fastened slip sheet over cementitious wood-fiber roof decks. However, some roof membrane manufacturers allow insulation to be directly attached to the cementitious wood-fiber roof deck of not less than 2 inches (51 mm) in thickness with either mechanical fasteners or cold adhesive. The use of hot asphalt as a means of attaching roof insulation requires a slip sheet over cementitious wood-fiber roof decks.

* + - * 1. Slip Sheet: Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet wood fiber decks.

Coordinate installation requirements with selections made in ROOFING SYSTEM article in Part 2.

* + - * 1. Base Layer:  Embed base layer of insulation into ribbons of insulation adhesive.
				2. Base Layer:  Set base layer of insulation in solid mopping of hot roofing asphalt.
				3. Base Layer:  Loosely lay base layer of insulation units over substrate.
				4. Upper Layers:  Adhere upper layers of insulation using insulation adhesive.
				5. Upper Layers:  Set upper layers of insulation in solid mopping of hot roofing asphalt.
				6. Upper Layers:  Loosely lay upper layers of insulation units over substrate.
			1. Installation Over Lightweight Insulating Concrete Decks:  Attach insulation in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].
				1. Mechanically fasten vented base sheet to lightweight insulating concrete, with vented side down, using mechanical fasteners specifically designed and sized for fastening to lightweight insulating concrete decks.

Coordinate installation requirements with selections made in ROOFING SYSTEM article in Part 2.

* + - * 1. Base Layer:  Embed base layer of insulation into ribbons of insulation adhesive.
				2. Base Layer:  Set base layer of insulation in solid mopping of hot roofing asphalt.
				3. Base Layer:  Loosely lay base layer of insulation units over substrate.
				4. Upper Layers:  Adhere upper layers of insulation using insulation adhesive.
				5. Upper Layers:  Set upper layers of insulation in solid mopping of hot roofing asphalt.
				6. Upper Layers:  Loosely lay upper layers of insulation units over substrate.
			1. Lay subsequent layers of insulation with joints staggered from joints of preceding layer in accordance with manufacturer's instructions.
			2. Place tapered insulation to required slope pattern in accordance with manufacturer's instructions.
			3. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
				1. Cold Storage: Hold back insulation board from parapet walls, flat edges, expansion joints, curbs, pipes, and penetrations a minimum of 1 inch (25 mm) and install spray foam to fill all gaps. Completely fill gaps at insulation-to-wall interfaces with spray foam to the height of the insulation.
			4. Wrap steel beams, columns, pipes, conduits, and rods that penetrate cold storage roofing a minimum of 48 inches (1219 mm) with insulation.
				1. Minimum Thickness: Equal to half of the roofing system insulation thickness.
			5. Do not install more insulation than can be covered with membrane in same day.
		1. INSTALLATION - COVER BOARD
			1. Install cover board over insulation with joints staggered from joints of insulation in accordance with manufacturer's instructions.
			2. Trim cover board neatly to fit around penetrations and projections as directed by cover board manufacturer.

Retain one of four paragraphs below as applicable to Project.

* + - 1. Mechanical Attachment:  Fasten cover board in accordance with manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].
			2. Loosely lay cover board over substrate.
			3. Adhere cover board using insulation adhesive in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].
			4. Set cover board in solid mopping of hot roofing asphalt in accordance with roofing manufacturer's instructions[ **and FM (AG) Factory Mutual requirements**].
		1. INSTALLATION – CONDUCTIVE MEDIUM FOR ELECTRONIC LEAK DETECTION (ELD) TESTING
			1. Install conductive medium directly below membrane in accordance with manufacturer's installation instructions and ASTM D7877 and ASTM D8231.
		2. INSTALLATION - MEMBRANE
			1. Install membrane and flashings in accordance with roofing system manufacturer's instructions.
			2. Roll out membrane, free from wrinkles or tears.
				1. Mechanically Attached Membranes:  Roll membrane out perpendicular to metal deck ribs.
			3. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Shingle joints on sloped substrates in direction of drainage where possible.

Coordinate membrane attachment method with selections made in ROOFING SYSTEM article in Part 2.

* + - 1. Adhered Application:
				1. Adhesive:  Apply adhesive at prescribed rate and in conformance with manufacturer’s instructions. Bond membrane and apply pressure by means required by manufacturer. Adhere one roll before proceeding to adjacent rolls. Avoid trapping air between membrane and substrate.

Where a gypsum cover board is used, the roofing membrane may not be hot asphalt attached. Gypsum cover boards may not be encapsulated in hot asphalt from the top and bottom.

* + - * 1. Hot Roofing Asphalt:  Apply solid mopping of asphalt at temperature and rate required by manufacturer and install fleece-backed membrane.
				2. In addition to adhering, mechanically fasten roof membranes securely at terminations, penetrations, and perimeter of roofing.
			1. Mechanical Attachment:
				1. Install membrane and mechanical attachment devices in accordance with manufacturer's instructions. Attach securely at terminations, penetrations, and perimeter of roofing.
			2. Induction Welded Attachment:
				1. Install induction-welded plates and fasteners into insulation per manufacturer requirements.
				2. Install membrane and induction weld membrane to coated plates per manufacturer requirements. Attach securely at terminations, penetrations, and perimeter of roofing.
			3. Self-Adhered Application:
				1. Remove release liner and apply membrane in accordance with manufacturer's instructions. Roll over substrate while avoiding wrinkles.
				2. Secure membrane by push brooming into place and rolling as required by manufacturer.
				3. In addition to adhering, mechanically fasten membranes securely at terminations, penetrations, and perimeter of roofing.

Refer to Technical Advisory Bulletin for test welding of seams: [https://documents.gaf.com/technical-bulletins-&-notes/c-39-test-welding-thermoplastic-membranes.pdf](https://documents.gaf.com/technical-bulletins-%26-notes/c-39-test-welding-thermoplastic-membranes.pdf).

* + - 1. Seams:  Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings. Test lap edges with probe to verify seam weld continuity in accordance with manufacturer’s technical bulletins.
			2. At intersections with vertical surfaces terminate and seal top of sheet flashings with termination bars secured to nailing strips or structural backing or in conformance with roofing manufacturer's approved details.
				1. Insert flashing into reglets and secure.
			3. Extend membrane under [**copings**] [**fascias**] [**gravel stops**] [**edge metals**] and secure to outside face of wall.
			4. Around roof penetrations, seal flanges and flashings with flexible flashing.

Roofing expansion joint and area divider locations need to be indicated on the drawings.

* + - 1. Install roofing expansion joints where indicated. Make joints watertight.
			2. Walkways:  Install walkways in accordance with roofing system manufacturer's instructions at the following locations. Provide manufacturer's minimum clearance between units.
				1. Perimeter of each rooftop unit.
				2. Between each rooftop unit location, creating continuous paths connecting rooftop unit locations.
				3. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
				4. Top and bottom of each roof access ladder.
				5. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
				6. Locations indicated on Drawings.
				7. Other locations required by roof membrane manufacturer's requirements.
		1. INSTALLATION - PAVERS
			1. Install pavers in accordance with manufacturer's instructions.
				1. Fully support edges; shim and adjust pavers to provide level surface.
				2. Provide manufacturer's minimum clearance between units.
		2. INSTALLATION – VEGETATIVE ROOFING
			1. See Section 075563.
		3. FIELD QUALITY CONTROL
			1. See Section ​ 014000 - Quality Requirements​ for independent field[ **testing and**] inspection requirements, and requirements for monitoring quality of specified product installations.
			2. Provide [**regular**] <**Insert requirement**>​ on-site attendance of roofing manufacturer's representative during installation of this work.

Manufacturer typically requires pullout tests for lightweight insulating concrete roof decks, wood and wood panel roof decks, poured gypsum roof decks, cementitious wood-fiber plank roof decks, and steel roof decks less than 0.295 inch (0.749 mm) thick.

* + - * 1. Perform fastener-pullout tests in accordance with roof system manufacturer's requirements. Submit test results to manufacturer[ **and Architect**] within 24 hours after performing tests.
				2. Probe heat welded seams and test seams in accordance with manufacturer’s recommendations.
			1. Electronic Leak Detection (ELD) Testing:  Test roofing areas to detect discontinuities in roofing membrane in accordance with ASTM D7877 or ASTM D8231.
				1. Perform tests before overlying construction is placed.
				2. Prepare field report indicating daily details of work performed and locations of discontinuities, if any.
				3. Testing agency to submit training certification to ensure technician performing ELD testing is currently certified in accordance with relevant training program.
				4. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

Retain paragraph below for optional air leakage testing.

* + - 1. Qualitative Air Leakage Testing: Test in accordance with ASTM E1186, smoke pencil with pressurization or depressurization.
			2. Repair or remove and replace components of roofing system where tests or inspections indicate they do not comply with specified requirements. Perform repairs using manufacturer’s approved repair procedures.
			3. Perform additional testing and inspecting at Contractor's expense to determine if repaired or additional work complies with specified requirements.
		1. CLEANING
			1. See Section 017000 - Execution and Closeout Requirements for additional requirements.
			2. Properly dispose of all product wrappers, pallets, cardboard, scrap, waste and debris. Replace damaged material with new materials.
			3. Clean adjacent construction where soiled by work of this section. Comply with manufacturer of adjacent construction's instructions and procedures.
		2. PROTECTION
			1. Protect installed roofing system from construction operations.
			2. Correct deficiencies in work in accordance with warranty[ **or guarantee**] requirements. Repair or replace defaced or damaged finishes caused by work of this section.
1. END OF SECTION  075423