

FIRESTONE BUILDING PRODUCTS
LIVEROOF[®] PRE-VEGETATIVE GREEN
ROOFING SYSTEM

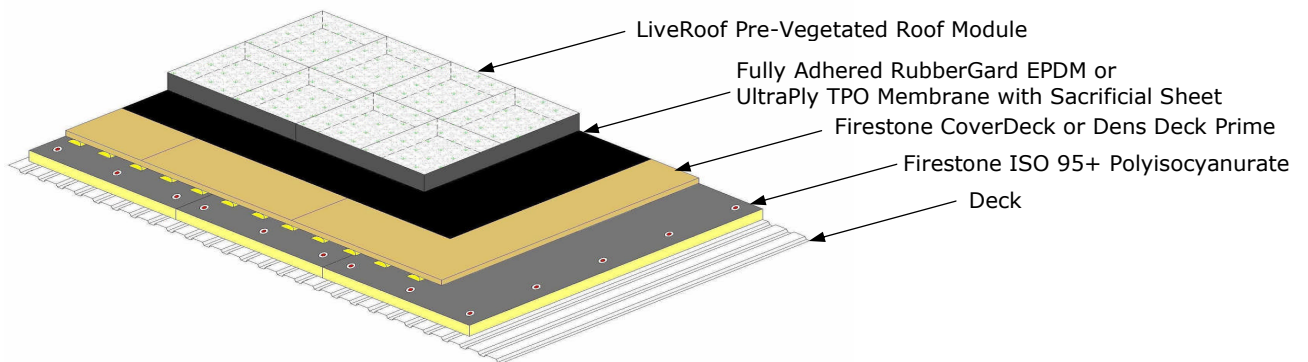
April 7th, 2008

TABLE OF CONTENTS

1.01 General Design Criteria	3
1.02 Quality Assurance	6
1.03 Vegetative Roof Module Elements	7
1.04 Installation of Modules	12
1.05 Maintenance	16

1.01 General Design Criteria

The LiveRoof Module is a fully pre-vegetated garden roofing product that provides the building owner with a quick and easy way to turn any Firestone RubberGard EPDM or UltraPly TPO roof into an environmentally friendly and aesthetically pleasing roof. Comprised of a heavy duty 100% recycled post industrial polypropylene, LiveRoof is designed to be easily placed directly on top of the roofing system and connect together using simple overlap technology. Each LiveRoof module arrives to the job site fully grown, giving the roof an instant green blanket of vegetation. In addition, since the modules are grown off-site there is no need to coordinate any extra soil or plant deliveries.



A. Roof System General Guidelines

1. Parameters of this manual outline the minimum requirements for a Firestone Red Shield Warranty. Local code and insurance requirements may require specific enhancements.
2. LiveRoof Modular Roof Systems utilize the following membranes fully adhered to an approved substrate:
 - RubberGard Platinum Membrane
 - RubberGard MAX Reinforced EPDM Membrane
 - RubberGard Non-Reinforced EPDM Membrane
 - UltraPly TPO membrane
3. A certified Structural Engineer must be contacted prior to installation to ensure that the deck can withstand the weight of the saturated Pre-Vegetative Modules, specified roofing system and any other live or construction loads.
4. A minimum roof slope of $\frac{1}{4}$ " in 12" should be provided to ensure proper drainage at the waterproofing level. The Pre-Vegetative Roofing Module shall not be installed over a 2" in 12" slope without appropriate engineering or irrigation.

5. LiveRoof Modular Roof Systems should be installed in the absence of frozen soil or frost hazards and when temperatures are neither below 45° F (7.2° C) or above 95° F (35° C).
6. Precaution must be taken when Modules are installed in High Wind areas. Please contact Firestone Technical Services should the project be located in an area that is prone to high wind events.
7. Prior to installation of the LiveRoof Modules, install a Firestone Protection Mat, (consisting of a sacrificial layer of EPDM or TPO) directly over the Roofing membrane.
8. When installing Modules, do not drag into position. In addition use caution when lifting trays into place.
9. Firestone does not review or calculate dew point analyses and therefore, does not accept responsibility for damage due to recurrence or location of dew point. Although not all projects require a vapor retarder, a design review should be considered for all projects to determine if a vapor retarder is necessary.
10. Statements in this guide are provided in good faith with the expectation that a design professional be consulted prior to any job decisions being made.

B. Warranty Requirements

Firestone will offer a 10, 15, or 20 year Red Shield warranty depending on membrane and fastener type, as well as membrane gauge. Only Firestone brand products are covered in the Scope of the Red Shield Warranty.

Warranty Requirements		
Warranty Length	Fastener Options	Membrane Options
10 Year	Firestone All Purpose or Heavy Duty Fastener with Insulation Plate	.060" Firestone RubberGard Standard .060" or .075" Firestone RubberGard MAX .090" Firestone Platinum. .060" or .080 UltraPly TPO
15 Year	Firestone All Purpose or Heavy Duty Fastener with Insulation Plate	.060" Firestone RubberGard Standard .060" or .075" Firestone RubberGard MAX .090" Firestone Platinum. .060" or .080" UltraPly TPO
20 Year	Firestone Heavy Duty Fastener with Insulation Plate	.075" Firestone RubberGard MAX .090" Firestone Platinum .080" UltraPly TPO

Note: Cover Boards adhered in an approved insulation adhesive are required over mechanically attached insulation.



Firestone Recommends “stripping” in the Seams prior to the installation of the Protection Mat and LiveRoof Module.

1. General

- a) A Firestone Pre-Installation Notice (PIN) must be submitted a minimum of two weeks prior to installation. The purpose of the Pre-Installation Notice is to ensure that the waterproofing system meets the requirements of the warranty requested and will perform under the Pre-Vegetative Roofing System.
- b) LiveRoof Garden Modules require a minimum of two months notice to ensure proper on-site growing.
- c) Firestone Requires the Roofing System be inspected by a Firestone Technical Representative prior to installation of the protection mat and Vegetative Trays. All necessary repairs must be completed prior to installation of the modular system.

Note: The approved Firestone Licensed Applicator must notify Firestone at least three weeks in advance of the applicable inspection dates for coordination purposes.

- d) Firestone requires that a flood test or other leak detection system be conducted prior to installing the protection mat and vegetative modules.
- e) Only Firestone brand products are covered in the Scope of a Red Shield Warranty. These products include membrane, flashings, adhesives, sealants, insulation, and other Firestone Branded products that are used in this application.

2. Limitations

- a) Firestone Roof System must be installed by an approved Firestone Licensed Applicator.
- b) Firestone Licensed Applicators must attend the LiveRoof Training prior to module installations. For additional information on attending the LiveRoof Training seminar please visit www.LiveRoof.com to located the nearest LiveRoof Affiliate Grower
- c) Firestone Roof System Tie-ins to other roofing systems are not warranted by Firestone.

- d) Firestone is not responsible for the care or maintenance of the vegetation or growth media. Firestone does not guarantee that the plants will survive any period of time.
- e) The formation or presence of fungus or mold is dependant on a broad range of factors. The presence of spores and nutrients, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems all contribute to the growth and survival of mold/fungus. These factors are beyond the control of Firestone, and Firestone shall not be responsible for any claims, repairs, or damages relating to the presence of any molds, fungi, bacteria, or spores in the air, land, or water serving the building.
- f) Firestone does not offer warranties on Residential applications.

C. Conditions

The Following conditions require special considerations and may not be warrantable. Firestone recommends that a design professional be involved in the design process. For additional assistance, please contact Firestone technical Services at 1-800-428-4511.

- 1. Substrates that do not provide adequate fastener or adhesion pullout resistance.
- 2. Buildings with high interior humidity
- 3. Cold storage and freezer facilities
- 4. Certain Situations may arise where Firestone specifications and/or roofing requirements cannot be applied. It may not be possible for Firestone to issue the desired warranty for projects that deviate from the current specifications, unless granted by a special request from Firestone Technical Services.

1.02 Quality Assurance

A. Job Site Considerations

- 1. Protect all Components of the Firestone Roofing Systems from damage including but not limited to:
 - Damage that may result from the continued construction process.
 - Damage from petroleum products, greases, oils (mineral and vegetable), animal fats and other by products that may come in contact with the membrane.
 - Damage from chemicals, fertilizers, and other gardening products.
 - Protect Firestone roof system components from direct Contact with continuous steam or heat sources in excess Of 180° F (82° C).

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Interim updates at: www.firestonebpco.com
Revision No. 1 1/1/2008

2. Store all Firestone membrane in the original undisturbed plastic wrap in a manner to protect it from damage.
3. Insulation must be properly stored and protected from ignition sources.
4. Pre-Vegetated Modules, must be properly stored to avoid damage on the roof and/or the growth media. Remove Plastic wrap from Hoppits to prevent modules from baking in the sun

B. Safety

1. Material Safety Data Sheets (MSDS) must be available at all times. All safety regulations recommended by OSHA and other agencies having jurisdiction.
2. Fumes involving adhesive solvents and asphalt products may be drawn into the building during installation through rooftop intakes. Refer to the Firestone Technical Information Sheet "Recommended Guidelines for working on an Occupied Building" for specific guidelines.
3. Keep all adhesives, sealants, and cleaning materials away from ALL ignition sources (i.e., flames, fire, sparks, etc.) Do not smoke while using these materials.
4. Consult container labels, Material Safety Data Sheets, and Technical Information Sheets for specific safety instructions for all products.

1.03 Pre-Vegetative Roofing Module System Elements

The following section outlines the components necessary for the correct installation of the LiveRoof Pre-Vegetative Modular Roof System. For additional information related to Firestone brand products please refer to the Technical Database at www.firestonebpc.com.

A. LiveRoof Pre-Vegetative Roofing Module

LiveRoof Pre-Vegetative Garden Modules are black in color and are comprised of 100% post industrial recycled 100 mil thick polypropylene. The trays will interface using overlapping edges and come fully grown at the day of delivery.



Property	Description
Pre-Vegetative Roofing Module Size	1' x 2' (304 mm x 609 mm)
Depth of Roofing Tray	3-1/4" (82.5 mm) 4-1/4" (107 mm) with soil elevator
Color of Module	Black
Weight of Planted Module Fully saturated	4" depth Approx. 27-29 lbs. Per sq. ft.
Module Material	100% post-industrial recycled 100 mil thick Polypropylene
Module Drainage Channel Height	1/2" (13 mm)
Protection Mat	Firestone .045" EPDM or TPO
Growth Media	Proprietary LiveRoof specified engineered soil, enhanced German FLL specifications, 93+% (by dry weight) inorganic content for minimal shrinking/decomposition.
Plants	A recommended design of fibrous succulents that can survive with minimal irrigation in an extensive rooftop environment in the project location. See Liveroof.net for additional vegetative information.
Plant Size	Plants arrive at the job site fully grown covering a minimum 95% of the module surface area.
Edge Treatments	Firestone Garden Roof Edge Metal

B. Firestone Roofing System (Fully Adhered Only)

Quick Specification

<p>Slope Minimum ¼" in 12" slope must be provided to promote positive drainage.</p> <p>Construction Type New Construction, Complete Tear-off, or recovers with any wet or damaged materials removed prior to installation.</p> <p>Building Height Limitations Firestone Vegetative Roof Tray Systems are limited to buildings 75' or less. Taller buildings may require specific design enhancements.</p> <p>Deck () Min. 22 Gauge Steel () Min. 3000 psi Concrete () Min. 1/2" Plywood/OSB () Min. 2" Cementitious Woodfiber () Min. 2" Poured Gypsum</p> <p>Note: A certified Structural Engineer must be contacted prior to installation to ensure that the deck can withstand the weight of the saturated Vegetative trays, specified roofing system and any other live or construction loads.</p>	<p>Insulation () 1.5" Firestone ISO 95+ GL () 2.0" or greater Firestone ISO 95+ GL</p> <p>Insulation Attachment () Firestone All Purpose Fastener () Firestone Heavy Duty Fastener () Firestone Concrete Drive Fastener () Firestone Polymer Fastener () Firestone I.S.O. Twin Pack () Firestone I.S.O. Spray S () Firestone I.S.O. Fix II</p> <p>Cover Board () Firestone CoverDeck 250 or 500 () Dens-Deck or Dens-Deck Prime</p> <p>Cover Board Attachment () Firestone I.S.O. Twin Pack () Firestone I.S.O. Spray S () Firestone I.S.O. Fix II</p> <p>Note: Cover Board must be installed using an approved Firestone adhesive. Fasteners are not acceptable to attach the Cover Board.</p>	<p>Membrane</p> <p>RubberGard EPDM: () .060" Firestone RubberGard EPDM () .060" Firestone RubberGard MAX () .075" Firestone RubberGard MAX () .090" Firestone Platinum EPDM</p> <p>UltraPly TPO: () .060" Firestone UltraPly TPO () .080" Firestone Platinum TPO</p> <p>Note: Firestone recommends stripping in the seams for added protection prior to the placement of the Protection Mat and Vegetative Modules.</p> <p>Protection Mat: () Firestone .045 RubberGard Membrane () Firestone .045 UltraPly TPO Membrane</p> <p>Surfacing () LiveRoof Green Roof Module</p>
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1. Insulation

The Following insulation can be used in the construction of the LiveRoof Garden Roof Module System:

- a.) Firestone ISO 95+: Closed cell poliso foam core laminated to a black glass reinforced mat facer.

2. CoverBoards

CoverBoard must be attached without the use of mechanical fasteners. When attaching insulation with adhesive, Firestone requires the use of 4' x 4' boards. The following CoverBoards can be used in the construction of the Garden Roof Tray System:

- a.) Dens Deck Prime : Glass faced gypsum board.
- b.) Firestone CoverDeck 250 / 500: High performance mineral coverboard that combines high wind and water resistance with excellent lightweight/high strength characteristics.

3. Membranes

The following Membranes can be used in conjunction with other Firestone brand products in the completion of the LiveRoof Garden Roof Module System.

- a.) Firestone RubberGard EPDM : Minimum 60 mil non-reinforced EPDM.
- b.) Firestone RubberGard MAX EPDM : Minimum 60 mil reinforced EPDM.
- c.) Firestone RubberGard Platinum : 90 mil non-reinforced EPDM
- d.) Firestone UltraPly TPO : Minimum 60 mil reinforced TPO
- e.) Firestone UltraPly Platinum : 80 mil reinforced TPO

Note: please refer to Section 1.01 B of this section for warranty requirements.



For all other components related to Fully Adhered RubberGard EPDM or UltraPly TPO systems please refer to the corresponding design guide located on the Technical Database at www.firestonebpc.com. These components include but are not limited to: Bonding Adhesive, Fasteners and plates, "T" Joint Covers, Sealants, QuickSeam accessories, Termination Bars, Flashings, Pipe Boots, Inside / Outside Corners, and QuickPrime Plus.

C. Growth Media

Growth media is a proprietary LiveRoof specified engineered soil, enhanced German FLL specifications, consisting of 93+% (by dry weight) inorganic content for minimal shrinkage/decomposition.

D. Plants

Firestone recommends a selection of fibrous succulents that can survive in a non-irrigated, or minimally irrigated, extensive rooftop environment in the project location. Plants should be selected according to the USDA or Arborday.org hardiness zone classifications.

1. Plant Species

LiveRoof Modules arrive at the job site fully grown. It is imperative that a minimum of 2 months prior to installation, LiveRoof be contacted for proper plant selection. LiveRoof Modules are pre-planted using plugs and/or cuttings to ensure a particular design. For plant selections please refer to your local grower, found at www.liveroof.com.

- a.) Choosing different types of sedums can not only adds to the aesthetics of the roof, but can also allow for a low maintenance roof. Some species may tolerate the climate better than others which allow for the roof to continue performing as designed.



There are over 600 species of Sedums. Please refer to the local grower for the recommended plants for your region.

There are over 600 species of Sedums. Please refer to the local grower for further information.



Sedum Spurium "Roseum"



Sedum Album



Sedum Spurium Fuldaglut



Sedum Reflexum

E. Irrigation Systems (optional)

The need for a permanent irrigation system depends upon the climate, roof exposure, and size. Simple systems such as a hose/sprinkler or spigot is practical for small roofs and is highly recommended during prolonged periods of hot, dry, and windy weather patterns. It is the responsibility of the Building owner to ensure the LiveRoof is properly hydrated.

F. Additional Landscaping Items (optional)

Additional Landscaping items such as pavers, walkway pads, metal edging, and ballast may be needed to complete the look of the LiveRoof. Firestone specifically recommends design walkways around the pre-vegetative modules to allow for maintenance and watering.

1. Firestone Garden Roof Paver– 2' x 2' x 2" concrete plaza pavers weighing a minimum of 18 psf with a minimum compressive strength of 6500 psi.
2. Firestone Garden Roof Edge (LR) - Aluminum edging specifically designed to be used in conjunction with LiveRoof Modules.
3. Firestone QuickSeam Walkway Pads – Firestone QuickSeam Walkway pads are a high quality rubber with QuickSeam Tape factory laminated to the bottom.
4. Stone Ballast – Size #4 Nominal 1-1/2" diameter rounded water worn gravel conforming to ASTM D4448.

1.04 Installation of LiveRoof Garden Module

The following section refers to the installation of the LiveRoof Garden Module. Prior to installation of any module, the roofing system must be inspected and found to meet the current specifications for a Firestone Fully Adhered Garden System. Refer to the Firestone Technical Database for additional information at www.firestonebpco.com.

A. Installation of the Firestone Protection Layer

1. Prior to installation sweep all debris, dirt, or foreign material from the membrane surface.
2. Unroll the Firestone Protection Layer overlapping the side laps a minimum of 3" and end laps a minimum of 6".
3. Extend Layer up penetrations and vertical surfaces past the height of the tray.



During Windy conditions, temporary ballast may be required to prevent the protection layer from moving. Vegetative Roofing Modules should be installed as soon as possible to prevent movement in the protection layer.

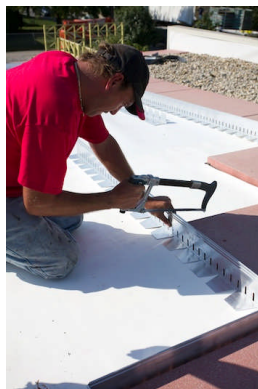
B. Delivery of the Live Roof Garden Module

1. LiveRoof Modules are to be installed on the rooftop within 4 hours of delivery.
2. Caution must be taken when handling LiveRoof modules to prevent damage to the module or the roofing components.
3. LiveRoof Modules are to be conveyed to the roof surface with proper Equipment that is designed to carry the collective load of the specially designed Hoppit® (See picture below)
4. Do not set Hoppit directly on the rooftop, but cushion it with tires, closed cell foam, or plywood.
5. Be aware that a fully loaded Hoppit may weigh as much as 1100 pounds. It is imperative to account for this weight to avoid overloading of the roof.



C. Installation of Landscaping items

Using the Firestone Garden Edge Metal outline the border of the LiveRoof System.



D. Installation of the LiveRoof Module

Prior to installation, please familiarize yourself with the design of the LiveRoof Module. Typically the module will be identified with a sticker that faces the installer, otherwise identify the front and back by locating the overlapping edges that faces the installer.



1. The Sacrificial membrane must be swept clean before placing modules.
2. Typically start at the top right of the area and set the module down. The sticker should be facing the installer and the two overlapping edges should be on the top and the right to ensure proper placement with the next module.
3. Place and push the first module tightly against the edging or parapet with the overlapping edge away from the installer.
4. Set the next module next to the first installed module and push it gently into place over the module to its right. Use caution as to not damage the module or the soil elevator. Ensure that the overlapping lip of the second module overlaps the first module.



5. Continue this process until the first row is completed. Begin the second row using the right to left technique ensuring that each module overlaps and is securely in place.



Caution must be used when placing the trays to avoid damaging the roofing membrane or protection mat. LiveRoof Firestone Pre-Vegetative Roofing Modules must be lifted and gently placed into position. Do not drag the trays across the roof as this could cause unnecessary damage.

6. Once the second row is set into place, the soil elevators can be removed. Soil Elevators should not be removed until it is completely surrounded by either modules or edging. Soil elevators should be pulled out sideways as not to disturb soil. Avoid pulling directly upward to avoid displacing soil.

Note: Do not allow more than two rows to be installed prior to removing soil elevators. This minimizes traffic that could cause damage to the plants or the module.



7. Repeat this process until all modules have been installed.



E. Initial Watering

Once the LiveRoof Modules have been installed, immediately and completely water the plants. Soak the module's soil from top to bottom using about 1 ¼ gallons of water per module. Check the modules by using your finger to confirm that the soil is moist from the top to bottom.

1.05 Maintenance

Maintenance is the responsibility of the building owner. Firestone is not responsible for the care or growth of the vegetation, nor does the Firestone Red Shield warranty cover the performance or survival of the plant. The following guidelines are recommendations to ensure that the Roofing System continues to serve its primary waterproofing objective and assist in the growth of vegetation:

A. Annual Maintenance

A. Soil Testing and Fertilization.

During April 1 to 15 of each year, administer an annual soil test for PH and fertility levels.

Maintain pH in the range of 6.5 to 8.0. In the event that pH is outside of the 6.5 to 8.0 range, consult LiveRoof, LLC for the appropriate amendment.

Maintain fertility in the normal range using a typical field soil fertility test as provided by A&L labs. When indicated, apply a single springtime application of Nutricote 14 14 14, Type 180 (180 day release period), at 20lbs per 1000sf. Follow the Nutricote labeled directions for application rate, which take priority over any recommendations listed here. Runoff potential does exist and should be evaluated by the applicator in accord with the site specifics; the greater the runoff

sensitivity, the lower the application rate. All applications of fertilizer are the sole responsibility of the applicator.

B. Irrigation

Watering

While in northern North America, successive watering may not be needed to keep your LiveRoof® alive, protracted hot dry weather can result in plant thinning or death. In warmer climates, depending upon rainfall and exposure, regular irrigation will probably be required. Accordingly, LiveRoof® recommends irrigation, in a manner practical and efficient for the scale of the installation, as a “temporary” management tool under the following conditions:

Prolonged hot dry weather, in the northern temperate zone, is generally defined as periods of 75 degree weather, with less than 1” of rainfall persisting for 4 weeks or longer. This time period will likely be less if the temperatures are hotter, the climate warmer, on sloping rooftops, or roofs exposed to strong winds. Such conditions can dry out the green roof substrate and cause the plants to go dormant or in extreme cases to dry up and die. Dormant plants tend to shrink to a smaller size and expose soil, which can predispose the system to weed encroachment.

When hot dry weather persists for greater than 4 weeks, irrigation is to be applied, temporarily, to re-wet the soil to the point of runoff

NOTE: There are no absolutes when it comes to irrigation. Check the plants for wilting in the morning rather than midday. Irrigate if the plants show signs of wilting in the morning.

In **areas of reflected light**, such as next to south facing walls, more frequent irrigation should be applied to keep the soil from becoming excessively dry.

C. Inspections and Plant Care Protocol

Conduct the following EVERY 2 WEEKS (twice per month) during the entire Spring through Fall Growing Season. Conduct year round in climatic regions where the LiveRoof does not freeze in winter.

Conduct hand weeding during the bimonthly inspection. Pull all weeds, never allow any weed to flower, set seed and complete its life cycle.

The interval may be adjusted in accord with seasonal variations in weed growth, but the interval should never exceed 2 weeks or long enough to allow for weeds to flower and set seed.

Never allow a woody plant to establish in a green roof system as their root systems are extensive and can damage roof membranes.

Herbicides, whether pre-emergent or post-emergent, are not recommended as they are not healthy for the environment and can contaminate runoff. A need for pre-emergent herbicides is a sign of weeding too infrequently.

Displaced Soil

Any soil displaced, typically due to nesting birds, should be immediately replaced with LiveRoof Engineered Green Roof Soil.

Drainage Inspection

Roof drains should be cleared of any debris, pebbles, leaves, etc. during the twice monthly inspection to keep drains flowing freely.

Debris / Trash Removal

Remove immediately debris or trash during bimonthly inspection. Especially during fall and spring, rake LiveRoof® planting clean of any matted tree leaves to prevent smothering.

Pesticides

Pesticide use is discouraged and should always be considered secondary to cultural and biological control measures, as pesticides can get into runoff water and cause environmental damage. Pesticide use should only be conducted by qualified and licensed applicators, and on an "as needed" basis. All applications of pesticides are the sole responsibility of the applicator.

Note: LiveRoof™ is a registered trademark of LiveRoof, LLC A subsidiary of Hortech, Inc.