CARLISLE'S ROOFGARDEN

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April 2009

CARLISLE Carlisle SynTec

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Roof Garden Waterproofing System

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PART I GENERAL

1.01 DESCRIPTION

The Carlisle Roof Garden Waterproofing System utilizes Sure-Seal® (black) non-reinforced or Sure-Tough™ reinforced EPDM membrane, Sure-Seal AFX-Plus FleeceBACK® EPDM membrane or Sure-Weld™ TPO membrane that is fully adhered to an approved substrate. The thickness of the membrane is dependant upon the roof garden type and warranty selected. Refer to Paragraph 1.03, Design Guidelines, for specific requirements.

Adjoining sheets of EPDM membrane are spliced together using 3" wide SecurTAPE™/Primer and overlaid with 6" wide Pressure-Sensitive Flashing. Sure-Weld TPO membrane field splices are joined with a minimum 1-1/2" wide hot air weld overlaid with reinforced Sure-Weld membrane, heat welded along all edges.

Various components including Root Barriers, Polystyrene Insulation, MiraDRAIN® G4 Drainage Composite, Engineered Growth Media and Vegetation are installed above the membrane dependant on desired planting schedule, allowable loads and the climactic region of the project.

1.02 ROOF GARDEN DEFINITIONS

A. Ultra-Extensive (shallow) Roof Garden System

A shallow planting system (2.5" to 4" in depth) ideally suited for areas that will receive little maintenance. Recommended plants include sedums, herbs and grasses. The anticipated weight above the membrane assembly is generally between 4.8 and 6 pounds per square foot, per inch of system depth, in a saturated state.

B. Extensive (medium depth) Roof Garden System

A medium depth planting system (soil depth of 4" to 8") where recommended plants include sedums, herbs, grasses and other vegetation which can grow in this depth of media. In temperate climates, un-irrigated systems can be provided without difficulty; however, drip, mist or spray irrigation systems may be required to support more diverse plant types or for installations in semi-arid climates. The anticipated weight above the membrane assembly is generally less than 50 pounds per square foot.

C. Intensive (deep) Roof Garden System

A planting system of greater depth (soil depth greater than 8") that requires regular maintenance, such as watering, fertilizing and mowing/weeding. A variety of plants are available including sod grass, annual or perennial flowers, shrubs and even small trees. This system typically requires a structural concrete roof deck to support the larger dead load. An irrigation system may be utilized in these assemblies, as required. The anticipated weight above the membrane assembly is generally greater than 50 pounds per square foot.

1.03 DESIGN GUIDELINES

The Roof Garden Waterproofing assemblies will incorporate membranes from 90-mil EPDM and 80-mil TPO in deep garden applications to 60-mil material for the shallow garden assembly (for standard 10 or 15 year warranties). Root barriers must be incorporated as part of the deep and medium depth garden assemblies. Moisture retention mats are required for shallow garden assemblies and are recommended for gardens with medium depth depending upon the site condition and the soil's ability to retain moisture.

To facilitate drainage, a minimum roof slope of 1/4" in 12" must be provided at the waterproofing membrane level.

A. Ultra-Extensive (shallow) Roof Garden Assembly

Proper substrate shall be provided beneath the waterproofing membrane. This can be accomplished with the use of adhesive or fasteners to secure the roof insulation and Dens-Deck Prime set in adhesive or asphalt as the underlayment for the membrane.

1. For 10 or 15-year warranties, the membrane shall be 60-mil EPDM or Sure-Weld TPO adhered to Dens-Deck.

   For 20-year warranted systems, 75-mil Sure-Tough EPDM or 72-mil Sure-Weld EXTRA TPO membrane is required.

   In lieu of the standard EPDM or TPO membranes, AFX-Plus FleeceBACK membrane may be hot mopped over the Dens-Deck Prime or directly over structural concrete (in conjunction with 2 plies of base sheets for 20-year warranties).

2. For 10, 15 or 20-year warranties, the membrane is overlaid with CCW MiraDRAIN G4 drainage composite.

3. The growth media shall be placed directly onto the CCW MiraDRAIN G4 drainage composite.

4. Once the growth media is in place, irrigation, if applicable, and vegetation can be installed.

B. Extensive (medium depth) Roof Garden Assembly

Proper substrate shall be provided beneath the waterproofing membrane. This can be accomplished with the use of adhesive or fasteners to secure the roof insulation and Dens-Deck Prime set in adhesive or asphalt as the underlayment for the membrane.

1. For 10 or 15 year warranties, the assembly requires the use of either 75-mil Sure-Tough reinforced EPDM or 72-mil Sure-Weld EXTRA TPO membrane installed in an adhered fashion. For 20 year warranted systems, 90-mil EPDM or 80-mil Sure-Weld TPO is required.

   As an option, AFX-Plus FleeceBACK membrane may be hot mopped over the Dens-Deck Prime or in conjunction with 2 plies of base sheets directly over structural concrete for 10, 15 or 20-year warranties.

2. The membrane shall be overlaid with a layer of CCW 300HV Protection Fabric, a root barrier of 40-mil non-reinforced Geomembrane and CCW MiraDRAIN G4 Drainage Composite. The growth media shall be placed directly onto the CCW MiraDRAIN G4 drainage composite.

3. Once the growth media is in place, irrigation, if applicable, and vegetation can be installed.

C. Intensive (deep) Roof Garden Assembly

Proper substrate shall be provided beneath the waterproofing membrane. This can be accomplished with the use of adhesive or fasteners to secure the roof insulation and Dens-Deck Prime set in adhesive or asphalt as the underlayment for the membrane.

1. The membrane may be 90-mil EPDM or 80-mil Sure-Weld EXTRA TPO installed in an adhered fashion. AFX Plus FleeceBACK membrane may be hot mopped over the Dens-Deck Prime or in conjunction with 2 plies of base sheets directly over structural concrete. ***As an alternate, 145-mil FleeceBACK may applied directly over a structural concrete deck using FAST adhesive.***

2. A layer of minimum 2" thick extruded polystyrene insulation with drainage channels is used above the membrane to insulate the roof, facilitate drainage and protect the membrane against puncture. As an alternative, expanded polystyrene placed over a drainage mat can be utilized.

3. A root barrier consisting of 40-mil non-reinforced Geomembrane is installed above the insulation.

4. A layer of CCW MiraDRAIN G4 Drainage Board is used above the root barrier for rapid lateral drainage of the roof garden assembly.

5. The growth media shall be placed directly onto the CCW MiraDRAIN G4 drainage composite. Once the growth media is in place, irrigation, if applicable, and vegetation can be installed.

D. Refer to Carlisle's GR Details included at the end of this specification for the various assembly options available.

1.04 QUALITY ASSURANCE

A. This Roof Garden Waterproofing System must be installed by a Carlisle Authorized Roofing Applicator in compliance with shop drawings as approved by Carlisle. There must be no deviations made from Carlisle's specifications or the approved shop drawings without the **PRIOR APPROVAL** of Carlisle.

B. A **pre-installation meeting** should be coordinated by the specifier and attended by the roofing applicator, membrane manufacturer's representative and other trades working on the roof system both before and after membrane installation. The purpose of this meeting is to discuss the necessity of ensuring proper membrane protection during all phases of installation and to review other applicable requirements or unusual field conditions.

C. Upon request by the Authorized Applicator, an inspection will be conducted by a Technical Representative of Carlisle to ascertain that the membrane roofing system has been installed according to Carlisle's specifications and details. This **inspection** shall be coordinated **prior to installing the "above membrane roof garden components"** so access to the membrane is not impaired.

D. Flood testing, electronic testing or other leak detection means is **required** to check the waterproof integrity of the membrane prior to installing any above membrane components.

E. An in-progress inspection may be scheduled after the initial inspection (after the membrane installation is completed) to ensure proper protection procedures are being followed to prevent possible damage to the membrane during the installation of above membrane components.

F. ***All projects given a 20-year overburden warranty must have a Carlisle-certified consultant on site during construction. Carlisle's Design Services department should be contacted for a full consultant list by region.***

Note: The roofing applicator must notify Carlisle at least 3 weeks in advance of the applicable inspection dates for coordination purposes.

1.05 SUBMITTALS

A. To ensure compliance with Carlisle's warranty requirements, **all projects should be forwarded to Carlisle for review** prior to installation.

B. **A dimensioned layout of all field splices shall be included** along with the project submittals (shop drawing and Request for Warranty).

C. For all projects, prior to project inspection by Carlisle, a final shop drawing must be approved by Carlisle.

1.06 WARRANTY

A. A **10, 15 or 20-year** System Warranty is available for a charge on commercial buildings and applies only to **products manufactured or marketed by Carlisle SynTec Incorporated**. The membrane system is defined as membrane, flashings, adhesives, sealants and other Carlisle brand products utilized in this installation. For a complete description of these products, refer to the "Products Section" or the applicable "Attachment" in the Carlisle specifications.

For a nominal charge, a 10, 15 or 20-year Overburden Warranty can be added. The warranty covers all components above the membrane limited to the protection fabric, polystyrene, drainage products, moisture retention mat, and growth media. In the event of a failure, Carlisle is responsible for overburden removal, roof repair, and replacement of the overburden.

If a 20-year No Dollar Limit warranty including overburden is desired, one of Carlisle's certified Green consultants must be utilized on the project during the design and construction phases.

B. **Access for warranty service**

If a 10, 15 or 20-year Overburden Warranty is not obtained, it shall be the owner's responsibility to expose the waterproofing membrane assembly in the event warranty service is required.

C. The formation or presence of mold or fungi in a building is dependent upon a broad range of factors including, but not limited to, the presence of spores and nutrient sources, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems and their maintenance and operating capabilities. These factors are beyond the control of Carlisle and Carlisle shall not be responsible for any claims, repairs, restoration or damages relating to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in any building or in the air, land, or water serving the building.

1.07 JOB CONDITIONS

A. Coordination between various trades is essential to avoid unnecessary rooftop traffic over sections of the roof and to prevent damage to the membrane. Heavily traveled areas must be protected by placing temporary protection courses to prevent damage to the membrane.

B. The use of a vapor retarder to protect insulation and reduce moisture accumulation within an insulated roofing assembly should be investigated by the specifier. Consult the latest publications by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) and NRCA (National Roofing Contractors Association) for specific information.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the original, unopened containers labeled with the manufacturer's name, brand name and installation instructions.

B. Job site storage temperatures in excess of 90° F (32° C) may affect shelf life of curable materials (i.e., sealants, cleaners, primers, adhesives, SecurTAPE, Pourable Sealer, Pressure-Sensitive Flashing and uncured flashing).

C. When liquid adhesives and sealants are exposed to lower temperatures, restore to a minimum of 60° F (16° C) before use. Do not store containers with opened lids due to loss of solvent that will occur from flash off.

D. Sure-Seal AFX-Plus FleeceBACK membrane, when specified, should be stored in its original plastic wrap or be covered to protect from moisture. Any moisture absorbed by the fleece-backing must be removed by using a wet-vac system, prior to membrane application.

E. Store Sure-Weld TPO membrane (when applicable) in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored breathable tarpaulins. Sure-Weld EXTRA membrane that has been exposed to the elements for approximately 7 days must be prepared with Weathered Membrane Cleaner prior to hot air welding. Refer to Carlisle's Sure-Weld Specifications, Part II, Application, for applicable requirements.

F. Insulation, Dens-deck Prime and base sheets, when specified, must be stored so they are kept dry and are protected from the elements. Store insulation and Dens-Deck Prime on a skid and completely cover with a breathable material such as tarp or canvas. If the insulation is lightweight, it should be weighted to prevent possible wind damage.

G. Carlisle Engineered Roof Garden growth media, when specified, should be stored under cover whenever possible to avoid excessive moisture absorption. Care should be taken not to damage the packaging to avoid leakage when hoisted to the rooftop.

H. Carlisle Roof Garden Plants, when specified, should be used immediately upon arrival in the case of sedum cuttings. If plugs are specified, they should be unpacked immediately upon arrival and planted within three (3) days. Unused plugs should be stored in an outdoor location with access to at least four (4) hours per day of direct sunlight.

PART II PRODUCTS

2.01 GENERAL

The components of this roofing system are to be products of Carlisle. The installation, performance or integrity of products by others is not the responsibility of Carlisle and is expressly disclaimed by the Carlisle Warranty.

2.02 MEMBRANE

Sure-Seal® (black) EPDM, Sure-Seal® AFX-Plus FleeceBACK® EPDM or Sure-Weld® TPO membrane can be used with this system. Refer to Paragraph 1.03, Design Guidelines for required membrane thickness that is dependent upon the type of Roof Garden and warranty selected. For membrane physical properties, refer to "Attachment I" at the end of this section.

2.03 RELATED CARLISLE MATERIALS

A. For use with **Sure-Seal EPDM and AFX-Plus FleeceBACK membrane** – Sure-Seal Bonding Adhesive (used with Sure-Seal membrane only), SecurTAPE, Primer, Lap Sealant, Cured EPDM Flashing, Pressure-Sensitive Flashing, "T" Joint Covers, Elastoform Flashing, Fasteners/Plates, Water Cut-Off Mastic, Pourable Sealer, Pre-Molded Pipe Seals, Pressure-Sensitive Inside/Outside Corner, Pourable Sealer Pockets and Termination Bars.

B. For use with **Sure-Weld TPO membrane** – Sure-Weld Bonding Adhesive, Cut-Edge Sealant, reinforced and non-reinforced Sure-Weld Flashing, Water Cut-Off Mastic, Universal Single Ply Sealant, Molded Pocket Sealant, Weathered Membrane Cleaner, Pre-Molded Pipe Seals, Split Pipe Boots, Curb Wrap Corners and Termination Bars.

C. Other Carlisle products, such as insulation and edgings/copings, are also required when such components are to be included as part of the System Warranty.

2.04 CARLISLE ROOF GARDEN COMPONENTS

A. **Protection Fabric – Carlisle CCW 300HV** (16 oz/yd^2) is a polypropylene non-woven needle-punched fabric that is stabilized to resist soil chemicals, mildew, and insects and is non-biodegradable. Designed to prevent abrasion to the membrane when a root barrier is used in some Extensive Roof Garden assemblies. Available in 12.5' x 200' and 40" x 200' rolls.

B. **CCW MiraDRAIN G4 Drainage Composite** consists of a high impact polystyrene core with "cups" and high-flow overflow drains. A non-woven 100% post-industrial recycled polyester combination filter fabric and moisture retention mat is bonded to the retention side of the molded core to prevent passage of particles into the water reservoirs. Designed to filter and retain water in all Roof Gardens while allowing excess water to quickly reach the drainage system.

CCW MiraDRAIN G4 Drainage Composite is 1.21" thick and holds up to 0.32" of rainfall. Packaged in 4' x 50' rolls weighing 70 pounds.

C. **Polystyrene Insulation** ***(available from Carlisle)***

1. **Insulfoam XIV** is a minimum 40 psi compressive strength**,** moisture resistant, closed cell expanded polystyrene with ¼" x ¼" drainage channels every 2" O.C. Installed directly over the roof membrane in Intensive (deep) garden assemblies. Available in 4'x 4'and 4' x 8' board sizes with a thickness of 1" to 40". Readily available in custom lengths and widths.

2. **Dow Roofmate or Foamular 404/604** is a minimum 40/60 psi compressive strength, moisture resistant, closed cell polystyrene foam insulation with drainage channels along board edges to promote drainage at the membrane level. Installed directly over the roof membrane in Intensive (deep) garden assemblies. Available in 2' x 8' board sizes with a thickness of 1" to 4".

Extensive Sites				**Extensive & Intensive Sites**	**Intensive Sites**	**FLL Guidelines For Extensive Multi-Course Sites**	**FLL Guidelines For Intensive Multi-Course Sites**
Analysis	**Units**	**Results**					
	CEGM-R*		**CEGM-L***	**CEGM-P***	**CEGM-I***		
Bulk Density (dry weight	lbs/cu.ft.	45.7	35.8	34.0	41.6		
Bulk Density (saturated weight)	lbs/cu.ft.	72.5	57.5	69.3	74.4		
Total Pore Volume	Vol. %	71.9	78	73.4	74		
Maximum Water Holding Capacity	Vol. %	46	37	61.6	53.2	>35	>45
Air-Filled Porosity (at max. WHC)	Vol. %	25.6	41	16.0	20.9	>10	>10
Water Permeability	cm/s	0.03	0.48	0.063	0.02	>0.001	>0.005
Water Permeability	in/min.	0.731	11.4	1.49	0.38	>0.0236	>0.0118
pH		6.6	7.4	6.7	6.1	6.5 – 8.0	5.5 – 8.0
Soluble Salts (water, 1:10, m:v)	mmhos/cm	0.1	0.4	0.23	0.25		
Soluble Salts (water, 1:10, m:v)	g (KCl)/L	0.47	1.3	0.96	1.07	<3.5	<2.5
Organic Matter Content	mass %	5.2	7	7.2	9.3	<8	<12.0

D. **Root Barriers**

1. **Root Barrier** – Carlisle 40-mil non-reinforced Geomembrane is a non-reinforced polypropylene sheet specifically formulated for use in below grade and vegetated applications to resist root growth and soil bacteria. Used in Intensive (deep) and Extensive (medium depth) Roof Garden Systems. Available in widths of 12' and lengths of 100'. Adjoining sheets **must be overlapped a minimum of 3"** and heat welded. Carlisle 40-mil non-reinforced Geomembrane passes the demanding DIN 4062 long-term root penetration tests.

2. **Biobarrier –** In certain Intensive Roof Garden applications, Biobarrier synthetic hormone root barrier is used in selective areas. Biobarrier releases a root-thwarting compound at a few parts per billion, preventing particularly invasive roots from damagine the water waterproofing membranes. Biobarrier is available in 12" x 100' rolls and 58.5" x 100' rolls.

E. **Carlisle Engineered Growth Media** – a lightweight FLL-approved growth media used for roof garden applications. Applied at the specified depth on Carlisle Roof Garden assemblies.

* CEGM – Carlisle Engineered Growth Media

F. **Carlisle Roof Garden Plants**

1. **Plugs** – Carlisle plant plugs are available in 1’ x 2’ flats/trays containing either 24 or 72 individual plants. A wide selection of plants (>50) specifically chosen for rooftop environments are available from Carlisle. Plants are available in 24-cell flats containing 2.5" diameter plugs; 72-cell flats contain 1.5” diameter plugs.

2. **Cuttings** – Carlisle sedum cuttings are available in bulk and are sold by the pound. More than 12 different varieties of sedum cuttings can be used to propagate Carlisle Roof Gardens. Carlisle sedum cuttings must be planted with Carlisle Moisture Retention Gel to ensure that cuttings have adequate moisture to successfully root in a rooftop environment.

3. **Vegetated Sedum Tiles –** Carlisle’s Vegetated Sedum Tiles are available in 1.4 square foot trays. Designed to enable rapid installation and ensure full (95 %+) vegetated coverage on the day of installation. Each tile weighs approximately 5 pounds and is planted with 6 to 8 varieties of sedum.

G. **Carlisle Roof Garden Aluminum Edging** – a 1/8" thick, 4" high, slotted, extruded aluminum edging used to separate roof garden assemblies from adjacent walkways or perimeter stone ballast. Additional heights are available from Carlisle.

2.05 OTHER NON-CARLISLE PRODUCTS

A. **“Hardscape” Items:**

1. **Individual concrete plaza pavers** – 2' x 2' x 2" thick precast concrete pavers weighing a minimum of 18 psf with a minimum compressive strength of 6500 psi.

2. **Paver Pedestals** – Rubber paver pedestals to elevate the surface of the pavers above the roof membrane and promote positive drainage and protection from freeze/thaw.

3. **Stone Ballast** – Nominal 1-1/2" diameter rounded water worn gravel which conforms to ASTM D448, gradation size #4, applied at a minimum of 10 pounds per square foot.

4. **Other –** Products such as concrete curbs, landscape lumber (wood timbers, etc.) or other desired landscape products suitable for this application. Used to transition between Ultra-Extensive, Extensive and Intensive Roof Garden areas to act as a “growth media stop.”

C. **Asphalt** (ASTM D 312): Type III or IV Hot Asphalt used for mopping AFX-Plus FleeceBACK membrane to structural concrete or approved base sheets. As an option, Modified SBS or SEBS Asphalt may be used. Application rate is 18-22 pounds per square (100 square feet) for membrane mopping (28-32 pounds per square for insulation attachment, if applicable).

Property/ASTM	**Type III**	**Type IV**	**Modified Asphalt**
Softening Point (° F) D-36	Min. – 195 Max. – 205	Min. – 210 Max. – 225	Min. – 215 Max. – 235
Flash Point (° F) D 92	Min. – 525 Max. – 600	Min. – 525 Max. – 600	Min. – 525 Max. – 600
Penetrations Units D 5	@ 32 ° F = 6 @ 77° F = 16-24	@ 32 ° F = 6 @ 77° F = 13-22	@ 32 ° F = 7 @ 77° F = 18
Ductility @ 77° F, cm D 113	3.0	2.0	7.0
Solubility in Trichloroethylene % D 2042	99.8	99.8	97.5

D. **"Cut Back" Asphalt Primer** – Meets ASTM D 41 – Used to prime structural concrete decks prior to mopping AFX-Plus FleeceBACK membrane or associated base sheets. Coverage rate is 1 to 2 gallons per 100 square feet depending on surface porosity.

E. **Type IV Glass Felt** (Meets ASTM D 2178) – Used as a two-ply base sheet over structural concrete prior to mopping FleeceBACK AFX-Plus membrane. Felts are mopped at the rate of 23-25 pounds per square. Rolls typically weigh approximately 40 pounds and are 39.4" wide by 161.8" long. Coverage rate per roll is 5 squares (500 square feet).

PART III EXECUTION

3.01 GENERAL

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

3.02 ROOF DECK CRITERIA

Proper decking shall be provided by the building owner. The building owner or its designated representative must ensure that the building structure is investigated by a registered engineer to assure its ability to withstand the total weight of the specified roofing system, as well as construction loads and live loads, in accordance with all applicable codes. The specifier must also designate the maximum allowable weight and location for material loading and storage on the roof.

A. For **Ultra-Extensive** (**shallow) Roof Garden Systems**, any roof deck capable of withstanding the roof loading may be accepted.

B. For **Extensive (medium depth) and Intensive (deep) Roof Garden Systems**, structural concrete roof decks are recommended due to the increased weight of the roof assembly when the system is at its maximum water capacity

C. Defects in the roof deck must be reported and documented to the specifier, general contractor and building owner for assessment. The Carlisle Authorized Roofing Applicator shall not proceed unless the defects are corrected.

3.03 SUBSTRATE REQUIREMENTS

The substrate must be relatively even without noticeable high spots or depressions and shall be dry, relatively smooth, free of protrusions, debris, sharp edges or foreign materials and must be free of accumulated water, ice and snow. Cracks or voids in the substrate greater than 1/4" must be filled with a suitable material.

3.04 INSTALLATION

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

A. Membrane Installation

1. Follow Carlisle's applicable Adhered Roofing System Specifications for specific surface preparation procedures, membrane positioning and adhesive application requirements.

2. In preparation for membrane splicing, overlap adjoining EPDM and AFX-Plus FleeceBACK membrane sheets approximately 4".

3. Sure-Weld TPO membrane shall be overlapped approximately 2" in preparation for heat welding.

B. Membrane Splicing With SecurTAPE (for Sure-Seal EPDM and AFX-Plus FleeceBACK membranes)

1. Tape splices must be a minimum of 2-1/2" wide using 3" wide SecurTAPE extending 1/8" minimum to 1/2" maximum beyond the splice edge.

2. **All field splices shall be overlaid with 6" wide Pressure-Sensitive Flashing**.

3. Prior to SecurTAPE and Pressure-Sensitive Flashing application, the splice area must be primed with Sure-Seal HP-250 or LV-600 Primer. LV-600 Primer is required in areas where volatile organic compound (VOC)

regulations are in effect.

4. Detailed splicing procedures, which are contained in the applicable Adhered Roofing System specifications, must be followed (i.e., cold weather application procedures, primer application, SecurTape installation, lap sealant application, etc.).

C. **Heat Welded Splices** (for Sure-Weld TPO membrane)

1. Heat weld the Sure-Weld membrane sheets using the Automatic Heat Welder or Hot Air Hand Welder and silicone roller. A **minimum 1-1/2" wide heat weld** between adjoining sheets is required.

2. **All field splices shall be overlaid with 6" wide Sure-Weld Pressure-Sensitive Cover Strip (in conjunction with HP-250 or LV-600 Primer).** As an alternate, 6" wide reinforced Sure-Weld membrane can be used as an overlay providing it is heat welded along all edges (Cut-Edge Sealant required on at all cut edges).

   Note: When 6" wide reinforced Sure-Weld membrane is used to overlay field splices, splice intersections ("T" joints) between Sure-Weld membrane and field splice overlay must be overlaid with a heat welded 6" x 6" section of Sure-Weld non-reinforced flashing. Refer to Carlisle's Sure-Weld specifications for specific requirements.

3. Weathered Membrane Cleaner must be used to remove surface oxidation on the membrane surface when the material has been exposed to the elements for 7 days. Apply Weathered Membrane Cleaner with a clean HP Splice Wipe or other white rag. **Prior to heat welding, wipe the surface of the membrane where the cleaner has been applied with a clean, dry, HP Splice Wipe or white rag to remove all cleaner residue.**

4. All additional splicing requirements contained in our Sure-Weld Adhered Roofing System specifications must be strictly followed (i.e., membrane cleaning/preparation, heat welding procedures, equipment setup, seam probing etc.).

D. **Flashing**

Walls, curbs, skylights and all other penetrations through the membrane must be flashed in accordance with Carlisle's published specifications/details for the applicable membrane specified.

1. All existing **loose** flashing must be removed prior to the application of new flashing. New membrane flashing must extend above all existing intact flashing but must not conceal weep holes or cover existing throughwall counterflashing.

2. In areas where metal counterflashing is used as the vertical termination, the counterflashing must be sealed with a rubber grade caulking to prevent moisture migration behind the new wall flashing.

3. Install surface mounted reglets and compression bar terminations directly to the wall surface.

4. When using AFX-Plus FleeceBACK membrane, at roof drains and wall/curb flashings (at compression seal terminations such as terminations bars and coping stones), the **fleece-backing must be removed** from the back of the membrane so Water Cut-Off Mastic can be applied directly to the EPDM membrane surface.

5. Vertical field splices at walls, curbs, etc., must be overlaid in the same fashion as the field splices.

6. When using **90-mil EPDM** membrane, all **pipe flashing details shall conform to Carlisle's Adhered 30 year warranty specification** (refer to Carlisle Detail X3A-8).

7. **Uncured Elastoform Flashing or Pressure-Sensitive Uncured Flashing** must be limited to overlayment of vertical seams (as required at angle changes), or to flash inside/outside corners, vent pipes, scuppers and other unusually shaped penetrations where the use of pre-molded pipe seals, cured EPDM membrane or Pressure-Sensitive Flashing (semi-cured) is not practical.

Note: Even when working in elevated temperatures, in most cases a heat gun will be required to elevate the temperature of uncured Elastoform Flashing to a higher than warm tool temperature (which is between 105°F (40°C) and 110° F (43°C) to permit proper forming of the uncured flashing.

8. On 15 or 20-year System Warranty projects, Carlisle's Termination Bar, in conjunction with Water Cut-Off Mastic, must be installed under all metal counterflashings used for vertical wall terminations.

9. **Roof Drains**

On roof gardens with deeper growth media, drains should be covered with a perforated "drain viewing box" with removable lid (at the growth media surface) for inspection purposes. 1-1/2" nominal diameter rounded river washed gravel is applied around the "viewing box" (minimum 12" in width) to promote drainage.

On Ultra-Extensive (Shallow) and some Extensive (Medium – with shallower soil depth) Roof Garden Waterproofing assemblies, standard cast iron compression ring clamping drains may be able to be used with 1-1/2" nominal diameter rounded river washed gravel applied around the drain sump area (minimum 12" in width) for drainage; however, "drain viewing boxes" are recommended.

E. Application of Roof Garden Components

Limit traffic over completed roof membrane sections to essential personnel only. Heavily traveled areas (staging areas, corridors used to transport garden roof components) must be protected using 1/2" thick plywood or other sheathing.

1. A flood test or electronic test is required to ensure the waterproof integrity of the membrane system. After the membrane and flashings have been in place approximately 24 hours, plug drains and provide necessary barriers to contain water.

"Flood" membrane surface with water to a depth of 2" for a period of 24 hours. Inspect for leaks and repair membrane if defects are found. Retest after repairs have been made.

Note: On Sure-Weld TPO systems, electronic testing (Electric Field Vector Mapping – EFVM) may be used to test membrane/flashing for defects. EFVM systems must be used in conjunction with Carlisle's Sure-Weld FleeceBACK membrane systems.

2. Sweep the surface of the membrane to remove all debris and loose or foreign material.

3. **Carlisle MiraDRAIN G4 Drainage Composite**

a. On Ultra-Extensive (shallow) Roof Garden systems, the CCW MiraDRAIN G4 Drainage Composite is placed directly over the membrane.

On Extensive (medium) and Intensive (deep) Roof Garden systems, the CCW MiraDRAIN G4 Drainage Composite is placed directly over the Geomembrane Root Barrier.

b. Install CCW MiraDRAIN G4 Drainage Composite with the green fabric facing upward.

1) Place Drainage Composite so that water flows with the overlap, not against it.

2) Place the dimpled edge over the preceding flanged edge to join adjacent panels.

3) Fabric on the drainage composite extends 6" beyond the edges of the polystyrene core to provide an overlap to adjacent panels. When placing adjacent panels, overlap fabric in the direction of water flow.

4. **Polystyrene Insulation** (for Intensive garden systems)

a. Insulation shall have a minimum compressive strength of 40 psi. Only polystyrene with drainage channels shall be used.

b. Install insulation loose laid directly over the membrane with all joints tightly butted.

c. Extend insulation up walls, curbs, etc. to the height of the top of the growth media layer.

5. **CCW 300HV Protection fabric -- used beneath root barrier (below) on Extensive (medium) assemblies.**

a. A 16 oz./yd^2 polypropylene non-woven needle-punched fabric that is stabilized to resist soil chemicals, mildew and insects and is non-biodegradable. Used as a protection layer between the waterproofing membrane and root barrier to prevent abrasion and provides cushioning from installation. Available in rolls 40" in width by 200' in length and 12.5' in width by 200' in length.

7. **Carlisle 40 mil non-reinforced Geomembrane Root Barrier**

a. On Extensive (medium depth) garden systems, position Geomembrane Root Barrier loose-laid over the CCW 300HV Protection Fabric.

On Intensive (deep) roof garden assemblies, the Geomembrane Root Barrier shall be loose-laid over the polystyrene insulation layer that is installed above the membrane.
For both assemblies, overlap the adjacent Geomembrane Root Barrier sheets a minimum of 3" in preparation for splicing. **The membrane must be spliced together as outlined below.**

b. Splicing surfaces shall be clean. Dirt/contaminants can be removed from splice areas with Carlisle Weathered Membrane Cleaner.

Weathered Membrane Cleaner must be used to remove surface oxidation on the root barrier surface when the material has been exposed to the elements for 7 days. Apply Weathered Membrane Cleaner with a clean HP Splice Wipe or other white rag. **Prior to heat welding, wipe the surface of the root barrier where the cleaner has been applied with a clean, dry, HP Splice Wipe or white rag to remove all cleaner residue.**

c. **Geomembrane Root Barrier Splicing**

When Sure-Weld TPO membrane is used, Geomembrane sheets shall be field welded a minimum of 1-1/2" in width using a Heat Welder. As an option for roof garden assemblies that use EPDM or FleeceBACK AFX membranes, Carlisle SecureTAPE/HP-250 Primer can be used to splice adjoining sheets of the Root Barrier.

d. Extend Geomembrane Root Barrier up walls, curbs, etc. to the height of the top of the growth media layer.

8. **Roof Garden Aluminum Edging**

a. Depending on the type of garden assembly, loose lay the Roof Garden Aluminum Edging on top of the Moisture Retention Mat or Drainage Board. Temporary blocking shall be provided on the outside edge of the angle to prevent shifting during the application of growth media.

b. A separate section of Protection Fabric shall be installed on the inside of the Roof Garden Aluminum Edging so it is even with the top of the angle and extends a minimum of 6 inches past the horizontal flange off the retainer angle.

9. **Growth Media/Planting**

a. Spread Carlisle Engineered Roof Garden growth media to the specified depth. When growth media is ordered from Carlisle, the exact amount needed to achieve the settled/compacted depth specified is supplied. In most cases, growth media is hoisted to the roof using a crane. During installations in which there is crane access to the majority of the rooftop, SuperSack bags are hoisted to within 24"- 36" above the intended location. The bottom of the SuperSack is slit with a razor or knife, and the growth media is allowed to flow onto the roof in a controlled manner. During installations where rooftop crane access is limited, a designated growth media drop area is assigned. At this location, multiple wheelbarrows are congregated beneath the hoisted SuperSacks and the growth media is allowed to slowly flow into the wheelbarrows, at which point the wheelbarrows are brought to the proper roof area and the growth media is distributed. Always be sure to dispense to locations in a manner that will not overload the structure.

b. Once the growth media has been distributed, planting of vegetation can begin. If planting is to be achieved through the use of cuttings or clippings, Carlisle Retention Gel must be applied to the roof surface at a rate of approximately 1 pound per 250 square feet. This can be accomplished by manual/hand broadcast or by use of a rotary seed/fertilizer spreader pushed across the roof in straight lines spaced approximately 6' - 7' on center. Once Carlisle Retention Gel is distributed across the entire surface of the applied growth media, cuttings/clippings may be applied by manual/hand broadcast. Recommended rate for cutting/clipping application is 1 pound per 11 square feet for rapid vegetative coverage. The Roof Garden **must** be irrigated to the point of runoff immediately after cuttings/clippings are applied and the Moisture Retention Gel becomes saturated. Gel will reach maximum size in approximately 30 minutes. Carlisle recommends planting multiple varieties at once to avoid monoculture on the rooftop and to give better visual appeal. When cuttings/clippings are used to propagate the Roof Garden, it is **ABSOLUTELY MANDATORY** that an irrigation system be used for a **MINIMUM** of 45 days to ensure proper establishment of the cuttings/clippings. This can be accomplished by a temporary overhead irrigation system or by a permanent sub-irrigation system utilizing buried drip tape, etc., in conjunction with proper irrigation controls. Consult with Carlisle for recommended irrigation settings.

c. If plugs are being used to propagate the Roof Garden, plants/plugs are removed from their cells and placed on the rooftop in the vicinity of where planting will occur. To plant the plugs, a 2" deep indentation is made into the growth media, the plug is inserted, vegetation facing upwards, and the growth media is tamped around the submerged plug base. Tamp the growth media around the base of the plug by hand to ensure that the plug is securely buried. Once planting is complete, irrigate the Roof Garden to the point of runoff. In the case of 2.5" plugs (24 plugs per flat), recommended spacing is 8" – 9" on center (1.78 – 2.25 plugs per square foot). If using smaller plugs (72 plugs per flat), recommended spacing is 6" – 8" on center (2.25 – 4 plugs per square foot). Carlisle's website provides guidance on dozens of rooftop plant species and recommended planting rates.

d. To plant sedum tiles, simply remove the tiles from the plastic containers and lay them onto the surface of the growth media so that the edges of the tiles are butted together. If sub-irrigation is being used, it can be installed on the surface of the growth media and covered with the tiles. The Roof Garden must be thoroughly soaked with water using a sprinkler, hand sprayer, or sub-irrigation system (if installed at the same time as the growth media and vegetation) until the Roof Garden assembly is saturated to the point of run-off.

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Roof Garden Waterproofing System

"Attachment I"
Membrane Physical Properties

May 2008

A. Sure-Seal 60-mil and 90-mil Non-Reinforced EPDM membrane

Sure-Seal 60-mil EPDM membrane is available in maximum widths of 50' and lengths up to 200'.

Sure-Seal 90-mil EPDM membrane is available in 10' widths and 100' lengths.

These membranes conform to ASTM D 4637 – 96, Type I (non-reinforced) with the following physical properties.

Physical Property	Test Method	SPEC.(Pass)	Typical 60 and 90 Mil
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10
Tensile Strength, min, psi (MPa)	ASTM D 412	1305 (9)	1650 (11.3)
Elongation, Ultimate, min, %	ASTM D 412	300	480
Tear Resistance, min, lbf/in (kN/m)	ASTM D 624 (Die C)	150 (26.3)	200 (35)
Resistance to Heat Aging* Properties after 4 weeks @ 240°F (116°C) Tensile Strength, min, psi (MPa) Elongation, Ultimate, min, % Tear Resistance, min, lbf/in (kN/m) Linear Dimensional Change, max, %	ASTM D 573 ASTM D 412 ASTM D 412 ASTM D 624 ASTM D 1204	 1205 (8.3) 200 125 (21.9) ±1.0	 1500 (11) 225 215 (37.6) -0.4
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks
Brittleness Temp., max, deg. F (deg. C)*	ASTM D 746	-49 (-45)	-67 (-55)
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0	2.0
Water Vapor Permeance* max, perm	ASTM E 96 (Proc. B or BW)	0.10	.05
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m^2 total radiant exposure at .70 W/m^2 irradiance, 176°F (80º C) black panel temp.	ASTM G 155	No Cracks No Crazing	No Cracks No Crazing

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.

B. Sure-Tough 75-mil Reinforced EPDM membrane

Sure-Tough 75-mil Reinforced EPDM membrane has enhanced reinforcement to maximize puncture and tear resistance. Membrane is available in 10' widths and 100' lengths and conforms to ASTM D 4637 – 96, Type II (reinforced) with the following physical properties.

Physical Property	Test Method	ASTM SPEC.(Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness Over Scrim, min, in. (mm)	ASTM D 4637 Annex	.015 (.381)	.032 (0.81)
Color	N/A	N/A	Gray/Black
Breaking Strength, min, lbf (N)	ASTM D 751 Grab Method	90 (400)	230 (1023)
Elongation, Ultimate, min, %	ASTM D 751 Grab Method	250 **	500 **
Tearing Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	70 (311)
Brittleness Temp., max, deg. F (deg. C) *	ASTM D 2137	-49 (-45)	-60 (-51)
Resistance to Heat Aging * Properties after 4 weeks @ 240°F Breaking Strength, min, lbf (N) Elongation, Ultimate, min, % Linear Dimensional Change, max, %	ASTM D 573 ASTM D 751 ASTM D 412 ASTM D 1204	 80 (355) 200 ** ±1.0	 250 (1112) 250 ** -0.7
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104° F Specimen wrapped around 3" mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption* After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8.0, -2.0 **	+2.0 **
Hydrostatic Resistance, min., psi (MPa)*	ASTM D 751	380 (2.6)	440 (3.0)
Static Puncture Resistance, lbf (N)*	FTM 101C Method 2031	N/A	>250 (1112)
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, 7560 kJ/m^2 total radiant exposure at .70 W/m^2 irradiance, 176°F (80°C) black panel temperature	ASTM D 4637 Conditions	No Cracks No Crazing	No Cracks No Crazing

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.

** Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced product.

C. Sure-Weld TPO membrane

Sure-Weld 60, 72 or 80-mil Reinforced Thermoplastic Polyolefin (TPO) membrane conforms to ASTM D 6878 with the following physical properties. Membrane sheets are available in rolls 12, 10 or 8 feet wide by 100 feet long. Sure-Weld Membrane is available in white, gray or tan.

Property (Metric-SI Units)	**Test Method**	**Property of Unaged Sheet**		**Property After Aging** (1) **28 days @ 240° F**	
		60-mil	**72 or 80-mil EXTRA**	**60-mil**	**72 or 80-mil EXTRA**
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±5		
Thickness Over Scrim, min, in. (mm)	ASTM D 6878 Optical Method	0.024 (0.610) ±10	72-mil 0.030 (0.762) ±10 80-mil 0.034 (0.8642) ±10		
Breaking Strength, min, lbf (kN)	ASTM D 751 Grab Method	250 (1.1) Min. 360 (1.6) Typ.			
Elongation at Break of Fabric, %					
Tearing Strength, lbf (N) 8" by 8" specimen					
	ASTM D 751	25 Typ.	72-mil		72-mil
Brittleness Point, max, °F (°C)	ASTM D 751 B Tongue Tear	55 (245) Min. 130 (578) Typ.	350 (1.6) Min. 400 (1.8) Typ. 80-mil 350 (1.6) Min. 425 (1.9) Typ.	250 (1.1) Min. 360 (1.6) Typ.	350 (1.6) Min. 400 (1.8) Typ. 80-mil 350 (1.6) Min. 425 (1.9) Typ.
Linear Dimensional Change (shrinkage), % After 6 hours at 158°F (70°C)	ASTM D 2137	-40 (-40) Min. -50 (-46) Typ.		25 Typ.	
Ozone Resistance, 100 pphm, 168 hours	ASTM D 1204	±0.5 Max. -0.2 Typ.		55 (245) Min. 130 (578) Typ.	
Resistance to Water Absorption After 7 days immersion @ 158°F (70°C) Change in mass, %	ASTM D 1149	No Cracks			
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 471 (top surface only)	4.0 Min. 2.0 Typ.			
Field seam strength, lbf/in. (kN/m) Seam tested in peel	ASTM D 3274 2 yr. S. Florida	9 – 10 Typ.		No Cracks	
Water vapor permeance, Perms	ASTM D1876	25 (4.4) Min. 60 (10.5) Typ.			
Puncture resistance, lbf (kN)	ASTM E 96	0.10 Max. 0.05 Typ.			
	FTM 101C Method 2031	300 (1.3) Min. 350 (1.6) Typ.	40 (7.0) Min. 60 (10.5) Typ.		
Resistance to xenon-arc Weathering (2) Xenon-Arc, 17,640 kJ/m^2 total radiant exposure, visual condition at 10X	ASTM G 155 0.70 W/m^2 80°C B.P.T.	No Cracks No loss of breaking or tearing strength	72-mil 350 (1.6) Min. 400 (1.80) Typ. 80-mil 400 (1.8) Min. 450 (2.0) Typ.		

(1) Aging conditions are 28 days at 240° F (116° C) equivalent to 400 days at 176° F (80° C) for breaking strength, elongation, tearing strength, linear dimensional change, ozone and puncture resistance.

(2) Approximately equivalent to 8000 hours exposure at 0.35W/m^2.

D. AFX-Plus FleeceBACK membrane

AFX-Plus FleeceBACK membrane incorporates 60-mil Sure-Seal (black) non-reinforced EPDM laminated to 7.5 ounce per square yard, non-woven polyester, polypropylene blended fleece-backing resulting in a total finished sheet thickness of 105-mils. A selvage edge is provided on one edge along the length of the membrane with pre-applied splice tape (SecurTape) for membrane splicing. Membrane is available in widths of 10 feet (3 m) and lengths of 50 or 100 feet (15.2 m or 30.4 m) and conforms to ASTM Standard D 4637-96, Type III (fabric-backed membrane) with the following physical properties:

Physical Property	Test Method	SPEC.(Pass)	Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness over Fleece, min, in. (mm)	ASTM D4637 Annex	.045 (1.143)	.060 (1.524)
Weight 1b/ft^2 (kg/m^2)			0.38 (1.94)
Breaking Strength, min, lbf (N)	ASTM D751 Grab Method	90 (400)	200 (890)
Elongation, Ultimate, min, %	ASTM D 412	300 **	480 **
Tearing Strength, min, lbf (N)	ASTM D 751 B Tongue Tear	10 (45)	45 (200)
Brittleness point, max, °F (°C)	ASTM D 2137	-49 (-45)	-67 (-55)
Resistance to Heat Aging * Properties after 4 weeks @ 240°F (116°C) for Sure-Seal	ASTM D 573		
Breaking Strength, min, lbf (N)	ASTM D 751	80 (355)	200 (890)
Elongation, Ultimate, min, %	ASTM D 412	200 **	225 **
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.7
Ozone Resistance * Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen wrapped around 3 inch (7.5 cm) mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption * After 7 days immersion @ 158°F (70°C) Change in mass, max, %	ASTM D 471	+8, -2 **	+2.0 **
Resistance to Outdoor (Ultraviolet) Weathering * Xenon-Arc, 7560 kJ/m^2 total radiant exposure at 0.70 W/m^2, 176°F (80°C) black panel temperature	ASTM G 155	No Cracks No Crazing	No Cracks No Crazing

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.

** Specimens prepared from coating rubber compound.

E. 40 mil non-reinforced Geomembrane Root Barrier

A non-reinforced polypropylene sheet specifically formulated for use in below grade applications to resist root growth and soil bacteria. Used on Intensive (deep) and Extensive (medium depth) Roof Garden Waterproofing Systems. Available in widths of 12' and lengths of 100' and conforms to the following physical properties.

Physical Property	Test Method	Property Of Unaged Sheet	Property After Aging 30 days @ 185 °F
Tolerance on nominal thickness, %	ASTM D 5199	± 10	
Mass per unit area, lb/ft^2 (g/ft^2) (kg/m^2)	ASTM D 5261	0.21 (95) (1.03) typical	
Tensile strength, lbf (kN)	ASTM D 638 Dumbell IV	72 (12.6) min. 96 (16.8) typical	72 (12.6) min. 96 (16.8) typical
Tensile elongation, %	ASTM D 638	700 min. 750 typical	700 min. 750 typical
Tear resistance, lbf (N)	ASTM D 1004	12 (53.3) min. 18 (80.0) typical	12 (53.3) min. 18 (80.0) typical
Low temperature flexibility, °F (°C)	ASTM D 2136 1/8 in. mandrel 4 hour @ temp.	- 40 (- 40) max. - 50 (- 46) typical	
Linear Dimensional Change (shrinkage), %	ASTM D 1204		+/- 1.0 max. - 0.5 typical
Ozone resistance, 100 pphm, 168 hours	ASTM D 1149	No cracks	No cracks
Carbon Black content, % (Black membrane only)	ASTM D 4218	2 min. 2.75 typical	
Resistance to water (distilled) absorption After 30 days immersion 122 °F (50 °C) Change in mass, %	ASTM D 471	1.0 max. 0.5 typical	
Field seam strength, lbf/in. (kN/m) Seam tested in peel after weld	ASTM D 1876	Cannot separate weld (breaks outside weld)	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (N)	ASTM D 4833	30 (133) min. 40 (178) typical	30 (133) min. 40 (178) typical
Resistance to xenon-arc weathering[1] Xenon-Arc, 10,080 kJ/m^2 total radiant exposure, visual condition at 10X	ASTM G 155 0.70 W/m^2 80 °C B.P.T.	No cracks No loss of breaking or tearing strength	

[1] Approximately equivalent to 8000 hours exposure at 0.35 W/m^2 irradiance. B.P.T. is black panel temperature 9/03

Roof Garden Waterproofing System

"Attachment II"
Roof Garden Matrix

March 2008

Shallow **Growth media up to 4" in depth**		
Components	**10/15 year**	**20 year**
EPDM	60 mil	75 mil
TPO	60 mil	72 mil
AFX-Plus	105 mil	105 mil + 2-Ply
Polystyrene	N/A	N/A
Protection Fabric	CCW 200V	CCW 300HV
Root Barrier	N/A	N/A
Drainage Board	CCW GR9200	Same
Moisture Retention Mat	21–22 oz./sq. yd. Polypropylene	Same
Medium **Growth media from 4" – 8" in depth**		
Components	**10/15 year**	**20 year**
EPDM	75 mil	90 mil
TPO	72 mil	80 mil
AFX-Plus	105 mil + 2-Ply	Same
Polystyrene	N/A	N/A
Protection Fabric	CCW 300HV	Same
Root Barrier	40 mil NR Geomembrane	Same
Drainage Board	CCW GR9200	Same
Moisture Retention Mat	Optional	Same
Deep **Growth media greater than 8" in depth**		
Components	**10/15 year**	**20 year**
EPDM	90 mil	Same
TPO	80 mil	Same
AFX-Plus	105 mil + 2-Ply	Same
Polystyrene	Insulfoam, Foamular or DOW (40 psi)	Same
Protection Fabric	CCW 300HV	Same
Root Barrier	40 mil NR Geomembrane	Same
Drainage Board	CCW MiraDRAIN HC	Same
Moisture Retention Mat	N/A	N/A