**SECTION 07 33 63.02**

**VEGETATED ROOF ASSEMBLY OVER PROTECTED PVC SINGLE-PLY MEMBRANE**

**Based On DFD Master Specification Dated (02/06/17)**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may need to add project related materials, delete items, or modify what is currently written herein, and yet maintain the integrity and intent of the quality specified herein. The Division of State Facilities expects your input and quality enhancement comments.

This section may change periodically. The date by the title is associated with the latest revision/change. DO NOT DELETE THE DATE. Obtain the most current specification section for each project. Pay special attention to all ’Notes to Specifier’ identified in blue typeface. Roof system options are identified within **[brackets]**. This language may be used or deleted as required by the scope of project. This section should be reviewed carefully as it has language for both new construction and re-roofing.

Owner recommends contacting DSF Project Managers Dave Bartelt and/or Lisa Pearson prior to the selection and development of the vegetated roof system and its plant/growth media specification. This section should be considered for new construction installation of vegetated roofing systems over concrete or steel decks with a minimum 1/4” per foot slope or existing construction remodel projects with a minimum 1/8” per foot slope, or confirmed positive drainage (for retro-fit applications).

Identify herein all Contractor and Agency expected routine and annual maintenance of the composite waterproof membrane vegetated roof system assembly over the 20-yr warranty and/or life cycle period including all expected and required routine maintenance and all system care costs associated with the following; watering, weeding, replanting, aeration of growth media, growth media testing and fertilization of the vegetated roof system.

Identify permanently secured or approved weighted railing and/or permanently secured safety tie-off equipment and locations of each on the bid document roof drawings.

Provide water availability on plumbing drawings for care of the vegetated roof system.

**PART 1 - GENERAL**

**scope**

The work in this section includes all materials, labor, tools, equipment, and services necessary to install a thermoplastic single-ply waterproofing system, integrated leak detection system, vegetated roof drainage components, insulation, growth media, plant media, hardscapes, and associated system components including metal flashing.

PART 1 - General

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Operation and Maintenance

Construction Verification

**RELATED work**

Applicable provisions of Division 1 shall govern work under this Section. The Contractor shall consult these provisions in detail prior to proceeding with work.

Related sections and divisions:

Section 05 52 00 – Metal Railings

Section 06 10 53.01 – Roofing Related Miscellaneous Rough Carpentry

Section 07 08 00 – Commissioning of Thermal and Moisture Protection

Section 07 63 00 – Sheet Metal Roofing Specialties

Section 07 72 33 – Roof Accessories

Section 22 11 00 – Facility Water Distribution

Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

Section 26 41 00.01 – Roof Level Lightning Protection Upgrade

Section 32 84 00 – Planting Irrigation

At a minimum, Code-compliant permanently secured, approved weighted railings, or permanently secured safety tie-off equipment and locations designed to protect maintenance personnel must be specified and installed around the perimeter of all vegetated roofing systems.

”Lightning Protection Systems” that must be removed, altered, interrupted or disabled to perform the new work must be upgraded at the roof level. The Contractors qualified lightning protection system Installer shall submit a written statement that the roof level portion of the installation would\* qualify for a UL “Master Label”.

Vegetated roofing systems must have a permanent available water source for temporary irrigation systems during initial plant establishment and for supplemental watering during drought periods. Temporary irrigation systems must cover 100% of vegetated areas without requiring re-location, adjustments, or other modifications to achieve complete coverage. Permanent irrigation systems are preferred when possible. If a permanent irrigation system is planned, confirm with Agency Contact and Owner prior to bidding.

All membrane surfaces must have continuous protection coverage. Those membrane areas not covered by the vegetated roofing system should have protecton material components and ballast or pavers. No roof surface waterproofing membranes should remain exposed.

In the event that the Contractor wishes to make improvements in materials and/or techniques, or is required to make improvements by his material manufacturer in order to obtain guarantees/warranties, he shall make written request stating in full the nature of the proposed changes and stating that the changes, if approved, will be accomplished at no increase in cost.

**REFERENCE Standards**

ASTM American Society for Testing and Materials

ASTM C1491-03 Standard Specification for Concrete Roof Pavers

ASTM D-448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction

CGSB Canadian General Standards Board

NRCA National Roofing Contractors Association– Vegetative Roof Systems Manual

FLL Forschungsgesellschaft Landschaftsentwicklung Landscahftsbau

ANSI/SPRI VF-1 – External Fire Design Standard for Vegetative Roofs

ANSI /SPRI RP-14 – Wind Design Standard for Vegetative Roofing Systems

USDA Plant Hardiness Zone Map

**guarantee and warranties**

State of Wisconsin Roof System 5-yr Guarantee: Provide written **five (5) year** guarantee warranting all roofing and flashing required under contract, to be watertight and free from defects in materials or workmanship for period of time, as stipulated in guarantee form.

Contractor shall perform a minimum of two (2) roof system inspections during the term of this guarantee. The first inspection shall be approximately two (2) years after installation date on five (5) year guarantee with final inspection performed within last 6-months of five (5) year guarantee. Contact Agency Contact to arrange a site visit date. Agency Contact will accompany the Contractor. Submit written inspection reports, e-mailed to Owner (DFD Project Manager) and Agency Contact immediately after inspection is performed and prior to guarantee expiration.

It is recommended that the Contractor take digital photos of the finished work for their files and future reference.

A copy of the required State of Wisconsin Roof System 5-yr Guarantee form shall be bound herein located at the end of this Section and may be acquired at the following State website; doa.wi.gov/DFD.

The Contractors Performance-Payment Bond is only required to apply to this trade section during the construction period and the first year of the guarantee period. Said Bond shall not apply to any extended guarantee period beyond the first year. Such extended guarantees are limited to the applicable Contractor and manufacturer as herein specified.

Contractor, sub-contractors and roof system suppliers shall review the guarantee required herein and its content prior to providing a quote for the work required by this Section.

Warranty shall include all labor and materials cost to inspect, repair, removal and replacement of all vegetated roof system components.

It is recommended that the Contractor take digital photos of the finished work for their files and future reference.

State of Wisconsin Vegetated Roofing System Manufacturer **20-yr Guarantee**: Provide written twenty (20) year guarantee for a Total System Warranty meeting the following requirements:

A copy of the required State of Wisconsin Vegetated Roofing System Manufacturer 20-yr Guarantee form shall be bound herein located at the end of this Section and may be acquired at the following State website; doa.wi.gov/DFD.

**Roofing Contractor shall sent application request for warranty(s) required herein to membrane supplier prior to start of Work.**

The roofing sub-contractor shall provide this Section to the membrane manufacturer and all component sub-contractors for review and acceptance of the requirements of the Section prior to submittal of bid costs for the work and performance required by this Section to obtain the required warranty.

All elements and components of the work and materials required by this Section shall be included and inclusive of the work performed by and the responsibility of, the roofer and/or the roofer sub-contractor(s) to provide the Total System Warranty as required herein.

Contractor, sub-contractors and roof system suppliers shall review the guarantee required herein and its content prior to providing a quote for the work required by this Section.

Provide a Roofing System Manufacturer’s Total System Warranty meeting the following requirements:

Leakage Warranty: The roofing system manufacturer shall warrant in writing that they will pay all costs of repair or replacement to the roofing system, including removal and reinstallation of all existing components including growth media and plant material necessary to stop leaks which occur during a period of **twenty (20) years** from the date of completion, as a result of workmanship or deterioration of the roof system. The warranty shall be a comprehensive, non-prorated, total system warranty covering labor and materials.

Thermal Warranty: The roofing system manufacturer shall warrant in writing that they will pay all costs of repair or replacement of thermal insulations, including removal and reinstallation of existing components including growth media and plant material, if thermal resistance of insulation material falls below 80% of the original published R-value requirements during a period of **twenty (20) years** from the date of completion. The warranty shall cover labor and materials.

Wind Speed Warranty: The roofing system manufacturer shall warrant in writing that they will pay all costs of repair or replacement to the roofing system, including removal and reinstallation of all existing components including growth media plant material necessary as a result of damage caused by wind speeds less than 55 miles per hour during a period of **twenty (20) years** from the date of completion. The warranty shall cover labor and materials.

Vegetation Warranty:

Verify plant material types that are warranted under manufacturer’s system, this may vary between extensive, semi intensive and intensive system. Excludes Owner supplied and installed annual plantings.

The roofing system manufacturer shall warrant in writing that they will pay all costs of repair or replacement to the roofing system vegetative media if vegetation does not cover 50% of the roof area after one (1) year of installation and 80 percent of the roof area after **two (2) years** of installation. For pre-vegetated mat systems, plantings will achieve 90 percent coverage of planted areas in year one (1) and maintain 90 percent coverage of planted areas in year two (2). The warranty shall cover all associated labor and materials.

Warranty shall cover failure of the vegetated system, including but not limited to failure of the plant media to thrive due to compression or decomposition of the growth media.

Vegetated Roof Component Warranty: The roofing system manufacturer shall warrant the material integrity of the vegetated roof components for a period of **twenty (20) years** from the date of completion. The warranty shall cover labor and materials against failure of components in vegetated roof covering system, except vegetation. Warranty shall cover errors in the design, material failure or defect, improper assembly, incompatibility of various components, and deterioration.

Contractor Maintenance Plan: As part of the scope of work, the contractor shall include a vegetated roof maintenance plan for a period of **three (3) years** following completion to include bi-annual system inspections, removal of unwanted plants and debris, cleaning of roof drains and maintenance borders, and maintenance recommendations to the Owner. Contractor shall provide written report to owner which documents inspection findings, actions taken, and results to be supplied to owner as a maintenance log at end of 3 year period.

Manufacturer Limitation of Liability: The following shall be acceptable limitations of manufacturer liability:

Overburden for Intensive Landscapes: The manufacturer shall not liable for:

The costs of overburden removal or replacement for overburden depths greater than twelve (12”) inches or removal of more than 100 square feet of overburden per individual leak.

If an individual leak occurs in a linear fashion more than five feet in length, the manufacturer shall not be required to remove and replace more than three-feet of overburden on either side of the line of leakage.

Total liability: The manufacturer’s total liability shall at no time exceed the original amount of the installed cost of the system, including material and labor.

Corrections of defects, imperfections, and faults shall not relieve the Manufacturer or Contractor from his responsibility for additional corrective work during the remaining time period.

The following information shall be included on all guarantee and warranty documents:

The Contractors Performance-Payment Bond is only required to apply to this trade section during the construction period and the first year of the guarantee period. Said Bond shall not apply to any extended guarantee period beyond the first year. Such extended guarantees are limited to the applicable Contractor and manufacturer as herein specified.

THIS IS MANDATORY. The Architect/Engeineer shall send one (1) copy each (In PDF/scan format via e-mail) of all Contractor submitted and “signed” roof system State guarantees, manufacturer warranties, manufacturer metal guarantee and other guarantees associated with the roof system to Owner at the following e-mail address; dave.bartelt@wisconsin.gov.

State of Wisconsin (Owner), Agency, city or township, street address where work was performed, building name, Owner Project number, Owner (DOA) building number, all roof areas involved and total sq. ft. area of all roof areas.

Membrane supplier material and installation requirements may vary concerning issuance of the NDL (“No-Dollar-Limit”)/”Total System” warranty.

Include and provide all product(s), labor and installation methods necessary and as specified herein, including manufacturer requirements not found specified herein, as required by the approved manufacturer to obtain the specified warranty requested herein.

New membrane, insulation, shop fabricated and/or manufacturer fabricated metal flashing, pre-molded and/or factory supplied associated roof system products, their fasteners and/or all products used for adhesive and/or adherence purposes and sealants shall be covered by the manufacturer” Total System” warranty specified herein and the State Guarantee.

Existing re-installed metal flashing and new wood blocking securement shall be covered in the State guarantee but not the membrane supplier NDL (“No-Dollar-Limit”)/”Total System” warranty specified herein.

Shop fabricated metal flashing materials as specified in section 07 63 00 and herein or as required for a complete watertight system may be provided in lieu of manufacturer fabricated metal flashing and shall be covered in the manufacturer total system warranty specified.

**QUALITY ASSURANCE**

Nothing shall substantially deviate from work included in this specification unless specifically approved in writing by Owner.

Refer to “Technical Documents and Other Submittal” for number of submittal required.

*[Submittal: For new construction or remodel projects with tapered deck structure or tapered insulation systems, the Prime Contractor shall setup a meeting between the roofing contractor, plumbing contractor and other contractors as required to coordinate the final drain location. A final roof drain and scupper drawing shall be submitted to the Architect/Engineer for review and approval after all locations are established. All penetrations shall be reviewed such that they do not impede water flow. Saddles and crickets may be required to transfer water around such obstructions.]*

Submittal: Take digital camera photos of all phases of the work, illustrating all layers and levels of the roofing and vegetated systems installations to be submitted to Owner in a timely manner throughout the installation period and as agreed upon by Owner or with final submittals.

Roofing Contractor shall submit manufacturer’s current written documentation stating that they and their roofer employees are ”approved applicators” in good standing able to perform quality work on new construction projects, remodel projects including mechanical and electrical new work penetrations or abandonment of existing roof penetrations that require minor system repair, replacement and/or new material installed into a portion of the existing roof system with intension to seam in to the existing roof system membrane to achieve a watertight condition. This requirement shall apply to all work requiring submittal of a State Guarantees and/or manufacturer warranties.

Roofing Contractor shall be recognized by the membrane supplier as an “approved” and “authorized” Contractor applicator of the roof membrane system and all associated products and components as specified herein. Contractor shall have been in business for a minimum of three (3) years and within the past three (3) years the Contractor shall be able to document the successful completion of a minimum of three (3) projects of similar size and/or scope of the Work as specified in this Section. Backup documentation/verification may be requested by the Owner.

Roofing Contractor shall notify the membrane supplier in writing of their intent to obtain all system material and send application for the warranty for work required herein. Letterhead documentation shall be sent to the membrane supplier and include a current date, indicate the Owner Project Number, bid document technical Section(s), indicate in full the composition of roof system to be install per bid documents and be signed by the Roofing Contractor Representative.

Membrane supplier shall provide Roofing Contractor with a current date written documentation reply stating the receipt of Contractor request including warranty application and statement that the Roofing Contractor is an ”approved and authorized Contractor applicator” in good standing, for the work specified herein. A copy of this letterhead documentation shall be submitted to Owner at the preconstruction meeting.

Such document shall include a current date, acknowledgement the Owner Project Number, bid document technical Section(s), include the roofing Contractor business name, certification status, year of issue and duration of such status.

SITE VISIT: Roofing Contractor shall notify membrane supplier of start date and arrange for membrane supplier to meet with the on-site foreman on the 1st or 2nd day after start of the Work. Notify the Agency Contact concerning the membrane suppliers visit so the Agency Contact may be present.

Changes or variations to the roof system composition as required herein shall be approved by the Owner.

Changes installed without Owner written approved shall be cause for rejection of the Work in its entirety.

Roofing Contractor on-site Foreman shall be approved by the membrane supplier and shall remain on-site throughout the duration of the project.

Contractor workers employed on this project shall be recognized by the supplier of the roof membrane system as “approved” or “authorized” applicator(s) and within the past two (2) years, the worker shall be able to document the successful completion of a minimum of three (3) projects of similar size and/or scope of the Work as specified in this Section.

All roofers by trade, and employed on this project shall have a certificate of successful completion of training for the system to be installed. Undocumented roofers shall not be allowed to perform the work required herein pertaining to the physical placement/installation of any and all of the roof system components specified herein.

Membrane supplier certificate of successful completion of training for each roofer employed on this project shall be submitted to Owner. Document shall be up to date, indicate worker name, certification status, year of issue and duration of such status.

Contractor shall provide a list of all workers to be employed on this project. The list shall indicate each of the workers by name and their construction trade including the Project foreman and Contractor main office contact person.

List shall include after-hour/weekend emergency phone contact personal and their office and cell phone numbers, for use in case of emergency situations.

Labors, sheet metal workers or other non-roofer employees shall not be allowed to perform the actual installation of any part of the membrane suppliers warranted roof system required by this Section without manufacturer documentation of proper training, as required herein.

Contractor shall obtain and provide Owner with the membrane suppliers most current dated three (3) ring or spiral bound installation and detail manual.

Contractor shall perform work required using details provided within the specifications, on the drawings or as required by the membrane supplier for a proper watertight installation and to allow issuance of warranties required herein.

All system components not specifically identified herein but required by the membrane supplier for the roof system installed by the Work required in the Project Manual shall be provided and included in the membrane supplier watertight warranty as required herein. System components required by the Work in the Project Manual but otherwise not warranted by the membrane supplier shall be upgraded to be membrane supplier specific products at the time of bid such that they are covered by the warranty required herein.

Provide all equipment recommended by the membrane supplier for proper installation of the materials specified.

Roofing installations shall comply with fire resistive rating as defined in the Wisconsin Administrative Code. Required rating on these roofs: U.L. Class A.

**Prior to the start of construction, it is required that the Contractor’s foreman shall be in attendance at preconstruction/pre-installation meeting(s).**

It is the responsibility of the Lead Contractor to obtain the services of a competent Contractor for the following associated Work.

Electrician Contractor: For removal and reinstallation of roof curb-mounted exhaust fans and associated covers, ventilators, electrical equipment associated wiring connections at the unit(s) as required to perform the Work.

Plumber Contractor: To re-lead drain pipe, repair and/or reset the roof drain bowls to interior piping as required to perform the Work required on this project.

Mechanical Contractor: For removal of belt, chain driven and/or electrical exhaust fans and associated flex connection and duct runs/piping and its associated roof curb penetration.

Raise all existing [install new] mechanical and electrical trade’s roof system penetrations to a minimum height of 8” above the finished roof system including growth and plant media.

Contractor shall notify the Agency Contact 24 hours in advance of all Electrical, Plumbing and Mechanical disconnections.

Integrated Leak Detection System Installing and Testing Firm: To verify waterproofing membrane is free of any holes, open seams, and capillary defects that will allow water infiltration. Installing and testing firm approved or certified by membrane leak detection system manufacturer, with minimum three year record of satisfactory experience.

Landscape Contractor: For installation of growth media and plant media, required maintenance, weeding, irrigation, etc. Landscape Contractor must have prior experience with the installation of vegetated roofing systems. Within the past three (3) years, the Landscape Contractor shall be able to document the successful completion of a minimum of one (1) project of similar size and scope of the work specified in this section. Landscape Contractor must have sufficient training and equipment to comply with all applicable fall protection requirements.

[Lightning Protection Contractor: For removal, re-installation, replacement of broken components and written verification as stated in specification section 26 41 00.01 of existing cabling, lightning rods, associated products and proper anchoring, fastening and/or adherence of all of cabling and rods and/or rod base plates. Verify that this installation does not interfere with the proper installation of the roofing metal flashing and its clip/cleat fastening point.

The lightning protection system rods shall not be installed/fastened to any horizontal portion of the roof system metal flashing or coping.]

All roofing penetrations shall extend a MINIMUM of 8” above the finished roofing system including plants and growth media.

It is the responsibility of the Agency to perform inspection of the roof areas to be replaced by this project and to provide the following services:

State Agency: Existing Electrical, Plumbing and Mechanical installations and associated equipment pipe and duct runs shall be identified/verified by the Agency Contact as in use or be spray painted in ORANGE by the Agency Contact if they are abandoned or shall be abandoned and shall be removed by the Roofing Contractor, and verify that the electrical run is terminated, prior to start of work by Contractor. Electrical conduct runs lying directly on the existing roof membrane shall be relocated by the Agency Contact prior to start of work.

It is the responsibility of the contractor to include a sufficient allowance for third-party collection and laboratory analysis of the growth media to verify compliance with this specification. One test shall be required for each 100 cubic yard of growth media produced for the project and shall be conducted by an approved testing agency / laboratory. Testing shall follow FLL and ASTM procedures.

At the discretion of Owner, a third-party may be selected and retained by Owner to perform bidding and installation review and assessment.

**product DELIVERY, STORAGE AND HANDLING**

Make no deliveries to the project site until ready to install or approved storage is provided. The State will not accept delivery nor will the State be responsible for any materials or equipment stored on the premises.

Protect landscape (hard and soft) and all work in place from damage resulting from the storage, preparation, handling and application of waterproofing.

Deliver materials in original unopened containers of packaging clearly labeled with manufacturer’s name, brand name, instructions for use, all identifying numbers and U.L. labels.

Keep all materials dry while they are transported, stored or installed. Do not allow materials to be exposed to any moisture anywhere, at any time, during transportation, storage, handling and installation. Reject and remove from the site any new materials which exhibit evidence of moisture during application, or have been exposed to moisture. Reject and remove from the site any material which has moisture content more than 10 percent greater than the Equilibrium Moisture Content (EMC) at 90 percent relative humidity.

Growth media shall be protected from compaction or contamination during storage.

Store moisture sensitive materials in a clean, dry area protected from water and direct sunlight.

Store all adhesives at temperatures between 60°F (15.5°) and 80°F (26.6°C). If exposed to lower temperatures, restore materials to 60°F (15.5°C) minimum temperature before using.

Store all materials on raised platforms with weather protective coverings. The manufacturer’s standard packaging and covering is not considered adequate weather protection. Tarpaulins are preferred for protection of all roof materials. If visqueen coverings are used, venting of each package is required. MATERIAL STORAGE WILL BE CONSTANTLY MONITORED AND STRICTLY ENFORCED.

Materials stored on roof and plaza decks shall be limited to the safe loading of installed materials, decking and structural framing.

**TECHNICAL SUBMITTALS AND OTHER DOCUMENTS**

At [Before] the preconstruction meeting and prior to start of work, submit the following for approval by Owner:

The following information shall be included on all submitted documents:

Agency/Location/Address where work is performed obtained from the Agency Contact listed to include Building Name, Bldg. State Number, Roof Areas, DFD Project Number and total sq. ft. of all roof areas.

MEMBRANE SUPPLIER WARRANTY ACKNOWLEDGEMENT

Upon receiving the Contract Offer from the Owner, Contractor shall immediately notify the membrane supplier of intent to purchase the product and to obtain the warranty as specified by this Section.

Submit three (3) copies of the Contractors dated notification letter sent to the membrane supplier.

Submit three (3) copies, on membrane supplier letterhead, stating acknowledgement of such notice and agreement to provide the warranty required by this Section. The letterhead acknowledgement shall include the date such letter was issued, Owner Project title, Project number, Section number(s), membrane supplier representative signature and be addressed to the Roofing Contractor.

CONTRACTOR AND WORKER QUALIFICATION

Submit three (3) copies of the membrane suppliers current written documentation stating the Contractor is an ”approved Contractor applicator” in good standing, for the work specified herein shall to be submitted to Owner at the preconstruction meeting. Document shall be up to date, indicate Contractor name, certification status, year of issue and duration of such status.

Submit three (3) copies of the membrane supplier’s certificate of successful completion of training for each roofer employed on this project shall be submitted to Owner at the preconstruction meeting.

Document shall be up to date, indicate worker name, certification status, year of issue and duration of such status.

Submit: Three (3) copies of a list of all workers to be employed on this project. The list shall indicate each workers name and trade. Project supervisor and main contact person shall be identified. List shall include after-hour/weekend emergency phone contact personal and their office and cell phone numbers. (See Quality Assurance herein)

ROOF DRAIN VERIFICATION

Submit: Three (3) drawing copies indicating location of coordinated drain and scupper locations. For new construction or remodel projects with tapered deck structure or tapered insulation systems, the Prime Contractor shall setup a meeting between the roofing contractor, plumbing contractor and other contractors as required to coordinate the final drain location. A final roof drain and scupper drawing shall be submitted to the Architect/Engineer for review and approval after all locations are established. All penetrations shall be reviewed such that they do not impede water flow. Saddles and crickets may be required to transfer water around such obstructions. (See Quality Assurance herein)

MEMBRANE SUPPLIER INSTALLATION INSTRUCTIONS

Submit: Two (2) copies of the manufacturer’s most current paper-copy installation/instruction and detail manual concerning the installation of the roof system and all associated products that will be used in this project. One copy shall be turned over to the Agency Representative at the preinstallation meeting or before. (See Quality Assurance herein)

Submit web-site information to allow access to membrane supplier’s most current installation and detail manual. (See Quality Assurance herein)

INSTALLATION DETAILS AND REQUIREMENTS

Submit three (3) copies of manufacturer reviewed construction documents conducted by an authorized manufacturer’s technical representative. Review shall be conducted for each project and shall approve all details intended for use will meet or exceed manufacturer’s warranty requirements. All copies shall be dated, signed by manufacturer representative and include the Owner Project number.

RECYCLED MATERIALS

Submit three (3) copies of a Waste Management Plan to Owner for review. Include recycle business name, address, contact person, and phone number where all recycled roofing material removed by this project will be delivered.

MATERIAL LIST

Submit three (3) copies of a list of all materials intended for use on the project, to include roofer and all other sub-contractor composite system materials, starting at the roof deck and identified by manufacturer's name, size, thickness, type or grade. List shall be submitted on Roofing Contractor's letterhead stationery. Submit product data sheets as required.

Contractor shall state the following on the material list submittal:

**“New products installed on this project do not contain asbestos”.**

When removing an existing roof where existing materials might contain asbestos, insert the following paragraph(s):

*[INCLUDE THE FOLLOWING WHEN WORKING ON EXISTING ROOF SYSTEMS]*

[ASBESTOS TESTING

Submit three (3) copies of test results including a drawing indicating location where tests samples are taken. Contractor replacing the roof system is required to take a minimum of two (2) samples of existing roof system(s) components encountered starting at the roof deck including existing vapor retarder, to be sent to a testing lab. Take (1) sample at the base flashing and one (1) sample from the field of the roof. Additional samples are required where roof areas are not of the same roof system or installation period. Each test result shall properly identify the Owner Project No., project location, bldg. name, bldg. number & roof area/location where the test sample was taken. Test lab and associated removal and disposal charges shall be the responsibility of the Contractor at no additional cost the project.

A Contractor owner or employee shall have taken the exterior asbestos supervisor course and possess current documentation that they are an ‘Exterior Asbestos Supervisor’ able to take existing roof system samples as required to be tested for possible asbestos contamination.

All workers removing asbestos must be certified to perform the work.

ASBESTOS – POSTIVE RESULTS

Submit three (3) copies of the necessary regulatory notifications for asbestos removal or three (3) copies of core sample test results indicating the roofing materials slated for removal do not contain asbestos. (Refer to General Requirements Article “HAZARDOUS SUBSTANCES – ASBESTOS, LEAD AND POLYCHLORINATED BIPHENYLS (PCB’S)” for additional information.)

Test lab results must be submitted prior to start of work.]

PLANT MEDIA LIST

Submit three (3) copies of a list of all nursery sources and their location, plant species lists, quantities, size, root condition, and confirmation of availability of materials for installation per project schedule. Substitutions will only be considered for lists submitted at the preconstruction meeting. No late submittal substitutions will be accepted.

GROWTH MEDIA ANALYSIS

Three (3) copies of a list of all certificate of compliance of the growth media mix that it meets density, air filled porosity, water holding capacity, hydraulic conductivity, particle size distribution, organic matter, pH, soluble salts and other chemical parameters as described in this specification. Testing shall follow FLL and ASTM procedures. The submittal should include testing analysis for growth media samples from an approved laboratory. (Example: Agricultural Analytical Services Laboratory, College of Agriculture Sciences, The Pennsylvania State University, University Park PA 16802, 814-863-0841, www.aasl.psu.edu. (NO GROWTH MEDIA SUBSTITUTIONS ACCEPTED.)

THIRD PARTY ANALYSIS

It is the responsibility of the Contractor to include a sufficient allowance for third-party collection and laboratory analysis of the growth media to verify compliance with this specification. Contractor shall submit third party results of such analysis toOwner for review and approval. Submit three (3) copies of a list of third party contacts, company name, contact personal and their phone numbers.

CHEMICALS AND FERTILIZER IN GROWTH MEDIA

Submit three (3) copies of the following. Provide written documentation describing type and amounts of fertilizer and chemicals that are in the growth media and/or products approved for use as part of the vegetated roof system at the time of installation. Products must be acceptable and approved for use in the State of Wisconsin and the municipality where they are being installed. Products must not generate harmful by-products as they migrate through the growth media which are deleterious to the storm water run-off system.

ONGOING GROWTH MEDIA TESTING AND FERTILIZATION SCHEDULE

Submit three (3) copies of the following. Provide a 20-yr system growth media and fertilization requirements and testing schedule obtained from the vegetated roof system manufacturer indicating future time future time lines for the testing and re-fertilization of the growth media by the Owner. The schedule provided shall reference the project approved plant growth media.

VEGETATED PLANT MEDIA LIFE EXPECTANCY

Submit three (3) copies of the following. Contractor shall provide a written statement obtained from the vegetated roof system manufacture illustrating the expected normal life cycle and replanting time frame of each one of the plants in the approved plant media system.

INSTALLER AND PRODUCT CONTACT INFORMATION

Submit three (3) copies of the following. Contractor shall submit a complete written inventory of all Contractors and suppliers associated with installation, supply and service of the roof waterproof membrane system and the vegetated roof system to include all associated roofing material, vegetated system equipment, supplies, plant media, extended care provider and all warranty providers. The inventory list should include company names, contact person(s), e-mail address, phone number, fax number and product and services provided to the project.

At the discretion of Owner, a third-party may be selected and retained by Owner to perform bidding and installation review and assessment.

SAFETY REPORT

Submit one (1) copy of a written report to be given to the Owner at the preconstruction meeting, describing in detail the Contractors implementation of specific OSHA regulations, Contractor’s worker safety program methods/means, roof perimeter safety and identification of the “watch person” required at all roof levels. Identify fire extinguisher and their locations, all equipment/operators on roof/ground in setup/storage area and travel routes used while performing the work.

INTEGRATED LEAK DETECTION SYSTEM INSTALLATION AND TESTING REPORT

Submit three (3) copies of proposed system diagram showing complete monitored area, rooftop structures and equipment, and roof penetrations for building utilities and services. Show location of integrated leak detection system conductor cable, measurement grid, and contact boxes.

MSDS DATA

Submit one (1) copy of all MSDS paperwork for each products used on this project to be given to the Owner at the preconstruction meeting.

EMERGENCY AND OFFICE CONTACT PHONE LIST

Submit one (1) copy of the Contractor’s office superintendent and job foreman daytime, after hours and weekend phone contact numbers to be given to the Owner at the preconstruction meeting.

Maintain at least one (1) copy of the following at the project site throughout construction:

Specifications, drawings, addenda, value enhancement, change order and all approved submittals.

Latest version of the manufacturer’s handbook including details and technical information concerning application techniques for all primary roofing system materials required by the work.

Material Safety Data Sheets (MSDS) manual for all materials used on this project.

**SUBMITTALS - FINAL DOCUMENTS REQUIRED UPON COMPLETION OF THE WORK**

**Prior to final payment, submit the following to Owner as one (1) package including a cover page listing all documents sent:**

The following information shall be included on all guarantees, warranty and other submittal documents:

Agency, city or township, street address where work was performed, building name, Owner Project number, Owner (DOA) building #, all roof areas involved and total sq. ft. of all roof areas.

DIGITAL PHOTOS

Provide digital camera photos throughout the project as required by these specifications and/or requested by Owner. Contractor shall take multiple digital camera photos of the following to be submitted electronically, via e-mail to Owner. Cell phone photos are not acceptable.

Submit digital camera photos’ of the various difficult watertight locations and mechanical fastening that will be hidden from view or otherwise concealed beneath the completed work. Multiple photos shall be taken of the entire installation starting at the roof deck and continuing throughout the roof system and vegetated system installation as it progresses in layers, as required per specification.

Submit digital camera photos’ of all changes to the scope of work to include existing conditions as the work takes place in its various stages [of demolition and]of the new as it takes place in its various stages.

Provide digital camera photos’ of the completed work. Photos shall include the various metal flashing details, transitions and penetration height changes and in general an over-all view of the field of all roof areas. Photos shall be identified by the roof area where photos are taken.

[RECYCLED MATERIALS

Submit three (3) copies of a completed Waste Management Plan to Owner [Architect\Engineer] for review. Include recycle business name, address, contact, and phone number where all recycled roofing material removed by this project will be delivered.

Upon completion, Contractor shall submit a final summary of the progress reports, including the percentage of recycled waste (weight or volume) to the quantity of waste that would have been otherwise land filled.

Submit recycler receipt for all deliveries showing all received product their weight and % calculation as described in GENERAL REQUIREMENTS, Article 28.

Submit a final summary of the progress reports, including the percentage of recycled waste (weight or volume) to the quantity of waste that would have been otherwise land filled.

Submit recycler receipt for all deliveries showing all received product their weight and % calculation.

Material kept for reuse and delivered to the Contractor’s property or given away at the site by the Contractor shall be identified as well. The total sq. ft/bulk sum of all material shall be recorded and submitted.

[Contact the following or another recycling company to arrange for pick up of EPDM and/or whole-piece insulation intended for disposal by the Contractor.

“Nationwide Foam, Inc.”: Recycles insulation and will arrange for flatbed drop off and removal at a cost less than landfill fees. Contact: Ken Wardrop at (888) 820-2760 Ext. 29 or e-mail at ken@nationwidefoam.com.

Contact local concrete companies or earth fill providers concerning disposal of existing concrete and/or stone ballast.

Contact a metal recycling company for metal debris containers, pickup or delivery of metal debris intended for disposal.]

[WASTE MANIFEST

Submit two (2) copies of the Waste Manifest Records to Owner if required in accordance with General Requirements Article “HAZARDOUS SUBSTANCES – ASBESTOS, LEAD AND POLYCHLORINATED BIPHENYLS (PCB’S)”.]

[AS-BUILT DRAWING

Submit one (1) copy of a fully dimensioned as-built roof plan showing all seam and patch locations, actual locations and sizes of roof drains, vents, fans, etc.]

STATE OF WISCONSIN ROOF GUARANTEE:

Submit one (1) original guarantee as required herein. (Refer to GUARANTEE article in Part 1 of this Section).

MEMBRANE SUPPLIER ROOF WARRANTY

Submit one (1) of the original membrane suppliers warranty of all membrane warranties required herein. (Refer to GUARANTEE article in Part 1 of this Section).

MISCELLANEOUS METAL WARRANTY:

Submit one (1) original of manufacturer warranty as required by Specification Section.

[LIGHTNING PROTECTION CERTIFICATION**:**

Submit one (1) original document of all testing required by Specification Section 26 41 00.1).]

SETTLEMENT CERTIFICATE [AND WAGE RATE AFFIDAVIT]:

Submit one (1) copy of each document.

INTEGRATED LEAK DETECTION SYSTEM TESTING FIRM REPORTS

Submit one (1) copy of all test reports, for each required test. Field Quality Control Report to include digital drawings, digital photographic documentation, and written report detailing location and nature of membrane breaches, defects found, and verification of corrective actions taken.

**PROJECT CONDITIONS**

Application of the membrane shall not commence nor proceed during inclement weather. All surfaces to receive the membrane shall be free of water, dew, frost, snow and ice.

Perform all Work under temperature and climatic conditions recommended by materials manufacturer.

After demolition, any existing membrane residuals shall be removed or rendered to the satisfaction of the waterproofing manufacturer.

The concrete surface shall be free of excessive roughness, voids, protrusions and exposed aggregates.

The concrete surface shall be free of laitance, loose mortar, oil and all other contaminants.

Moisture content of concrete shall be tested immediately before application of any membrane material, using a moisture meter or other approved method. The concrete shall be dry.

Adhesives contain petroleum distillates and are extremely flammable. Do not breathe vapors or use near an open fire. Do not use in confined areas without adequate ventilation. Consult container or packaging labels and Material safety Data Sheets (MSDS) for specific safety information.

Protection of surfaces

Take every precaution to prevent water leakage or debris falling into building interior or other such occurrences. Contractor is responsible for any damage to the building interior or contents during construction.

Provide special protection or avoid heavy traffic on completed work. Temporary protection shall be erected/installed at all interior and exterior locations as required to prevent damage or marring of existing surface. Walkways and work platforms shall be provided as necessary.

Wall surfaces shall be protected with suitable cover to prevent damage, staining or discoloration that might result from operations such as removal, disposal, replacement or removing equipment or materials to the roof surface.

Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, etc.) to come in contact with waterproofing membrane. Any exposure to foreign materials or chemical discharges must be presented to membrane manufacturer for evaluation to determine any impact on the water proofing membrane assembly performance.

Provide provisions for temporary ballast of installed components to protect against blow-off until completion and greening of roofing system.

Disposal of materials

All materials to be disposed of shall be loaded directly onto truck by means that will prevent damage to all existing new surfaces and to control pollution. Free-fall of debris from roof will not be allowed.

**OCCUPANCY**

The Owner shall occupy the building during demolition and construction and the facility shall remain operational.

Coordinate all work in advance with the Owner.

**DUST CONTROL**

When work involves removal of roofing material not containing asbestos:

It is imperative that dust be kept to a minimum during removal of the roofing system.

Debris shall be transported on covered trucks.

Debris shall be removed as it accumulates.

As it pertains to interior conditions, no excessive disturbance of the structure which causes air‑borne debris will be tolerated.

**PRE-INSTALLATION CONFERENCE**

A job site meeting of the Contractor, Waterproofing Contractor, Waterproofing Manufacturer, [Plumbing Contractor], [Electrical Contractor], [Landscape and Irrigation Contractor], Architect/Engineer, Owner, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof mounted equipment shall be held to verify all conditions.

Demolition work shall be completed to such a degree, prior to this meeting, that all types of subsurface conditions are exposed and prepared for membrane installation.

All prints, drawings and specifications affecting the Work of this Section shall be examined.

The Contractor shall schedule this meeting. Notify all parties of the time a minimum of seven days prior to the meeting date.

Waterproofing installation shall not start until after this meeting.

Review methods and procedures related to roofing installation, including manufacturer’s written instructions.

Review and finalize construction schedule and verify availability of materials. Contractor’s personal equipment and facilities needed to avoid delays.

Review requirements for deck substrate conditions and finishes, including flatness and fastening.

Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

Review temporary protection requirements for the roofing system during and after installation.

Review roof leak testing, observation and repair procedures after roofing installation.

Do not proceed with installation of vegetated roof components over sections of the waterproofing until after integrated leak detection testing and report is submitted including verification of repairs.

Waterproofing must be accepted by the Owner, Architect/Engineer, Contractor and Roofing Manufacturer.

**WORK SEQUENCE**

The Contractor shall sequence the waterproofing work with the other work of the Contract so as not to necessitate construction traffic from this or other trades over unprotected waterproofing membrane.

Contractor shall coordinate the Work with installation of associated roofing, waterproofing, flashings, and roof accessories specified under other sections as the Work of this Section proceeds.

Sequence the Work with attention to preventing deterioration of installed roofing by minimizing the use of newly constructed roof deck for storage, walking surface, and equipment.

Do not install membrane system materials when precipitation is imminent.

Do not proceed with installation of vegetated roof components over sections of the waterproofing until after integrated leak detection testing and report is submitted including verification of repairs. Waterproofing must be accepted by the Owner, Architect/Engineer, Contractor and Roofing Manufacturer.

**PART 2 - PRODUCTS**

**mEmbRane Suppliers and materials**

Owner has pre-approved specific membrane manufacturers and membrane suppliers whose membrane is manufactured and labeled specifically for them.

Approved Membrane Manufactures and Membrane Suppliers: Basis of system design – Restricted Manufacturers:

Sika Sarnafil; Manufacturer

Versico Roofing Systems; Supplier - Membrane manufactured by Carlisle SynTec Systems.

Flex Roofing Systems; Manufacturer

Manufacturer shall have had membrane in use for a minimum of fifteen (15) years.

Unapproved Manufacturer and/or Supplier products installed on the Project shall be cause for rejection of the roof system in its entirety and shall be completely replaced at no cost to the Project.

All associated products required by the Manufacturer and membrane Supplier for proper, complete and warranty specified installation of the specified membrane shall be approved and provided by the approved membrane Manufacturer.

Use new materials only; salvaged or used materials are unacceptable and shall be removed from the site and be recycled.

**INSULATION MATERIALS**

It is required to design roofs in accordance with the provisions of the State Energy Code relative to system “U” value. When specifying tapered insulation, use average thickness for basis of calculations. Vegetated roof systems shall include an additional 10% R-value above what is required to compensate for cold-water thermal performance losses. Tapered insulation layout drawing submittal shall state the average R-value to be achieved by the new roof system prior to approval of the system. A coverboard is required over rigid insulation.

A minimum of two-layers of Extruded Polystyrene Rigid insulation meeting the following requirements shall be used:

Minimum Compressive strength: ASTM D-1621, 40 psi.

ASTM C-578, Type VI

Maximum water absorption by volume, ASTM C-272, .1%

Minimum R-value per inch of 5, ASTM C-518.

Acceptable products are Roofmate by Dow Plastics and Foamular 404 / 404 RB by Owens-Corning.

[Tapered Insulation: ASTM C1289, Type II, Class 1, Grade 2; rigid board Polyisocyanurate insulation with felt or fibrous mat facing on both sides, factory tapered to [1/8”] [1/4”] [1/2”] per foot slope. Tapered insulation board shall have a start thickness at the perimeter of the roof drain sump of 1/2”. Maximum board size = 48” x 48”; maximum board thickness (including fill boards) = 2-1/2”. ”. Insulation system design and layout drawing provided shall indicate a minimum of two (2) layers to allow for staggering of insulation joints in both directions.]

[Tapered Insulation: ASTM D 1621 40PSI ridged extruded polystyrene insulation factory tapered to [1/8”] [1/4”] [1/2”] per foot slope. Tapered insulation board shall have a start thickness at the perimeter of the roof drain sump of ½”. Maximum board size = 48” x 48”; maximum board thickness (including fill boards) = ½”. Insulation system design and layout drawing provided shall indicate a minimum of two (2) layers to allow for staggering of insulation joints in both directions.]

[Polyisocyanurate: ASTM C1289, Type II, Class 1, Grade 2; rigid board insulation with felt or fibrous mat facing on both sides. For mechanically attached boards, maximum size = 48" x 96"; for adhered boards, maximum size = 48” x 48”. Thickness = [1-1/2”] [2.0”].

[Thermal Barrier / Cover board, Gypsum: 1/2” Minimum thickness, ASTM C36, FMRC Class 1, UL 1256, UL Class A, 4’ x 4’ maximum board size for asphalt and adhesive applications; 4’ x 8’ maximum board size for mechanically attached and loose-laid applications.]

**VAPOR RETARDER**

[None required.]

6 mil polyethylene sheeting is required on all roof decks prior to installation of new roofing. Based on interior design conditions, the specifier shall specify one of the vapor retarder systems as required.

[Vapor Retarder: Minimum requirement: 6 mil Polyethylene sheeting.]

[Vapor Retarder: Consisting of two (2) plies No. 15 organic felt set into full mopping of (minimum twenty five (25) pounds per square) of hot asphalt directly adhered to the [concrete] [thermal barrier mechanically attached to the steel roof deck. Thermal barrier shall be attached to the steel deck with a minimum of eight (8) fasteners per 4x8 board or manufacturer’s requirements, whichever is more conservative.]

[Vapor Retarder: Membrane manufacturer’s approved self-adhered vapor retarder with a perm rating of .5 or less directly adhered to the [concrete] [thermal barrier mechanically attached to the steel roof deck. Thermal barrier shall be attached to the steel deck with a minimum of eight (8) fasteners per 4x8 board or manufacturer’s requirements, whichever is more conservative.]

[Vapor Retarder over Steel Deck and Concrete Deck NOT Sealed at Perimeters:

A minimum 6-mil vapor retarder shall be specified and required over the entire metal roof deck and be tape sealed at membrane lap, perimeter and all penetrations, on all new construction Project roofs, remodel Projects or mechanical equipment Projects penetrating the existing roof system and requiring roof replacement, where the interior of the building will be open to outside elements during construction or closed off from outside elements for protection to perform wet work and to provide heated areas at the interior under the new roof system. The vapor retarder will help prevent moisture transfer into the new roof system insulation during interior Work.]

**INTEGRATED LEAK DETECTION SYSTEM COMPONENTS**

Integrated leak detection is required on all vegetated roof projects. An on demand system is the minimum required.

Conductor cable, conductive mesh/grid, measurement grid moisture detection tape, sensor cable/grid, and/or conductive glass felt etc. as necessary to affect a complete integrated leak detection system as required per manufacturer.

The following systems are Restricted Manufactures for the project:

On Demand Leak Detection system: Electric Field Vector Mapping® (EFVM) by International Leak Detection Inc., Electronic Leak Detection (ELD) by Honza Group Incorporated, Electric Gradient Leak Locate (EGLL) with IntegriScan by Detec systems, Smartex VM Vector mapping by Progeo®.

Continuous Monitoring Leak Detection system: Electro-resistive system, Smartex IS by Progeo®.

**WATERPROOFING AND PROTECTION COMPONENT MATERIALS**

Membrane system shall be an 80-mil minimum thickness reinforced thermoplastic waterproofing system. Membrane systems shall meet or exceed ASTM D4434 or D6754-02.The following systems are approved for the project:

Sika Sarnafil G476-20; Sika Sarnafil, Canton, Massachusetts

Versiflex Reinforced FRS 80 Mil Membrane; Versico, Inc., Carlisle, PA

Flex MF/R 80 Mil; Flex Roofing Systems; Leesport, PA

Membrane Flashing: Reinforced and un-reinforced membrane flashing as recommended by the membrane manufacturer.

Bonding Adhesive: Membrane bonding adhesive for flashings and field membrane as required by the membrane manufacturer.

Water-Base Adhesives: Are not-acceptable when adhering membrane to insulation on mechanically fastened systems where the fastener plate is directly below and in contact with the underside of the membrane to be adhered to the insulation.

[Grid Adhesive: For loose-laid membrane applications: manufacturer’s urethane sealant for horizontal and vertical applications.]

Protection Sheet: Manufacturer’s fabric or similar component to provide membrane protection is water permeable, durable synthetic fiber material with good resistance to puncture. May be an integral part of a drainage panel. Protection sheet shall NOT be treated with chemical root-growth inhibitors.

[Root Barrier: IF REQUIRED, manufacturer approved water-permeable root barrier/protection sheet. Protection sheet shall NOT be treated with chemical root-growth inhibitors.]

[Membrane Separation /Leveling/Protection Component: Manufacturer’s approved membrane to separate waterproofing membrane from concrete and contaminated substrate conditions deleterious to membrane performance and durability.]

**DRAINAGE MATERIALS**

Appropriate drainage mat must be selected based on the type of roofing system being installed i.e. extensive, semi-intensive, or intensive. Wherever possible and weight restrictions allow, lightweight aggregate is preferred for use over drainage composites.

Pre-fabricated Drainage Course: Pre-fabricated drainage and protection material.

[Slope Retention Systems: Manufacturer’s slope retention system approved / required for use with vegetated systems installed at slopes greater than 1:12 or when required by the system manufacturer.]

Moisture retention mat: manufacturer’s non-woven geotextile fabric intended to retain water and particulates to provide support for plant media. Water retention capacity of not less than .2in/ft sq will be necessary.

Filter Fabric: non-woven polymeric geotextile fabric.

**EDGING / MEDIA RETAINER**

Sides of edging should not be left exposed. Pavers, ballast or growth media should be designed so that they are within an 1” of the top of the edging, especially along maintenance routes. Corners shall be prefabricated and compatible with adjacent edging pieces. Edging should have drainage holes or perforations to allow a free flow of water but hold growth media in place. Drainage flow rate must meet FLL or ASTM standards. Minimum thickness of .1” Edging should be fabricated with a base system to be held in place by the growth media or ballast.

Edging: [Mill Finish Aluminum] [Stainless and Epoxy Powercoat] with drainage openings, prefabricated corner sections, and clips and connectors

Configuration: [L-shaped] [T-shaped]

Gauge or Thickness: [.100”] [.210”]

Wall and Base Size: [3” to 8.5” in .5” increments x 3.25” to 7.5” in .5” increments]

Method of Attachment [ ]

**GROWTH MEDIA MATERIALS**

Confirm appropriate growth media for each specific project. Final plant selection must be approved by Lisa Pearson, ASLA, at DSF, Lisaj.pearson@wisconsin.gov.

If rapid vegetation cover is desired for the project use pre-planted mat systems secured to the growth media.

Owner will not allow the use of pre-planted modular tray systems. Systems that provide, upon intallation, growth media that is 100% continuous and allows unrestricted root growth, water and nutrient transmittance may be considered as similar to a built up system.

**Extensive Vegetated System**

The following growth media shall be used for extensive roof systems with growth media depths three (3”) to five (5”) inches in depth:

Property Requirement

Grain Size Distribution

 Clay fraction < 1%

 Passing #200 sieve 1-3 %

 Passing #60 sieve 5-25%

 Passing #18 sieve 20-50 %

 Passing 1/8-inch sieve 55-95 %

 Passing 3/8” sieve 90-100 %

Density

 Application Density 38 lbs – 69 lbs / cf

 Saturated Density 56 lbs – 87 lbs / cf

 Dry Density 31 lbs – 62 lbs / cf

Water and Air Management

 Saturated water capacity > 30 %

 Saturated air content > 10 %

Saturated Hydraulic Conductivity > 1.4 in/hr

pH, Lime, and Salt Content

 pH (saturated paste) 6.0 – 7.5

 carbonate content < 25 g/l

 salts content (water extract) < 2.5 g/l

Organics

 OM content 3 – 6 mass %

 C/N ratio < 20

Nutrients in lb / 1000 CF

 Nitrogen (NO3) 3 – 15

 Phosphorous 1 – 7

 Potassium 6 – 15

 Calcium 19 – 65

 Magnesium 3 – 15

 CEC Capacity >5 cmol/kg

Compost Fraction

Meet or exceed USEPA Class A Standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32 (a) (pathogens) and/or be permitted in the state of origin to produce Class A material.

Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.

Values shall be adjusted due to availability of local materials or special project conditions related to plant selection and or environmental conditions.

Nutrients shall be adjusted with appropriate slow-release fertilizer with micronutrient additions if below lower target range.

**Semi-Intensive Vegetated System**

The following growth media shall be used for extensive roof systems with growth media depths equal or greater than five inches (5”) in depth to twelve (12”) in depth:

Property Requirement

Grain Size Distribution

 Clay fraction < 2 %

 Passing #200 sieve 3-6 %

 Passing #60 sieve 10-30%

 Passing #18 sieve 20-50 %

 Passing 1/8-inch sieve 55-95 %

 Passing 3/8” sieve 90-100 %

Density

 Application Density 50 lbs – 75 lbs / cf

 Saturated Density 62 lbs – 93 lbs / cf

 Dry Density 44 lbs – 68 lbs / cf

Water and Air Management

 Saturated water capacity > 35 %

 Saturated air content > 15 %

Saturated Hydraulic Conductivity > 2.8 in/hr

pH, Lime, and Salt Content

 pH (saturated paste) 6.0 – 7.5

 carbonate content < 25 g/l

 salts content (water extract) < 3.0 g/l

Organics

 OM content 3 – 6 mass %

 C/N ratio < 20

Nutrients in lb / 1000 CF

 Nitrogen (NO3) 3 – 15

 Phosphorous 1 – 7

 Potassium 6 – 15

 Calcium 19 – 65

 Magnesium 3 – 15

 CEC Capacity >5 cmol/kg

 Compost Fraction

Meet or exceed USEPA Class A Standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32 (a) (pathogens) and/or be permitted in the state of origin to produce Class A material.

Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.

Values shall be adjusted due to availability of local materials or special project conditions related to plant selection and or environmental conditions.

Nutrients shall be adjusted with appropriate slow-release fertilizer with micronutrient additions if below lower target range.

Expanded lightweight aggregate: For use as a fill material for drainage / water retention components as required; Lightweight Aggregate, 3/8” – ¾” ESCS Expanded Shale, Clay and Slate ceramic lightweight aggregate.

**Intensive Vegetated System**

The following growth media shall be used for extensive roof systems with growth media depths greater than twelve (12”) in depth and where greater plant selection is required:

Property Requirement

Grain Size Distribution

 Clay fraction < 2 %

 Passing #200 sieve 5-15 %

 Passing #60 sieve 10-25%

 Passing #18 sieve 20-50 %

 Passing 1/8-inch sieve 55-95 %

 Passing 3/8” sieve 90-100 %

Density

 Application Density 44 lbs – 68 lbs / cf

 Saturated Density 62 lbs – 93 lbs / cf

 Dry Density 38 lbs – 68 lbs / cf

Water and Air Management

 Saturated water capacity > 40 %

 Saturated air content > 10 %

Saturated Hydraulic Conductivity > 1.0 in/hr

pH, Lime, and Salt Content

 pH (saturated paste) 5.5 – 7.5

 carbonate content < 25 g/l

 salts content (water extract) < 3.0 g/l

Organics

 OM content 6 – 12 mass %

 C/N ratio < 20

Nutrients in lb / 1000 CF

 Nitrogen (NO3) 3 – 15

 Phosphorous 1 – 7

 Potassium 6 – 15

 Calcium 19 – 65

 Magnesium 3 – 15

 CEC Capacity >5 cmol/kg

 Compost Fraction

Meet or exceed USEPA Class A Standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32 (a) (pathogens) and/or be permitted in the state of origin to produce Class A material.

Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.

Values shall be adjusted due to availability of local materials or special project conditions related to plant selection and or environmental conditions.

Nutrients shall be adjusted with appropriate slow-release fertilizer with micronutrient additions if below lower target range.

Expanded lightweight aggregate: For use as a fill material for drainage / water retention components as required; Lightweight Aggregate, 3/8” – ¾” ESCS Expanded Shale, Clay and Slate ceramic lightweight aggregate.

Erosion control mat: Manufacturer’s mat composed of straw and/or coconut fiber stitched together with biodegradable thread forming top and bottom netting intended to control erosion of growth media prior to installation and growth of plant media. Mat shall be 100% biodegradable and use 4-inch organic plastic stakes used for securement.

Miscellaneous sheet metal: All sheet metal components such as flashings, borders, drain screens, etc. in contact with growth or plant media shall be stainless steel.

**PLANT MEDIA**

Permanent water source is required for establishment and maintenance of extensive vegetated systems. Recommended plants may be added to or edited per the specific site requirements. Confirm plant selection for each specific project. Local plant sources are preferred. Final plant selection must be approved by Lisa Pearson, ASLA, @ DSF, Lisa.Pearson@wisconsin.gov.

Sedum, succulent, and perennial vegetation for extensive depth planted-in-place systems:

Plant and maintain sedum cuttings, plugs, and pre-planted vegetated mats in accordance with Manufacturer’s written specifications by an approved Contractor. Sedum cuttings should only be installed between April 15 to May 15 and or September 1 to September 15. Plugs should be used if installation occurs during the summer months.

Install sedum cuttings and plugs in such a manner to provide 50 % coverage in 1 year and 80% coverage within 2 years of indicated areas.

Pre-planted vegetated mats shall provide 90% coverage within 1 year of indicated area and maintain 90 percent coverage of planted areas in year two.

Plant media should be hardy to zones 3, 4 or 5 depending on project location in Wisconsin.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scientific Name | Drought Tolerance | Growth Form | Mature Height | Bloom Color/Time |
| *Achillea tomentosa**Allium moly**Allium schoenoprasum*  | high highvery high | small perennialhardy bulbhardy Bulb | 3" - 7"10”-12”12" - 15" | Yellow/ Spring-SummerYellow/SpringYellow/Spring |
| *Armeria maritima* | high | clump | 4" - 5" | White-Pink- Red/Spring |
| *Delosperma nubigenum* (Zone 5 only) | very high | spreading 10" | 2" - 3" | Yellow/Summer |
| *Sedum acre**Sedum acre ‘Aurea’**Sedum album* |  high highvery high | spreading 12” spreading 12”-15” spreading 12" | 2”-3”1”-2”3" - 4" | Yellow/SummerYellow/SpringWhite/Summer |
| *Sedum album ‘Coral Carpet’**Sedum album ‘Green Ice’**Sedum album ‘Murale’**Sedum dasphyllum* (Zone 5 only)  | very highvery highvery highvery high | spreading 6”-8”spreading 6”-8”spreading 12”spreading 5" | 1”1”-2”4”2" - 3" | White/SummerWhite/SummerWhite/SummerWhite/Summer |
|  |  |  |  | Yellow/Summer |
| *Sedum ewersii* | very high | spreading 6" | 5" - 6" | Pink/Summer |
| *Sedum floriferum "Weihenstaphaner* *Gold" or ‘Bailey’s Gold’* | very high | spreading 10" | 3" - 4" | Yellow/Summer |
| *Sedum fosteranium (reflexum)*  | very high | spreading 8" | 4" - 5" | Yellow/Summer |
| *Sedum hybridum "Immergrauch"*  | very high | spreading 8" | 5" - 6" | yellowSummer |
| *Sedum kamtschaticum* | very high | spreading 10" | 4" - 6"  | Yellow/Summer |
| *Sedum kamtschaticum var. ellacombianum**Sedum ochraleucum* (Zone 5 only) | very highvery high | Spreading 12”spreading 9" | 4”-5”5" - 6" | Yellow/SummerYellow/Summer |
| *Sedum sarmentosum* (Zone 5 only) | very high | spreading 24" | 1.5" - 2" | Yellow/Summer |
| *Sedum sexangulare* | very high | spreading 8" | 4" - 5"  | Yellow/Summer |
| *Sedum sichotense**Sedum spurium atropurpureum**Sedum spurium “Dragons Blood”**Sedum spurium “Fuldaglut” (part shade)* | very highvery highvery highvery high | Spreading 8”spreading 8”spreading 8”spreading 10" | 6”-7”3”-4”5”-7”4" - 5" | Pink/FallPink/FallRed/FallPink/Summer |
| *Sedum “Green Mantle”**Sedum “John Creech”**Sedum spurium ‘Voodoo’**Sedum ternatum* (shade)*Sempervivum arachnoideum* (hybrids) | highvery high very highhighvery high | Spreading 6”-8”Spreading 6”-8”Spreading 6”-8”spreading 6”-8”ground cover | 2”-3”4”-6”4”-6”2”-3”3" - 4" | Yellow/SummerPink/SummerRose/Summer-FallWhite/SummerRed/Summer |
| *Sempervivum tectorum* (hybrids) | very high | ground cover | 3" - 4" | Pink/Summer |
| *Sempervivum tomentosum* (hybrids) | very high | ground cover | 3" - 4"  | Yellow/Summer |

**Semi-Intensive Vegetative System**

Note to specifier: A permanent water source is required for establishment and maintenance of vegetation used in semi-intensive and intensive vegetated systems. Permanent irrigation is recommended. Wisconsin Native Vegetation recommended for semi-intensive depth planted in place systems. Native perennials should include both forbs and grasses. Recommended plants may be added to or edited per the specific site requirements.

Install and maintain plugs in accordance with Manufacturer’s written specifications by an approved Contractor. Pregrow plugs at the nursery in growth media similar to the growth media it will planted into onsite (not typical organic nursery potting soil).

Install plugs in such a manner to provide 50 % coverage in 1 year and 90% coverage within 2 years of indicated areas.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |  |  |
| Latin Name | Common Name | Flower | Bloom Time | Height | Sun Exposure | Soil Moisture |
| *Allium cernuum*  |  Nodding Wild Onion  | Purple | July/Aug | 18" |  Full Sun to Part Shade  | Mesic to Dry Mesic |
| *Anemone cylindrica*  |  Thimbleweed  | White | June/July | 24" |  Full Sun to Part Shade | Mesic to Dry  |
| *Anemone patens wolfgangiana*  |  Pasque Flower  | Purple | April/May | 6" |  Full Sun to Part Shade | Dry Mesic to Dry |
| *Aguilegia canadensis* |  Columbine | Red | April/June | 24" | Full Sun to Part Shade | Mesic to Dry  |
| *Aster ericoides* |  Heath Aster | White | Aug/Oct | 24" |  Full Sun to Part Shade | Mesic to Dry |
| *Aster laevis* |  Smooth Aster | Blue-Violet | Aug/Oct | 4' |  Full Sun to Part Shade | Mesic to Dry Mesic |
| *Aster sericeus* |  Silky Aster | Purple | Sept/Oct | 12" |  Full Sun to Part Shade  | Mesic to Dry |
| *Carex bicknellii* |  Bicknelli's Sedge |  |  | 3' |  Full Sun | Mesic to Dry Mesic |
| *Carex muhlenbergia*  |  Sand Bracted Sedge |  |  | 24" |  Full Sun to Part Shade | Dry  |
| *Carex pensylvanica**Carex radiata**Coreopsis lanceolata**Coreopsis palmata*  | Pensylvania SedgeStar SedgeLanceleaf CoreopsisPrairie Coreopsis  | YellowYellow | June/AugJune/Aug | 6”-12”18”24”24" | Part to Full ShadePart to Full Shade Full Sun Full Sun to Part Shade  | Mesic to DryMesicDryMesic to Dry  |
| *Dalea (Petalostemum) candidum* |  White Prairie Clover | White | June/Sept | 24" |  Full Sun to Part Shade | Mesic to Dry  |
|  *Dalea (Petalostemum) purpurea* |  Purple Prairie Clover | Purple | July/Sept | 24" |  Full Sun to Part Shade | Mesic to Dry  |
| *Echinacea pallida*  |  Pale purple coneflower  | Purple | June/July | 3' |  Full Sun to Part Shade | Mesic to Dry  |
| *Echinacea purpurea* |  Purple Coneflower | Purple | July/Sept | 4' |  Full Sun to Part Shade  | Mesic to Dry Mesic |
| *Eragrostis spectabilis*  |  Purple love grass  |  |  | 24" |  Full Sun to Part Shade | Dry  |
| *Euphorbia corollata* |  Flowering Spurge | White | June/Aug | 3' |  Full Sun to Part Shade | Mesic to Dry  |
| *Fragaria virginiana**Geum triflorum* *Heuchera richardsonii*  | Wild StrawberryPrairie SmokeAlum Root  | WhitePinkWhite | April/JuneApril/MayMay/July | 6”6”-9”24" | Full SunFull SunFull Sun to Part Shade | DryDryMesic to Dry |
| *Liatris aspera* |  Rough Blazing Star  | Purple | July/Oct | 3' |  Full Sun to Part Shade  | Mesic to Dry |
| *Liatris cylindracea*  |  Cylindrical blazing star  | Purple | July/Oct | 12" |  Full Sun to Part Shade | Dry Mesic to Dry |
| *Penstemon digitalis*  |  Foxglove beard tongue  | White | June/July | 4' | Sun to Shade | Mesic to Dry Mesic |
| *Penstemon hirsutus*  |  Hairy beard tongue | Purple | May/June | 18" | Sun to Shade | Wet Mesic to Dry |
| *Potentilla arguta* | Prairie cinquefoil  | Yellow | June/Sept | 24" |  Full Sun to Part Shade | Dry Mesic to Dry |
| *Rudbeckia fulgida* | Orange Coneflower | Orange | July/Sept | 3' |  Full Sun to Part Shade | Wet Mesic to Dry Mesic |
| *Rudbeckia hirta*  |  Black-eyed Susan  | Yellow | June/Oct | 24" |  Full Sun to Part Shade | Wet Mesic to Dry  |
| *Ruellia humilis* |  Wild Petunia | Purple | June/Aug | 12" |  Full Sun | Mesic to Dry  |
| *Schizachyrium scoparium*  |  Little Bluestem  |  |  | 3' |  Full Sun to Part Shade | Wet Mesic to Dry  |
| *Solidago ptarmicoides*  | Upland White Aster | White | June/Sept | 12" |  Full Sun | Dry Mesic to Dry |
| *Solidago rigida* |  Stiff Goldenrod | Yellow | Aug/Oct | 4' |  Full Sun to Part Shade | Wet Mesic to Dry  |
| *Sporobolus heterolepis*  |  Prairie Dropseed  |  |  | 3' |  Full Sun | Dry Mesic to Dry |
| *Tradescantia ohioensis* |  Ohio Spiderwort | Blue-Violet | May/July | 3' |  Full Sun to Part Shade | Wet Mesic to Dry  |
| *Viola pedata* |  Bird's Foot Violet | Purple | May/June | 4" |  Full Sun to Part Shade  | Dry Mesic to Dry |

**MISCELLANEOUS ACCESSORIES**

Roof Drain Assemblies: Two-stage Protected Roof Membrane (PRM) assembly roof drains to accommodate surface and below-grade runoff approved for use by the roofing system manufacturer. Drain assemblies to include inspection chambers to accommodate final roof system height.

Pavers: Concrete pavers manufactured for use as roof or plaza deck pavers; with absorption not greater than ASTM C140; with no breakage and maximum 1 percent mass loss when tested for freeze thaw according to ASTM C67; 2’-0” x 2’-0” x 2” pavers.

Basis of Design Product: Subject to compliance with requirements, provide [manufacturer; product name]

Hanover Architectural Products

Wausau Tile Products

Thickness: [1 5/8 inches] [1 ¾ inches] [2 inches] [2 3/8 inches] [ ].

Face Size: [12 inches square] [18 inches square] [24 inches square] [as indicated].

Weight: [18 lb/sq ft] [22 lb/sq ft] [ ].

Compressive Strength: [7500 psi] [6500 psi] [ ] minimum when tested according to ASTM C 140.

Color: [insert color]

Paver Supports: Paver manufacturer’s standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including [fixed height] [adjustable or stackable] pedestals, shims, and spacer tabs for joint spacing of [1/8 inch] [3/16 inch].

Ballast: Nominal [1 ½”-2”] [2 ½”] diameter, [Washed or River Stone] [Clear limestone] without fines.

Other Materials: All other materials not specifically described but required for a complete and proper installation of the work in this section, shall be as selected by the Contractor subject to approval by the Owner.

**PART 3 - EXECUTION**

**EXAMINATION**

Examine the areas and conditions under which work in this section will be installed. Bring to the Owner attention any conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

Examine the surface condition of the substrate and the conditions under which fluid-applied waterproofing work is to be performed. Clean the substrate of substances and projections detrimental to the Work. Voids and holes shall be filled with an approved material and be struck flush with adjoining surfaces.

New concrete substrate must be dry and free of any unapproved curing compounds or form release agents.

Proceeding with the work shall signify the Contractor’s acceptance of the substrate being covered by the new installation.

Architect/Engineer shall include a note on new construction roof drawing and plumber drawing bid documents requiring the Contractor to call a meeting between the Roofing Contractor and Plumbing Contractor to coordinate the final drain location. A/E shall inspect installation at the start of this work to assure proper installation.Tapered insulation drawing shall be re-submitted to the A/E after drain locations are approved by all, in writing. Tapered insulation installed contrary to the low point of the drain, over flow or scupper locations shall be cause for rejection of the work.

Approved tapered insulation drawing layouts shall be reviewed by the Contractor installing the work in this section prior to start of such work, and before ordering the materials, to assure that the tapered insulation layout will correspond with the exact location of new and/or existing roof drains and primary through-wall and/or roof edge drain scupper locations.

Tapered insulation systems that are not installed such that they drain directly and positively to the roof drain shall be removed and installed correctly by the roofing Contractor at no additional cost to the project.

Architect/Engineer shall calculate insulation depth to be achieved by the new tapered roof system design at all roof edge, outer wall and roof-to-wall intersection and properly identify structural wall/wood blocking height requirements in relation to metal flashing coverage and counterflashing receiver height.

**DEMOLITION IN STRUCTURES AND CONSTRUCTION TO REMAIN**

Remove existing construction including roofing membrane, insulation, flashings, sheet metal and blocking as required to complete the installation of new roofing work as shown or specified.

Provide protective devices, enclosures, rails and similar items necessary to provide for normal public passage and to prevent bodily injury to occupants of the building.

Use of the building, or any of its mechanical or electrical systems, shall not be curtailed without prior agreement with the building Owner.

**DISPOSAL OF MATERIALS**

All demolition material not scheduled for reuse and shall be removed from the Owner's site by the Contractor.

Confirm what materials, if any, shall be retained by Owner. Stockpiled material designated to be retained at a location designated by the Owner.

No prolonged accumulation of debris will be allowed.

Remove all salvaged items from the site as demolition progresses. Storage or sale of removed items on the site will not be allowed.

Notify in writing the proper regulating authorities having jurisdiction as to the intent of the demolition. Time is of essence.

Line refuse dumpsters with plastic sheeting and disposing sheeting with each load of refuse which includes roof materials containing asbestos.

Contractor is responsible for the proper location and method of disposal for each individual component of the roofing system. Disposal of contaminated waste material shall be carried out in a manner appropriate to hazardous materials.

No burning on site will be permitted.

**PREPARATION**

Archtiect/Engineer must calculate insulation, growth media, and plant depth as necessary to be achieved by the new roof system design at all roof edge, outer wall and roof-to-wall intersection and properly identify structural wall/wood blocking height requirements in relation to metal flashing coverage and counterflashing receiver height.

All surfaces must be dry, smooth, free of depressions, voids, protrusions, clean and free of unapproved curing compounds, form release agents and other surface contaminants.

Cast in-place concrete/Composite deck

Poured in place concrete must be monolithic, smooth, and free of voids, spall areas, laitance, honeycombs, and sharp protrusions.

Substrate Preparation

Thoroughly sweep the substrate which is to receive the new membrane of loose debris, dirt and dust.

The Contractor is responsible for the deck and final surface preparation. The cleaned surface shall be in accordance with the recommendations of the system manufacturer.

The Roofing Contractor shall sandblast or grind the vertical surface of walls, columns, curbs and drains which will receive fully-adhered membrane or flashings.

Surfaces to receive a membrane shall be even. Protrusions and bumps shall be ground flat and with a similar texture as the surrounding area. Pits, scaled areas, depressions or traction grooves in the surface which will inhibit a uniform membrane application shall be filled with an epoxy mortar, or a similar material that is compatible with the membrane system.

All movement or shrinkage cracks greater than 1/16 in. shall be dressed with manufacturer’s approved bond-breaker tape or sealant. Treat all construction and expansion joints as indicated on drawings using manufacturer’s recommendations.

Surfaces other than concrete shall be prepared as required by the manufacturer’s recommendations.

If concrete surface is exposed to moisture prior to installation or membrane assembly, concrete surfaces shall be visibly dry and pass a 4-hour rubber mat test (no condensation) prior to application of membrane. Mat shall be taped to deck on all edges.

The Contractor shall not start installing the membrane system until personnel authorized by the membrane manufacturer inspect and approve the substrate and related conditions as suitable for receiving the membrane system.

**SEPARATION LAYER**

Install manufacturer’s substrate separation layer to concrete deck as necessary.

**INTEGRATED LEAK DETECTION INSTALLATION**

Ground screen is sharp; wear gloves and eye protection.

Unroll the grounding screen over the prepared substrate.

Overlap adjacent grounding screen a minimum of 3 inches. Positive contact between adjacent sheets is required at both side and end laps. Adjacent layers must be taped together using a piece of duct tape or aluminum tape spaced approximately 5 ft. o.c. to prevent shifting.

Connect the grounding screen to a conductive part of the structure at several separate locations – examples: metal deck or metal curb, metal vent stack, etc. Use a 2-inch wide strip of grounding screen extended from the grounding screen to the structure; tape it into place with duct tape or Aluminum tape.

Install the membrane directly over the grounding screen.

**WATERPROOFING SYSTEM INSTALLATION**

All flashing systems are to be designed and detailed so as to create redundant flashing systems with no exposed finish membrane. Wherever possible, watertight sheet metal flashings should be integrated with the membrane system to provide an initial barrier against water penetration. Membrane flashings should be the second-barrier against water penetration.

Thermoplastic Membrane Installation

Install membrane per manufacturer’s approved layout and techniques. Allow membrane to relax a minimum of 30 minutes prior to heat welding laps and seams.

At no time shall asphaltic materials, coal tar products, polystyrene, oil in any form, or other incompatible materials come into contact with the thermoplastic PVC membrane or other system components. Equipment shall have no sharp edges and shall be clean and free of any contaminants. Promptly remove any portion of PVC waterproofing that becomes contaminated.

Workmen and all others that walk on the waterproofing shall wear clean, soft-soled shoes so as not to damage materials. Heed all manufacturer’s cautions and warnings in regard to product use. Membrane is slippery when wet or covered with frost, snow and ice. Take proper precautions.

Hot Air Welding

Adjacent sheets shall be welded in accordance with manufacturer’s published instructions. All seams shall be hot air welded. Overlaps shall be with the flow of water where possible.

Welding equipment shall be provided by or approved by the membrane manufacturer.

All surfaces to be welded shall be clean and dry. No adhesive or contaminants shall be present within lap areas.

Patch all 3-way membrane overlaps (T joints) with a maximum, 60-mil, 4 inch round or square patch.

A minimum 8 inch (20.3 cm) wide cover strip shall be used where membranes meet at end laps and all non-selvedge edges. Butt adjoining sheets tightly, center the cover strip over both membranes and hot air weld.

Machine welded seams shall achieved by the use of automatic welding equipment, dedicated portable generators (30 A, 220 V and recommended minimum 7,500 Watts). No other equipment shall be operated off the generator.

Perform three (3) test weld test cuts in the morning and three (3) test weld cuts in the afternoon each day membrane is being installed to confirm proper welding techniques.

Flashing Installation

All flashings shall be installed concurrently with the waterproofing membrane according to manufacturer requirements as the job progresses. Flashings shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces. All masonry joints shall be struck flush. Rough or incompatible surfaces may be covered with minimum ½ inch CDX plywood.

Complete the entire waterproofing assembly and flashing in a single working day; avoid exposure of any components to rain, snow, or dew. If rain threatens during the day, or in an emergency, protect the unfinished exposed waterproofing and flashing components.

All flashing membranes shall be mechanically fastened along the top edge with appropriate fasteners and termination bar.

All flashings shall extend a minimum of 8 inches (20.3 cm) above the overburden. Any exposed membrane must be approved for UV exposure. Seal top termination with an acceptable sealant.

A minimum 8 inch wide cover strip shall be used where flashing membranes meet at end laps, butt joints, and all non-selvedge edges. Butt adjoining sheets closely, center the cover strip over both membranes and hot-air weld. Complete inside and outside corner flashing ails with prefabricated corner patches.

No bituminous elements shall be in contact with the waterproofing membrane. Flashing substrates contaminated with coal-tar shall be overlaid with minimum 1/2 inch (13 mm) thick CDX plywood or min. 24 gallon stainless steel sheet metal.

All flashings shall be hot-air welded at their joints and at their connections with the deck membrane.

**ROOT BARRIER, DRAINAGE MAT AND INSULATION INSTALLATION**

Examine the surface area to be covered with subsequent topping materials in order to insure that all surface areas have received the membrane, the membrane is free of damage, it is properly protected, and all flashings have been properly installed.

Install the specified prefabricated drainage mat in the locations shown in the Drawings. Cut and fit the drainage mat at penetrations and the perimeter. Bond lap edges in the drainage mat per the manufacturer’s recommendations. At the perimeter of the drainage mat, bond the integral filter fabric to the adjacent vertical membrane surface per the manufacturer’s recommendations at the locations shown in the Drawings.

Where indicated, install filter fabric with a minimum six-inch (6”) overlap. Extend fabric above anticipated growth media level; trim fabric after installation is complete.

Ensure close fit and alignment of all insulation boards limiting any gaps to 1/8" maximum. Stagger all board joints within the field of the roof. Offset the end and side joints a minimum of 6" from the joints of the preceding layer.

Drainage and separation layers shall be installed in such a manner so that no membrane is in contact with extruded polystyrene insulation.

Border and Separation Curb Installation.

Maintenance borders / vegetation-free zones shall be incorporated around all penetrations and continuously around the perimeter. In addition, pavers must be installed for sufficient maintenance access. Access shall be continuous from roof ingress/egress point to perimeter border and throughout the vegetated areas for maintenance.

Install borders, separation curbs, etcetera as indicated.

Class A rated barrier zones shall be installed to partition roof sections to not exceed 15,625 SF in total area. Each roof section shall not have any dimension greater than 125 feet.

Class A rated three-foot (3’) vegetation-free barrier zones shall be installed around all non-combustible mechanical units, walls, and penetrations, etcetera. Six-foot (6’) vegetation-free barrier zones shall be installed around all combustible surfaces including wood and vinyl siding or other similar surfaces with low inherent flame and heat resistance.

Pavers shall be installed for barrier zones that may be used for foot traffic for maintenance purposes.

Ballast and Paver Installation

Install ballast and pavers as indicated on drawings.

Ballast shall be installed at a rate of 20 pounds per square foot.

**GROWTH AND PLANT MEDIA INSTALLATION**

Install growth media as specified.

Growth media shall not be placed in such a manner that will load a span on one side of a column while the opposite span is unloaded.

Growth media or other materials craned to the roof shall be deposited directly over a confirmed column location prior to distribution or installation.

Growth media shall be placed carefully to avoid damage or displacement of other materials or adjacent surfaces.

Growth media shall be placed within 1 inch of the final grade.

After placement of growth media, compact growth media with a 200 – 300 pound landscape roller or lightly compacted with a hand held mechanical compactor to achieve a 20% compaction as determined by ASTM D1557.

After compaction, thoroughly water or jet entire area. Low areas shall be filled with additional growth media and re-wet to achieve uniform final grade.

Install manufacturer’s erosion control mat per manufacturer’s printed instructions.

Vegetation Installation – Planted in Place

DO NOT BEGIN installation of plants until a permanent water source is available, and verified to be operational. An irrigation system (temporary or permanent) is defined as being able to deliver one-inch of water per hour for all surfaces to receive plants.

Installation of sedum by cutting

Install manufacturer’s sedum cuttings at a rate of 4-5 pounds of cuttings per 100 square feet. Scatter or broadcast cuttings onto surface as recommended by manufacturer.

Install hydro mulch or protective cover to areas with sedum cuttings immediately after installation to s to secure them to the growth media surface. Reapply mulch as necessary until plant establishment to secure cuttings and growth media from wind erosion.

Installation of plants by plugs

Install Sedum, perennial, native forb and grass plugs individually as required.

Install all varieties as shown on the planting plan.

Install manufacturer’s erosion control mat on all areas planted with plugs to prevent growth media erosion.

Vegetation Installation – Pre-planted Mat

DO NOT BEGIN installation of plants until a permanent water source is available, and verified to be operational. An irrigation system (temporary or permanent) is defined as being able to deliver one-inch of water per hour for all surfaces to receive plants.

Install pre-planted mat system per manufacturer’s written requirements using growth media as required for specified vegetated system depth.

Pre-planted mat systems shall be secured to the drainage composite in such a manner to secure the mat to the roof until plant root systems can establish.

**FIELD QUALITY CONTROL**

Integrated Leak Detection System Testing

Integrated leak detection system contractor to conduct testing at the following times:

 After installing membrane and before placing any overburden.

 Upon completion of overburden installation.

 Within one (1) year of roofing system completion.

Arrange and coordinate all leak detection contractor activities, to include conductor wire installation as necessary. Roofing Contractor will be present during Integrated Leak Detection test to make break repairs immediately. Repairs will be re-tested and noted on the final QC report supplied by the Integrated Leak Detection supplier.

In the event a defect is detected, any necessary repairs shall be made to the satisfaction of the Architect/Engineer and Manufacturer, and the test area retested.

Test results report shall be submitted to the Owner and to the Architect / Engineer upon completion of all stages of testing.

Manufacturer’s Inspection

During the course of the work and upon substantial completion, the Manufacturer shall inspect the work to verify conformance of the work with the Manufacturer’s recommendations and warranty requirements.

**CLEAN UP**

Remove trash, debris, and equipment from job site.

Repair damage and remove stains caused by the Work.

**operation and maintenance**

Execute a 3-year establishment period maintenance for vegetated roof plantings.

Maintenance shall include cultivation, weeding, disease and insect pest control. Procedures shall be consistent with good horticultural practices necessary to ensure vigorous, healthy growth of plant material.

Provide hand weeding and organic fertilizer, as required to maintain the health and vigor of the plants.

During the course of maintenance, excess waste materials shall be promptly removed at the end of each workday.

Maintenance Schedule of Activities

Schedule: year one to include a minimum of 6 maintenance visits to the project in the first 12 months and 4 site maintenance visits for years two and three.

Provide a schedule to the owner that details planned maintenance activities including names of subcontractors.

Maintenance Reports

Provide reports to the owner summarizing activities, observations, necessary corrections and recommended changes to the maintenance routine, if any.

Irrigation

Provide water for intensive vegetated roof systems without permanent irrigation systems during establishment period from hose bib as required and during occasional drought conditions.

For vegetated systems requiring irrigation ensure permanent irrigation system is provided and working properly. Routine maintenance of the irrigation system is required including winterizing of the system and spring start up.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 07 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

**END OF SECTION**