07 00 01.02 Roofing Systems Standard

Part 1 – General

A. Purpose
   1. The Pennsylvania State University Office of Physical Plant, in its continued dedication to maintaining roof systems and getting the longest roof life possible through proper planning, design, construction, and maintenance has developed the following minimum design standard. This standard is intended to provide guidance and direction on materials, proper design, and proper construction to achieve a minimum (50) fifty-year life roof system between complete tear-offs.
   2. The University relies on proper design, materials selection, and rigid inspection for adequate performance of roofing systems. Roofing systems shall be designed and installed according to manufacturer's recommended installation procedures. Conflicts with and/or deviations from this standard shall be addressed in the design review.

B. Applicability
   1. Any project which proposes a new roof, a roof replacement, a roof recover, isolated roof repairs and-roof system-remediations.

C. Definitions
   1. Design Professional – the architect or other professional contracted with the University to design the roof system.
   2. Green (vegetative) Roof – A roof with a layer of vegetation planted over a waterproofing system that is installed on top of a flat or slightly–sloped roof.
   3. Low Slope Roof – A roof with a slope less than a 2/12 roof pitch
   4. New Roof – New construction where additional roof area is being added to the PSU portfolio.
   5. RAMP – Roof Asset Management Program
   6. Roof Recover – Recovering an existing roof system with a new roof system. This can only be done one time per IBC and IEBC.
   7. Roof Remediation – large scale repairs to a roof system that may include roof membranes and flashings.
   8. Roof Repair – isolated repairs to address individual leaks.
   9. Roof Replacement – Complete tear off (down to the existing structural roof deck) of an existing roof system to be replaced with a new roof system.
   10. Steep Slope Roof – A roof with a slope more than a 2/12 roof pitch.

D. Referenced Standards - The following codes and regulations, including their appendices, as amended, are hereby incorporated by reference:
   1. ASCE American Society of Civil Engineers – ASCE 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures – 2010 Edition
   2. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers - ASHRAE 90.1 Energy Standard for Buildings
      a. Section 5 and 189.1 section 7 requirements are to be met.
   3. ASTM C-406 Standard Specification for Roofing Slate and Federal Specification SSS-451
      a. Grade S-1
   4. FM Factory Mutual (FM Global) - Wind Uplift Rating: FM 1-90
   5. IBC International Building Code - current PA edition
   6. IEBC International Existing Building Code - current PA edition
   7. NRCA National Roofing Contractors Association
      a. Roofing Manual (current edition) and relevant technical bulletins

   b. CERTA – Certified Roofing Torch Applicator shall be current for all employees who will be using open flame to install heat applied materials
8. OPP Design & Construction Standards
   a. 01 05 10.01 Roofscape Design Guide
   b. 01 35 20.02 Roof Fall Protection and Prevention
      1) 100% permanent fall protection coverage required for new and replacement roof work
   c. 01 80 00 Performance Requirements
      1) Design of building envelope for new or renewed facilities shall include selection of thermal and moisture protection systems, including insulation, weather barriers, air barriers, and light colored (high heat reflective and emissive) exterior wall and roof finishes in accordance with 01 80 00 PERFORMANCE REQUIREMENTS.
      2) 01 81 13 Sustainable Design Requirements related to roofing systems.

E. Design Reviews and Submittals
1. Proposed roof design in general should be reviewed with the University Architect. Refer to 01 05 10.01 Roofscape Design Guide.
2. Proposed roof systems other than modified built-up or that deviate from any of the manufacturers and/or products listed, shall be reviewed with the RAMP committee. The RAMP committee meets monthly. Contact the manager of the Roof Asset Management Program.
   a. Initial meeting with RAMP should take place during Schematic Design after a design review with the University Architect and should include project goals, general roof layout, description of proposed roof system(s), coordination with related systems such as fall protection and/or rooftop equipment, justification of deviation from standards including a detailed review of deviations from the standard, life cycle cost comparisons, market conditions, and schedule impact.
   b. Follow-up meetings with the University Architect and/or the RAMP Committee should be scheduled during subsequent design phases if the proposed design or budget changes, and to discuss more detailed roof system components such as roof color, edge metals, parapets, scuppers, special details, specification etc.
   c. The design team is responsible for submitting minutes of the meeting(s) as a record of the conversation and outcomes.
3. All roof designs are to be submitted for review through OPP's design review process (Bluebeam) at each design phase.

F. Warranty
1. All built-up and single ply roof systems shall have an all-inclusive minimum (30) Thirty-year (NDL) No Dollar Limit manufacturer's warranty. Warranty shall cover all materials of the roof system and shall begin when the project is completed and accepted by Penn State University and the Manufacturer.
   a. For low slope built-up roof systems, the design team shall investigate providing a thirty (30) year warranty extension.
2. All low slope roof systems shall have a two (2) year contractor's workmanship warranty beginning at Substantial Completion, which shall include all manufacturer required maintenance tasks at the manufacturer's required frequency, but not less than twice per year with 6 month minimum between iterations.
3. All steep slope slate roof systems shall have a minimum (100) One-hundred-year material warranty and a five (5) year contractor's workmanship warranty.

4. Metal coping caps, gravel stop edges and metal edges are to be included in the manufacturer's complete system warranty. Color/finish determined on project-by-project basis.
5. Penn State Office of Physical Plant (OPP) Roof Crew will often perform roof remediation. Products shall be selected so that repairs by OPP do not void the manufacturer's or contractor's warranty.

G. Service Responsibilities
   1. Manufacturer to Owner for low slope roofs – Manufacturer Technical representative shall inspect the roof each of the first two years within +/- 30 days of the annual warranty anniversary date and provide a written report of general conditions, required repairs to maintain warranty status and other pertinent recommendations. At the conclusion of the first two (2) years, the manufacturer shall inspect the roof once every five (5) years.
   2. Contractor to Owner for low slope roofs – Twice per year for the two (2) year contractor's warranty, remove and dispose of all debris from the roof membrane and drain bowls, gutters, and scuppers. A written report shall be submitted to Penn State to acknowledge the maintenance has been performed. Refer to contractor's workmanship warranty above.

Part 2 – Products

A. Performance Requirements
   1. Wind-Uplift Resistance: Provide a roofing system that is designed to resist uplift pressures as determined by ASCE 7-10, applicable building code, and a minimum of FMG 1A-90. Materials used in a tested FM system may be acceptable even if the overall system is not an approved FM system. System shall still meet attachment requirements for corners, perimeters, and field of roof. Manufacturer adhesive and mechanical attachment requirements shall be part of the submittal package.
   2. All roofing systems shall meet the appropriate FM Global criteria for wind loss prevention. PSU may submit designs to their insurer (FM Global) for input for additional comments, requirements and/or waivers from tested assemblies for wind uplift design. RoofNAV is desired and exceptions will be reviewed by OPP.
   3. All roofing systems shall have a class "A" rating as listed by Underwriters Laboratory, Inc., for fire resistance and all products shall bear the appropriate listing mark or classification marking and the company's name, trade name, trademark, or other recognized identification.
      a. All roofing materials must be confirmed to be free of asbestos fibers.
      b. Newly installed roofs must have a minimum of 1/4" per foot slope. Exceptions require written approval from OPP. Existing roofs require positive drainage.

B. Manufacturer and Installer Qualifications
   1. All primary roof system materials, including each type of roofing sheet (felt) or membrane, bitumen, adhesives, base flashings, miscellaneous flashing materials, and sheet metal components, including fascia and coping shall be produced and warrantied by a single manufacturer, which has produced that type of product successfully for not less than ten (10) years. Provide secondary products (insulation, mechanical fasteners, lumber, etc.) only as recommended and accepted by manufacturer of primary products for use with the roofing system materials.
   2. Roofing contractors shall have a minimum of five (5) years' experience installing the specified roofing system/components and be approved by the primary products manufacturer to install their roof systems.

C. Approved roof systems
   1. Low-Slope roof systems:
      a. Modified Built-Up Roof Systems are the preference for all low-slope roof systems.
         1) In the event alternatives to modified built-up roof systems are proposed (see Design Reviews and Submittals paragraph above), preference is for the PVC/KEE single-ply systems followed by EPDM.
      b. Modified Built Up Roofing Manufacturers and Products
         1) Basis of Design: Performance Roof Systems, Inc. (formerly Derbigum Americas, Inc.), Kansas City, MO
            a) Field Membrane
               (i) Base Ply: Derbibase Ultra
               (ii) Intermediate Ply: Derbibase Ultra
               (iii) Cap Ply: Derbicolor GP FR
            b) Flashing Materials
               (i) Base Ply: Derbigum GP
               (ii) Cap Ply: Derbicolor GP FR
               (iii) Liquid Flashing Derbiflash
         2) Tremco, Inc., Beachwood, OH
            a) Field Membrane
               (i) Base Ply: Powerply Heavy Duty Base
               (ii) Intermediate Ply: Powerply Heavy Duty Base
               (iii) Cap Ply: Powerply Premium FR
            b) Flashing Materials
               (i) Base Ply: Powerply Heavy Duty Base
               (ii) Cap Ply: Powerply Premium FR
               (iii) Liquid Flashing Alpha Guard MT TC
         3) The Garland Co., Inc., Cleveland, OH
            a) Field Membrane
               (i) Base Ply: Flex Base 120
               (ii) Intermediate Ply: Flex Base 120
               (iii) Cap Ply: Stress Ply Max FR Mineral
            b) Flashing Materials
               (i) Base Ply: Flex Base 120
               (ii) Cap Ply: Stress Ply Max FR Mineral
               (iii) Liquid Flashing Tuff-Flash by Garland
      c. PVC (Polyvinyl Chloride Membrane) Manufacturers and Products
         1) Carlisle Syntec Systems, Carlisle, PA
            a) Sure-Flex PVC 80 mil membrane
         2) Sarnafill, Canton, MA
            a) Sarnafill G 140-80 mil membrane
         3) Flex, Leesport, PA
            a) Flex MF/R 80 mil membrane
      d. KEE (Ketone Ethylene Ester) – additive to PVC where foot traffic is anticipated
         1) Carlisle Syntec Systems, Carlisle, PA
            a) Sure-Flex PVC/KEE HP 60 mil membrane
         2) Fibertite, Wooster, OH

a) Fibertite Xtreme FB 60 mil membrane
3) Flex, Leesport, PA
a) Flex MF/R 60 Elvaloy membrane
e. EPDM (ethylene propylene diene monomer) Manufacturers and Products
1) Carlisle Syntec Systems, Carlisle, PA
a) Sure-Seal Kleen Non-reinforced 90 mil fully adhered
2) Firestone Building Products, Indianapolis, IN
a) Rubbergard™ EPDM Platinum™ Membrane 90 mil fully adhered
3) Johns Manville, Denver, CO
a) JM EPDM NR 90 Mil fully adhered

2. Steep Slope roof systems:
a. Steep slope roof systems will be considered on a project-by-project basis and are subject to design reviews with the University Architect and RAMP committee. Considerations to be reviewed include but are not limited to aesthetics (materiality, color, reflectivity), longevity, roof access, maintainability, water drainage, and ice accumulation.
3. Green (vegetative) roof systems:
a. Green (vegetative) roof systems will be considered on a project-by-project basis and are subject to design reviews with the University Architect and RAMP committee.
b. Evaluate green and/or high SRI (cool) roof options and design for lowest life cycle cost.
c. Coordinate design of green roofs with requirements in 01 81 13 Sustainability Design Requirements and 33 40 00 Storm Drainage Utilities.

D. Other Product Requirements
1. Vapor Barriers – All Systems
a. Vapor Barriers shall be provided on all roof projects and shall be part of an FM Global approved design attached per FM Global requirements. Characteristics such as material, thickness, perm rating etc shall be appropriate for the roof system in which it is employed.
2. Coverboard shall be minimum 1/2” thick high-density type or thicker if required for fire resistance.
a. Georgia Pacific DensDeck or other product with equivalent performance for compressive strength, water absorption, mold resistance, flute spanability, permeance etc.
b. On metal decks, provide a base layer of 5/8” moisture -resistant, fire-rated gypsum board with a 1/2" gypsum coverboard over the insulation.
3. Insulation shall be closed-cell polyisocyanurate, ASTM C1289, Type II Class 2, Grade 2 or other type approved by the system manufacturer, the University and the University’s insurer.
a. Maximum insulation thickness shall be two (2) inches for any given layer.
4. Insulation Adhesive
a. Olybond 500
b. Insta-Stik Roofing Adhesive
c. Millennium Adhesive
d. Roof system Manufacturer’s Insulation Adhesive to comply with specified warranty terms and requirements and meet all applicable wind uplift requirements.
5. Membrane Adhesives shall be low VOC emission type.
6. Wood Blocking at curbs and roof edges: Pressure-treated lumber should not be used unless wood is in direct contact with concrete. Where used, pressure-treated lumber should be separated from adjacent materials to prevent corrosion.

7. Counterflashing's shall be 0.050 mil finish aluminum unless exposed to public view, where factory painted aluminum should be considered for review with the University Architect.
8. Roof coatings will be considered on a project-by-project basis.
9. Walkway Pads
   a. At roof areas subject to foot traffic such as is needed for regular access to equipment, do not block roof drainage with continuous strips of walkway or equipment/curbs.
   b. Tack weld individual pads so that moisture does not get trapped below the pad.
   c. Provide slip-resistant walkway pads.
10. Roof Penetrations
    a. Pitch pockets generally will not be permitted. If pitch pockets are to be used they must be reviewed by the Professional with the University. Design of all roof penetrations shall be in accordance with the recommendations and details of the National Roofing Contractors Association.
    b. All roof penetrations shall have a minimum 12" clearance between penetrations and be held a minimum 12" from roof perimeter.
    c. Mechanical equipment stands shall adhere to the following schedule:

Minimum Height Standards

Width of Equipment	Height of Legs
Up to 24"	14"
25" to 36"	18"
37" to 48"	24"
49" to 60"	30"
61" and Wider	48"

11. Roof Drains
    a. Roof inlets generally shall be of Dura-coated cast iron body, dome strainers, setting and clamping rings, extension sleeves, sump receivers, etc.
    b. Roof drains shall be installed at low points, or mid-span, and not at column locations.
    c. No-hubs shall be used between drain bodies and rainwater conductors.
    d. 8' by 8' drain sumps are required.

Part 3 Execution

A. Examination/Preparation
   1. Roof decks should meet manufacturer requirements for installation of roof system component. Hazardous or structurally unsafe condition must be reported to the university.
   2. During design, all building air intakes shall be verified and shut down during all roofing work in those areas.
   3. Protect all new and existing roof areas subject to foot, material, and storage traffic.
   4. During design, contact Environmental Health & Safety to coordinate any necessary testing for materials that may contain asbestos or PCBs (polychlorinated biphenyls).

B. Environmental requirements
   1. Proceed with roofing work only when existing and forecasted weather conditions will permit the roof system to be installed in accordance with manufacturer's requirements.

C. Installation Requirements
   1. All roof curb flashing shall be a minimum of twelve (12) inches above the finished roof surface.
   2. Drainage crickets shall have a 40% dimension ratio of length to width.
   3. All roof top curbs and units shall have drainage saddles installed to promote drainage.

4. Vapor barrier terminations shall be a minimum of one (1) inch above cant strip on vertical wall for B.U.R. and one (1) inch above finished roof surface onto vertical wall for single ply systems.
5. Steep slope roofs shall have ice and water shield installed on the entire roof deck surface. Special conditions where ice and water shield could be detrimental, such as reducing ventilation and/or causing excessive condensation, shall be reviewed with the Project Leader and University Architect.
6. Watertight night seals shall be installed at the end of each work day.
7. Roofing cants shall be installed at all intersections of horizontal and vertical flashing surfaces.
8. A fire alarm strobe and horn shall be installed at the entrance to the roof.

D. Field Quality Control
   1. Prior to issuance of documents for construction, teams shall discuss the benefits and risks of flood testing for the project and if agreed to by the Owner, add flood testing per ASTM D5957-98(2013): Standard Guide for Flood Testing Horizontal Waterproofing Installations to the contract documents, to be provided by the Contractor.
   2. Manufacturers shall provide a technical field representative to make weekly site inspections and to report job progress and quality of work during entire duration of low-slope roofing installation work. Reports shall be sent to PSU personnel for the project.
   3. Within one month of completion of roof work, the roof contractor shall employ an independent infrared roof scanning company to complete a ground-based infrared scan of all roof areas in the project scope.

E. As-Builts
   1. At a minimum, as-built drawings shall include, but are not limited to changes to the roof layout, insulation changes, and changes to details.

F. O&M from Designers
   1. Manufacturer’s maintenance and inspection requirements must be provided by the designer prior to final payment.
   2. Warranty information must be provided by the designer prior to final payment.

End of Standard