



Division of Facilities Development

Minimum Design Guidelines for Roofing and Waterproofing Systems (R02/06/2017)

Notes to Specifier:

Obtain and read the most current version of the DOA-DFD “Minimum Design Guidelines for Roofing and Waterproofing Systems”.

Note the revision date of this document (R02/06/2017) at the title. This document and all others addressed herein may be upgraded periodically. Visit the DFD website for each new Project to obtain the latest updated document. Obtain a document when you are actually ready to use it.

INDEX

Part 1 - General

- References
- Guarantee and Warranties
- Guarantee and Warranty Roofing and Metal Flashing Final Submittals
- Submittals

Part 2 – Design Requirements

- Roof Slope
- Roof Deck
- Roof Drains and Drainage
- Vapor Retarder
- Other Design Requirements
- Wind Lift

Parts 3 – Roofing Systems

- DFD Master Specifications Sections
- DFD Standard Details
- State Guarantee and State Manufacturer Guarantee
- Associated Materials for all Roof Systems
- Materials for Hot-Applied Roof Systems
- Materials and Use on Low-Slope Ballasted or Fully-Adhered Single-Ply Roof Systems
- Materials for Steep-Slope Roof Systems
- Fluid-Coat Membranes and Spray Polyurethane Foam (SPF)
- Vegetated Roof Assembly
- Vegetated Roof System Guideline Policy
- Existing Lighting Protection Systems
- Recycle or Salvage of Roofing Materials

PART 1 - GENERAL

Design of roofing systems for all State of Wisconsin facilities shall comply with the minimum standards requirements herein. Each roof system Section is membrane specific. **Sections shall not be altered to allow for installation of unapproved products.**

Deviation from any of the articles of these Standards shall be allowed only by prior written approval from a DFD Roofing Project Manager.

Standards herein shall apply to new construction, remodel, mechanical and electrical trade roof top unit upgrade, repair, replacement or abandonment and roof maintenance projects, renewable energy projects, outside source tower, antenna and all associated units and cabling and their penetrations and where new roofing or re-roofing and/or repairs to existing systems is required.

Specifier shall visit the DFD website for each new project to obtain the latest edition of the following documents applicable to the particulars of the project and its unique design.

DFD Master Specification Sections, DFD Standard Details, State Guarantee and State Manufacturer Guarantees documents are located on the DFD web-site at;

www.doa.wi.gov/DFD.

Click on Document Library & Master Specs.

Click on Master Specifications/Design Guidelines

Click on **07** – Thermal and Moisture Protection.

Specifier: Shall contact DFD Project Manager to inquire about existing in-force roof guarantees or warranties.

Roofing Contractor Holding a State 5-yr Guarantee: Contractor shall be included by company name in the roofing Section of the bid documents and used by the General Contractor to perform all required roof related work for the duration of the 5-yr guarantee.

After the Expiration of the State 5-yr Guarantee: The Manufacturer holding No-Dollar-Limit (NDL), Non-Prorated or System Warranties shall be included in the roofing Section of the bid-documents and used by the low bid General Prime Contractor as the warranted material source. The General Prime Contractor may acquire multiple quotes from various manufacturer approved roof system applicator's to perform all roof related repairs without interruption in the duration of the original warranty.

Roofing Contractors or roofing sub-contractors performing any work on State buildings shall be recognized by a manufacturer to be in good standing, able to provide and install their product, and shall submit a written statement from the manufacturer to the DFD Project Manager or AE prior to their being approved to perform any work on the project.

Roofing Contractor shall submit letter from manufacturer acknowledging work performed and that the original warranty in force shall continue to fulfill the life of original warranty.

Cabling, Solar Collectors, Photovoltaic Panels: Outside independent source installations such as satellite, radio and associated antennas or other communication devices and their cable trays shall not be placed nor installed on the roof system nor penetrate the roof system. Refer to DFD Standard details concerning support and minimum elevations required. Outside independent

source Contractors shall be made aware of the height requirements and DFD Standard details prior to start of the work.

Mechanical Units: Units supported over roof areas shall be installed at a proper elevation to allow for future roof replacement. Refer to DFD Standard details concerning support and minimum elevations of 1-1/2' or 3-0', as required by size of the equipment. Include specific detail drawings within the bid documents.

Wall Louvers, Doors, Windows and all Other Penetrations: Shall be installed at a proper elevation to allow for future roof replacement. Refer to DFD Standard details concerning support and minimum elevations, that should be include within the bid documents.

Hangers and Supports: Mechanical, electrical and other cabling Contractors shall not hang or support the Work from the roof deck in any fashion. Conduit runs shall not be laid on the roof deck nor laid on the structural support that supports the roof deck. No fasteners shall penetration the roof deck by any trade other than the roofing contractor and only if mechanical fastening is specified for the new roof system.

Pressure Treated Plywood and Lumber: These products shall not be specified nor provided for use anywhere within the new roof system as a substrate material intended to receive mechanical fasteners used to secure metal roof panels, panel clips, metal coping, roof penetration curbs cap and counterflashing, all other metal flashing, roofing insulation and membrane installations that are a part of the roof system.

Note: Damage or failure of the roof system due to use of treated lumber or treated plywood is not covered within the manufacturer system warranty.

Lightning Protection: Where existing Lightning Protection must be removed or displaced to perform the new work, the system shall be upgraded to current code requirements. Lightning rod anchor-point or support, cabling or cable clamps shall not be fastened to roofing metal coping or other edge metal flashing.

REFERENCES

The Specifier shall obtain the latest edition of the following DFD documents applicable to their particular design:

DFD "Master" Specifications Sections
DFD Standard Details
State Guarantee or State Manufacturer Guarantee

Do not save any DFD "Master" Specifications Section for use on a future Project. The documents are subject to revision without notice. Obtain latest versions for each new Project.

Pay special attention to *Notes to Specifier* in the color red, italic typeface.

Roof system options are identified within [brackets] by the color blue. This language may be used or deleted as required by the scope of Work.

DFD "revisions" to the specification sections are indicated by the date in the color green, to the right of the project title located on the first page of each "Master" specification (Example;

BASED ON DFD MASTER SPECIFICATION DATED (R01/11/10). This date shall remain as part of the bid documents.

Obtain the most current specification Section for each project. Each Section has language for both new construction roofing and re-roofing projects.

DFD standard details as well as manufacturer standard details shall be used to further clarify the roof system water proofing, terminations, and metal flashing membrane protection required by the bid documents as required, to obtain the manufacturer warranty.

Provide details for all work required by the bid documents such that there shall be little question as to the intent of the design and work required of the Roofing Contractor. Refer to DFD Standard details, manufacturer details and include any and all details as required to perform the work in the bid documents.

GUARANTEE AND WARRANTIES

State of Wisconsin Roof System 5-yr Guarantee is required for all new and re-roofing projects. (Refer to DOA-4522).

Check the DOA website for the most current version of the State Roofing System Guarantee Form. All State guarantee form(s) required for the work shall be bound within the project bid document specifications and located at the end of each roof system Section.

The following statement is on all State guarantees and within the Master specification sections since 2009; **Contractor shall perform a minimum of two (2) roof system inspections during the term of this guarantee with final inspection performed within last 6-months of term. Submit written inspection reports to DFD Project Manager and Agency Representative prior to guarantee expiration.**

State of Wisconsin Roof System Guarantee One (1) or two (2) year guarantees shall be used where penetrations and repairs are provided in the existing roof systems which are not covered by a guarantee or warranty.(Refer to DOA-4522A and DOA-4522B).

Low Slope Roof Systems

Black/Dark Colored Membrane: When considering heating versus cooling days, black/dark membrane is considered more beneficial and recommended for use in over 2/3 of the northern continental USA.

White/Light Colored Membrane: NOT recommended.

- 1) The membrane surface can be very slippery.
- 2) White appearance darkens from during construction and atmospheric debris soon after applied and continues to darken.
- 3) The claimed advantages of the white reflectivity depreciate with age.
- 4) White reflective quality is not an advantage in northern and colder 2/3 of USA.

Single-Ply Roof System: Membrane Supplier's twenty (20) year NDL ("No-Dollar-Limit")/"Total System" labor and material warranty shall be specified for black 60-mil EPDM fully-adhered or black EPDM 60-mil ballasted roof systems.

- 1) Life expectancy is 40+ years.
- 2) Easily maintained.
- 3) 60-mil is the standard system.

Single-Ply Roof System: Membrane supplier's thirty (30) year NDL ("No-Dollar-Limit")/"Total System" labor and material warranty for black 90-mil EPDM fully-adhered system.

- 1) Life expectancy is 40+ years.
- 2) Easily maintained.
- 3) Used in conjunction with longer life copper standing seam roofs.

Water-Base Adhesives Products: Are NOT acceptable alternate products.

Hot or Cold Applied Asphalt: Is NOT an acceptable insulation adhesive.

White EPDM Membrane: Is NOT an acceptable alternate membrane.

TPO Membrane: Is NOT an acceptable alternate membrane.

PVC Membrane System: Is NOT an acceptable alternate exposed membrane roof system as of 01/2014.

PVC Membrane System: Is still an acceptable system within, under and protected by a vegetated and/or concrete plaza roof systems.

BUR Modified: Is NOT an acceptable alternate roof system.

BUR Asphalt/gravel Roof System: Membrane supplier's twenty (20) year NDL ("No-Dollar-Limit")/"Total System" warranty shall be specified for new construction roofing or re-roofing Projects. See guidelines in Section for choice of products to obtain NDL.

- 1) Life expectancy is 25 - 30 years.

This system should be used cautiously due to exhaust fumes health concerns near air intake, animal housing and other sensitive locations.

This system is generally used when re-roofing heating plants.

BUR/gravel – Coal-tar: This roof system is no longer used due to exhaust fumes health concerns.

Steep-Slope Roof Systems

Asphalt Shingle Roof System: Manufacturer ten (10) year Non-Prorated and forty (40) year Prorated warranty shall both be specified for new construction or re-roofing Projects.

Fifty (50) year manufacturer prorated warranties are available when using higher grade shingles.

Ten (10) year non-prorated warranty is stated in DFD Section to allow more manufacturers involvement in the bidding process. A manufacturer may offer more than the ten (10) year non-prorated warranty.

T-Lock Asphalt Shingles: Are no longer produced but may be available thru the last supplier or their outlets as left over stock. The last supplier was IKO Products.

Three-Tab Asphalt Shingles: Are NOT the recommended choice, unless required to match existing construction and approved by historical society representatives.

- 1) Life expectancy is 18 - 21 years.
- 2) Fungus resistant for approx. 15 years due to copper in surface of product.
- 3) Three tab slot cut-outs allow for greater surface wear and esthetic value deterioration.

- 4) Less material cost, greater labor cost due to cut out slot alignment than architectural.
- 5) More waste at rake cut offs not usable on opposite rake.

Architectural Asphalt Shingles: Are the recommended choice and provide a longer expected system life versus three-tab shingles.

- 1) Life expectancy is 18 - 22 years.
- 2) Fungus resistant for approx. 15 years due to copper in surface of product.
- 3) Less exposed surface wear and longer esthetic value than three-tab shingle.
- 4) Material cost is higher but labor cost is lower versus three-tab shingle.
- 5) Material cut off at one rake may be used at opposite rake with much less waste.

Cedar Shingle and Shake: Used where required to maintain existing status or esthetic values.

- 1) Life expectancy is 18 - 25 years.

Granular Coated Steel Shingles: Are slightly higher cost with longer life expectancy and recommended choice when considering new or re-roofing options versus cedar or asphalt shingles. There are a number of qualities offered by use of this roof system.

- 1) Life expectancy is 35+ years.
- 2) Not fungus resistant but can be **cleaned with mild bleach and water mixture.**
- 3) Safety: Prevents snow and ice slide off - pedestrian walk, entry or service doors.
- 4) Option: Self-ventilating system shingle configuration, eliminating substrate construction.
- 5) May be applied over existing asphalt shingles (not over existing cedar).
- 6) This is a metal base product and has capability of being restored if need be in the future.
- 7) System may be taken apart, stored and reused on another building.

Fluid-Coated Silicone/granules over Spray Foam Insulation (SPF): “State of Wisconsin - Fluid Coating and Spray Polyurethane Foam (SPF) Roofing System Manufacturer Fifteen 15 Year Guarantee” (Refer to DOA-4522H).

- 1) Life expectancy is 15 - 20 years.

This system is not used as a new roof system but as an overlay roof system over existing BUR systems.

A moisture meter nuclear scan must be performed to find wet areas for removal and to assure the new work will be placed over dry conditions that will not blister, due to moisture in the existing BUR system.

Vegetated Roof System: State of Wisconsin - Vegetated Roof System Manufacturer 20-yr Guarantee (Refer to DOA-4522K).

- 1) Life expectancy is 20 - 25 years.
- 2) **Costlier to install and maintain care and growth.**
- 3) **Replacement costs high, removing overburden to replacing waterproof membrane.**
- 4) **Must have water and walk out access available.**
- 5) **Care is continual, safety rail, tie-off and roof access guidelines required.**
- 6) **Depending on roof size, two exits may be required, by code.**

Polyurea 2-Part – Fluid-Coat over Existing Metal Roof: “State of Wisconsin - Fluid Coating and Spray Polyurethane Foam (SPF) Roofing System Manufacturer Fifteen 15 Year Guarantee” (Refer to DOA-4522H).

This system is used over existing galvanized metal roof systems to provide a watertight system.

- 1) Life expectancy is 15 - 18 years.
- 2) This process may be applied over and over for continuance of watertight condition.

- 3) Applied mainly on exposed screw fastened galvanized metal panels, not on nailed panels.
- 4) Application of this system will provide a monolithic watertight membrane at all lap and penetrations.

Kynar-Fluoro Polymer – Fluid-Coat over Existing Pre-Finished Metal: “State of Wisconsin – Fluoro Polymer Coating Roof System Manufacturer 15 Year Guarantee” (Refer to DOA-4522J).

This system is used over existing ‘kynar’ coated metal roof systems to bring back esthetic value..

- 1) Life expectancy is 15 - 25 years.
- 2) This process may be applied over and over as required for continuance of esthetic values.
- 3) Applied over faded and minor deterioration ‘Kynar’ colored metal panels.
- 4) Product is not used to obtain a watertight condition.

Metal Double-Crimped Standing Seam Roof System: State of Wisconsin – Metal Roofing/Wall Panel System five (5) year, ten (10) year or twenty (20) year warranty shall be specified, as required for new construction or re-roofing Projects. (Refer to DOA-4522C, DOA-4522D or DOA-4522L).

- 5) Steel or aluminum life expectancy, 20 - 30 years +.
- 6) Copper life expectancy, 50-years +.
- 7) 24 gauge standard steel is recommended panel value.
- 8) 0.040 gauge aluminum would be acceptable and recommended panel value.
- 9) Copper is very expensive but will be a longer lasting system.
- 10) Steel and aluminum esthetic color value will fade to various degrees throughout its life, depending on the color.
- 11) ‘Kynar’ coating may be applied to bring back or change the esthetic value lost to fading.
- 12) Copper may become greenish patina in color and/or may become partially bronze in color as it ages.

Metal Exposed or Concealed Fastener System: Are acceptable where higher quality longer lasting systems are not required and/or to reduce costs.

- 13) Life expectancy is 16 - 25 years depending on metal gauge.
- 14) 24 or 26 gauge standards. 22 gauge for cleats.
- 15) Esthetic color value may fade throughout its life depending on the color.
- 16) ‘Kynar’ coating may be applied to bring back or change the esthetic value lost to fading.
- 17) Lighter gauge metal may start to show signs of rust sooner than 24 gauge.

Panel Manufacturer’s Finish Warranty: Provide the sheet metal panel manufacturer’s standard pre-finished panel twenty (20) year warranty against material defects, corrosion and finish degradation stating at a minimum that the metal finish will not chalk in excess of an eight (8) rating, or fade in excess of a five (5) rating, when tested in accordance with ASTM D2244 and ASTM D4214.

(Optional) Panel Manufacturer’s Weather tightness Warranty: Provide the sheet metal panel manufacturer’s standard no-dollar limit 20 year warranty against defects that result in leaks.

(Optional) Ice Dam Membrane Manufacturer’s Warranty: Provide Manufacturer’s minimum twenty (20) year warranty against product defect that result in leaks.

(Optional) Synthetic Underlayment Membrane Manufacturer’s Warranty: Provide Manufacturer’s minimum twenty (20) year warranty against product defect that result in leaks.

SUBMITTALS

The Specifier shall submit 35% and 100% construction documents for review and approval by the Division's Roofing Project Manager, which include the following:

Roof plan shall be drawn at a minimum scale of $1/16" = 1' - 0"$. Call the Project Manager as to a preference of half-size or full-size paper sets and/or electronic copy review sets.

Roof system installation details shall be drawn at a minimum scale of $1-1/2" = 1' - 0"$. Refer to and include all pertinent DFD Standard Details and manufacturer standard or specialized details for work required by the scope of project.

Review and provide relevant DFD Standard detail(s) or reference manufacturer detail(s) for all perimeter edge, wall coping and edge flashing including elevation changes and end of run at wall locations, rake, apron, step-flashing, valley, gutter, downspout, fascia, counterflashing, 2-pc counterflashing (DFD detail is required), equipment and unit curb, mechanical and electrical penetrations, scupper, over-flow drain, drain and sump area (Include elevation and insulation start thickness), louver (Provide min. standard height and Health Care Facility min. height), door threshold, window, stands and all other "Standard" details as found on the DFD website. Provide the following detail in bid documents.

Wood blocking is required under all metal edge and coping.

Minimum 45-mil EPDM membrane protection is required to be installed under metal coping continuing over each edge, covering the wood blocking and cut equal to but no less than $1/2"$ short of hemmed metal edge so as to be concealed by the horizontal line of metal coping or edge flashing. Membrane shall lap minimum 4" and seams sealed.

Provide DFD Standard 2-pc counterflashing detail where roof system terminates at walls, curbs and other penetrations through the roof system. Receiver shall be anchored to wall per DFD detail.

Minimum height of equipment, stands, duct or electrical bank runs to allow proper space to replace the roof system in the future shall be either $1-1/2'$ or $3-0'$ as indicated on the DFD Standard details. $1-1/2'$ allows the roofer to be able to reach under the unit. $3'-0"$ allows the roofer to be able to kneel and crawl under the unit to perform re-roofing.

Minimum louver height, termination and 2-pc counterflashing details above finished roof system.

Minimum height 30"; See Specification Section 23 33 00 and DFD Standard detail concerning requirements for higher minimum height as required by Health Care Code.

Minimum height at door sills, window/ curtain wall or other penetrations.

Roof drains. Provide starting elevation and insulation start thickness at outside of minimum sump area on detail.

Minimum drain area sump area shall be 4' square.

Provide expansion joint details and details at transitions and terminations.

Provide note on Architectural and Plumbing trade drawings for roofer to verify all tapered insulation drawing plan drain locations with physical location of roof drain as installed by Plumbing trade prior to AE approval of tapered insulation drawing.

“Cast-iron” drain strainers shall be standard and noted on the roof & plumbing drawings and within the plumbing specification section.

PART 2 - DESIGN REQUIREMENTS

The structural design of all roof related components shall allow for appropriate dead, live and drift loads per applicable building codes, loads encountered during construction and the concentrated loading of mechanical and other roof mounted or hung equipment.

Existing and new construction structural design shall be verified and noted on the drawings as able to support the weight of the new roof system. Structural analysis, design calculations shall be stated on the bid document drawings when providing a vegetated roof assembly over waterproof membrane (composite) roof system.

ROOF SLOPE

New "Low-Sloped" Roof Systems: The final roof slope shall be 1/4" per lineal foot minimum and 3/4" per lineal foot maximum.

Roof drain sump area slope shall not exceed 3/4".

New "Steep-Slope" roof systems: The final roof slope shall be 4" per lineal foot or greater.

Re-roofing Existing "Low-Sloped" Roof Systems: The final roof slope shall be a minimum of 1/8" per lineal foot.

“New Construction Fully-Adhered Systems” Requiring Mechanical Fastening to Metal Deck:

The first layer of insulation (Min. 1-1/2 “) only shall be mechanically fastened over existing or specified vapor retarder over metal deck. Additional layers of insulation shall be fully-adhered over the first layer in membrane suppliers approved adhesives to encapsulate the mechanical fastener and its fastener plate.

Note: Fully mechanical fastened insulation systems over metal deck have been found to fail due to possible rusting/deteriorated of the screw plate due to years of naturally found moisture movement within the system.

New Construction - “Cold Weather” Option, Installation of a Mechanically Fastened Roofing System:

Prepare screw/plate/insulation to receive application of a minimum 6” x 6” piece of manufacturer peel-and-stick over each screw/plate mechanical fastener to entomb the application and aid in preventing direct condensation/moisture contact with the screw/plate. The goal would be to prevent future possible rusting of the plate at the screw head and failure of the roof system.

When new or existing conditions dictate use of tapered insulation, the maximum height shall be limited to 10” at the highest point.

Drain sump area may be made larger to reduce height at perimeter.

Provide a minimum 8" base flashing, curb and penetration height (Refer to DFD Standard Details)

Roof systems with slopes greater than 3/4" per foot but less than 4" per foot will not be allowed.

ROOF DECK

Concrete or Metal Deck.

Deck deflections shall not exceed L/240 when subjected to a 300 pound concentrated load at mid-span.

Use minimum 22 gauge thickness when metal deck is specified.

Mechanical fasteners shall be sized to be long enough to penetrate through the upper flute of the metal roof deck only, with a maximum penetration of 3/4" or as required by the manufacturer specifications to obtain the warranty specified.

No fasteners shall be installed that could be long enough to penetrate the lower flute of the metal roof deck.

Fasteners, where visible to interior, shall be finished to the color of the interior metal or scheduled to be painted with the deck.

Mechanical, electrical or other trades shall not support, hang or anchor their work to or from the metal roof deck.

Electrical or other trades shall not install their conduit or piping on the top flange of structural steel truss where it is supporting a metal roof deck.

Electrical or other trades shall not install their conduit or piping to be directly on top of metal deck on upper or in lower flutes or on concrete decks such that those runs will be directly under and involved in the new roof system and its components. Roof system insulation shall not be cut to accommodate such installations.

Minimum plywood deck thickness shall be 1/2". Edge support "H" clips are required if deck supports are 24" or greater on center or per plywood or OSB minimum span instructions.

ROOF DRAINS AND DRAINAGE

AE shall include a note on roof drawing and plumber drawing bid documents requiring the General Contractor to call a meeting between the roofing contractor and plumbing contractor to coordinate the final drain location. Realistic drain locations will be determined by understanding plumbing and other Contractor run/installation requirements.

For New Construction or remodel projects, tapered insulation drawing shall be submitted a second insulation layout drawing to the AE for approval after drain locations are established and approved by all mechanical trades, in writing.

Roofing contractor shall start at the drain and work outward to the high points when laying out the final approved tapered insulation system.

Tapered insulation installed contrary to the low point of the drain, over flow or scupper locations shall be cause for rejection of the work and therefore shall be removed, at no cost to the project, and re-installed to start at the drain bowl.

Contractor shall inspect installation of tapered insulation at the start of this work to assure proper installation.

Interior positive drainage is the preferred method of water removal on low sloped buildings. Drain location shall take into consideration deflection and camber (both short and long term) of the roof deck under both minimum and maximum loading conditions.

Roof drains shall be cast iron, with flange, deck clamp, bottom outlet with removable galvanized finish painted cast-iron dome strainer and flashing ring integral with gravel stop.

Rusty or paint damaged roof drain strainers shall be sanded, primed and re-painted prior to final installation.

Roof drains shall be set to proper elevation within the drain sump to allow for positive drainage without standing water, with the top of the flashing ring one inch above the deck.

Sleeve type drain inserts may be used on maintenance repair projects only if no other assembly will work in the existing drain conditions, where embedded in concrete deck.

Drain body shall be replaced if in deteriorated condition. Drain insert will be considered if replacement is cost prohibitive, but may not be covered by manufacturer warranty.

Through-wall roof drains to interior space shall not be used in new construction.

Existing through-wall drains shall be designed out of the roof drainage system during re-roofing of existing systems.

Through-wall strainers shall be removed and drain shall be permanently plugged at roof entry to prevent water backup into the new roof system from existing drain line or interior damage.

No roof area shall have fewer than two, 4 inch diameter roof leaders. Maximum spacing for leaders shall be no more than sixty feet in any direction. Maximum roof area drained by each leader: 2400 square feet per leader.

VAPOR RETARDER

Vapor retarders shall be provided whenever the dew point calculations indicate that the dew point may be located within the roof insulation system.

Vapor retarders shall be provided for wet areas or areas exposed to moisture conditions; loading dock, airport hangers, kitchens, shower rooms and other wet room areas including clothing wash & dry rooms, swimming pool, sauna, hot tub, running tracks and gymnasiums.

Vapor Retarder over Steel Deck and Concrete Deck NOT sealed (from interior air movement) at Perimeters or Penetrations: A minimum 6-mil vapor retarder shall be specified and required over the entire metal roof deck. Tape and seal 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/or 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.

Note for New Construction Projects: It has been found that moisture transfer during new construction winter activities allows interior environment evaporation to enter the roof system causing severe curling of the insulation within the system. The vapor retarder will help prevent moisture transfer into the new roof system insulation during interior Work.

Minimum requirement: 6-mil Polyethylene sheeting lapped minimum 1'-0" and turned up at the perimeter and penetrations a minimum 4". Provide tape type seal at all laps, perimeter and all penetrations.

Option - Vapor Retarder: Membrane supplier's approved self-adhered vapor retarder with a perm rating of .5 or less directly adhered to the metal or concrete deck.

Option - 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.

Note to Specifier:

See DFD Master Roofing Specification 07 51 13 concerning placement of organic vapor retarder over substrate.

OTHER DESIGN REQUIREMENTS

The Architect/Engineer shall design the roof system 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.

New construction roofing or re-roofing minimum average R-values shall be noted on the roof plan at each roof area and for each system.

Expansion joints and area dividers shall be provided at the following locations;

Expansion joints locations in the structural system.

Structural framing or decking directional changes.

BUR: Roof structures change in direction, such as "T", "H", "L" and "U" shaped buildings.

Where a precast concrete deck, steel or poured concrete deck meet.

Where interior heating conditions changes may occur.

Anticipate structural movement locations between walls and roof decks.

Mechanical equipment, curbs, supports and penetrations;

Refer to DFD Standard Details at DFD website: doa.wi.gov/DFD to review details for minimum height of equipment, stands, duct or electrical bank runs to allow proper space to replace the roof system in the future.

New construction shall design curbs to contain all piping and electrical penetrations, at each location, for the unit to be supported.

Vibrations from roof deck mounted or joist structural mounted mechanical equipment shall be isolated from the membrane and metal flashings.

Water discharge from mechanical equipment shall not be allowed to discharge directly onto the roof surface.

Mechanical units or penetrations shall not be located in valleys or drain areas or restrict the flow of water.

Adequate space shall be provided between mechanical units, penetrations, and walls so that roofing materials can be installed properly.

Curbs and supports shall either be wood or pre-manufactured metal frame.

Curbs with built-in metal base flashings or cants shall not be used.

Pre-manufactured curbs and supports shall meet or exceed the following criteria:

Minimum 18 gauges galvanized steel reinforced metal frame structurally capable of supporting intended loads with no penetrations through the curb flashing.

Apply a 2" x 4" wood plate over metal base flange to achieve solid fastening into the deck such that curb or stand will not be dislocated. Mitered and continuously welded inside and outside corners to achieve a solid void free unit.

Minimum height shall be 8 – 12 “.

Build to accommodate roof system termination to include a two piece metal counterflashing/receiver.

Provide metal caps over all curb and stands with fabricated flange to receive additional metal counterflashing extensions and to provide a watertight connection.

Mechanical and Electrical supply required at the curbs shall be brought up through the roof deck and shall be terminated within the curb cavity to prevent excess roof membrane penetration. Use of pitch pockets or other roof system penetration terminations shall be avoided where possible. Refer to DFD Standard Details.

Consider providing 110 duplex electrical services at the curb for use during construction activities on the roof level and future re-roofing, mechanical trade and Agency repairs.

Pipe and conduit supports shall have an integral adjustable roller assembly that allows for expansion and contraction. Refer to DFD Standard Details.

Use of wood sleepers directly on the roof system to support equipment, pipes, A/C etc. is unacceptable.

WIND UPLIFT

All components of roof systems shall be designed to withstand the wind velocities and subsequent uplift pressures set forth in FM 1-28.

The manufacture shall approve all mechanical fasteners required to secure all roof system components.

Quantity and location of fasteners shall be determined by manufacturer requirements per code and to obtain the warranty specified.

PART 3 – ROOFING SYSTEMS

The Architect/Engineer shall limit his selection of a roofing systems to the various systems outlined below.

The A/E shall not specify a roofing system utilizing any component that has not been in production for and a history of use for a minimum of fifteen (15) years.

DFD MASTER SPECIFICATIONS

The following Master Specifications are currently available on the DFD Website:

PVC – There is NO Section, PVC is NOT an acceptable alternate product as an exposed roof system, with the exception that it may be used in vegetated and concrete plaza roof systems where it is not exposed but protected within the system.

TPO – There is NO Section, TPO is NOT an acceptable alternate product.

White EPDM - There is NO Section, white EPDM is NOT an acceptable alternate product.

BUR Modified – There is NO Section, BUR Modified is NOT an acceptable alternate product.

Coal tar BUR – There is NO Section, coal tar BUR is NOT an acceptable alternate product.

Section 07 31 13	Asphalt Shingles
Section 07 31 24	Granular Coated Steel Shingles
Section 07 31 29	Wood Shingle and Shakes
Section 07 33 63.01	Vegetated Roof - Hot Fluid Applied Membrane
Section 07 33 63.02	Vegetated Roof – Thermoplastic Single-Ply Protected
Section 07 33 63.03	Vegetated Roof - Thermoplastic Single-Ply Membrane

Section 07 51 13	Built-Up Bituminous Roofing (using asphalt)
Section 07 53 23	Ethylene-Propylene-Diene-Monomer (EPDM)
Section 07 56 63.01	Fluid-Applied over Metal Roofing (Acrylic)
Section 07 56 63.01	Fluid-Applied over Metal Roofing (Kynar-Fluoro Polymer)
Section 07 56 63	Fluid-Applied over Metal Roofing (Polyurea 2-Part)
Section 07 57 13.01	Fluid-Applied over Various Surface Roof (Silicone over Spray Polyurethane Foam (SPF)
Section 07 61 31	Standing Seam Sheet Metal Roofing
Section 07 63 00.01 13.01)	Sheet Metal Fluid Applied Roofing Specialties (For use with 07 57
Section 07 63 00	Sheet Metal Roofing Specialties

Additional Specifications may be added as they become available.

DFD STANDARD DETAILS

The following DFD Standard Details are currently available on the DFD Website:

A2.1 – A2.28 PDF	Fully-Adhered EPDM Details
A3.1 – A3.27 PDF	BUR Construction Details
A4.1 – A4.28 PDF	Ballasted EPDM Details
A6.1 – A6.25 PDF	Fluid Coating Details
A7.1 – A7.12 PDF	Asphalt Shingle Details
A2.1 – A2.28 ACAD	Fully-Adhered EPDM Details
A3.1 – A3.27 ACAD	BUR Construction Details
A4.1 – A4.28 ACAD	Ballasted EPDM Details
A6.1 – A6.25 ACAD	Fluid Coating Details
A7.1 – A7.12 ACAD	Asphalt Shingle Details

Details may be added or updated as required and they become available.

STATE GUARANTEE AND STATE MANUFACTURER GUARANTEE

The following State and Manufacturer State of Wisconsin guarantees are currently available on the DFD Website:

- 1-yr Roof Guarantee (Use on existing roof system with no guarantee or warranty)
- 2-yr Roof Guarantee (Use on existing roof system with no guarantee or warranty)
- 5-yr Roof Guarantee (Standard guarantee used for all new shingle, single-ply and BUR systems)
- 5-yr Metal Roof and Wall Panel Guarantee
- 10-yr Metal Roof and Wall Panel Guarantee
- 20-yr Metal Roof and Wall Panel Guarantee
- 10-yr Fluid-Coating – Manufacturer - State of Wisconsin Guarantee
- 15-yr Fluid-Coating – Manufacturer - State of Wisconsin Guarantee
- 15-yr Kynar-Fluoro Polymer Fluid-Coating – Manufacturer- State of Wisconsin Guarantee
- 20-yr Fluid-Coating – Manufacturer - State of Wisconsin Guarantee
- 5-yr Plaza Deck Waterproof Guarantee
- 10-yr Plaza Deck Waterproof Guarantee
- 20-yr Vegetated Roofing System – Manufacturer - State of Wisconsin Guarantee.

Guarantees may be added or upgraded as required and they become available.

ACCEPTABLE ASSOCIATED MATERIALS FOR ALL ROOF SYSTEMS

All materials required by the system specified shall be supplied by an approved manufacturer to provide the system and warranty as specified by the bid documents.

Manufacturers not listed or noted within the specific specification sections as an approved or equal manufacturer of the products required for the system specified shall be approved by DFD prior to bid opening.

Softwood Lumber: ALSC PS20, grade No. 2 or better; 19% maximum moisture content, size as detailed or required.

All lumber used on this project shall be graded by an agency certified by ALSC.

Sheathing: APA certified; CDX fir plywood or OSB (oriented strand board)

ALSC PS 20 - American Softwood Lumber Standard.

APA - American Plywood Association.

Pressure Treated Plywood and Lumber: These products shall not be specified or provided for use in roofing projects as a substrate material intended to receive mechanical fasteners used to secure metal roof panels, panel clips, metal coping, roof penetration curbs cap and Counterflashing, all other metal flashing, roofing insulation and membrane installations that are a part of the roof system.

ACCEPTABLE MATERIALS FOR HOT-APPLIED ROOF SYSTEMS

Perlite insulation conforming to ASTM C728.

Polyisocyanurate insulation with felt or fibrous mat facing on both sides conforming to ASTM C1289.

Smooth surface or gravel covered membrane consisting of four (4) plies of asphalt coated fiberglass mat conforming to ASTM D2178, Type IV in full mopping of ASTM D312 Type II or Type III hot asphalt.

Flashings shall be reinforced modified bitumen over a minimum of two (2) plies of asphalt fiberglass backer felt. Flashings shall be applied in asphalt.

Lead Flashings: Four (4) lb./sq. ft. lead minimum.

Mastics: Asbestos-free.

All products provided shall be asbestos free.

ACCEPTABLE MATERIALS AND USE FOR LOW-SLOPE BALLASTED OR FULLY-ADHERED SINGLE-PLY ROOF SYSTEMS

Insulation shall only be installed below the roof waterproof membrane.

Concrete or Light-Guard (LG) ballasted systems: Is NOT an acceptable alternate.

Mechanical Attached or Fully-Adhered PVC Membrane: Is NOT an acceptable alternate.

Water-base adhesives products: Are NOT acceptable.

Asphalt: Is NOT an acceptable insulation adhesive, unless specific conditions require its use to adhere to the deck.

2" x 8" x 16" Concrete Pavers: Are NOT acceptable.

2' x 2' x 2" Concrete Block: Are acceptable for walkway, ladder and roof entry landings and preferred over manufacturer adhered EPDM paver products.

Polyisocyanurate insulation with felt or fibrous mat facing on both sides conforming to ASTM C1289.

Expanded polystyrene insulation conforming to ASTM C578, Type IX.

Perlite insulation conforming to ASTM C728.

Recommended: Fully-Adhered 60 mil EPDM non-reinforced cured single-ply membrane conforming to ASTM D4637 (**Use as your first choice for longer life versus stone ballast 45 or 60-mil. EPDM**)

Recommended: Stone Ballast 60 mil EPDM non-reinforced cured single-ply membrane conforming to ASTM D4637 (**Use as your first choice for longer life versus 45 mil.**)

Recommended: Fully-Adhered 90 mil EPDM non-reinforced cured single-ply membrane conforming to ASTM D4637. **Use when applying a 90-mil. EPDM tie-in detail under longer lasting metal such as copper, or tile roof systems.**

Recommended for Vegetated or Plaza Systems: Fully-Adhered [60+] variable mil PVC as indicated within the “Master” specifications or as required by the manufacture to issue a 20 year warranty.

“New Construction Fully-Adhered Systems” Requiring Mechanical Fastening to Metal Deck:

The first layer of insulation (Min. 1-1/2”) only shall be mechanically fastened over existing or specified vapor retarder over metal deck. Additional layers of insulation shall be fully-adhered over the first layer in membrane suppliers approved adhesives to encapsulate the mechanical fastener and its fastener plate.

“Cold Weather” Option, Installation of a Mechanically Fastened Roofing System:

Prepare screw/plate/insulation to receive application of a minimum 6” x 6” piece of manufacturer peel-and-stick over each screw/plate mechanical fastener to entomb the application and aid in preventing direct condensation/moisture contact with the screw/plate. The goal would be to prevent future possible rusting of the plate at the screw head and failure of the roof system.

Mechanical Fasteners: Shall be sized to be long enough to fasten into the upper flute of the metal deck only, with a maximum 3/4" penetration unless membrane supplier requires additional penetration, in writing. No fasteners shall be installed that could be long enough to penetrate the lower flute of the metal deck. Fasteners installed that are longer than stated herein shall be cause for rejection of the Work, removal of such fasteners and repair of the metal deck, to the Owners satisfaction.

Exposed to Interior Fasteners: Color coordinate fasteners to match the interior color of the metal deck and submitted for Owner review and written approval. Un-approved or incorrect colored fasteners shall be cause for rejection of the Work or be painted to match the color of the metal deck.

ACCEPTABLE MATERIALS FOR STEEP-SLOPE ROOF SYSTEMS

Asphalt shingle, tile, wood shingle or shake and porcelain enamel roofs;

Recommended Underlayment: Synthetic Underlayment: ASTM D226, ASTM E-108 Class A Fire, weight per roll 45#/10sq. roll.

Note: Use of this product offers its own 6-month waterproof, and this product will not wrinkle when wet. Use of this product allows the Contractor to remove all existing roofing and shortens the need for long term on site dumpsters. Use of this product allows a more uniform re-roofing assembly.

Note: Underlayment SHALL cover the Ice & Water completely.

Note: It has been found that the lack of such coverage allows the shingle to melt into Ice & Water membrane which melts into the deck requiring decking replacement upon re-roofing.

Not Recommended Unless by Special Requirement: Underlayment: ASTM D226, Type I, No. 15 or 30; asphalt saturated organic felt, non-perforated.

Self-Adhering Ice & Water Backup Protection Membrane: Polyethylene surfaced, self-adhering modified bitumen.

Architectural Asphalt/Fiberglass Laminated 40-yr Shingle: Algae-resistant, ASTM D3161 Class F wind resistance, self-sealing, metric size; 13-1/4" x 38-3/4" or similar with 5-5/8" shingle exposure to the weather, minimum weight **215 – 245#** per square and verified per manufacturer product data documents. Each lamination shall have a minimum tear resistance of 1450 grams when tested in accordance with ASTM D3462.

Asphalt/Fiberglass Shingles: ASTM D3018, Type 1; ASTM D3161; ASTM D3462 at the time of installation; fire and wind resistant roofing shingles.

Granular Coated Steel Shingles: Various length and width for standard 'shingle' or 'shake' look, self-ventilated or direct contact granular coated surface on metal base.

Shingles shall be attached to the roof deck with roofing nails with minimum of 3/8 inch diameter heads. Staples are not acceptable.

Metal Roofs;

Prefinished standing or batten seamed metal roof panels with machine folded and sealed seams.

Prefinished Galvanized: ASTM A653, G-90, [22] [24], Kynar 500 prefinished galvanized is standard.

22 gauge for continuous cleats.

24 gauge for flashing, standing seam, pourable sealer pans, sleeves and hoods.

Aluminum: ASTM B209, Series 3000, Temper H-14, [0.032"] [0.040"] [0.050"]

Stainless Steel: AISI, Type 304, No. [2B] [2D]; [26] [28]

Copper: ASTM B370, Temper H00; [16] [20] oz. copper sheet.

Lead-Coated Copper: ASTM B101, Temper H00; [16] [20] oz. lead-coated copper sheet.

Sealants shall be one-part polyurethane conforming to FS TT-S-00230C, Type II, Class A. (For all non-fluid roofing systems)

VEGETATED ROOF SYSTEMS

20-yr composite manufacturer warranty required for all projects.

An 'Embedded Leak Detection System' shall be mandatory on all projects.

Single-ply Polyvinyl-Chloride (PVC) and Hot-Applied Asphalt membrane systems are approved for use as waterproofing membrane and are found to be compatible with the required detection system.

Tray systems are not acceptable.

Acceptable low-sided trays may be acceptable if they allow for root system to grow beyond the tray walls. Low-side tray systems shall be approved in writing by DOA-DFD prior to specifying for use.

Extensive, Semi-Intensive and/or Intensive Vegetated Systems may be specified.

Design with 'Growing Media' per DFD "Master" specification section.

EXISTING LIGHTNING PROTECTION

Include lightning protection upgrade on re-roofing projects.

Existing systems shall be upgraded at the time roof is replaced or when any type of new equipment is provide and installed such that the new equipment is now higher than the existing lightning protection system in use.

Upgrade would be limited to the roof area only.

Lightning protection systems shall be installed and verified as functional.

Ground rod or 'loop' systems shall be verified as functional when complete by certified Contractor/installer.

RECYCLE OR SALVAGE OF ROOFING MATERIAL

Contractor shall contact a recycling company to arrange for pick up of EPDM and/or whole-piece insulation intended for disposal by the Contractor.

Contractor shall contact a metal recycle company for metal debris containers, pickup or delivery of metal debris intended for disposal.

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

Contractor shall contact a recycler service as to delivery of asphalt shingle roofing. Some of the recyclers may take cedar/shake shingle and sheet-rock debris.

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.

Material kept for reuse and delivered to the Contractors 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.

***** END OF MINIMUM DESIGN STANDARD *****