Low Slope Membrane Roofing

Division 070000-2 Thermal and Moisture Protection

2.1 New Construction:

- There shall be a positive slope to the roof drainage system. Roof slope shall be accomplished with the roof structure unless specifically approved otherwise by the Project Manager.
- Secondary slopes to drains, such as crickets and saddles, are preferred to be provided by the roof structure; however other methods such as tapered insulation may be used as approved by the Project Manager
- The roof deck shall slope a minimum of 1/2“per foot. Saddles, if required, should be a minimum of ½” per foot to direct water runoff to points of drainage.
- Surfacing shall be selected to be compatible with the roof materials and warranty.
- Roof insulation system made of rigid materials shall be installed in multiple layers. All joints shall be staggered both horizontally and vertically.
- The roof system, including insulation, shall be installed in accordance with FM Global 1-90 rating based on the type of roof insulation.
- Roof insulation shall be compatible with the new roof system membrane and covered under the Roof Systems Manufacturer’s Warranty as a written endorsement if manufactured by a different company.
- Roof accessories shall be selected for their compatibility with the roof membrane system and included in the Roof Systems Manufacturer’s Warranty as a written endorsement if manufactured by a different company.
- Flashings shall be selected so that they are compatible with the specified roof systems and comply with the Roof Systems Manufacturer’s Warranty. If flashings are made by a separate manufacturer, an endorsement to the Roof Systems Manufacturer’s Warranty shall be required.
- The top of the base flashing shall be a minimum of 12” above finished roof.
- The Roof System Manufacturer’s Warranty shall be a 20 Year, No Dollar Limit, Total System Warranty.
- Overflow drainage protection shall be required for all roof drains.

2.2 Existing Construction:

- Methods of positive slope to drain shall be explored. The design criterion for existing roofs is ¼” per foot for the body of the roof and ½” per foot for saddles and crickets, unless specifically approved otherwise by the Project Manager.
- Roof insulation system made of rigid materials shall be installed in multiple layers. All joints shall be staggered both horizontally and vertically.
- The roof system, including insulation, shall be installed in accordance with FM Global 1-90 rating based on the type of roof insulation.
- Roof insulation shall be compatible with the new roof system membrane and covered under the Roof Systems Manufacturer’s Total System Warranty.

- Roof accessories shall be selected for their compatibility with the roof membrane system and included in the Roof Systems Manufacturer's Warranty as a written endorsement if manufactured by a different company.
- Flashings shall be selected so that they are compatible with the specified roof systems and comply with the Roof Systems Manufacturer's Warranty. If flashings are made by a separate manufacturer, an endorsement to the Roof Systems Manufacturer's Warranty shall be required.
- The top of the base flashing shall be a minimum of 12" above finished roof.

When adding slope insulation to a point of drainage:

- Be aware of existing parapet heights, curb heights and weep hole heights when estimating and designing the highest point of a sloped insulation system.
- It may be more economical to install a new trunk line and internal roof drains than to taper the roof toward a difficult drain location with an irregular pattern.

When roof decks are covered with an existing roof system that has been leaking, there is a high probability that roof insulation is wet. In this case wet insulation shall be removed and replaced.

2.3 Characteristics and Considerations:

- **Description**: Tectum Wood fiber deck panels, poured gypsum concrete decks and pre-cast gypsum panel roof decks are the most drastically affected by moisture in a short period of exposure. Plywood can swell and warp due to the presence of moisture. Metal deck flutes can rust quickly if water stands in them.
- **Performance Requirements:** The performance requirements shall always be checked for the characteristics, the performance attachment and insulation/membrane compatibility with the selected deck manufacturer.
- **Design Criteria:** Storage, installation and handling of the materials must all be considered.. Minimum thickness and/or gauges must be chosen from structural span capabilities, wind uplift concerns and loading considerations.
- **Structural Support:** Wind uplift, loading considerations, roof framing systems, minimum thickness, anchorage and staggering of panels must all be considered.
- **Roof Openings:** Any roof openings that are cut through the roof deck must be supported by added structural framing or otherwise preplanned. A structural Engineer shall be involved in the design of the repair of the structural deck.
- **Surface Conditions:** An inspection for surface conditions must be conducted before application of roof materials. For slurry fill type decks, inspect for moisture free and fairly smooth surface with no ripples, ridges depressions or other concerns. For metal decks, check for tightness of laps, proper attachment to structural supports, rust and/or debris such as splinters or saw dust in the flutes. The metal deck must have good attachment to the structure.
- **Cant Strips** should be fire resistant and/or fire retardant. In re-roofing over slurry filled roofs, use a separate cant strip as opposed to a slurry cant strip built into deck.
- **Venting and Drying:** It is important for strength, attachment and moisture content that wet fill type decks must be vented and dried. Protection of a curing deck must be provided in cold or inclement weather. Any damaged material should be removed and properly replaced.

- **Precautions:**
    - Electrical conduits that are tight to the underside of the deck must be measured and marked on the topside of the deck where fasteners are being utilized.
        - High humidity areas can affect deck performance. Check with the deck manufacturer to identify the proper design for high humidity conditions.
        - Additional insulation and the consideration of a vapor barrier are based upon dew point calculations to limit possible condensation.
        - Superimposed loads occur during construction by temporarily overloading a roof area and damaging the roof deck and /or structure. These damaged areas shall be repaired before continuing on with the roof work.
        - Weather and temperature can damage the roof deck. All damage shall be repaired and/or replaced before the installation of the roof insulation and roof membrane system.
        - Roof deck materials shall be protected from the elements in transportation, storage and during installation.
        - Damaged roof deck surfaces must be repaired. If repair is not sufficient then the roof deck must be removed and replaced.
        - Vertical alignment pertains to panel installed decks. They should align vertically. An elevation change greater then ⅛" is not acceptable. The height difference, if not too great, can be grouted and smoothed to a transition.

2.4 Roof Decks:

The primary function of the roof deck is to provide adequate and long term support for the roof system. Other aspects to be considered follow:
Roof Expansion Joints relieve stresses that build up due to building movement. They are critical to the proper and long-term performance of a roof system. The expansion joint must be designed so that it extends through the complete building assembly. Drainage shall be designed on both sides of the expansion joints. The expansion joint shall not impede drainage. Roof expansion joints shall be designed into the roof system at the following locations and /or circumstances:

- Change of deck type
- Where a metal deck changes direction of its flutes
- Where the roof deck changes materials
- Change of structural system
- Building additions
- In continuance with building expansion joints
- Where differential movement occurs between roof deck and walls
- Where a wing off of the main roof is in the design, such as "T", "U" or "L" shaped buildings
- When there are drastic temperature changes within the building, such as refrigeration and /or swimming pools

Roof Area Dividers do not affect the deck. Roof area dividers separate the membrane and roof insulation. Consult with manufacturer's latest recommendations for usage of roof area dividers.2.4.1 Types of Roof Decks:

Steel Roof Decks shall be 22 gauge or heavier with a G-90 galvanized coating. Check with manufacturer's span tables for recommended gauges, span and attachment to superstructure. Attachment of the roof system shall be secured with the base layer of a 2-layer insulation system mechanically fastened as per FM Global latest requirements for I-90 wind uplift ratings.

Structural Concrete Roof Decks are made from various design mixes of concrete. They are as follows:

- Structural lightweight concrete uses lightweight aggregate like expanded shale, slate and/or clay.
- Structural concrete is heavier and uses aggregate that is made of stone, plus water and Portland cement.

The main types of structural concrete roof decks are:

- Post tensioned roof decks that are poured, cured and have tension cables that are tightened after the concrete cures. Cutting through post-tensioned roof decks is not allowed. All piping penetrations shall be cast by use of sleeves etc.
- Pre cast and pre-stressed roof decks are formed at a factory and shipped to a job site. Cutting through pre-cast and pre-stressed roof decks is not allowed. All piping penetrations shall be cast by use of sleeves etc.
- Cast in place concrete is done at the job site with forms and poured concrete such as flat plate, waffle slab and beam and slab concrete decks.
- Concrete decks must be dry and primed with an asphaltic primer, then roof insulation shall be mopped with continuous coverage of hot asphalt to the concrete deck.

Wood Planks and Plywood Decks: Wood plank roof decks are solid wood planks. If there is deterioration of the existing wood planks then replacement with like kind lumber is required. Pay attention to width, length and thickness. Also be aware if planks are straight edge, single tongue and groove or double tongue and groove..

Plywood decks are thin layers of wood glued together. They tend to warp easily when exposed to moisture. When replacing plywood decks use panels rated for structural use as decking. End joints of panels must be staggered and fasteners shall not have smooth shanks because the fasteners back out easily. Use annular ringed fasteners.

Lightweight Insulating Concrete Decks shall have a minimum thickness of 2". The Lightweight Insulating Concrete shall have a pull test of 125 pounds of withdrawal resistance for threaded screw type mechanical fasteners and 40 pounds for expansion type fasteners.

Lightweight Concrete Decks can be applied over the following structure:

- Bulb Tee and Formboard
- Structural concrete
- Galvanized metal slotted deck

When re-roofing and after removal of the existing roof system, all voids and divots shall be filled with compatible compound. A hot applied roof system shall have a nailed vented base sheet. Consult with manufacturers for proper fasteners and

nailing patterns. Single ply roof systems shall have a nailed slip sheet/separator sheet. Consult with manufacture for latest recommendations.

Tectum Wood-fiber Deck Panels will lose structural capacity in the presence of sustained moisture and **shall not be used on new facilities**. Approval shall be obtained from the Project Manager if a tectum roof deck is to be used in existing construction.

For replacement of existing tectum decks the method of attachment shall be investigated. Roof deck attachment is normally accomplished by clips to a structural framing system.

Roof membrane system base sheet shall be attached with a nail system that "hooks" into the wood fiber deck. Do not mop hot asphalt directly to the tectum deck. Voids and joints in the deck must be grouted.

Poured Gypsum Concrete Decks will lose structural capacity in the presence of sustained moisture and **shall not be used on new facilities**. Approval shall be obtained from the Project Manager if a poured gypsum concrete deck is to be used in existing construction.

Poured gypsum concrete decks have a reinforced wire mesh embedded in the mix. When making repairs to the deck, remove the defective gypsum and expose 3" of wire mesh around perimeter and attach new mesh, anchor and re-pour gypsum mix.

A vented base sheet or a double-coated base sheet shall be used in hot applied roof systems. The Architect–Engineer shall consult with the manufacturer for latest recommendations. Do not mop directly to poured gypsum. For single ply roof systems nail a slip sheet/separator sheet. Consult with manufacturer for latest recommendations.

Pre-cast Gypsum Panel Roof Decks are made of tongue and groove metal frames filled with gypsum concrete. The panels are installed over bulb tees or clips that connect directly to the structural framing. Pre-cast gypsum panel roof decks will lose structural capacity in the presence of sustained moisture and shall not be used on new facilities. Approval shall be obtained from the Project Manager if pre-cast gypsum panel roof decks are to be used in existing construction.

A double-coated base sheet shall be used in hot applied roof systems. The Architect–Engineer shall consult with the manufacturer for latest recommendations. Do not mop directly to pre-cast gypsum. For single ply roof systems nail a slip sheet/separator sheet. Consult with manufacturer for latest recommendations.

2.5 Roof Membrane Securement:

2.5.1 Built Up and Modified Bitumen Roof System requirements:

- Tectum wood fiber type decks require a mechanically attached base sheet. Do not mop directly to tectum wood fiber decks.
- Lightweight insulating concrete and poured gypsum decks shall receive a mechanically attached base sheet. Do not mop directly to this deck.
- Pre-cast gypsum panel roof decks shall have a mechanically attached double-coated base sheet. Do not mop directly to the roof deck.
- Metal decks shall have 2 layers of roof insulation; the first layer shall be mechanically fastened with fasteners and plates. See FM Global latest recommendations. The second layer shall be staggered and mopped solidly. The

membrane system can then be adhered in hot asphalt or cold process adhesive.

- Poured in place concrete roof decks can be primed and mopped directly over. Protection must be provided with membrane and mastic at joints, perimeters and projections to keep bitumen from flowing through the roof deck during application.
- Built up roofs and modified bitumen roofs shall not be applied directly over a pre cast panel type of roof deck. A layer of rigid roof insulation board shall be installed to bridge gaps. The roof membrane shall then be adhered with a continuous application of adhesive and/or bitumen.
- Wood plank and plywood roof decks shall have a rosin-sized sheathing paper and a double coated base sheet nailed in an approved manner with annular ringed nails. Rigid roof insulation is then adhered to the base sheet with adhesive and/or hot bitumen in a continuous application. The membrane system is adhered in the same manner.

2.5.2 Thermoplastic and Thermosetting Single Ply Roof Systems requirements:

- Tectum wood fiber type decks shall be installed with a slip sheet separator and mechanical fasteners before installing single ply membranes. Fully adhered membranes shall be applied to mechanically fastened slip sheet separators or rigid roof insulation that is adhered to the separator sheet. Do not mechanically fasten the single ply roof system.
- A slip-sheet shall be mechanically fastened on lightweight insulating concrete and poured gypsum decks. This shall be performed prior to installing a fully adhered single ply membrane.
- Pre-cast gypsum panel roof decks shall have a slip sheet separator mechanically attached before installing a single ply system. Adhere rigid roof insulation to the slip sheet. The single ply system shall be fully adhered to the roof insulation system.
- Metal decks shall have two layers of rigid roof insulation. The first layer is mechanically attached (FM Global latest recommendations). The second layer is staggered and mopped solidly into place. The roof membrane system shall be fully adhered in adhesive and/or hot bitumen.
- Poured in place concrete roof decks shall have a separator sheet and rigid roof insulation attached to the deck. The single ply membrane shall be fully adhered to the rigid roof insulation.
- Pre-cast panel roof decks require a separator sheet mechanically attached before installing rigid roof insulation. Single ply membrane shall be fully adhered.
- Wood plank and plywood roof decks shall have a separator sheet mechanically attached before installing rigid roof insulation. Verify securement of single ply membrane by fully adhering it to the roof deck.

2.6 Rigid Board Roof Insulation:

Purpose and Description: The primary purpose of rigid board insulation is a thermal barrier between inside and outside temperature differences. Another primary purpose of rigid board roof insulation is to perform in the capacity as a “foundation” for the roof membrane system. With proper assembly it can reduce moisture condensation of the interior of a building.

Tapered rigid insulation is assembled to move water to points of controlled drainage. Under

certain circumstances, rigid board insulation can aid in fire retardant/resistant assemblies.

Two-layer insulation is utilized to break the thermal joint between boards on the bottom layer. Plus, the second layer installed with an appropriate adhesive can cushion the fastener heads if the first layer has been mechanically fastened.

Properties of Roof Insulation:

- Compressive strength to withstand foot traffic conditions.
- Dimensional stability under heat and moisture.
- Moisture resistance.

The roof deck assembly, insulation and the membrane chosen shall comply with UL, insurance regulations and Kentucky Building Code. Care shall be taken to ensure compatibility with adhesives chosen and components shall be integrated into the roof system.

Roof insulation provides thermal resistance to heat transfer. Therefore, where possible a two-layer rigid board roof insulation system shall be installed.

2.6.1 Types of Roof Insulation:

- **Perlite Board roof insulation** is manufactured from expanded volcanic mineral combined with binders. Board sizes are 2'x4', 4'x4' and 4'x8'. They vary in thickness from ½" to 3". Approximate R-Value per inch is 2.78.
- **Polyisocynanurate Foam Board roof insulation** is a closed cell, rigid foam insulation that is sandwiched between organic or inorganic facers. Board sizes are 4'x4' and 4'x8'. They vary in thickness from 1" to 4". The approximate R-Value per inch is 5.6.
- **Expanded Polystyrene Board (EPS) roof insulation** is bead board insulation made from molten polystyrene formed into beads. The beads are expanded and stabilized in curing bins and cut into boards. Board sizes are 4'x4' and 4'x8'. They vary in thickness from 1" to 12". The approximate R-Value per inch depends of the density of the beads. Type I has an R-Value of 3.85 per inch. Type II has 3.92 per inch. Type III has 4.71 per inch. Type IV has 4.35 per inch. Note: do not use EPS Board with hot bitumen or solvents.
- **Extruded Polystyrene Board (XPS) roof insulation** is made from molten polystyrene formed in an extruder under pressure containing interconnecting closed cells. Board sizes are 2'x8' and 4'x8'. They vary in thickness from 1" to 4". The R-Value per inch is 5. XPS Board shall not be used with hot bitumen or solvents.
- **Wood-Fiberboard roof insulation** is composed of wood and cane fibers mixed together with binders. Board sizes are 2'x4', 4'x4' and 4'x8'. They vary in thickness from ½" to 2". The approximate R-Value per inch is 2.78.
- **Composite Board roof insulation** is composed of 2 layers of different types of insulation that are factory laminated together.
- **Gypsum board** is a gypsum base core sandwiched between paper or glass-mat facers. It is used as a base layer on metal decks as a fire retarder in combination with other thermal resistance insulation boards. The board size is 4'x8' and they are ½" to ⅝" thick. The approximate R-Value is 0.56 per inch.

2.6.2 Tapered Roof Insulation Systems: The primary purpose of tapered roof insulation systems is to move water to a point of controlled roof drainage. Positive drainage is an important element in the performance of a roof system.

Sloped Structure vs. Tapered Insulation: In new construction the structure shall be designed to provide positive slope for drainage. In existing re-roof projects a tapered system can be utilized.

Design Criteria for Tapered Systems: Each project is different; however, there are similar criteria for consideration:

- Be aware of substrate conditions when deciding the slope to accommodate any potential existing deck deflections and/or deck irregularities. Take into account the actual slope of the existing roof deck.
- The quantity, size and location of all roof drains and through-wall scuppers shall work in harmony with the tapered insulation design.
- The tapered roof insulation system must be compatible with the chosen membrane system for the Project. The criteria of slope and thickness design must be coordinated with the Roofing Systems Manufacturer's recommendations.
- A tapered insulation system shall have varying degrees of thickness and therefore varying degrees of thermal resistance over the roof area. Two approaches in designing the thermal resistance of a tapered roof insulation system are:
    - Minimum R-Value which is determined by the thinnest location of the insulation and the type of insulation.
    - Average R-Value is determined by the average thickness of the insulation over the roof area with the type of insulation.

Moisture Control or Dew Point: is determined typically by the minimum thermal insulation within a roof assembly. The minimum R-Value approach is recommended to determine the need for a vapor retarder.

Types of Tapered Roof Insulation: Factory tapered roof insulation is manufactured initially from square edge roof insulation boards that are factory tapered to provide a predetermined slope. The board stock is typically 2'x 4', 4'x 4' or 4'x 8'. The most common slopes are ⅛" per foot, ¼" per foot and ½" per foot. The material types are as follows:

- Cellular Glass
- Perlite
- Polyisocyanurate
- Polystyrene (Not to be used with hot asphalt and/or solvents)
    - Extruded
    - Expanded
- Wood Fiberboard

Wet fill tapered insulation systems are applied as slurry and the slope is screeded onto the approved structural roof deck. They are composed of wet fill light insulating concrete. Consult manufacturer for design mix, substrate information, weather and temperature for installation, attachment of membrane system and FM and UL requirements.

2.7 Roof Membranes: Built up roof membranes are composed of multiple layers of bitumen. Plies of reinforcement, such as fiberglass felt or polyester fabric are installed between each layer of bitumen.

Built up roof membrane material:

2.7.1 Bitumen:

Asphalt is the primary bitumen utilized for the built up roof assembly. Asphalt is divided into four categories based on slope guidelines and Manufacturer's recommendations:

- Type I asphalt is susceptible to flow at roof temperatures and shall not be used on slopes over ¼" per foot
- Type II asphalt is moderately susceptible to flow at roof temperatures and can be utilized on slopes up to ½" per foot
- Type III asphalt is relatively non susceptible to flow at roof temperatures and can be used on slopes up to 3" per foot.
- Type IV asphalt is relatively non susceptible to flow at roof temperatures and can be used on slopes up to 6" per foot.

The Architect-Engineer shall reference the Roofing Systems Manufacturer's latest suggestions for compatibility and slope design requirements.

Polymer Modified Asphalt is made from standard roofing asphalt that has been modified by the addition of products such as styrene ethylene butadiene styrene (SEBS). SEBS has been used for hot interply mopping adhesive and/or for top pour and gravel surfaces.

Solvent based asphalt for use with Cold-applied Built up roof membranes are made from asphalt and thinned with solvent to become a liquid material. They can be applied with the appropriate membrane without the use of a kettle. Odorless product is preferred.

2.7.2 Built up Roofing Reinforcing Felts, Sheets and Fabrics:

Base sheets serve many functions including:

- To separate a roof system from a substrate.
- To provide support over slightly rough irregularities.
- To serve as attachment on nailable decks.
- To strengthen the roof system.
- To serve as a single layer vapor retarder.

Types of base sheets:

- Asphalt coated fiberglass base sheets are used in built-up roofing. Common type is a No. 28 glass fiber base sheet.
- Asphalt Coated, glass fiber venting base sheets are used over lightweight insulating concrete.
- Asphalt-saturated organic base sheets are used as underlayments and base plies in built up assemblies.

Ply sheets are installed over base sheets, directly over acceptable decks or over rigid stock board insulation. Ply sheets can be installed in 3-ply and 4-ply system configuration.

Type IV Fiberglass ply sheets are the most commonly used ply sheets for built up roofing.

Type VI Fiberglass ply sheets are heavier than Type IV ply sheets.

Cap and Flashing Sheets can be organic roll roofing, asphalt-coated glass fiber or modified bitumen cap sheet. All can be finished on the surface with colored mineral granules.

2.7.3 Built up Roof Membrane Surfacings protect the bitumen and felt from direct sunlight and weather. The surfacing may contribute to benefits of thermal stability, fire resistance, reflectivity and impact resistance. The types of surfacing for built up roofs follow:

- **Aggregate Surface,** such as #67 pea gravel, is set in a flood coat of hot bitumen. The aggregate helps to stabilize a heavy flood coat of bitumen, adds weight to the membrane for wind protection, UV protection, hail protection, improves the fire rating and improves the appearance of the finished roof system.
- **Mineral Surface** is applied with mineral surfaced cap sheets usually asphalt-coated glass-fiber or polymer-modified mineral surfaced cap sheets. These sheets can be applied with hot asphalt or cold adhesives. The cap sheet provides UV protection, weather protection and improves the finished appearance of a roof system.
- **Smooth (liquid applied) Surfacing** is a built up roof with a top coating or glaze coat of hot asphalt. This process involves a protective layer of a liquid applied coating. The coating can be black bitumen products, white elastomeric or aluminum-pigmented products.
- **SBS polymer modified cap sheet** can be utilized in a built-up roof assembly for the surface. These sheets come with a foil faced finish or a granule surface.
- **SBS polymer modified base sheet** can be utilized in a built-up roofing assembly for the flashing system. Currently the foil faced or a granule surface SBS modified sheet is utilized for flashing as a top sheet in a 2-ply flashing configuration

2.7.4 General application information for Built-up roofing materials is as follows:

- Roll Materials should be kept dry.
- Brooming of felt is required to promote hot asphalt bleed through.
- Lay roof so that water runoff is not against the laps but rather over the laps, i.e., shingle fashion.
- Built–up membranes should be laid as continuously as possible. Wood nailers, curbs and penetrations must be in place for roofing to start. Fishmouths and buckles must be cut and flattened before the next sequential ply is installed.
- Phase application of built up roofs is not recommended. Any phased construction shall be approved by the Project Manager. Make sure to limit traffic over recently installed plies until the bitumen has cooled.
- Permanent walkway pads shall be installed to provide access to equipment where maintenance is required.
- Heating and applying asphalt must be in accordance with Equiviscous Temperature (EVT) principals.
- For aggregated surfaces, the aggregate must be placed in the asphalt while the asphalt is still hot. About 50% of the aggregate shall be embedded in the asphalt

when it cools.

2.7.5 Bitumen Application Information:

Equiviscous Temperature (EVT)-- When applying built up roofing, felts should be laid in the hot bitumen when the bitumen's temperature falls within the EVT application range. The rates of interply bitumen application will vary according to:

- The particular bitumen's EVT temperature range.
- The weight of the rolls.

Equiviscous Temperature is a concept that correlates the temperature with the viscosity. The EVT is marked on each carton of asphalt. EVT is to be maintained at ± 25º for proper application at the roof mop cart.

Recommendations for Heating Bitumen:

- Maintain kettle and tanker temperatures less than 25º below actual posted flash point of material used.
- Never heat materials over the flash point.
- Do not allow asphalt to stand in lugger too long.
- Insulate hot pipes and luggers to maintain temperature in cold weather.
- Circulate bitumen while heating.

The roofing contractor shall be responsible for monitoring the temperature at the point of application to ensure the proper EVT during the application.

2.7.6 Polymer-Modified Bitumen Roof Membrane: Modified bitumen roof membrane materials are composed of reinforcing fabrics (polyester, glass-fiber or combination of both) and serve as the carriers for the hot-polymer modified bitumen that is manufactured into roll material.

Polymer-modified bitumen roofing sheets are factory coated on one or both sides with modified bitumen. They are produced in wide variety of weights and wide variety of reinforcements. The smooth surface sheets are used as base sheets and have the following principal functions:

- Separate the roof membrane from the substrate.
- Provide support over irregular surface.
- Serve as attachment on nailable decks.
- Serve as first layer in multiple layer system.
- Serves as a vapor retarder.

Polymer-modified asphalt, granule-surfaced cap and flashing sheets can also be manufactured with a foil-faced finish. They come in different weights and thickness based upon their reinforcement and amount of SBS modified bitumen. Currently the foil faced SBS and granule surfaced modified sheet is utilized for flashing as the top sheet in a 2 ply flashing configuration.

2.7.7 Modified Bitumen Roof Membrane Surfacing can be one of the following:

- **Aggregate surfacing** is field applied to serve as an opaque covering for protection from the UV and weather, adds weight to increase wind uplift resistance and can improve the looks of the roof surface. It also improves fire resistance and hail

resistance ratings.

- **Mineral surfacing** is widely used and provides UV and weather protection.
- **Metal foil laminate surfacing** can be utilized for roof covering. These sheets come pre-surfaced from the Manufacturer.
- **Smooth liquid applied surfacing** involves a reflective coating that is applied to a smooth surface modified bitumen roof membrane. The coatings can be asphalt emulsions, aluminum pigmented coatings and acrylic roof coatings. Application information for polymer-modified bitumen roofing materials is as follows:

Delivery and Storage:

- All materials should have product labels intact.
- Any damaged materials must be rejected.
- All roll goods must be stored on their ends.
- Cover materials with a breathable covering.

Roll material application information:

- Roll material should be kept dry and install over dry surfaces.
- All rolls to be cut and relaxed before installing into roof system. See manufacturer's recommendations.
- Limit traffic over newly installed materials.
- Permanent pathways shall protect a finished membrane from roof top traffic damage.
- Heating and applying asphalt for interply sheets should be performed in accordance with EVT principals.

Modified Bitumen Application Information: The bitumen must be heated above the EVT for the proper application of SBS polymer modified bitumen membrane materials. It has to be hot enough to promote thorough adhesion lamination of the plies. The rates of interply bitumen may vary according to:

- A particular bitumen's viscosity.
- The weight of the polymer-modified bitumen rolls.
- The deck and substrate temperature.
- The ambient air temperature and material used.

Temperatures of mopping asphalt that are too high can lead to:

- Incomplete film coverage.
- Voids between plies.
- Potential lack of long-term durability.
- Safety hazards.

Temperatures of mopping asphalt that are too low can lead to:

- Poor adhesion
- Potential felt slippage problems.

It is recommended to contact the modified bitumen sheet manufacturer for specific requirements of asphalt temperature requirements (EVT).**The roofing contractor shall be responsible for monitoring the temperature at the point of application to ensure the proper EVT during the application.**

Recommendations for heating bitumen: Excessive prolonged heating of asphalt can be damaging or cause fire hazards; consult Manufacturer for specific requirements.

2.7.8 Thermoplastic Roof Membranes, commonly referred to as single ply membranes follow:

- **PVC Membranes** are reinforced with glass fiber or polyester mat or fabric and produced in thickness ranging from 45 mils to 90 mils. Most are resistant to bacterial growth and plant root development. The thermoplastic membranes are seamed by heat welding the laps with hot air.
- **PVC Alloys of Thermoplastics** are produced with PVC and various polymers. These membranes are thermoplastic in nature (i.e., laps are heat welded). The different types of membrane are as follows:
    - **Copolymer Alloy (CPA)** membranes are 30 to 50 mils thick and some are resistant to chemicals, certain oils and grease. CPA can be installed ballasted, fully adhered or mechanically fastened. Laps are heat welded.
    - **Ethylene Interpolymer (EIP)** are 32 to 60 mils thick. EIP are installed in ballasted or mechanically attached configuration. Laps are heat welded.
- **Thermoplastic Olefin (TPO)** membranes are compounded from a blend of polypropylene and ethylene-propylene rubber polymers. The membranes are 40 to 100 mils thick. They are resistant to degrading from exposure to animal fat and vegetable oils. TPO membranes can be installed as ballasted, fully adhered or mechanically attached.

Thermoplastic Membrane Attachment can be accomplished in one of three ways:

- Ballasted system – Ballasted systems are not to be used on Commonwealth of Kentucky projects without the written permission from the Division of Engineering and Contract Administration!
- Mechanically attached - must verify wind uplift ratings I-90.
- Fully adhered - best for long-term performance.

Thermoplastic Roof Membrane Surfacings are factory applied to the membrane and can be installed with no added coating. If ballast or pavers are used, then the ballast should be well rounded with no sharp edges. A separator sheet should also be installed for added protection.

General Guidelines for Thermoplastic Membrane Materials:

- Product labels intact. Materials shall be wrapped for protection.
- Rolls may be stored lying horizontally.
- Sweep surface free of any sharp objects before storage.
- Lids must be secured on bucket goods.
- Water based adhesive must be protected from freezing.

General Application Information for Thermoplastic Roofing Materials:

- Install membrane over clean and dry surface.
- Install membrane so that water flows over the laps in shingle fashion.
- Ensure that wood nailers, curbs drains and other penetrations are in place before roofing.
- Ensure that wrinkles in laps are cut out and patched to maintain seam integrity.
- Follow manufactures guidelines for safe handling of materials.
- Limit traffic over newly installed membrane.
- Install permanent walkway paths to protect the membrane from roof top traffic.

Thermoset Roof Membrane is commonly referred to as single ply membrane. There are three common subcategories of thermoset roof membrane:

- **EPDM –** Ethylene Propylene Diene Monomer is an elastomeric compound. EPDM sheets range in thickness from 45 mils to 120 mils and are usually black. The most common thickness utilized is 45 mils or 60 mils. The minimum thickness to be used on Commonwealth of Kentucky projects shall be 60 mils. EPDM membranes exhibit good resistance to UV, weathering and abrasion. EPDM also has good low temperature flexibility. The laps are joined with double stick tape or glue. Membrane systems can be fully adhered or mechanically fastened.
- **CSPE –** Chlorosulfonated Polyethylene is a synthetic rubber material commonly called Hypalon. CSPE is resistant to ozone, some chemicals and pollutants. The laps are joined by hot air welding. Membrane systems can be ballasted, fully adhered or mechanically fastened.
- **PIB –** Polyisobutylene roof membranes are formulated with a butyl based that can be formed into a sheet. PIB roof membranes range in thickness from 100 mils to 120 mils. The laps are joined with a sealing tape. PIB membranes are sensitive to coal tar pitch, specific solvents, and some organic oils and fats. PIB can be adhered to an approved substrate with hot asphalt, cold applied adhesive or fully ballasted.

Thermoset Membrane Securement may be specified as follows:

- Ballasted system – Not to be used.
- Mechanically attached – must verify wind uplift ratings I-90
- Fully adhered – best for long term performance.

Thermoset Roof Membrane Related Roofing and Flashing Materials: Separator sheets are utilized to allow the membrane to move independently from a substrate without damaging the membrane from abrasion. It also separates incompatible membranes.

Materials used for separator sheets include thick polyester or glass-fiber mats, polyethylene sheeting, reinforced kraft paper or fleece backing.

Related flashing material includes vulcanized and non-vulcanized EPDM roof membranes. Unreinforced EPDM sheet membrane is used for projections and inside/outside corners. Usually 60 mil reinforced (or thicker) EPDM sheet membrane is used for base flashing.

General Application Information for Thermoset Roofing Materials:

- Materials shall be stored on a clean surface, free from gravel and/or sharp objects.
- Materials shall be in packing shroud from the Manufacturer and well marked.
- Lids shall be on buckets on job site.
- Water based adhesives shall be kept from freezing.
- Membranes shall be installed over clean and dry surfaces.
- Laps shall be installed in shingle fashion so that runoff does not flow against the laps.
- Single ply seams shall be checked before the job completion.
- Traffic over fully adhered membrane shall be limited until it has cured.
- Roof membrane shall be laid as continuously as possible.
- Shrinkage of membrane considerations shall be addressed at base wall and edge securement details. Also, penetrations through the deck and roof are important considerations.
- Irregularities such as wrinkles in laps shall be smoothed out prior to seaming a membrane.
- Fish mouths shall be cut and patched.
- Thermoplastic and Thermoset membranes shall not be used where grease will be present on the roof.