

GENERAL DESIGN RECOMMENDATIONS

3.1 DECK DESIGN

3.1.1 General Deck Design Criteria:

All roof decks must be designed and constructed in strict accordance with the published specifications of the deck manufacturer and comply with/ or exceed established criteria set forth in the NRCA Roofing & Waterproofing Manual, UL Guidelines, Factory Mutual Guidelines or those set by other building codes authorities. The ultimate responsibility for the design of the deck, the deck system components and proper attachment of all roofing materials to the deck lies with the Architect, Engineer and Owner.

3.1.1.1 Design Loads:

The deck must provide for minimal deflection and be designed to support the new Ecology roof system and other anticipated loads - meeting all code requirements for the overall live and dead load capacities. The decking contractor and architect/engineer and owner are responsible for the suitability of the roof deck to receive the new roof system and handle wind uplift forces anticipated in the area.

3.1.1.2 Corrective Action:

The roofing contractor should notify the Owner, in writing, of any deficiencies noted before attempting to install new roofing. No roof work should proceed until the deck has been properly constructed and is free from any surface irregularities, moisture, dirt, debris or other loose materials.

Any deck openings left from equipment removal should be replaced with equal specification decking materials and properly secured to the existing decking.

Any rusted or otherwise damaged decking shall be replaced and properly fastened with materials equal to those being removed prior to beginning the application of any new roofing.

3.1.1.3 Wood Nailers:

All eaves, gable ends, and openings in the roof must have treated wood nailers or curbs installed. The nailers are necessary to secure roofing felts, edging, gravel stops, and roof fixtures. They should be of equal depth to any insulation being installed and secured with proper fastening materials for the decking type and to meet Factory Mutual or other code guidelines.

The wood treatment shall not react with asphalt. Creosote or other oil based wood treatments should not be used.

Roof edges should not be flush with the roofing membrane, but tapered to direct water to interior drains wherever possible.

3.1.1.4 Slope:

A minimum positive roof slope of 1/4" in 12" is recommended by the NRCA and Factory Mutual in order to insure proper drainage. Ecology Roof Systems® will not issue any guarantee on roofs that hold drainage water for periods longer than 48 hours. Ecology and the roofing contractor assume no responsibility for roofs designed with insufficient slope to release the drainage of water or for the structural integrity of the roof deck.

The following information is also being presented in addition to the above general conditions for specific deck types:

3.1.2 Steel/Metal Decks:

Steel decking must be installed in accordance with the Steel Roof Deck Design Manual guidelines of the Steel Deck Institute and specifications of the deck manufacturer. New steel decks and replacement decks shall be factory galvanized or factory coated with aluminum zinc alloy for corrosion protection. Existing steel decking, normally primed, should be considered for application of a permanent protective coating of paint prior to the installation of the replacement roof system. In highly corrosive or chemical atmospheres, individual deck manufacturers should be contacted for recommendations in special finishes required. Steel decks should be no lighter than 22 gauge with 1½" deep deck ribs and conform to the recommendations of the latest Factory Mutual Loss Prevention Data Bulletin I-28.

Application of Ecology materials over any other form of metal decking, such as "aluminum" should be reviewed with Ecology's Technical Department for application acceptability.

Steel roof decking requires the installation of a minimum thickness 1" rigid board insulation with the insulation board joints supported on bearing surfaces of the steel roof deck to support the installation of the new roof system and subsequent rooftop activity without crushing

of the insulation.

The insulation manufacturer's and Factory Mutual 1-28 guidelines should be followed for minimum thickness required and the proper attachment of the insulation for a particular deck design and insulation used.

The fastener used to anchor the roof insulation to the roof deck shall be Factory Mutual tested and approved for use on the type of deck being roofed.

Ecology supports the use of a double layer of insulation over metal decks with the individual layers of panel joints staggered. The bottom layer should be mechanically fastened or adhered in accordance with Factory Mutual guidelines and the top layer adhered in Type III (Steep Grade) hot asphalt. **This approach provides greater rigidity to the roof system while preventing thermal bridging and heat loss through fasteners and panel joints.**

NOTE: Recent Factory Mutual Guidelines in Loss Prevention Bulletin 1-28 appear to require fastening of both layers as a unit. Mopping or adhering the second layer with adhesive is not shown as an acceptable alternative. If FM is required for the project, the specifier should check with Factory Mutual for clarification and the specifier should be aware of insulation types and combinations that would be acceptable for double layer specifications.

3.1.3 Poured Concrete Decks

All concrete decks must be unfrozen, smooth, even and dry condition before installation of any roofing materials.

The surface should be free of any concrete curing agents with compatibility of asphalt to residual curing agents pre-determined. Any loose or deteriorated concrete and uneven surfaces which might cause adhesion or standing water problems with the new system must be repaired to provide an acceptable surface for the installation of the new roofing materials.

Surfaces must be primed with Ecology's ERS-301 Asphalt Primer and left to dry. Before installing new roofing materials the NRCA Deck Dryness Test must be successfully performed.

Installations over concrete decking requiring the use of insulation shall have the insulation installed in continuous moppings of hot applied ERS All Temp, ERS Hot Flex Asphalt or approved Type III (Steep) or Type IV (Special Steep) certified asphalt. Ecology's ERS *INSULHESIVE* may also be used to bond the insulation to poured concrete decks.

Where uninsulated systems are being specified, the base ply must be fully adhered in Ecology's ERS-302 or ERS-309 Cold Adhesive or spot mopped to the deck in accordance with NRCA Guide #CAGA.

3.1.4 Pre-Cast/Pre-Stressed Concrete Slabs

Deck panels shall have no more than 1/4" height difference between panels. Panels shall be properly secured at sides and ends. All uneven joints shall be leveled with grout to provide an even surface. Panels, especially pre-stressed, should be checked for bowing or unevenness which might impede drainage run-off. If conditions require correction, a tapered system should be installed using a lightweight structural concrete fill at a minimum thickness of 2" or a tapered rigid insulation system.

Priming of the deck surface with ERS-301 Asphalt Primer is recommended prior to installation of the new roof system.

Direct application of Ecology materials is not acceptable over these decks without an acceptable lightweight structural concrete fill or rigid board insulation system first being in place. If the deck already has a lightweight structural concrete fill over it, the fill must be dry in order to proceed with the installation of the new roofing system. Lightweight "insulating" concrete fills such as perlite and vermiculite are not a satisfactory substrate for the new roofing and will not be accepted over pre-stressed or pre-cast panels.

If a lightweight fill is not present, the joints between the panels should be stripped in with a heat welded 8" strip of Ecology's modified membrane or grouted prior to roof installation to prevent drippage through panel joints.

3.1.5 Gypsum

The deck must be dry and unfrozen and have a smooth surface. The deck shall be reinforced with wire mesh and be a minimum of 2" inches thick. Where the deck is damaged or wet, repairs must be made with the proper gypsum fill and reinforcements in accordance with the recommendations of the Gypsum Roof Deck Association. The repairs must be dry prior to installation of the new roofing system.

No direct adhesion or bonding to the deck should be done with any component of the new roof assembly.

On new gypsum decks, Ecology's ERS-403 Vented Base Sheet, ERS-507 (granule side down) or an Ecology approved vented base sheet shall be mechanically fastened using acceptable gypsum fasteners. When reroofing older dry deck systems, ERS-500-4 or an Ecology approved conventional G-2 base sheet can be fastened with Gypsum fasteners in patterns established by the Gypsum Roof Deck Association or Factory Mutual to provide a minimum initial withdrawal resistance of 40 lbs. per fastener or as

required in the latest FM 1-47 guidelines.

NOTE: Where a conventional glass base sheet is used, extreme care should be taken to relax the membrane prior to nailing to avoid wrinkles.

A recover board over the base ply is recommended to protect against membrane splits which may develop due to Gypsum cracking. Ecology will not be responsible for leaks due to membrane splits caused by the cracking of the gypsum deck under any circumstance.

3.1.6 Lightweight Structural Concrete:

Having a compressive strength of approximately 2,500 psi., the same criteria as outlined for poured concrete deck systems shall be used for applications of Ecology roof systems over this type of concrete deck. Care must be taken to assure proper curing and to protect exposed deck surfaces from moisture and freezing prior to the installation of the new roofing.

Lightweight structural concrete provides an acceptable substrate for pre-stressed and pre-cast deck systems where tapering is required.

3.1.7 Lightweight Insulated Concrete:

Due to the high moisture content in these types of deck systems, special considerations need to be taken in the design and installation of the new roof system. Generally, the greater concentration of these types of decks systems is found in the warmer climate areas of the U.S.

In order to be acceptable for Ecology installations:

- a. The deck must be a minimum of 2" thick, with a minimum compressive strength of 22-lbs./cu. ft. and placed over a slotted, not edge vented, form steel deck. The slots must provide a minimum 1.5% open area. The deck must be installed by an approved applicator of the deck manufacturer and the deck must be certified by the deck manufacturer to be able to support a fastener pull-out of 40 lbs. min., and be acceptable for installation of Ecology's modified membranes or built-up systems.
- b. Provision must be made for underside and top side venting. Roofing over lightweight fills placed over structural concrete, another roof system, or vapor retarders where proper venting is restricted is not recommended.
- c. No membrane or roof assembly installation is to begin until the proper cure time for the fill mix has passed.

- d. Installations over lightweight insulating concrete must be approved on an individual basis by Ecology's Technical Services Manager.

Ecology's ERS-403, ERS-507 or an Ecology approved vented base sheet, ASTM D-3672 Type II, should be fastened to the deck with approved fasteners and fastener patterns. If the deck is older and determined to be dry, ERS-500-4 or an Ecology approved base sheet may be used. In cases where insulation is to be installed, the insulation is to be adhered over the base ply.

Reroofing over an existing roof system on a lightweight insulating deck is not recommended.

3.1.8 Wood Plank Decks:

Wood plank decks must be comprised of clear, sound, well-seasoned lumber of not less than 1" thickness. Planks shall be tongue and groove, shiplap or splined together at side joints and matched at end joints and securely attached to supporting members with a bearing on rafters at each end. Knot holes in excess of 1/2" diameter and cracks larger than 1/4" should be repaired with 24 gauge galvanized steel, nailed two (2") on centers, using barbed, galvanized roofing nails around the perimeter of the metal repair.

In older deck systems, deteriorated plank should be replaced with equivalent materials and loose boards should be re-secured. If the old roof system was ballasted, the new roof system must include a minimum 3/4" layer of insulation as part of the new assembly to aid in the deck's re-adjustment to the weight load of the new system.

Wood plank decks must be covered by dry sheathing paper (rosin paper) prior to installing the new roofing system to aid in preventing asphalt drippage through plank joints and prevent the decks wood resins from attaching to the new roofing materials. An Ecology "ERS" Base Membrane should be secured to the deck, using screws and plates of minimum one (1") inch head diameter, angular shank nails with an adequate fastening pattern is required over the rosin paper to meet current Factory Mutual and NRCA recommendations.

Specifications calling for insulation, the nailed base membrane will serve as an acceptable substrate for the bonding of the insulation.

3.1.9 Plywood and O.S.B. Board Decks:

All veneer plywood and oriented strand board panels should be American Plywood Association (APA) rated with a minimum acceptable thickness of 1/2" and conform to A.P.A standards for type, grade, and installation. Non A.P.A. rated panels are not acceptable

substrates for Ecology roof systems. Plywood panels shall be minimum three-ply laminates and be rated "Exterior Grade CDX." Panels shall meet or exceed a span rating of 32/16 and have structural member support on no less than 24" centers.

Loose nails must be properly anchored to deck supports. Warped, crushed, wet, and rotted panels must be replaced with equal or better panels properly secured to the structural members.

It is recommended that dry sheathing paper (red rosin paper) be installed over the deck to prevent sticking of the base membrane to the deck. An "ERS" Base Membrane or an Ecology approved G-2 base sheet, shall be nailed with screws and plates or one (1") inch minimum head angular shank fasteners, at patterns and quantities established by current Factory Mutual or UL guidelines and as set forth in the current edition of The NRCA Roofing and Waterproofing Manual. For minimal wrinkling use one of the ERS-500 SBS Base Sheets. ERS-500 SBS Base Sheet is recommended.

Insulated specifications can have the insulation boards mechanically attached directly to the deck without the use of the separation layer of rosin sheathing paper. The insulation may also be secured to the nailed base membrane by means of a uniform mopping of ERS All Temp or approved Type III (Steep) asphalt. Ecology's system membranes can be applied directly to the nailed base or insulation per specifications for nailable and insulated systems.

No direct adhesion or bonding to the deck should be done with any component of the new roof assembly.

No guarantee will be issued on decks constructed of FRT (fire retardant treated) plywood documented to have resulted in industry-wide deck failures.

3.1.10 Cementitious Wood Fiber:

Generally, these decks are marketed under the names of Tectum, Permadeck, Insulrock, etc. The industry has experienced numerous problems with these decks. If acceptable, the Ecology roof system to be placed over these decks must meet the following requirements:

- a. Ecology strongly suggests a professional engineer be retained to design the new roofing system in tandem with Ecology Technical Services Manager.
- b. The deck must be constructed in strict conformance to the deck manufacturer's specifications with panels properly clipped to the supporting steel members. All joints shall be properly grouted, leveled and interlocked. A

level deck surface is required. A minimum 2" thickness is required with sufficient density to hold acceptable fasteners. FM guidelines should be followed in the type and spacing of fasteners and the specifications and tests required for fastener pull-out.

Any panels which have dislodged, warped or become wet must be replaced.

- c. The deck must be roofed before any moisture can attack the vulnerable deck system. A layer of rosin sheathing paper and a layer of ERS-500-4 SBS Base Membrane or an acceptable Ecology alternate must be attached with approved fasteners and in accordance with the most recent guidelines of Factory Mutual and the NRCA Roofing & Waterproofing Manual. The base ply shall be covered with a minimum layer of 3/4" recover board insulation installed per FM guidelines for the deck type, preferably with joints offset from the panel joints to add strength.
- d. No existing roofing systems shall be recovered over the old roofing without complete removal of the old roofing membrane and insulation to provide for proper examination of the decking prior to installing the new roof system.

3.1.11 Other Deck Systems:

Contact the Ecology Technical Services Manager for information on the use of Ecology roof systems on decks not described in this manual.

3.2 INSULATION SELECTION

3.2.1 General:

It is important for the specification writer to get updated information and performance criteria on a given insulation from the manufacturer of the insulation. Several changes in manufacturer's product specs have developed over the past few years. The federal government's environmental ozone regulations required removal of CFC blowing agents from the manufacturing process of cellular insulations such as isocyanurates, phenolics, and extruded polystyrenes. This regulation has required most manufacturers to substitute HCFC blowing agents, resulting in the re-thinking of the in-service R-value which, in general, has been reduced over previous board formulations for several of the manufacturers.

High-density perlite recover boards have been introduced for reroof systems, and as a protective board, for plastic foam insulation types. Several cases studies have shown problems with membrane blistering

when these boards have been used in non-venting roof systems. Since these boards contain a higher degree of cellulosic fibers they appear to contain an increased amount of retained moisture from the manufacturing process and need to be specified in applications where underside deck venting is possible. These thinner boards may also not provide enough insulating protection for applications over plastic foam insulations when used as a barrier board in mopped applications.

Ecology requires roof insulations used in the design and construction of Ecology roof systems to be manufactured for specific use in roofing applications. Insulation manufacturer's technical manuals and guideline specifications for the staggering of layers, mitering, taping, multi-layer applications, and the acceptability of mopping, heat welding, or the use of cold adhesives, should be verified. The boards should be listed and approved by the Factory Mutual System or listed in the Building Materials Directory of Underwriters Laboratories. All materials must be dry prior to installing them as part of the roof system. The insulation manufacturer must accept responsibility for any manufacturing defects which occur in the insulation.

Fastening shall be done in accordance with Factory Mutual guidelines for the deck system. No mopped installations of insulation boards directly to metal, wood, gypsum or other lightweight decking is recommended.

Whenever possible, particularly in mechanically fastened systems, where the fastener may serve as a thermal bridge from deck to roof membrane, it is recommended that a second mopped or adhered layer of insulation be installed with staggered joints over the first layer. **Refer to this manual's Section 3.1.2 for potential exceptions under the newest Factory Mutual 1-28 guidelines and a potential conflict in the above design concept.**

Insulation panels installed on metal decks should rest fully on the longitudinal deck ribs and not extend over into flute openings. Minimum insulation thicknesses for insulation panels on metal decks shall be in accordance with the manufacturer's published specifications.

All cellular foam insulations must be overlaid with an acceptable recover board, such as ERS Redi-Dek, as described in the following specific types of insulations.

For more details on acceptable insulations which may be used with Ecology specifications, contact the Ecology Technical Services Department.

3.2.2 Wood Fiberboard:

Wood fiber insulation must meet ASTM C-208-72 and Federal Spec LLL-I-535B. The boards shall have an

asphalt sealer applied to at least one side to form an acceptable surface for application of the Ecology roofing system.

Fiberboard insulation can be mechanically attached and is acceptable for mopping or cold process applications.

3.2.3 Ecology's ERS Redi-Dek:

Ecology's wood fiber insulation board with a laminated G-2 fiberglass base sheet. Two edges of the board are shiplapped. Sizes include 1/2" and 1" thicknesses. The boards can be installed in ERS All Temp, ERS Hot Flex Asphalt, Type III or IV mopping asphalt, with ERS INSULHESIVE on approved substrates, in ERS-302 or ERS-309, or with mechanical fasteners as outlined in Factory Mutual Guidelines for the deck type. This is an excellent choice for recover applications or as a protective layer over plastic insulations. Redi-Dek can be used with Ecology roofing membranes specified for torch, mop or cold process installation.

3.2.4 Perlite:

Perlite boards fall into two categories: Standard Density & High Density Recover Boards. The boards must meet Federal Spec HH-I-529 and ASTM Specification C-728. The boards shall have an asphalt sealer applied to at least one side for proper bonding of the bitumen and the Ecology roofing system to the board. Perlite insulation can be mechanically attached and is acceptable for mopping applications.

NOTE: 1/2" thick perlite recover boards shall be mechanically fastened or strip mopped to the substrate surfaces due to the potential moisture content of the board. This type of board should not be used on non-breathing roof decks or systems (such as concrete-types) or where vapor retarders are used. Carefully follow the installation procedures established by the manufacturer of the board in order to minimize the development of any potential blistering of the roof membrane over this type of insulation.

3.2.5 Fiberglass:

Fiberglass boards must meet ASTM C-726 and Federal Spec HH-I-526. The board surface must be laminated with an asphalt adhered kraft cover. Fiberglass boards should not be installed where the cover has been removed or is loose. The boards can be installed with mechanical fasteners and are acceptable for mop applications. Follow the manufacturer's published instructions for proper use and application procedures.

3.2.6 Basalt Wool:

Little long-term U.S. history is available on this insulation with most of the installations found in European markets. The compressive strength of the products being produced is somewhat soft with the

manufacturer's spec showing a range of 10 -12 in two products offered. The surface of the insulation has a laminated facer to prevent excessive absorption of asphalt into the insulation. Basalt Wool must meet ASTM C 726 and Federal Spec. HH-I-526C. The manufacturer promotes the use of this insulation in direct heat-welded (torch) applications, as well as mop installations. If selected, follow the manufacturer's guidelines for proper installation instructions.

For the immediate future, Ecology's Technical Services Manager should be contacted for acceptance of and installation requirements regarding the use of this insulation in Ecology specifications.

3.2.7 Cellular Glass:

Must meet the Pittsburgh Corning Foamglass specification criteria for physical properties and performance characteristics. The manufacturer promotes the insulation's use for high heat, high humidity, chemical/petrochemical exposure, and compressive loading. The board's brittle characteristics are not well designed for systems where mechanical loading may cause deck deflection, such as is present on steel deck systems. Follow the manufacturer's instructions for proper installation procedures.

3.2.8 Polyisocyanurate:

The boards must meet Federal Spec HH-1-1972 and the RIC/TIMA Standard Specification for Polyurethane and Polyisocyanurate Roof Insulation. Due to out-gassing problems associated with cellular breakage during installation and with roof temperature build-ups, many manufacturers require an additional layer of recover board. A 1/2" (minimum) layer of Ecology ERS Redi-Dek, wood fiber, 3/4" fiberglass, or perlite insulation should be installed over the top of isocyanurate insulations prior to installing the Ecology roofing system. If a mechanically attached, coated or vented base membrane is installed directly over the insulation, the membrane must have another fully adhered base membrane installed prior to the application of the Ecology cap membrane - also includes installations where Redi Deck is mechanically attached. Several UL & FM rated specifications call for the use of a gypsum type barrier board fastened to the deck to provide specific fire ratings. These boards, including those manufactured by Georgia-Pacific under the name Dens-Deck®, are acceptable for Ecology roof system installations. Generally, the board thicknesses range from 1/4" - 5/8" with little R-value added to the system. Please refer to the manufacturer's specific approvals and specification guidelines. Contact Ecology's Technical Services Manager for the use of these boards within Ecology specifications and the present Ecology fire ratings with these boards.

fastened.

No direct mop, adhesive or heat welded application of Ecology materials or base membranes should be done over these foam boards unless specifically authorized by Ecology Roof Systems® and accepted in writing by the manufacturer of the insulation. Follow the manufacturer's, NRCA, Factory Mutual and UL guidelines for proper application procedures.

3.2.9 Phenolic Foam:

Ecology roofing membranes should not be installed over systems where phenolic insulation is in use or being considered for use. Ecology also assumes no responsibility for corrosion problems which might develop in decking and fasteners with the use of phenolic insulations.

3.2.10 Asphalt & Perlite Aggregate:

The Ecology Technical Services Department should be called regarding specifications for these types of insulating fill systems. In general, they do not provide adequate substrates for Ecology materials.

3.2.11 Expanded Polystyrene:

Expanded polystyrene must have a minimum density of 1.0 pcf. Materials must meet the requirements of ASTM 578-87. All material must be certified to have been aged for a minimum of seven days. The boards are to have an adhered minimum 1/2" layer of recover board, such as Ecology's ERS Redi-Dek or wood fiber insulation, installed over the top with all joints staggered and taped on the recover insulation to prevent damage to the foam in the application of the roof membrane system. The overlay should be placed on the foam by back-mopping the overlay board with ERS All Temp, ERS Hot Flex, or approved Type III (Steep) or Type IV (Special Steep) asphalt and immediately installing the board to the foam insulation surface. The board may also be installed with mechanical fasteners to meet the newest Factory Mutual guidelines.

3.2.12 Barrier Boards:

3.2.13 Tapered Insulation Systems:

The guidelines set forth for the various types of insulations must be followed when specifying a tapered system using perlite, isocyanurate, or other plastic foams. The slope and acceptability of the roof area is the responsibility of the architect or specification writer, the tapered systems manufacturer and building owner. Ecology does not assume responsibility for the design and layout of any tapered system. All tapered panels must be fully adhered or fastened to themselves and to the deck system. Wherever tapered systems are installed, careful examination of existing curbs, pipes,

etc. must be made and corrective action taken to provide for adequate flashing depths for the new roof system.

3.2.14 Extruded Polystyrene and Others:

Consult with the insulation manufacturer and Ecology for acceptable systems and design procedures.

3.3 FASTENER SELECTION:

Only fasteners complying with FM Standard 4470 relative to corrosion resistance shall be used. Only FM approved fastener/plate combinations should be used.

Stress distribution plates from one manufacturer should not be installed with another manufacturer's fastener unless the combination is FM approved. Only the shortest fastener length possible to comply with the manufacturer's minimum penetration requirements should be used.

For information on Factory Mutual fastening requirements read the most recent updates of FM's data sheets 1-7, 1-28, 1-47, and 1-49. The roof designer or architect should become familiar with these requirements.

For Steel Decks:

The fastener should be long enough to penetrate the top bearing surface of steel roof decks, but not so long as to penetrate the steel roof deck at the bottom of the flutes.

Screw should be at least 1/2" longer than the insulation used. Minimum average pullout should exceed 375 lbs. for a 22 gauge deck.

For Structural Concrete Decks:

The fastener embedment should be 1 to 1-1/2" with minimum average pullout of 800 lbs. A pre-drilled screw/nail or direct-drive nail is the recommended fastener.

For Gypsum Decks:

It is recommended that a non-penetrating screw or penetrating wing toggle. The non-penetrating screw should have a minimum embedment depth of 1-1/2" with a 300 lb. minimum pullout. A wing toggle should extend through the deck and have a minimum pullout of 450 lbs.

For Wood Decks:

A screw type fastener penetrating 3/4" is recommended with a minimum average pullout of 375 lbs. for a 3/4" deck. Pullouts on a 1/2" deck would be lowered to 275 lbs. Present FM listings show only screw types listed.

If angular, shanked cap nails are used, a minimum 1" fastener embedment is needed. In the case of a 3/4" plywood deck, the fastener would extend approximately

1/4" below the underside of the deck.

The following fastener guide is given to aid the specifier in determining fastener selection sources for various deck designs and for use within Ecology specifications.

Fasteners should only be used in accordance with the manufacturer's recommendations and specifications. With several recent changes in Factory Mutual guidelines, it is always best to verify the latest recommendations in effect within the industry:

<u>Fastener</u>	<u>Manufacturer</u>
<u>Steel Deck</u>	
Standard or Heavy Duty Fastener	Olympic Fasteners
Dekfast #12, #14, #15 or Omega	Construction Fasteners
Roofgrip or Hextra Roofscrew	ITW Buildex
Hilti Fastener #12 or #14	Hilti, Inc.
Lexusco Insulation Clip	International Permalite
Rawl #12 or #14	Rawlplug Co, Inc.
DP, TP, or HD	Tru-Fast Corporation
<u>Lightweight Insulating Concrete</u>	
Zonotite (for base sheets)	W. R. Grace & Company
NTB-2H or 1.2 Base Sheet Fastener	Olympic Fasteners
Base Ply Fasteners	ES Products
Insuldeck Loc-Nail	E.G. Building Fasteners Corp.
Peel Rivet or TPR	Creative Const.. Components
Tube-Loc Nail	Simplex Nail & Mfg.
Hilti Toggle Bolt	Hilti, Inc.
<u>Pre-Cast & Structural Concrete</u>	
New Striker	ITW Buildex
Rawl HD #15, Spike, T-Spike	Rawlplug Company
Dekfast #14 or #15 Heavy	Construction Fasteners
H.Duty Fastener (14-10 or CD-10)	Olympic Fasteners
Hilti Fastener #14	Hilti, Inc.
CF	Tru-Fast Corporation
<u>Poured Gypsum</u>	
NTB-2H or 1.2 Base Sheet Fastener	Olympic Fastener
Polymer Gyptec	ITW Buildex
Speed-Lock Toggle	Rawlplug Co, Inc.
Hilti Toggle Bolt	Hilti, Inc.
Tube-Loc Nail	Simplex Nail & Mfg.
Hardened Do-all Loc-Nail	E.G. Building Fasteners Corp.
Nail-Tite Type A	ES Products Inc.
<u>Wood</u>	
<u>Screw Types:</u>	
Dekfast #12 , #14, #15, or Omega	Construction Fasteners
Standard or Heavy Duty Fastener	Olympic Fasteners
Roofgrip or Hextra Roofscrew	ITW Buildex
Hilti Fastener #12 or #14 Hilti, Inc.	
DP, TP, or HD	Tru-Fast Corporation
<u>Nail Types:</u>	
Roundtop or Plasti-Top	National Nail Corp.
11 Ga Annular Thread Roofing Nail	Independent Nail Co.
Sq. Cap Nail - Annular Thread (1")	Simplex Nail & Mfg.
Hardened Do-All Loc-Nail	ES Products Inc.

Also available for use as a fastening device for insulation panels is:

ERS INSULHESIVE Panel Fastener

Acceptable as an insulation adhesive for attachment of insulation boards to concrete, lightweight insulating concrete, steel, pre-cast concrete, wood, or existing smooth surface roof systems. Meets FM I-60 and I-90 requirements for wind up-lift resistance. Not recommended for use with perlite insulation boards. A 3/4" bead at one foot intervals along the length of the board shall be used to install the panels. Call Ecology's Technical Services Department for specific approvals on all Ecology specifications.

3.4 BASE AND SYSTEM PLY SHEETS

3.4.1 General:

While Ecology specifications permit the use of approved generic base membranes and ply sheets within the designs of certain roof systems, the type of guarantee offered by Ecology Roof Systems® may be effected when substitutions are made for Ecology offered products. Ecology believes the use of its own base plies in the specifications will add to overall project quality control and increase long term results due to the outstanding physical characteristics and performance enhancements they offer when incorporated into the roofing system.

Any generic membrane used within the system must be manufactured for use within a roofing system and be listed in the Underwriters Laboratories Building Materials Directory and approved for use in Factory Mutual systems. Requests for approvals for product substitutions should be submitted to Ecology's Manager of Technical Services.

3.4.2 System Felts:

Ecology offers fiberglass and polyester reinforced ply sheets and base sheets for use within its various modified and built-up system designs. Listed below are the types being used in Ecology's modified and built-up

ERS-410 Polyester Felt

Black unsaturated polyester mat for use as a ply sheet in Ecology built-up specifications and applied with ERS All Temp or ERS Hot Flex Asphalt.

3.4.2.2 Base Sheets:

Fastening of base membranes shall be per the recommended procedures of Factory Mutual for the fastener type, fastener placement, and spacing required for the system being specified.

designs.

3.4.2.1 Ply Sheets:

Ecology offers fiberglass and polyester ply sheets that are intended for use with Ecology Built-up and Modified Specifications:

ERS-310 Polyester Mat

Random-patterned, unsaturated polyester mat for use as a reinforcement in Ecology's cold-process multi-ply specifications using ERS-100 Rubberized Emulsion.

ERS-311 Fiberglass Mat

Random-patterned, unsaturated fiberglass mat. For use as a membrane reinforcement in Ecology's cold-process applications using ERS-100 Rubberized Emulsion.

ERS-312 Fiberglass Scrim

A heavy-duty 10 x 10 blue vinyl coated glass reinforcement mesh used in conjunction with all ERS Mastics and as a part of the Ecology Rain Coat System. Available in 6", 12" and 36" wide by 150' rolls.

Ecology ERS-400 Fiberglass Ply

Fiberglass felts that comply with ASTM D-2178, Type IV and Federal Specification SS-R-620B. ERS-400 felts should not be used as nailed ply sheet or in systems requiring the use of one layer of a base membrane. ERS-400 Fiberglass Ply Sheets are designed for use as an interply membrane in hot applied built-up systems and as an interply membrane in modified roof systems. ERS-400 felts should not be used with Ecology's ERS-302 or ERS-309 Cold Adhesives, but be installed with ERS All Temp, ERS Hot Flex Asphalt, or Type III or Type IV certified asphalt.

NOTE: Ecology also offers ERS-400-6, a Type VI premium heavyweight fiberglass mat meeting ASTM Spec D-2178-88a, Type VI.

ERS-401 Fiberglass Base Sheet

Meets the minimum standards for ASTM D-4601, Type II. They can be used with Ecology's ERS-302 or ERS-309 cold process adhesive, hot mopping asphalt, and may serve as a mechanically fastened base ply. When used with nailable decks, the felts may tend to grow when heated and should be relaxed prior to nailing in place. ERS-500 is much better for nailed specifications.

ERS-403 Vented Base Sheets:

Used as the base layer in any modified system or built-up system requiring lateral underside venting. The membrane with its design permits lateral release of pressure since it is not fully adhered when installed with Ecology's hot applied asphalt or approved equal. It is a non-woven glass sheet that is impregnated and coated with oxidized asphalt and surfaced with fine sand. Normal usage is on lightweight concrete and concrete decks. Conforms to ASTM D-4601, Type II.

NOTE: Ecology's ERS-507 Cap Membrane may also be used as a venting base sheet by fastening or adhering it with the granule side down.

ERS-500 SBS Series Fiberglass Base Sheets

Meets standards established through CGSB-37-GP-56M. Membrane properties include a wet processed, random-patterned fiberglass mat bonded together with water-resistant resins. The mat is then coated with special asphalts blended with high molecular weight, non-oil extended, SBS copolymers to increase tensile strength and flexibility. ERS-500 membrane characteristics include greater dimensional stability and no wrinkles on nailed specs. The membrane is available as ERS-500 (40 mils), ERS-500-4 (60 mils), or ERS-500-6 (85mils).

The heavier SBS modified coatings found on ERS-500-4 and ERS-500-6 offer more waterproofing protection and are strongly recommended for installations where only one base membrane will be used. Their thickness also provides a safer torch application environment.

ERS-500-4T & ERS-500-6T SBS Base Sheets

These are the same as ERS-500-4 and ERS-500-6. The membranes have fiberglass reinforcements and are coated with SBS modified asphalt. One side of the membrane is sanded and the other side has a polyethylene burn-off sheet for an aid in bonding to the selected Ecology torch applied cap membrane.

ERS-500-6P Polyester SBS Base Sheet

ERS-500-6P is a 90 mil., specially blended, high molecular weight, SBS non-oil extended modified asphalt membrane with a spunbound polyester reinforcement that is bonded with water-resistant binders and formulated with

flame-retardant compounds. It meets or exceeds performance characteristic standards set by CGSB-37-GP-56M. Applications include installation with ERS-302 and ERS-309 adhesives, as well as, with ERS All Temp and ERS Hot Flex asphalts. ERS-500-P can be used within Ecology built-up and modified specifications. ERS-500-P can also be used as a top ply in applications where ballast is desired.

ERS-605 Polyester Felt

A 45 lb. coated polyester felt for use as a base or top sheet in a hot applied built-up system using ERS All Temp or ERS Hot Flex asphalt.

ERS-606 APP Torched Base Sheet

An 88 mil. torch applied base sheet for use as a base or interply with Ecology's APP Cap Membranes. The membrane is formulated with quality weather-resistant APP (atactic polypropylene) polymers and selected asphalts. It is reinforced with a heavy-weight glass fiber mat. Installation is by torch welding or by mechanical fastening. ERS-606 has a marked 3" top selvage edge.

****** NOTE ******

Also used as base or interply membranes in Ecology modified roof systems are the following smooth surface Ecology Cap Membranes, which due to their reinforcements and thickness, create exceptional performance characteristics and waterproofing integrity when used in the design of the new roof system:

**ERS-501
ERS-503
ERS-600
ERS-602**

3.4.2.3 Cap Membranes:

The following are the APP & SBS cap membranes that are offered by Ecology roof systems. Product Pages for these membranes are located in Section 2 and Specifications using these membranes are included in Section 4 of this manual.

ERS-501 SBS/SEBS Modified Membrane

Smooth sanded surface membrane, 130 mils thick, with a minimum 180-gram/sqm non-woven needle punched spun-bound polyester. Contains high molecular weight non-oil extended SBS copolymers with flame retardant additives. Also available in SBS/SEBS formulation providing additional UV protection.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

ERS-501 must be coated or have aggregate surfacing. It can also be used as an interply membrane.

ERS-502 SBS/SEBS Mineral Surfaced Membrane

Has a reflective, factory-embedded, UV protective mineral surface. The membrane is 160-mils thick with a minimum 180-gram/sqm non-woven needle punched spun-bound polyester. Contains high molecular weight non-oil extended SBS copolymers with flame retardant additives. Also available in SBS/SEBS formulation providing additional UV protection.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

ERS-505 SBS Mineral Surfaced Membrane

A 120 mil thick membrane consisting of a minimum 2.0 lbs. per 100 sq. ft. fiberglass mat reinforcement. Contains high molecular weight non-oil extended SBS copolymers with flame retardant additives. The surface has factory embedded reflective ceramic granules.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

Generally used with heavier-weight glass or polyester base plies. See *Specifications: Series 2002 in Section 4.*

ERS-507 SBS Mineral Surfaced Membrane

115 mil thick mineral surfaced membrane with

ERS-503 SBS Modified Membrane

Smooth sand surfaced SBS membrane, 135-mils thick, with a non-woven, needle-punched spun-bound polyester fabric weighing a minimum of 140 grams/sqm laminated to a fiberglass mat of minimum weight of 2.0 lbs per 100 sq. ft. Contains high molecular weight non-oil extended SBS copolymers with flame retardant additives.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

ERS-503 must be coated or have aggregate surfacing. Can be used as an interply.

ERS-504 SBS Mineral Surfaced Membrane

Has a reflective, factory-embedded, UV protective mineral surface. The membrane is a 160 mils thick SBS membrane with a non-woven, needle-punched spun-bound polyester fabric weighing a minimum of 140 grams/sqm laminated to a fiberglass mat of minimum weight of 2.0 lbs per 100 sq. ft. Contains high molecular weight non-oil extended SBS copolymers with flame retardant additives.

wet-process, random patterned, fiberglass mat bonded together with water resistant binders. Contains high molecular weight non-oil extended SBS copolymers. Economical SBS membrane used in conjunction with one or more Ecology base plies.

The membrane can be installed in Ecology's ERS All Temp or ERS Hot Flex asphalt, conventional Type III or Type IV certified asphalt, or in Ecology's ERS-302 or ERS-309 Cold Process Adhesive.

Generally used with heavier-weight glass or polyester base plies. See *Specifications: Series 2002 in Section 4.*

ERS-600 APP Modified Torching Membrane

160 mil APP modified asphalt membrane with non-woven 175 gram/sqm polyester mat. Has a diamond embossed sanded surface which aids in adhesion of coatings. The back of the membrane has a polyethylene burn-off film for application with a torch welding device.

ERS-600 can only be installed with torch welded application and must be coated or

have aggregate surfacing. It can also be used as an interply membrane.

ERS-601 APP Mineral Surfaced Torching Membrane

180 mil APP modified asphalt membrane with special flame retardant additives and a reflective factory-embedded ceramic granule surface. The bottom surface has a polyethylene burn off sheet. The membrane's reinforcement is a tough non-woven 180 gram/sqm polyester mat. When used in systems with approved Ecology Base Membranes, ERS-601 carries UL Class A Fire Ratings without additional surface coatings.

ERS-601 can only be installed with torch welded application.

ERS-602 SBS Torching Membrane

This 140 mil thick SBS sand surface modified membrane has a dual reinforced scrim consisting of a non-woven needle-punched spun-bound polyester fabric, weighing a minimum of 140 grams/sqm, laminated to a fiberglass mat of minimum weight of 2.0 lbs. per sq. ft. ERS-602 is formulated with high molecular weight non-oil extended SBS copolymers.

ERS-602, with its polyethylene burn-off bottom surface, can only be installed with torch welded application. It must be coated or have aggregate surfacing if used as a cap membrane. It can also be used as an interply membrane.

ERS-603 SBS Mineral Surfaced Torching Membrane

A 170 mil thick SBS modified membrane with a factory-embedded reflective ceramic granule surface and a polyethylene burn-off bottom surface. ERS-603 is formulated with high molecular weight non-oil extended SBS copolymers. The membrane has a dual reinforced scrim consisting of a non-woven needle-punched spun-bound polyester fabric, weighing a minimum of 140 grams/sqm, laminated to a fiberglass mat of minimum weight of 2.0 lbs. per sq. ft. ERS-603 can only be installed with a torch welded application.

For a powerful system, use ERS-603 as a cap membrane over ERS-602 as the base.

ERS-604 & ERS-604T SBS Mineral Surfaced Membranes

Each membrane is a 170 mil SBS membrane, with a factory-embedded ceramic granule surface and with dual reinforced scrims, consisting of a non-woven needle-punched spun-bound polyester fabrics weighing a minimum of 140 grams/sqm laminated to a fiberglass mat of minimum weight of 2.0 lbs. per sq. ft. The premium formulation contains high molecular weight non-oil extended SBS copolymers with flame retardant additives.

Since the membranes contain flame retardant additives, a wide range of UL Class A Fire Ratings are available.

The bottom surface of ERS-604 is lightly sanded for mop or cold process applications.

ERS-604T is the same as ERS-604, except that it is a torch-applied version with a polyethylene burn-off sheet on the bottom.

ERS-607 APP Mineral Surfaced Membrane

A 180 mil thick APP modified cap membrane with factory-embedded reflective ceramic granules. The membrane's fire-resistant properties permit UL Class A Fire Ratings without the use of special coatings. ERS-607 is reinforced with a composite glass fiber and polyester scrim with the membrane tensile strength over 300 lbs. per inch in its weakest direction at 0°F, exceeding NBS Building Science Series #55 recommendations. The reinforcements are located near the top of the membrane to provide better weathering characteristics and puncture resistance.

ERS-607 has a sanded bottom which permits application by means of torch welding or with ERS-309 Rubberized Inter-Ply Adhesive.

ERS-607S APP Membrane

A 160 mil thick APP modified cap membrane with a sand surface. ERS-607S is reinforced with a composite glass fiber and polyester scrim with the membrane tensile strength over 300 lbs. per inch in its weakest direction at 0°F, exceeding NBS Building Science Series #55 recommendations. The reinforcements are located near the top of the membrane to

provide better weathering characteristics and puncture resistance.

ERS-607S has a sanded bottom which permits application by means of torch welding or with ERS-309 Rubberized Inter-Ply Adhesive.

ERS-703 SBS Aluminum Surfaced Membrane

A 150 mil membrane which contains high molecular weight non-oil extended SBS copolymers and specially selected asphalt. The top surface consists of embossed aluminum with small control channels built into the metal facing. A thin layer of low melt asphalt is used beneath these channels to enable metal expansion and contraction independently of the modified base. ERS-703 is reinforced with a dual scrim fiberglass and spun-bound polyester fabric.

Used as a cap membrane over approved Ecology base plies. ERS-703 also makes an excellent reflective flashing membrane. Due to the aluminum surface, it may be used in some applications where more aggressive chemical activity exists.

The membrane may be installed in one of Ecology's hot mopping asphalts or by means of torch welded application.

3.5.1 General Recommendations:

While Ecology specifications permit the use of an approved generic asphalt within the design of its roof systems, the type of guarantee offered may be effected when substitutions are made for Ecology products. Asphalt properties vary dramatically from manufacturer to manufacturer and can effect system performance if softening points and oils within the asphalt blends are not compatible with the Ecology membranes. Mexican produced asphalt is not acceptable for use with Ecology roofing membranes.

SBS modified membranes should be installed within the recommended EVT range for the asphalt being used, and at, or above, the minimum application temperature of 425° F at the point of application to adequately bond the membrane to itself and the substrate.

Do not mix different grades of asphalt or dilute with any other materials.

No Ecology APP modified membranes should be installed with hot mopping asphalt.

ERS-607 & ERS-607S are the only APP modified membranes which may be installed in a cold process adhesive.

Any polyethylene backed Ecology APP or SBS membrane designed for torch application should not be installed with hot asphalt or cold process adhesives.

Installation with coal tar pitch or pitch-contaminated asphalt is not approved with Ecology's modified bitumen membranes.

The recommendations of the NRCA Roofing and Waterproofing Manual and NRCA Technical Bulletin No. 2 or current edition should be followed showing the equiviscous temperature (EVT) range for asphalt heating and application.

The asphalt supplier shall certify the Type, Equiviscous Temperature, Finished Blowing Temperature, and Flash Point on each container or bulk shipping ticket.

3.5.2 Hot Application Asphalt:

Wherever mentioned, Ecology mopping asphalts are the standards for use within Ecology modified and hot applied built-up specifications. Ecology will not accept responsibility for problems caused by slippage of substituted asphalts or overheating. ERS All Temp and ERS Hot Flex Asphalt may be used for the installation of insulations permitting mop application, applicable ERS base plies, and ERS mop applied modified membranes.

ERS All Temp Asphalt

Ecology's ERS All Temp Asphalt meets or exceeds ASTM D-312 requirement. On slopes up to 1/2", ERS All Temp Type III, with a softening point range of 185-200°F and application temperature of 425-450°F.

On slopes over 1/2", All Temp Type IV with a softening point range of 205-225°F and application temperature of 425-450°F should be used.

Ecology's ERS-All Temp Asphalt must not be overheated for cold weather applications.

ERS Hot Flex SEBS Modified Asphalt

Meets or exceeds VOC requirements and ASTM D-312 standards and is acceptable for use on all Ecology mop applied modified and

built-up systems. Hot Flex shall have a softening point of 190°F with 800% elongation at 77°F. The bitumen is modified with a special blend of SBS/SEBS polymer modified asphalt to improve low temperature flexibility, weathering properties and elasticity. ERS Hot Flex can be used in conventional direct heating roofing kettles.

3.5.3 Cold Process Adhesives:

Wherever mentioned, Ecology's cold process adhesives are the standards for use within Ecology modified and cold-applied built-up specifications. Ecology will not accept responsibility for problems caused by slippage of substituted adhesives.

ERS-100 SBS Modified Emulsion

Containing no asbestos and meeting all VOC requirements, ERS-100 is a high solids, black, mineral colloid type, fluid-applied, bituminous, elastomeric roof coating modified with SBS rubber. Used with in conjunction with Ecology's ERS-1000 Roof Protection System with ERS-310 Polyester Felts or ERS-311 Fiberglass Felts. May be used as protective seal coat for built-up roofs, urethane foam applications or metal buildings. Exhibits excellent resistance to chemical, biological and ultraviolet degradation.

NOTE: Do not thin. Do not apply to ponded surfaces or when rain is imminent. Store at temperatures above 45°F.

ERS-302 Inter-Ply Adhesive

A specially formulated, asbestos free, solvent reduced, air blown, asphalt adhesive with fiberglass fibers which meets VOC requirements. Meets ASTM D-4479-85 Type I and Federal Specification SS-A-694-D (Modified). Excellent for areas where low-odor installation is required.

ERS-302 can be used as the interply waterproofing adhesive for Ecology cold applied built-up applications and as an interply adhesive for SBS base ply membranes and cap membranes (without polyethylene surfacing). The adhesive also can be used as a surface adhesive for gravel or granular roof toppings. ERS-302 may be applied by spray, brush or squeegee application.

NOTE: Should not be used with ERS-400 felts or with felts weighing less than 25 lbs. per

100 sq. ft. Should not be applied when rain is imminent or on damp surfaces.

ERS-309 SBS Rubber Inter-Ply Adhesive:

Meets all VOC requirements and ASTM D-4479-85 Type I and Federal Specification SS-A-694D (Modified). ERS-309 SBS Inter-Ply Adhesive is a high quality specially formulated SBS based, solvent reduced, asphalt adhesive reinforced with chopped fiberglass fibers. The rubberized asphalt provides excellent adhesive strength and the ability to withstand stresses of building movement due to thermal shock.

ERS-309 can be used as the interply waterproofing adhesive for Ecology cold applied built-up applications and as an interply adhesive for SBS base ply membranes and cap membranes (without polyethylene surfacing). The adhesive also can be used in as a surface adhesive for gravel or granular roof toppings. ERS-309 may be applied by spray, brush or squeegee application.

NOTE: Should not be used with ERS-400 glass felts or with felts weighing less than 25 lbs. per 100 sq. ft.. Do not thin. Do not apply to ponded surfaces or when rain is imminent. Store at temperatures above 45°F.

3.5.4 Primers and Roof Mastics:

Since some types of cold process materials may cause modified membranes to soften or may not provide adequate adhesion, only Ecology approved primers, roof adhesives and mastics should be used to install the Ecology roof system in areas where the specification calls for the material's use. Please refer to the individual Ecology Product Pages for the intended use and properties for the following Ecology products which are mentioned in the enclosed specifications:

ERS-300 Asphalt Mastic

A multi-purpose heavy-bodied asphalt based mastic with fiberglass fibers and safe for use with Ecology modified bitumen membranes. Meets Federal Specification SS-A-701B and ASTM D-41. Meets ASTM D 4586, Type I, Non-Asbestos and meets all present VOC requirements.

ERS-301 Asphalt Primer

A quick drying, non-fibrated, black asphalt based roof primer which meets or exceeds Federal Specification SS-A-701B, containing

no asbestos and meeting all VOC requirements.

ERS-304 Flashing Mastic

A full-bodied flashing mastic designed for use on vertical surfaces and for application of modified flashing membranes. Meets Federal Specification SS-C-153C, Type 1 and ASTM D 4586, Type I, Non-Asbestos.

ERS-306 Roof Elastomer

A one part multi-purpose elastomeric compound in either trowel or gun grade which is safe for use with Ecology modified bitumen adhesives. Cured compound exhibits rubber-like qualities and is designed for areas where elasticity is important. Contains no asbestos, meets all VOC requirements and meets or exceeds Federal Specification SS-C-153C Type I and ASTM D-2822-75 Type I & II.

ERS Pitch Pan Sealer

A one-part fast curing, water catalyzed polyurethane prepolymer which is modified by selected rubber aggregates. Designed for pitch pans or high movement roof penetrations. Contains no asbestos and meets all VOC requirements.

3.5.5 Coatings

Any roof coating placed on top of an Ecology built-up or modified roof system should be considered a maintenance item. While Ecology does provide warranties on the membranes used within a given specification, the maintenance of the applied coating on the roof surface is the responsibility of the building owner.

UL Fire Ratings are typically set up to use a specific coating for the approval they provide to Ecology Roof Systems® for a rated roof system. Where there are questions on which coating to use, please contact the Technical Services Manager at Ecology.

Please refer to the individual Ecology Product Pages in Section 2 for further information on the following Ecology Coatings products. Their application use is detailed in individual specifications listed in Specification Section 4:

ERS-200 Fibrated Emulsion

A non-toxic and non-combustible asphalt and clay emulsion fibrated with fiberglass fibers which is used as a protective coating for Ecology's modified and built-up systems.

Meets Federal Specification SS-R-1781-72 and ASTM D-1227 Type IV, along with all VOC requirements.

ERS-305 Aluminum Water Base Coating

A highly refined specification grade reflective aluminum coating manufactured from selected highly refined air-blown asphalt, special leafing and polished aluminum pigment blended into a water based vehicle. Provides a glare-free silver satin finish. Used as a reflective surface coating over Ecology modified and built-up roof systems. In general, the Ecology modified membrane should be granular surfaced when this coating is used to provide the best long term adhesion. Meets ASTM D-2824-76 Type I and contains no asbestos.

ERS-308 Aluminum Roof Coating

A highly refined specification grade reflective aluminum coating manufactured from selected highly refined air-blown asphalt, special leafing and polished aluminum pigments, all blended into a solvent based vehicle. Not recommended for use on smooth (sand) finish SBS membranes. Provides glare-free satin finish and meets ASTM D 2824-76 Type I containing no asbestos and meets all VOC requirements.

ERS-White Top

A resin rich, water based, copolymer compound designed for use as a reflective white coating for Ecology's built-up and modified systems. Available in several colors. When used on Ecology modified membranes, the membrane' surface should be granular to provide the best long-term adhesion. Contains no asbestos and meets all VOC requirements.

Rain Coat

One component, liquid-applied, soy-pil based white reflective coating. Used over existing cap membrane roofing and metal roofing. Applied by spray, roller, or squeegee to a uniform thickness of two-three gallons per 100 square feet. Non-toxic and compliant with VOC standards.

3.5.6 Caulking Sealants

The sealant shall consist of a single component, commercial grade high performance elastomeric sealant such as manufactured by, or similar and equal to, Sonolastic NP 1 by Sonneborn Building Products,

Minneapolis, MN.

3.6 OTHER DESIGN CONSIDERATIONS

3.6.1 Steep Slopes With Insulation:

Any heavily sloped roof deck, where the slope is two (2") inches in twelve (12") inches or greater, 4" wide treated wood nailers shall be mechanically fastened to the deck horizontally (perpendicular) to the slope at intervals no more than 30' and at height equal to the height of the insulation. Nailers should be present at all roof perimeters, including each side of the tops of adjoining slopes. Shims should be used to assure a level surface. The roof insulation should be mechanically fastened. Mopping of the insulation is permitted only when approved by the Ecology Technical Services Manager and when the insulation type and facer permits adequate bonding.

All roof system plies should be run vertically (parallel) to the roof slope. Cap membranes shall terminate at the nailer with end laps fastened every six (6") inches across the top width of the membrane ends. At peaks where the roof joins another sloped section, all field plies shall extend over the peak and the cap membrane terminated and fastened to the nailer on the opposite side.

On slopes exceeding 6" in 12", it may also be required to increase the spacing pattern of nailers to provide for fastening of all leading side laps of the cap membranes for modified systems and system plies for built-up roof specifications. Consult with Ecology's Technical Services Manager for requirements.

NOTE: Specifications using Ecology's ERS-600, ERS-601, ERS-602, ERS-603, ERS-607, ERS-607S, ERS-604T, or any torch applied Ecology modified membrane shall follow above recommendation when slope is 3/4" in 12" or greater.

3.6.2 Steep Slopes Without Insulation:

On nailable roof decks, where the slope is two (2") inches in twelve (12") inches or greater and no insulation is to be placed over the roof deck, the approved system base membrane is to be mechanically fastened to the deck system with approved fasteners for the type of deck and sufficient fastening patterns to meet Factory Mutual requirements. All system plies should be run vertically (parallel) to the roof slope.

On structural concrete roof decks, where the slope is two (2") inches in twelve (12") inches or greater, and no

insulation is to be used, in lieu of mechanical fastening of the base ply to the deck, the roof system base plies can be set in Ecology's ERS-302 or ERS-309 Inter-Ply Adhesive. Plies should be run vertically (parallel to the roof slope. Roll ends of the base membrane(s) should be fastened across the width on nine (9") centers with concrete expansion fasteners.

Roof system cap membranes should also be run parallel to the slope with roll ends fastened on 6" centers across the width. All fasteners at roll ends shall be covered by a minimum of four (4") inches by subsequent overlapping plies.

On slopes exceeding 6" in 12", it may also be required to also fasten all leading side laps of the cap membrane on twelve inch (12") centers, particularly with mopped or cold process specifications.

NOTE: Specifications using Ecology's ERS-600, ERS-601, ERS-602, ERS-603, ERS-607, ERS-607S, ERS-604T, or any torch applied Ecology modified membrane shall follow above recommendation when slope is 3/4" in 12" or greater.

3.6.3 Expansion Joints:

The decision on the location and number of expansion joints is the responsibility of the designer or structural engineer familiar with local codes, climatic conditions, and other anticipated geographic or structural requirements. Any joints installed should be in accordance with NRCA guidelines. However, industry experience has shown that expansion joints should be provided in the following areas to protect the new roofing from expansion or contraction within the substructure:

Where a change in decking materials occurs

Every 200 feet of continuous deck/roof span.

Where steel framing, structural steel or deck materials change direction.

Where building wings are installed at different angles or heights or building additions exist.

Where structural construction joints exist on the building for control of expansion or contraction.

In areas where temperature differences exist under the deck, such as from a heated environment to an unheated warehouse or canopy.

Wherever the designer deems it necessary to include

joints.

3.6.4 Vapor Retarders:

Considerable debate exists on the appropriate use and design of vapor barriers and retarders. No common ground seems to exist between manufacturers, approval authorities such as Factory Mutual and UL, the NRCA, RIEI and other industry experts. Ecology will not make any determination for their use and design or assume responsibility for their performance within the system.

Any subsequent damage to the Ecology roofing system caused by their use, or lack of presence, within the system will not be the responsibility of Ecology.

The building designer should make the necessary calculations on the need for the use of a vapor retarder within the roofing assembly and the selection and placement of roof components required to provide the desired result. Refer to the most current edition of the NRCA Energy Manual for the most recent data on the proper methods used to determine the need for a vapor retarder.

3.6.5 Drainage:

The roofing industry recommendations and guidelines call for positive slope to be built into all roof deck or roof substrate designs to accommodate prompt and complete removal of water. Acceptable designs for roof drainage would include sloping of the structural deck to adequately sized interior drains or exterior drainage systems, providing slope through tapered roof insulation systems or adding additional drains. It is recommended that a minimum 1/4" in 12" slope, inclined to drains or other outlets, is maintained throughout the roof system.

Areas which pond water for more than 48 hours are not acceptable for an Ecology roof membrane or system guarantee.

3.6.6 Perimeter Nailers & Curbs:

Wood nailers or curbs are required in all Ecology specifications - and shall be securely fastened to the deck around roof perimeters, expansion joints, slope transitions, and curb openings and other details as shown in Ecology's Roofing Details Section. Pressure treated wood with rot resistance is required and must be treated with agents that will not react to asphalt or cause harm to Ecology materials. Creosote or other oil based agents are not acceptable. All roof penetrations for equipment, expansion joints, pipes, curbs, walls and flashings must be set in place prior to the installation of any roofing materials.

Where insulation is to be installed, the nailers shall be of the same thickness as the insulation. Tapered cant strips at edges or curbs are acceptable to direct the

water away from the detail.

3.6.7 Cant Strips:

Cant strips should be installed at all angle breaks which are 45° or greater such as found at all points where the roof deck meets a parapet wall, elevation change, unit curb, etc. Cant strips should be no more than 45° and constructed of wood, wood fiber, perlite, fiberglass or concrete. Metal cants should be clad in plywood. The cant strips should be installed in Ecology's hot asphalt, roof mastic, and/or attached with mechanical fasteners. Fire-resistant materials should be used for all applications using a torch. The cant should be fully covered with an adhered ply of a coated Ecology base membrane for these types of applications.

3.6.8 Lead Flashings & Metal Surfaces:

All metal flashings shall be primed with Ecology ERS-301 Asphalt Primer, conforming to Federal Specification SS-A-701-B containing no asbestos and conforming to VOC requirements. Torch applications over lead require acid etching of the lead prior to priming. New galvanized metal must be cleaned prior to priming.

3.6.9 Electrical, Piping and Other Equipment:

Wherever possible, electrical, gas or other lines crossing the roof need to permit safety for workers installing the new roof system. Electric and gas should be shut-off wherever possible and lines which cross the roof should be properly re-routed to permit unimpeded flow of the roof installation. Completed roof systems should have piping mounted on pedestals, such as Ecology's Pipe Pedestals, to keep them raised off of the roof's surface. Additional layers of Ecology cap membrane may be required under the pedestals to prevent damage to the new roof system.

TV or other antennas must be supported using acceptable details for support of guide wires and the antenna piping.

ERS Pipestands

Non-penetrating heavy duty plastic pedestals designed to accommodate pipelines and to allow for expansion and contraction of the pipe without disturbing the stand. Spacing should be no more than at ten foot (10') intervals. Additional roof mat protection (walk-pad or membrane piece) should be provided under the pedestal to prevent crushing of the mat due to point loads.

Metal platforms, bolts and other metal penetrations need to be properly insulated and isolated from the roof system with acceptable roof details designed to properly

insulate the objects from the roof system.

Electrical conduit, placed on the deck should not be roofed over. This type of practice is common to structures where the deck (usually wood) serves as the ceiling and the electrical extends through and is hidden on top of the deck.

Roofing should also not be placed over piping which is located in steel deck channels.

Great care should also be exercised in the fastening of new roofing materials over decks where the electrical and other piping is secured to the bottom of the decking. In all cases it is advisable to isolate these items from the deck system.

Rooftop equipment, such as air conditioners, blowers, etc. should not be set directly on the new roof system without proper pedestals. Wood sleepers should not be used to rest equipment on. Ecology encourages the use of full curb or pedestal units for the mounting of units or the raising of units unto pipe stands to permit underside access for the installation and maintenance of new roofing. Excessive weight loads which crush or damage Ecology materials are not covered under warranty.

3.6.10 Walkways

Where the roof will be subject to foot or mechanical traffic due to servicing of rooftop mechanical units, window washing equipment, roof access points, at the base of ladders, etc., Ecology ERS Rubber Walk Pads shall be installed to-and-around those areas receiving the activity.

ERS Rubber Walk Pads

Manufactured from recycled rubber, the pads are available in 4' x 4' pieces x 1/2" or 3/8" thicknesses. ERS Rubber Walk Pads provide an excellent traffic bearing surface which withstands abuse and exposure to all varieties of weather conditions. ERS-300 Mastic, ERS-304 Flashing Mastic or ERS-306 Roof Elastomer can be used to adhere the walk pads.

In certain situations, an additional layer of a granulated Ecology cap membrane can be used for walkways. Consult with the Ecology Technical Services Department for approved use of this method.

Where metal grating or wood walkways exist, the walkways must be properly supported above the roofing and provide for easy access for any repairs that might

be needed to install or repair the roofing.

3.7 APPLICATION PROCEDURES FOR MODIFIED ROOF SYSTEMS

3.7.1 General:

Prior to installing any Ecology roof system, all preparatory work should be completed - including the acceptability of the deck, required nailer placement, and the placement of curbs and other roof details requiring placement of the new roofing on top of or directly attached to the details. If roof removal and replacement is being performed, no more roofing than can be completely installed in one crew working day should be removed. A clean and dry surface shall be provided for the new roofing.

Phased construction of the roof system is discouraged and must be approved in writing by Ecology Roof Systems to be acceptable on a given project.

Any metal flanges and masonry surfaces shall be pre-primed with ERS-301 Asphalt Primer and dry prior to receiving the new roof system. Any Ecology roof system where the new Ecology membranes are to be placed directly over an old/existing roofing membrane are to be pre-primed, with the surfaces dry, prior to installing the new roof system.

NOTE: Any lead surfaces to be torched to shall be acid etched with full strength distilled vinegar. Do not use asphalt primer.

Remove and discard roll wrapping paper and all poly tape from roll goods. Residual plastics (tape) left on the rolls can prevent proper fusion of the membrane to another membrane at the roll ends or laps during application.

All modified membranes should be unrolled prior to application. This will relax the membrane and can reduce wrinkling and partial adhesion problems during or subsequent to the application. Glass reinforced products will take longer than polyester reinforced products. Warm, sunny and calm days, will require shorter relaxation times. On colder days it might help to set the darkest roll side to the sun. The roll should be warm to the touch prior to installation. Unrolling the rolls at the beginning of the work day should allow ample relaxation time by the time all roof preparation work is completed. As a general rule of thumb, it will take 90 minutes minimum for a polyester reinforced membrane to relax at 72°F. Glass reinforced products will require 3 hours minimum.

In torching applications, where a multiple-head torch is to be used, the membrane should be unrolled, relaxed, aligned and re-rolled for application. In mopping or cold process applications, the roll shall be unrolled, relaxed, set into place and aligned over the base plies prior to re-rolling and application in the asphalt or adhesive. During installation, the applicators, should remain off the surface of the rolls being layed up to prevent dishing of the membrane and voids in the systems. Workmen should stay off of all newly installed roofing until the membranes have had chance to cool.

3.7.2 Application of Ecology Base Ply Membranes

The base plies for the roofing system shall be layed up over an acceptable, clean and dry substrate. After the rolls have been relaxed, the application shall begin at the low point of the roof. The base ply shall be positioned so the side laps of the cap membrane do not piggyback on top of laps on the base membrane. The base membrane shall be lapped a minimum of 2" on the sides and 4" on the ends or as marked on the membrane selected for the system. All end laps should be staggered no less than 3' apart.

Where multiple layers of the same base plies are to be installed, side laps shall be staggered to overlap a minimum of 1/2" past the center of the preceding sheet.

Where applications call for the use of more than one base membrane, with dissimilar types being used, the initial layer shall be layed up with a 12" starter strip placed at the low point and full layers installed thereafter. The second ply of base membrane shall have a 24" starter membrane and full layers installed thereafter. End laps should be staggered away from those of the first ply.

The base membrane shall be placed a minimum of 1" above the cant strip on all vertical surfaces.

The membranes shall be set in an adequate amount of asphalt (20 lbs. minimum - 30 lbs. maximum per 100 sq. ft.) or cold process adhesive (1-1/2 gallons minimum - 2-1/2 gallons maximum per 100 sq. ft.).

3.7.3 Application of Ecology SBS Mop Modified Membranes:

3.7.3.1 General

After removing all roll wrapping tape and/or paper from the roll, unroll the roll and allow it to relax on the roof's surface. Reroll the roll. If it is the first roll to be laid, align parallel to the roof edge or along the low point at

which slope exists. If roofing begins in a valley, a full width target roll should be placed down the center of the valley, attempting to keep side laps away from the lowest spot. Align succeeding rolls along the selvage edge of the previously layed roll.

NOTE: If the selvage edge on a granulated membrane has been removed, the side laps should be increased to 6".

On slopes up to 2" in 12", the roll should be laid perpendicular to the direction of the slope. On slopes greater than 2" in 12", the roll should be laid parallel (parallel) to the slope and the roll ends fastened at ends or the head lap on 6" centers. ERS All Temp Type III and ERS Hot Flex asphalt can be used for slopes up to 1/2" in 12". ERS All Temp Type IV asphalt should be used for slopes over 1/2" in 12".

NOTE: For specifications using ERS Hot Flex Asphalt, ERS-302 or ERS-309 cold process adhesives on slopes over 3/4", follow requirements outlined for steep slope roofs found in Section 3.6.1 & 3.6.2.

The membranes shall be set in an adequate amount of ERS asphalt (20 lbs. minimum - 30 lbs. maximum per 100 sq. ft.) or cold process adhesive (1-1/2 gallons minimum - 2-1/2 gallons maximum per 100 sq. ft.).

3.7.3.2 Using Hot Applied Asphalt To Install Modified Membranes

Ecology SBS membranes require that an asphalt temperature at the point of application be maintained at 425° F to insure proper fusion of the membrane to the substrate and the lap on the adjacent modified membrane. The roll should be unrolled immediately into a puddle of hot asphalt with mop not proceeding the roll by more than 4' at a time. The asphalt should be applied at the rate of approximately 25 lbs. per 100 SF, with a bead of asphalt extending beyond the 4" side laps by approximately 1/8".

End laps should be a minimum of 6". The practice of flying-in the end laps should be avoided to prevent false bonding of the membrane. Positive roll pressure should be used on the entire length of the roll to the roll ends.

Fusion of the membrane's laps should be checked carefully. If the membrane can be lifted after installation, it would indicate that the asphalt had cooled too much prior to receiving the roll, and the loose lap must be re-welded.

NOTE: At present no Ecology APP Roof Membranes are acceptable for installation with hot

applied asphalt.

NOTE: Several specifications are now being written to provide for torch or hot air welding of side laps and end laps on mop modified membranes. Properly done, this is very effective way of obtaining excellent seam strength. The mopping asphalt should be kept away from lap seams and end laps to prevent contamination of the seams.

3.7.3.3 Using Cold Process Adhesive To Install Modified Membranes

The rolls of Ecology's membrane shall be unrolled, relaxed and set into position, beginning at the low point and running perpendicular to the slope (follow slope limitations for the membranes). Fold the unrolled membrane in half (long length) to maintain side lap alignment. Apply Ecology's ERS-302 or ERS-309 cold process adhesive by squeegee or brush to the substrate at a uniform rate of 1-1/2 - 2 gallons per 100 SF, keeping the adhesive away from side and end lap areas.

Fold the roll into the adhesive and broom the membrane to remove trapped air and achieve embedment. Fold back the other side of the roll and repeat previous procedure. Lay balance of roof in similar fashion.

In general, it is recommended that all side and end laps be fused using a hot air welder or torching apparatus to achieve immediate maximum seam strength. For applications where cold process may be used for seaming, as well as field application, contact the Ecology Manager of Technical Services.

Follow the procedure set forth in Section 3.7.5 for end lap treatment. Side laps should be heat welded with a small (3/4" - 1" diameter) torch head apparatus or with hot air welding.

All laps should be carefully rechecked for voids and for fusion of the membranes to themselves. Repairs should be made immediately.

3.7.4 Torch/Heat Weld Application of Modified Membranes:

Remove all roll wrapping tapes. Unroll the roll, relax the roll, and, when ready, align the roll perpendicular to the slope beginning at the low point in the roof (follow application requirements for slope limitations mentioned previously). Reroll the roll leaving approximately 10' on the end to assure proper alignment. Torch weld the rolled portion. The disappearance of the sand/poly finish and the glossy appearance indicate proper heating of the modified bitumen. The surface should be uniformly heated across the width of the membrane. A

flow of 1/8" - 1/4" of modified bitumen should be seen at side laps to indicate proper heating. Reroll the laid out roll end and weld in place. Continue laying out rolls and welding in place. Side laps on Ecology Membranes are 4" with 6" end laps or as marked on the rolls.

Care should be taken not to overheat the membrane which could damage the reinforcements and cause too much bitumen displacement. No feathering of the side laps should be required. All laps and T-joints should be carefully checked for improper bonding and voids, and touched up with a small torch if necessary.

All Ecology APP Cap Membranes and certain Ecology SBS cap and base membranes can be applied with a torch welding apparatus.

All Ecology modified cap membranes may be heat welded onto vertical surfaces to assure proper adhesion. A smaller (3/4" - 1" diameter) torch head is recommended for flashing and detail work.

In all cases, the use of a heat welding device should be done with extreme care not to overheat the Ecology membrane causing damage to the membrane and its reinforcements. Safety procedures established by the Midwest Roofing Contractors CERTA Program should be diligently adhered to when using open flame heating apparatus in roofing applications.

3.7.5 End Lap Treatment:

On all Ecology membranes, with all systems, the end laps can be offset or staggered (not overlapping along the same end line). Laps should be staggered a minimum of 12".

For mineral or slate granules materials, the granules should be treated on the underlying sheet by heating the surface of the bottom layer and embedding the granules into the membrane with a trowel. This will provide better bitumen to bitumen fusion during the installation. The outside edge of the bottom layer should be feathered to provide a smooth transition for the Ecology membrane at the lap area. Particular attention should be placed on assuring a tight seal at all "T" joints.

On smooth surface (non-granulated) membranes, the end laps can be butted and a header ply run perpendicular to the rolls across the top of the ends sufficient enough to cover 6" onto the each side of the roll ends. All T-joints must be given particular attention to make certain proper fusion of the membranes has been achieved at this critical juncture in the installation of the membrane.

3.7.6 Flashing Details:

Refer to the Details Section 5 of this technical manual for a complete selection of diagrams approved for Ecology roof systems and specific membrane selections available for system specifications.

3.7.7 Application of Ecology's Roof Coatings:

3.7.7.1 General

All smooth (sanded surface) Ecology Modified APP, SBS Cap Membranes or Base Membranes, used as the top surface, require protection. Granulated membranes, which have a UV protective surface with the factory embedded granules, may be coated if desired. Some UL Class A Fire Rated systems require the use of specific coatings, even if the membrane is granulated. Please check the UL listings for the proper Ecology coating required.

Before surfacing is started, all end laps and side laps should be checked to assure the watertightness of the system. Individual Ecology Specification Sheets should be used to determine the coverage rates of individual coatings and acceptability on individual Ecology membranes.

The coating may be applied 30 days after the installation of the membranes. The roof surface should be broomed of all loose sand or granules prior to the application. The roof surface may need to be power washed or broomed and any dirt and debris removed that might have accumulated since the application.

The coating may be applied by roller, brush or airless spray. It should not be thinned. No voids or light areas should be present after application. Allow adequate dry time before recommencing roof traffic.

3.7.8 Aggregate/Mineral Surfacing:

3.7.8.1 General

If desired, all Ecology modified membranes may have their surfaces covered with embedded roofing aggregate. However, before the Ecology membrane surface is covered, all laps should be checked for watertightness. The surface should be clean and dry.

3.7.8.2 Applying Roofing Aggregate Surfacing

Where it is desired to have a graveled surface, such as on built-up or SBS modified specifications, the ballast should be embedded into a pour of hot applied Ecology asphalt or into Ecology's ERS-302 or ERS-309 cold process adhesive.

For hot asphalt applications, apply a hot pour of Type III asphalt (follow slope limitations for bitumen) at the rate of 60 lbs. per 100 SF and embed roofing aggregate (meeting ASTM D 1863 for grading and quality) at approximately 400 lbs per SF while bitumen is still liquid.

For cold process applications, apply a uniform pour of ERS-302 or ERS-309 adhesive at approximately 5 gallons per 100 Sq. Ft. Embed roofing aggregate to cover the adhesive.

3.7.8.3 Cold Applied Mineral Surfacing

Surfacing with ceramic granules can be accomplished by applying a uniform brush or spray applied coating of ERS-302 or ERS-309 at approximately 2 gallons per 100 sq. ft. over the prepared roof surface. Embed enough granules to cover the adhesive.

3.7.9 Walkway Installation:

Additional roof protection should be provided in areas at roof access points and where traffic exists. Areas which might require protection include: penthouse doorways, roof hatches and ladder access points, where regular roof traffic patterns exist, or might logically exist, between access points and units and around units which require periodic maintenance or repair.

3.8 APPLICATION PROCEDURES FOR BUILT-UP SYSTEMS

3.8.1 General:

Follow roofing practices outlined for installation of modified membranes. Where specifications involve use of polyester or glass fabrics for hot applied installations using ERS Hot Flex, ERS All Temp or one of Ecology's cold process specifications, consult with Ecology's Technical Services Department. This manual will be updated to cover built-up roofing specifications at a later date.

3.9 RECOVER APPLICATION

3.9.1 General:

The practice of roofing over another existing roof system requires additional design considerations. Deck "design weight loads", dew points and existing wet materials need to be pinpointed and corrective action taken in order to assure success with the new roof system. While Ecology shows roof systems which can be used for recover applications, we do require that the building

owner, contractor and other architectural or consulting authorities determine the suitability of such an application for the project involving Ecology materials.

Refer to comments made in the deck section of this manual to determine which decks and conditions exclude recover applications.

3.9.2 Coal Tar

Ecology SBS, SEBS, and APP modified membranes are incompatible with coal tar and its derivatives and should not be used in combination with coal tar products or placed in direct contact with coal tar products.

Caution: Mechanical attachment through existing coal tar pitch roofs is not recommended and should be avoided. Fastener penetration through these types of roofs may cause pitch drippage into the interior of the facility. Ecology assumes no responsibility for pitch drippage caused by the original roof system.

3.9.3 Without Insulation:

Where it is desired to bond directly to an existing smooth surface roof system, Ecology's ERS-403 Vented Base Membrane must be used if attachment is possible only by the use of an adhesive. Otherwise, an approved Ecology Base Membrane must be mechanically fastened to the deck using acceptable fasteners for the type of deck. Any wet areas must be removed and replaced prior to installation. All dirt and debris must be removed. Blisters and other surface defects such as splits should be repaired and the surface primed with Ecology's ERS-301 Asphalt Primer.

In most cases, Ecology would recommend that a recover insulation system be used as shown below for aesthetics and longer term performance. **No Ecology retrofit roof system should be placed over graveled roof systems without the use of recover insulation.**

No heat welded or directly bonded applications should be attempted over single ply membranes such as EPDM, PVC, CPE, EIP, CSPE and others in this category without a minimum layer of insulation down first.

3.9.4 With Insulation:

All loose gravel, dirt and debris should be removed by power vacuum and brooming. Embedded aggregate may remain in place. Ballasted loose laid and mechanically attached single ply systems (EPDM, PVC, CPE, CSPE, EIP, etc), should have all single ply sheets removed as part of the preparation.

All single ply flashings are to be removed to the wall surface. Installation over PVC, CPE, CSPE, EIP, EPDM, etc. is not recommended.

All wet insulation and bad decking is to be removed and replaced. New insulation used to fill the areas where the insulation was removed is to match the height of the existing roof level. Blisters and other roof surface irregularities are to be leveled to provide a smooth surface for attachment of the insulation.

Insulation boards approved for recovery, such as Ecology's ERS Redi-Dek, must be a minimum 1/2" wood fiber or 3/4" perlite, glass fiber or rock wool roof insulation. If other higher "R" value foam insulations are desired for use, they must be covered with one of the above recover boards prior to installing the roof membranes as outlined in this manual's sections on insulation types. When insulation attachment is being done directly to an old roof surface, and not by mechanical attachment to the deck, the roof surface must be primed with Ecology's ERS-301 Asphalt Primer and allowed to dry before installation of the new roof system. The insulation shall then be bonded to the original roof in solid moppings of ERS All Temp Type III asphalt, sufficient enough to achieve bond with the existing roof and new insulation.

Ecology's ERS INSULHESIVE may also be used to bond certain insulations to existing smooth surface roofing.

When mechanical attachment of the recover insulation is desired, the screws must be long enough to properly penetrate the deck being fastened to and meet current Factory Mutual recommendations for roof securement.

3.10 WATER CUT-OFFS

The contractor shall at the end of each work day, or at the point when inclement weather conditions exist, install temporary water cut-offs to completely seal/isolate the new roofing being installed from any water damage. The cut-off shall consist of a minimum of 2 plies of ERS-401 Glass Base Membranes set in hot asphalt or ERS-300 Asphalt Mastic and should be sealed on top with hot asphalt or roof mastic. If the substrate/deck is dirty and prevents proper adhesion of the cut-off, it should be cleaned and primed. If the work will be stopped for several days, the cut-off should include a layer of Ecology's Modified Cap Membrane and reinforcing fabric and mastic should be used to seal perimeter edges and other transitional lap areas. The water cut-offs are to be completely removed prior to

continued installation of new roofing. The cut-off shall be trimmed back to the point where the permanent roofing is installed and be removed from any deck or substrate surfaces to provide for continuing proper installation of the new roof system. The cut-off should extend approximately one foot beyond the day's finished work and at least 6" into the outside finished edge of the day's work.

Any water damaged roof membrane, insulation or other roofing components, not properly protected by the water-cut-offs, shall be completely removed and replaced.

3.11 STORAGE & HANDLING OF MATERIALS

Roll good materials should be stored on end on original pallets, if possible, to prevent damage to the material roll ends. Notify Ecology or other suppliers of any receipt of damaged materials.

If materials are stored outside, they should be raised off the ground and away from areas where water might stand. If stored on the roof, extreme care must be used to determine proper point load placement on the deck and to prevent deck damage. All materials must be properly covered with tarpaulins. Original shrink wrap is not sufficient protection. Plastic covers can cause condensation within the covered area. Double stacking of rolls or pallets is not allowed.

Wet materials should not be used since they can contribute to premature roof failure and may impose safety hazards during application.

Observe fire precautions regarding the handling and storage of any roofing materials or supplies.

Certain insulation materials should be protected from the sun to prevent UV degradation. During hot weather, protect all materials from direct sunlight induced heating.

Damaged materials should not be used, but trimmed or discarded to assure quality job control.

3.12 COLD WEATHER APPLICATIONS

Applications using Ecology membranes at temperatures below 40° F will require special handling considerations since rolls stored on rooftops will become stiffer under low temperature applications. Rolls should not be dropped or thrown since sudden shocks could cause cracking of the modified bitumen.

When situations require installing roofing materials during cold weather, the rolls should be kept on end in a heated area (above 60° F) until ready for use.

Relaxing of the rolls prior to installation is essential. Sunny, low wind, conditions may also be of use in warming the black surfaces of rolls prior to installation when the wind is calm. Stiff rolls should not be installed. See General Design Recommendations Section 3.7.1 for further information.

In order to achieve proper bonding of SBS roofing membranes, maintaining asphalt temperatures, at the point of application, will become more difficult in colder weather. Contractors should use insulated pipes and luggers to transport hot asphaltic materials. Close temperature control of asphalt placed in mopping carts is essential. Application during cold, windy days is discouraged. Mopping should be maintained close to the roll, no more than 2' ahead of the roll, with the roll pushed into the hot asphalt immediately. In some cases, switching to an Ecology torch welding system may provide a more successful application. Heat welding of side and end laps is recommended using a Leister or similar welding device.

Cold process adhesives (especially water-based products) should be kept warm and unfrozen to maintain product integrity and even application rates.

If the weather is a deterrent in achieving a quality watertight roof system, the application of the system should be suspended until weather permits. Phased construction, or the practice of drying in the roof with a base ply and performing the final cap membrane application at a later time, is strongly discouraged.

3.13 SAFETY PROCEDURES

The roofing industry has established several specific guidelines for the proper safe handling of materials and the use of open flame application systems. The roofing contractor is responsible to see that the applicators are trained in the safe and proper use of the materials and equipment while at the work-site. They should follow all applicable OSHA, local, state and federal guidelines for safety, not limited to, but including, proper clothing, safety rated ladders with proper tie-offs to the roof, safety lines for sloped roofs, safety warning lines on the roof and on the ground, and equipment which is labeled and in good working order and does not present a safety hazard due to its condition. Fire extinguisher should be present on the roof and on the ground.

Workers using torch welding equipment should have a

copy of "Torch Applied Roofing Do's and Don'ts" published by the Asphalt Roofing Manufacturers Association and preferably be C.E.R.T.A. (Certified Roof Torch Applicators Program) trained through the MRCA/RIEI programs.

Open flame should not be used around exposed timber or other combustible or highly flammable objects such as solvents, grease, oil, etc. Prolonged application of heat should be avoided. Flashing details may be best done by torching the surface of the membrane to be installed away from the wall or penetration and setting the membrane onto the flashing surface when it has been prepared.

After the day's work is completed, where torch welding has been used, the contractor shall initiate a fire watch for a minimum of thirty minutes. Crews should look for any hot spots, particularly around wall/edge and penetration flashings, which may be present and make necessary corrective repairs prior to leaving for the day. All local ordinances which may be in effect should be strictly adhered to.

3.14 MAINTENANCE & REPAIR

While the installed Ecology roofing system is generally maintenance free, the building owner should develop a maintenance program designed to protect the new roofing from premature failure. Efforts should be made to inspect the roof area at least twice per year:

1. An Ecology trained approved contractor, under the direction of an Ecology representative, should be used to make all repairs.
2. Listed below are several maintenance issues that need to be addressed:
3. Removal of any dirt, foliage or other debris accumulations.
4. Inspect & clean all gutters, scuppers and roof drains on a regular basis.
5. Inspect all coated roof areas for deterioration of the coating. Areas which are peeling or otherwise wearing off should be re-coated. Where granules have worn away, the area should be coated with adhesive and have new granules embedded or be coated with an approved Ecology reflective coating.
6. New equipment installations should be

performed by the Ecology approved contractor using appropriate Ecology roofing practices and materials.

7. Damaged caulking around skylights, metal details and termination bars should be replaced.
8. Open pitch pans need to be refilled.
9. Any altered drainage patterns that might be causing ponding of water should be corrected before roof or deck damage develops.
10. Damage to the roofing system which has been caused by workmen, or other causes, should be reported to Ecology Roofing Systems® before being repaired. If moisture has entered into the new roof system, the wet area will need be replaced with new Ecology approved materials.