



CARLISLE'S **SURE-FLEX™**

Mechanically Fastened and Adhered Roofing Systems

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June 2008

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ATTACHMENTS

Attachment I – Fasteners/Withdrawal Resistance Criteria

Attachment II – Membrane Securement Criteria





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Part I – General

1.01 DESCRIPTION

- A. The Sure-Flex™ Mechanically Fastened Roofing System incorporates reinforced Sure-Flex Polyvinyl Chloride (PVC) membrane, available in 81" wide field sheets and 40.5" perimeter sheets. All sheets are mechanically fastened over an approved insulation/underlayment to an acceptable roof deck with the appropriate Carlisle Fasteners and Fastening Plates. The membrane is available in white, tan or gray and in thicknesses of 50-mil (100' long), 60-mil (80' long) or 80-mil (65' long). Adjoining sheets of Sure-Flex membrane are overlapped and joined together with a minimum 1-1/2" wide heat weld. Membrane fastening requirements are outlined in "Attachment II" at the end of this specification.
- B. The Sure-Flex Adhered Roofing System incorporates maximum 81" wide white, gray or tan 50-mil, 60-mil or 80-mil thick reinforced Sure-Flex Polyvinyl Chloride (PVC) membrane or **Reinforced FRS PVC** (Polyvinyl Chloride) Membrane. Carlisle Insulation is mechanically fastened to the roof deck or secured with an approved adhesive and the membrane is fully adhered to the substrate with Sure-Flex PVC Bonding Adhesive. Adjoining sheets of membrane are overlapped and joined together with a minimum 1-1/2" wide heat weld.

Notes: Projects utilizing 50-mil membrane are eligible for a maximum 10-year System Warranty. For a 15-year Total System Warranty, minimum 50-mil membrane must be specified. When a 20-year Total System Warranty is required, 80-mil membrane must be used.

Mechanically Fastened Roofing Systems over cementitious wood fiber or gypsum decks, upon review, may receive a maximum 15-year Total System Warranty (minimum 50-mil membrane required) when the building height is not greater than 40' and a minimum of 3 perimeter sheets are utilized.

1.02 GENERAL DESIGN CONSIDERATIONS

- A. The maximum roof slope for Mechanically Fastened Roofing Systems is 18" in one horizontal foot. There are no maximum slope restrictions for the application of the Adhered Roofing System.
- B. When roof slopes exceed 5 inches per horizontal foot, use of an Automatic Heat Welder may be more difficult. A Hand Held Hot Air Welder should be specified.
- C. The mechanically fastened roofing system is **not acceptable** for installations on steel decks lighter than 22 gauge unless the steel deck is used in conjunction with lightweight concrete and a minimum of 360 pounds pullout per fastener is achieved with HP-X Fasteners into the steel deck below. Refer to the Metal Retrofit Roofing System Specification, published separately for other roofing options.
- D. Certain petroleum based products, chemicals, and waste products may not be compatible with this roofing system. Contact Carlisle for verification of compatibility and recommendations concerning an acceptable roofing assembly.
- E. Metal-Edge Systems and Copings should be designed in compliance with Section 1504.5 of the International Building Code and shall be tested in accordance with ANSI/SPRI ES-1.

- F. It is the responsibility of the specifier to review local, state and regional codes to determine their impact on this Sure-Flex Roofing System. Building codes are above and beyond the intended purpose of this specification. The respective owner or specifier should consult local codes for applicable requirements and limitations.

For code approvals with Carlisle's Sure-Flex Roofing Systems, refer to the Sure-Flex Code Approval Guide, published separately, Factory Mutual (FM) Approval Guide or Underwriters Laboratories (UL) Fire Resistance or Roofing Materials and Systems Directories.

G. **Drainage**

1. Drainage must be evaluated by the specifier in accordance with all applicable codes. Slopes may be provided by tapering the structure or through the use of tapered insulation; a sufficient number of roof drains should also be specified and properly located to allow for positive drainage. Significant ponding that could remain after 48 hours should be eliminated with the addition of auxiliary drains in low areas where ponding is anticipated.

Carlisle specifically disclaims responsibility for the design and selection of an adequate drainage system and drain accessories. Selection must be made by the building owner or the owner's design professional.

2. Small incidental areas of ponded water will not impact the performance of this roofing system; however, in accordance with industry standards, the roofing assembly **should be designed to prevent ponding** of water on the roof for prolonged periods (longer than 48 hours). Good roofing practice dictates proper drainage to prevent possible excessive live load and, in the event of a roof leak, to minimize potential interior damage to the roofing assembly and to the interior of the building.
3. **Tapered edge strips, crickets or saddles** are recommended where periodic ponding of water may occur. When the slope of the taper exceeds 2 inches to one horizontal foot, additional membrane securement at the base of the tapered edge strip will be required.
4. It is recommended that a minimum roof slope of 1/8" per horizontal foot be provided to serve long-term aesthetics.

H. **Retrofit - Recover Projects** (when the existing roofing material is left in place)

1. The removal of existing wet insulation and membrane must be specified. The specifier shall select an appropriate and compatible material as filler for voids created by removal of old insulation or membrane.
2. Entrapment of water between old and new membrane can damage and deteriorate new insulation/underlayment between the two membranes. **If a vapor retarder or air barrier is not specified**, Carlisle recommends existing membrane be perforated to avoid potential moisture accumulation to allow for detection of moisture to enable the building owner to take corrective action. This can be accomplished by drilling approximately 3/4" diameter holes every 100 square feet in the existing built-up roof or single-ply membrane (excluding PVC membrane).
3. **Existing PVC** membrane may be totally removed or existing membrane must be cut into maximum 10' x 10' sections. Any loose PVC flashings at the perimeter, roof drains and roof penetrations must be removed.

1.03 QUALITY ASSURANCE

- A. Carlisle recommends the use of Carlisle supplied products for use with Sure-Flex Roofing Systems. The performance or integrity of products by others, **when selected by the specifier and accepted as compatible by Carlisle**, is not the responsibility of Carlisle and is **expressly disclaimed** by the Carlisle warranty.
- B. This roofing system must be installed by a Carlisle Authorized Roofing Applicator in compliance with drawings and specifications as approved by Carlisle SynTec Incorporated.
- C. There must be no deviations made from Carlisle's specifications or Carlisle's approved shop drawings without the **PRIOR WRITTEN APPROVAL** of Carlisle SynTec Incorporated.

- D. After completion of the installation, upon request, an inspection shall be conducted by a Technical Representative of Carlisle to ascertain that the membrane roofing system has been installed according to Carlisle's published specifications and details applicable at the time of bid. This inspection is to determine whether a warranty shall be issued. It is not intended as a final inspection for the benefit of the owner.
- E. The solar reflectance of this roofing product may decrease over time due to environmental defacement such as dirt, biological growth, ponded water, etc. The roof should be monitored at regular intervals and maintained or cleaned when necessary to assure the maximum solar reflectance.
- F. The Sure-Flex membrane (white) meets the CRRC (California Roof Rating Council) requirement for reflectance and emittance. When tested in accordance with ASTM C1549, the material has an initial reflectance of .87 and a 3-year aged reflectance of .61. The material has also been tested for emittance in accordance with ASTM C1371. An initial emittance of .95 and a 3-year aged emittance of .86 were achieved.
- G. The Sure-Flex PVC membrane (white) meets the emittance requirements set forth by the USGBC (US Green Building Council) for their LEED (Leadership in Energy and Environmental Designs) Program. When tested in accordance with ASTM E408, an emittance of .94 was achieved and an SRI (solar reflectance index) of 110 was calculated using ASTM E1980.

1.04 SUBMITTALS

- A. To ensure compliance with Carlisle's minimum warranty requirements, the following projects should be forwarded to Carlisle for review prior to installation, preferably prior to bid:
 - 1. Mechanically Fastened systems specified with a fastener length exceeding 12 inches.
 - 2. Air pressurized buildings, canopies and buildings with large openings where the total wall openings exceed 10% of the total wall area on which the openings are located (such as airport hangars, warehouses and large maintenance facilities).
 - 3. Cold storage buildings and freezer facilities.
 - 4. Projects where the Sure-Flex membrane is expected to come in direct contact with petroleum-based products or other chemicals.
- B. Along with the project submittals (shop drawings and Request for Warranty), the roofing contractor must include pullout tests when results are below the requirements identified in this specification.
- C. Shop drawings must be submitted to Carlisle by the Carlisle Authorized Roofing Applicator along with a completely executed Notice of Award (Page 1 of Carlisle's Request For Warranty form) for approval. Approved shop drawings are required for inspection of the roof and on projects where on-site technical assistance is requested.

Shop drawings must include:

- 1. Outline of roof and size
- 2. Deck type (for multiple deck types)
- 3. Location and type of **all** penetrations
- 4. Perimeter and penetration details
- 5. Key plan (for multiple roof areas) with roof heights indicated

When field conditions necessitate modifications to originally approved shop drawings, a copy of the shop drawing outlining all modifications must be submitted to Carlisle for revision and approval prior to inspection and warranty issuance.

D. **Notice of Completion** (Page 2 of the Carlisle Request for Warranty form)

After project completion, a Notice of Completion must be submitted to Carlisle to schedule the necessary inspection of the project prior to issuance of the Carlisle Warranty.

E. **As-Built Projects** (roofing systems installed prior to project approval by Carlisle)

The Carlisle Authorized Applicator may supply Carlisle with an As-Built drawing for a project completed prior to Carlisle's approval. The As-Built drawings:

1. Must conform to Carlisle's most current published specifications and details applicable at the time of bid.
2. Must be submitted along with a completely executed Notice of Completion.
3. Must include the items identified in Paragraph 1.04.C above.

1.05 WARRANTY

A Membrane System Warranty is available for roofing systems on commercial buildings within the United States and Canada and applies only to **products manufactured or marketed by Carlisle SynTec Incorporated**. The membrane system is defined as membrane, flashings, adhesives, sealants and other Carlisle brand products utilized in the installation. For a complete description of these products, refer to Part II, Products, in this specification.

A. A **10-year Membrane System or Total System Warranty** is available for a charge for projects that use 50-mil, 60-mil or 80-mil membrane.

B. A **15-year Total Roofing System Warranty** is available for a charge for projects that use 50-mil, 60-mil or 80-mil membrane.

Mechanically Fastened Roofing Systems over cementitious wood fiber or gypsum decks, upon review, may receive a maximum 15-year Total System Warranty when building height is not greater than 40' and a minimum of 3 perimeter sheets are utilized.

C. A **20-year Total System Warranty** is available for a charge for projects utilizing 80-mil thick Sure-Flex membrane and incorporating additional design enhancements as outlined in this specification.

Note: Total System Warranty projects require that only materials from among those manufactured or marketed by Carlisle be specified and used to complete the roofing system. Some of the materials included are: insulation, membrane, flashing, adhesives, sealants, fasteners and plates and termination bars. Carlisle Edgings and Copings must also be specified when metal fascia systems are to be covered by the Carlisle Warranty.

D. Standard peak gust wind speed coverage is 55 mph (measured 10 meters above ground). Greater wind speed coverage, up to 72 mph peak gusts, is available upon request.

CAUTION: APPLICATIONS SUCH AS WALKING DECKS, TERRACES, PATIOS OR AREAS SUBJECTED TO CONDITIONS NOT TYPICALLY FOUND ON ROOFING SYSTEMS WILL **NOT** BE ELIGIBLE FOR A ROOFING SYSTEM WARRANTY.

E. **Access for warranty service**

It shall be the owner's responsibility to expose the membrane in the event that warranty service is required when access is impaired. Such impairment includes, but is not necessarily limited to:

1. Design features, such as window washer systems, which require the installation of traffic surface units in excess of 80 pounds per unit.
2. Any equipment, ornamentation, building service units and other top surfacing materials which are not defined as

part of this specification.

3. Rooftop equipment that does not provide Carlisle with reasonable access to the membrane system for purposes of warranty investigation and related repairs.
 4. Severely ponded conditions.
- F. The formation or presence of mold or fungi in a building is dependent upon a broad range of factors including, but not limited to, the presence of spores and nutrient sources, moisture, temperatures, climatic conditions, relative humidity, and heating/ventilating systems and their maintenance and operating capabilities. These factors are beyond the control of Carlisle and Carlisle shall not be responsible for any claims, repairs, restoration or damages relating to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like in any building or in the air, land, or water serving the building.

1.06 JOB CONDITIONS

- A. Coordination between various trades is essential to avoid unnecessary rooftop traffic over completed sections of the roof and to prevent subsequent damage to the Sure-Flex membrane roofing system.
- B. Concentrated loads from rooftop equipment may cause deformation of insulation/underlayment and possible damage to the membrane if proper protection is not provided. A protection course or sleepers must be specified.
- C. Use of a vapor retarder to protect insulation and reduce moisture accumulation within an insulated roofing assembly, should be investigated by the specifier. Consult latest publications by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) and NRCA (National Roofing Contractors Association) for specific information.
- D. On cold storage/freezer facilities, the perimeter and penetration details must be selected to provide an air seal and prevent outside air from infiltrating and condensing within the roofing assembly.

E. Wood Nailers

A **horizontal wood nailer** is used to provide an effective substrate for some installation details or other roof accessories. In addition, it is used to provide solid protection for edges of the membrane underlayment. Minimum thickness of the nailer must be such that the top of the nailer is flush with the top of the membrane underlayment.

1. Wood nailers are required for the securement of metal edgings, scuppers, and insulated pipes. **Parapet walls and most curbs do not require the utilization of wood nailers.**

Note: The width of the wood nailers must be specified to exceed the width of the metal flange of edgings, insulated metal curbs, scuppers, etc.

2. When treated lumber is specified, it is recommended that only lumber, which has been pressure treated with salt preservatives be specified. Lumber treated with other wood preservatives such as, Creosote, Pentachlorophenol, Copper Naphthenate or Copper 8-quinolinolate will adversely affect the Sure-Flex membrane when in direct contact and are, therefore, **unacceptable**.

Note: Most of the commonly available wood treatments contain copper compounds – these include Chromated Copper Arsenate (CCA), Alkaline Copper Quaternaries (ACQ), Copper Azoles (CBA), and Copper Zinc Arsenate (ACZA). Under the right conditions, these copper compounds can migrate through the roofing membrane and cause discoloration. In the worst case, membrane discoloration will result in a “brownish” color.

The copper compounds are also highly corrosive and copper is a known catalyst that can affect roof membranes, again, under the right conditions. It is Carlisle’s recommendation to use treated wood

only where absolutely necessary when the potential exists for direct contact with roofing membranes (including flashing).

If non-treated lumber is to be specified, it must be stored to protect it from moisture sources. A seal should be provided between the non-treated lumber and a concrete or gypsum substrate (similar to a sill sealer).

3. Methods used to fasten the nailer vary with building conditions; however, it is essential that secure attachment of durable stock be accomplished. Factory Mutual Loss Prevention Data Sheet 1-49, Perimeter Flashing, contains options for the spacing and sizing of fasteners.

1.07 PRODUCT, DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the original, unopened containers.
- B. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the specifier/owner to prevent overloading and possible disturbance to the building structure.
- C. Job site storage temperatures in excess of 90° F may affect shelf life of curable materials (i.e., adhesives and sealants).
- D. When the temperature is expected to fall below 40° F, outside storage boxes should be provided on the roof for temporary storage of liquid adhesives and sealants. Adhesive and sealant containers should be rotated to maintain their temperature above 40° F.
- E. Do not store adhesive containers with opened lids due to the loss of solvent that will occur from flash-off.
- F. Store Sure-Flex membrane on provided pallets in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable tarpaulins.
- G. Insulation and underlayment must be stored so that it is kept dry and is protected from the elements. Store insulation on a skid and completely cover with a breathable material such as tarp or canvas. If the insulation is lightweight, it should be weighted to prevent possible wind damage.

Part II – Products

2.01 General

The components of this roofing system are to be products of Carlisle or accepted by Carlisle as compatible. The installation, performance or integrity of products by others, **when selected by the specifier and accepted by Carlisle**, is not the responsibility of Carlisle and is expressly disclaimed by the Carlisle warranty.

2.02 Membrane

A. Sure-Flex Reinforced PVC Membrane

Sure-Flex 50-mil, 60-mil or 80-mil thick **Reinforced PVC** (Polyvinyl Chloride) Membrane conforms to the following physical properties.

Physical properties of the membrane are enhanced by a strong, polyester fabric that is encapsulated between the PVC based top and bottom plies. The combination of the fabric and PVC plies provide Sure-Flex Reinforced PVC membranes with high breaking strength, tearing strength, and puncture resistance.

Field membrane sheets are packaged in rolls 81" wide. Perimeter membrane sheets are available in a width of 40.5" wide. 50-mil thick membrane is available in lengths of 100', 60-mil is available in 80' lengths (for maximum 15-year

warranty) and 80-mil is available in 65' lengths (for maximum 20-year warranty). Sure-Flex Membrane is available in white, gray or tan (gray and tan colored membrane are not a standard stocked item and will require a lead time).

Sure-Flex Reinforced PVC Membrane			
Physical Property	Test Method	Property of Unaged Sheet	Property After ASTM D3045 aging 56 days @ 176° F
Tolerance on Nominal Thickness, %	ASTM D 751	± 10	
Thickness over scrim, in. (mm) 50-mil & 60-mil 80-mil	ASTM D 4434 Optical Method (avg. of 3 areas)	0.016 (0.406) min. 0.025 (0.635) min.	
Breaking Strength, lbf/in. (kN/m)	ASTM D 751 (Grab Method)	200 (35) min. 300 (53) typical	90% min. retention of original breaking strength
Elongation at Break of fabric, %	ASTM D 751	15 min. 25 typical	90% min. retention of original elongation
Tearing Strength, lbf (N) 8 x 8 in. specimen	ASTM D 751 (B-Tongue Tear)	45 (200) min. 100 (445) typical	
Low Temperature Bend, ° F (° C)	ASTM D 2136	-40 (-40) max. -50 (-46) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 176° F (80° C)	ASTM D 1204	+/- 0.5 max. -0.3 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 158° F (70° C) Change in mass, %	ASTM D 570	3.0 max. 2.0 typical	
Field seam strength lbf/in. (kN/m) Seam tested in peel after welding	ASTM D1876	25 (4.4) min. 60 (10.5) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (N) (see supplemental section for additional puncture data)	FTM 101C Method 2031	250 (1110) min. 280 (1245) typical 50-mil 320 (1423) typical 60-mil 380 (1690) typical 80-mil	
Resistance to xenon-arc weathering Xenon-Arc, 12,600 kJ/m ² total radiant exposure, visual condition at 10X (ASTM D 4434 light & spray cycle)	ASTM G155 0.35 W/m ² 63° C B.P.T. (10,000 hours)	No cracks No crazing	
B.P.T. is black panel temperature			

B. Sure-Flex Reinforced FRS PVC Membrane (Adhered Systems Only)

Sure-Flex 50-mil, 60-mil or 80-mil thick **Reinforced FRS PVC** (Polyvinyl Chloride) Membrane is designed specifically for **Fully Adhered applications** and conforms to the following physical properties.

Dimensional stability of the membrane is enhanced by fiberglass that is encapsulated between the PVC based top and bottom plies. The combination of fiberglass and PVC plies provide Sure-Flex FRS PVC membranes with enhanced dimensional stability for fully adhered roof systems using liquid applied bonding adhesives.

Membrane sheets are packaged in rolls 40.5" and 81" wide. 50-mil thick membrane is available in lengths of 100', 60-mil is available in 80' lengths (for maximum 15-year warranty) and 80-mil is available in 65' lengths (for maximum 20-year warranty). Sure-Flex Reinforced FRS PVC Membrane is available in white, gray or tan (gray and tan colored membrane are not a standard stocked item and will require a lead time).

Sure-Flex Reinforced FRS PVC Membrane			
Physical Property	Test Method	Property of Unaged Sheet	Property After ASTM D3045 aging 56 days @ 176° F
Tolerance on Nominal Thickness, %	ASTM D 638	± 10	
Thickness over scrim, in. (mm) 50-mil & 60-mil 80-mil	ASTM D 4434 Optical Method (avg. of 3 areas)	0.016 (0.406) min. 0.025 (0.635) min.	
Tensile Strength, psi (MPa) (machine & cross-machine direction)	ASTM D 638 (Grab Method)	1500 (10.4) min. 1900 (13.1) typical	90% min. retention of original breaking strength
Elongation at Break, % Machine direction Cross-machine direction	ASTM D 638	250 min. (270 typical) 220 min. (250 typical)	90% min. retention of original elongation
Tear Resistance, lbf (N)	ASTM D 1004	10 (45) min. 12 (53) typical	
Low Temperature Bend at -40° F (-40° C)	ASTM D 2136	Pass	
Linear Dimensional Change (shrinkage), % After 6 hours at 176° F (80° C)	ASTM D 1204	+/- 0.1 max. 0.5 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 158° F (70° C) Change in mass, %	ASTM D 570	3.0 max. 0.5 typical	
Seam strength, % of tensile strength	ASTM D638	75 min. 80 typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance (see supplemental section for additional puncture data)			
Resistance to xenon-arc weathering Xenon-Arc, 12,600 kJ/m ² total radiant exposure, visual condition at 10X (ASTM D 4434 light & spray cycle)	ASTM G155 0.35 W/m ² 63 ° C B.P.T. (10,000 hours)	No cracks No crazing	
B.P.T. is black panel temperature			

2.03 Insulations/Underlayments

- A. **Sure-Flex Mechanically Fastened Roofing System** can be installed directly over Carlisle Polyisocyanurate HP-H or SecurShield Polyiso. The system may also be installed directly over HP-Recovery Board, Dens Deck and Dens Deck Prime, or Securock. When EPS Insulation is specified, the Sure-Flex Mechanically Fastened System may be directly installed over Insulfoam SP (expanded polystyrene insulation consisting of closed-cell lightweight expanded polystyrene (EPS) with a fiber glass facer). Insulfoam SP has a nominal density of 1.25 lb/cu ft (pcf), and meets or exceeds the requirements of ASTM C578, Type VIII. Insulfoam SP is available in thicknesses of 1.0", 4.5", 4.75", 5.9" and 7.0". Standard Insulfoam EPS Insulation, when specified, must be overlaid with HP Recovery Board, Dens Deck or Dens Deck Prime, or Securock.
- B. **Sure-Flex Fully Adhered Roofing System** can be installed directly over Carlisle Polyisocyanurate HP-H or SecurShield Polyiso. The system may also be installed directly over HP-Recovery Board, Dens Deck or Dens Deck Prime, or Securock. When EPS Insulation is specified, it must be overlaid with HP Recovery Board, Dens Deck or Dens Deck Prime, or Securock.
- C. Refer to the Products section in the Carlisle Technical Manual for specific product information.

2.04 Related Materials

- A. **Sure-Flex PVC non-reinforced Flashing** is 80-mil thick and available in rolls **12" and 24" wide by 50' long**. Flashing is used for inside/outside corners and field fabricated pipe flashings when use of pre-molded accessories is not feasible.
- B. **Sure-Flex PVC "T" Joint Cover:** A 4-1/2" diameter, 40-mil thick, pre-cut non-reinforced PVC flashing used to overlay "T" joints at field splices when 60-mil or 80-mil Sure-Flex PVC membrane is used.
- C. **Sure-Flex PVC Bonding Adhesive:** A high-strength, synthetic rubber adhesive used for bonding Sure-Flex membrane to various surfaces. The adhesive is applied to both the membrane and the substrate at a coverage rate of approximately 45 - 50 square feet per gallon per finished surface (includes coverage on both surfaces).
- D. **Sure-Flex PVC Cut-Edge Sealant:** A clear-colored sealant used to seal cut edges of reinforced Sure-Flex membrane. A coverage rate of approximately 225 - 275 linear feet per squeeze bottle can be achieved when a 1/8" diameter bead is applied.
- E. **Water Cut-Off Mastic:** Used as mastic to prevent moisture migration at drains, compression terminations and beneath conventional metal edging (at a coverage rate of approximately 10' per tube or 100' per gallon).
- F. **Universal Single-Ply Sealant:** A 100% solids, solvent free, one-part, polyether sealant that provides a weather tight seal to a variety of building substrates. Can be used as a termination bar sealant or for use in counterflashing, coping, and scupper details.
- G. **PVC One-Part Pourable Sealer:** A one-part, moisture curing, elastomeric polyether sealant used to fill Molded Sealant Pockets. Packaged in four 1/2 gallon pouches per plastic bucket. One pouch will fill one Molded Sealant Pocket.
- H. **Foil Grip Aluminum Tape:** A general-purpose pressure-sensitive sealant used as a bond break at joints in PVC Coated Metal. Packaged in rolls 2" wide by 100' long.
- I. **PVC Membrane Cleaner:** Used to prepare membrane that has been exposed to the elements for approximately 7 days prior to heat welding or to remove general construction dirt at an approximate coverage rate of 400 square feet per gallon (one surface).
- J. **Sure-Flex PVC Coated Metal:** A 24 gauge, galvanized steel sheet coated with a layer of non-reinforced Sure-Flex Flashing. The sheet is cut to the appropriate width and used to fabricate metal drip edges or other roof perimeter

edging profiles. Sure-Flex Membrane may be heat welded directly to the coated metal. Coated metal is available in sheets 4' x 10' and comes packaged 30 sheets per pallet. Available in white, gray or tan.

- K. **Sure-Flex PVC Heat Weldable Walkway Rolls:** Sure-Flex Membrane offering superior tear, puncture and weather resistance and designed to protect Sure-Flex membrane in those areas exposed to repetitive foot traffic or other hazards. Walkway material may be heat welded to Sure-Flex membrane using an automated heat welder or hand held heat welder. Walkway Rolls are 36" wide by 60' long and are nominal 80-mils thick. Available in gray only.

2.05 Pre-Molded Accessories:

- A. **Sure-Flex PVC Inside Corners:** A pre-molded flashing for inside corners. Available in white only; 80-mil thick.
- B. **Sure-Flex PVC Outside Corners:** A pre-molded flashing for outside corners. Available in white only; 80-mil thick.
- C. **Sure-Flex PVC Pipe Flashings:** A pre-molded white pipe flashing used for pipe penetrations. Available for 1" – 6" diameter pipes with clamping rings included.
- D. **Sure-Flex PVC Split Pipe Seals:** A prefabricated flashing consisting of 60-mil thick reinforced Sure-Flex Membrane for pipes 1" – 6" in diameter. A split (cut) and overlapped tab are incorporated to allow the pipe seal to be opened and wrapped around the pipe when it is not possible to pull a standard pipe flashing over a round penetration. Available in white as a standard. Gray or tan can be special ordered and will require a lead time.
- E. **Sure-Flex PVC Square Tubing Wraps:** Fabricated flashings made of 45-mil thick reinforced Sure-Flex membrane for square tubing. A split (cut) and overlap tab are incorporated into these parts to allow the seals to be opened and wrapped around a square penetration. Available for 3", 4" and 6" diameter square tubing. Available in white as a standard. Gray or tan can be special ordered and will require a lead time.
- F. **Sure-Flex PVC Molded Sealant Pockets:** A pre-fabricated, interlocking, 2-piece, injection molded, flexible pocket with a rigid PVC vertical wall and pre-formed deck flanges. Used in conjunction with PVC One-Part Pourable Sealer for waterproofing pipe clusters or other odd shaped penetrations. Available in white only. Forms a 7-1/2" by 6" oval when completed.

2.06 FASTENERS/FASTENER PLATES

- A. **HP-X Fastener:** A heavy duty #15 threaded fastener with a #3 Phillips drive used with Carlisle's Piranha Fastening Plate to secure Mechanically Fastened Roofing Systems. It is used on minimum 22 gauge steel decks or minimum 15/32" CDX plywood decks. It is also designed to offer an optimum combination of driving performance, back-out and corrosion resistance with excellent pullout performance.
- B. **HP-Xtra Fastener:** An oversized diameter (.315") steel, threaded fastener used in conjunction with Piranha Xtra Plates for membrane securement into minimum 22 gauge steel or wood decks on Mechanically Fastened Roofing Systems.
- C. **HP Fastener:** A threaded E-coat square head fastener **for insulation attachment only**. Used into steel, wood plank, minimum 15/32" thick plywood or minimum 7/16" thick oriented strand board (OSB).
- D. **Pre-Assembled ASAP Fastener:** Carlisle's InsulFAST Fastener pre-assembled with a 3" diameter plastic plate used **for insulation attachment only** on Adhered and Mechanically Fastened Roofing Systems. Installed using Olympic Fasteners' Fastening Tool.
- E. **InsulFast Fastener:** A threaded Phillips drive fastener used with Carlisle Insulation Plates for **insulation attachment** to steel or wood decks.
- F. **CD-10 Fastener:** A hammer-driven, non-threaded E-Coat fastener for use with structural concrete decks rated 3,000 psi or greater.

- G. **HD 14-10 Concrete Fastener:** A #14 threaded fastener with a #3 Phillips drive used for minimum 3,000 psi concrete decks.
- H. **HP-NTB Fastener:** A glass-filled nylon fastener designed for securing insulation and/or membrane to specialty decks such as cement wood fiber, gypsum or lightweight concrete. The fastener is available with or without locking wire barbs which when engaged into the deck, can increase pullout and backout resistance of marginal decks.
- I. **Lite-Deck Fastener:** A oversized diameter fastener and associated 3" Lite-Deck Metal Plate for use on Adhered Roofing Systems to attach insulation to gypsum decks.
- J. **Piranha Plate:** A 2-3/8" diameter metal barbed fastening plate used with Carlisle HP-X, CD-10 or HD 14-10 Fasteners for membrane or insulation securement. This plate can be used for membrane or insulation securement on Mechanically Fastened Roofing Systems.
- K. **Piranha Xtra Plate:** A 2-3/8" diameter metal barbed fastening plate with an oversized hole for use with Carlisle HP-Xtra Fasteners for membrane securement on Mechanically Fastened Roofing Systems.
- L. **Seam Fastening Plate:** A 2" diameter metal plate used for insulation attachment on Mechanically Fastened Systems or membrane securement at angle changes on Adhered Systems in conjunction with the appropriate Carlisle Fastener.
- M. **Insulation Fastening Plate:** A nominal 3-inch metal plate used for insulation attachment in conjunction with the appropriate Carlisle Fastener.

Part III – Execution

3.01 GENERAL

- A. When feasible, begin application at highest roof level and work to lowest point to prevent moisture infiltration and minimize construction traffic on completed sections. This will include completion of all flashings and terminations.
- B. A proper substrate shall be provided by the building owner. The structure shall be sufficient to withstand normal construction loads and live loads.

3.02 ROOF DECK/SUBSTRATE CRITERIA

- A. Proper decking shall be provided by the building owner. The building owner or its designated representative must ensure that the building structure is investigated by a registered engineer to assure its ability to withstand the total weight of the specified roofing system, as well as construction loads and live loads, in accordance with all applicable codes. The specifier must also designate the maximum allowable weight and location for material loading and storage on the roof.
- B. The following chart identifies the acceptable roof decks/substrates and the minimum underlayment requirements.

Construction Type	Acceptable Roof Deck/Substrate	Mechanically Fastened	Adhered
New Construction	Steel (min. 22 gauge) (1) (2), Wood Plank (3/4" min.) or Fibrous Cement	Insulation	Insulation
	Structural Concrete (min. 3000 psi) or Gypsum	Insulation	Direct Application
	Plywood (min. 15/32" thick) or Oriented Strand Board (min. 7/16" thick)	Direct Application	Direct Application
	Lightweight Insulating Concrete	Insulation	Insulation
Retrofit/No Tearoff	Existing Smooth Surface BUR (3) or Mineral Surface Cap Sheet Gravel Surface BUR (4) or Coal Tar Pitch (4) (5) Or Modified Bitumen	Insulation	Insulation
	Existing Single-Ply	Direct Application (8)	Insulation
	Sprayed-in-Place Urethane	Complete Tearoff Required (7)	Complete Tearoff Required (7)
Retrofit/Tearoff	Existing roof material removed (regardless of deck type)	Insulation	Insulation

Notes:

Refer to Paragraph 3.03, Insulation/Underlayment, for various Carlisle insulations approved with this roofing system.

- (1) Local codes must be consulted regarding thermal barrier requirements.
- (2) Mechanically Fastened Systems cannot be specified on steel decks less than 22 gauge or for corrugated steel decks, regardless of gauge. Refer to the Metal Retrofit Roofing System Specification, published separately, for installation options.
- (3) Loose gravel must be removed to avoid entrapment of moisture.
- (4) Existing coal tar could drip into the building, especially when new insulation does not provide sufficient thermal value to prevent the surface of the coal tar from softening.
- (5) Carlisle's FleeceBACK Adhered Roofing System may be specified over existing sprayed-in-place urethane. Refer to published specifications for requirements.
- (6) An approved underlayment is **required** over existing ballasted single-ply systems and PVC roofing systems of any type.
- (7) Direct application permitted over smooth surfaced modified bitumen. Membrane shall be positioned with length of sheets parallel to modified bitumen field seams. At end laps or other locations where splices intersect modified bitumen field seams. 6" wide Sure-Flex Flashing must be heat welded over intersections.

- C. Withdrawal resistance tests are required for Carlisle's approval on certain types of roof decks. Refer to "Attachment I" at the end of this section for identification of approved decks and proper procedures for conducting pullout tests.
- D. For direct application over an acceptable roof deck/substrate as outlined on the chart above, the substrate must be smooth, free of debris, protrusions, sharp edges and loose and foreign material. Cracks or voids in the substrate, greater than 1/4 inch, must be filled with an appropriate material.
- E. On retrofit projects, all existing phenolic insulation must be removed.

3.03 INSULATION/UNDERLAYMENT

A. General

- 1. Roof insulation thickness must be determined by the thermal value required for each project and may be subject to code approval limitations. ASHRAE Publication 90.1 2007, which contains minimum R-values for various geographic locations throughout North America, shall be referenced to improve thermal efficiency and reduce carbon footprint. Refer to Table below for recommended R-Value increases.

Zone	Area	90.1	189.1
8	N Alaska & N Canada	R-20	R-35
7	Northern MN, Canada	R-20	R-35
6	Minneapolis, Maine	R-20	R-30
5	Up to Chicago	R-20	R-25
4	VA, St. Louis, etc.	R-20	R-25
3	Southeast & Most of CA	R-20	R-25
2	Primarily the Gulf Coast	R-20	R-25
1	Essentially Miami	R-15	R-20

- 2. On projects where a vapor retarder is used, the specifier must calculate insulation thickness to ensure the temperature at the vapor retarder will not fall below the calculated dew point.

3. For new construction projects in cold climate regions, the use of vapor retarders or air barriers is strongly recommended to safeguard against moisture generated during construction.
 4. Multiple layers of insulation are recommended with all joints staggered between layers.
 5. Do not install more insulation/underlayment than can be covered by membrane in the same day.
 6. All insulation boards must be butted together with no gaps greater than 1/4". Gaps greater than 1/4" are not acceptable.
- B. Carlisle Insulation/underlayment must be specified for all Total System Warranty projects or when the insulation is to be covered by the Carlisle Warranty. Any of the Carlisle underlayments listed may be specified:

Carlisle Insulation	Minimum Thickness	Mechanically Fastened	Adhered
HP Recovery Board	1/2"	Acceptable (1)	Acceptable (1)
Securock	1/4"	Acceptable (5)	Acceptable (5)
Dens-Deck/Dens-Deck Prime	1/4"	Acceptable (5)	Acceptable (Dens-Deck Prime only) (5)
Insulfoam SP (nominal density 1.25 lb/cu ft)	1"	Acceptable	Not Acceptable (must be overlaid with approved insulation)
EPS Composite Board	1-1/4"	Acceptable (2,3,4)	Acceptable (2,3,4)
EPS overlaid with HP Recovery Board or Dens-Deck/Dens Deck Prime	1-1/4"	Acceptable (2,3,4)	Acceptable (2,3,4)
Thermapink 18 and 25 Foamular® 400 and Durapink or Dow Styrofoam or Recovermate Extruded Polystyrene	1/2"	Not Acceptable (must be overlaid with approved insulation or HP Protective Mat)	Not Acceptable (must be overlaid with approved insulation)
Polyisocyanurate HP-H or SecurShield Polyiso	1"	Acceptable	Acceptable
Notes:			
(1) 1/2 inch thick HP Recovery Board cannot be specified as the sole membrane underlayment over wide rib (Type B) or intermediate rib (Type F) steel decks. HP Recovery Board must be at least specified with 1/2" thick gypsum board or 3/4" thick perlite.			
(2) Local codes must be consulted regarding the acceptance of expanded or extruded polystyrene insulation directly over steel decks.			
(3) EPS, the EPS surface of EPS Composite Board, Foamular or Dow roof insulation cannot be installed directly over coal tar pitch roof surfaces.			
(4) Polystyrene insulation cannot be installed directly over existing PVC membranes. A layer of HP Protective Mat must be specified as a separator.			
(5) Dens-Deck/Dens-Deck Prime or Securock must be used on top of an approved insulation. Their direct use over an existing roofing membrane or monolithic roof deck is not permitted.			
Tapered EPS, ThermaPink 25, Dow Deckmate or Deckmate Plus and Polyisocyanurate Insulations are also available.			

Restrictions:

1. Carlisle Roofing Systems cannot be specified in conjunction with Phenolic Insulation.
2. Fiberglass insulation cannot be specified, even if overlaid with additional insulation.
3. The direct application of Sure-Flex Membrane over expanded or extruded polystyrene insulation is not permitted.

3.04 INSULATION ATTACHMENT

For all Total System Warranty projects and those projects where the insulation attachment method is to be covered by the Carlisle System Warranty, the use of Carlisle Fasteners and Plates or FAST Adhesive (full-spray or ribbon application), VersiGrip Insulation Adhesive or OlyBond 500 BA Adhesive is required. Fasteners and plates (minimum 3" diameter for adhered systems), supplied by others may be used to **attach insulation** when the fastening assembly is Factory Mutual approved, recommended by the respective manufacturer and accepted by Carlisle prior to installation.

A. Mechanically Fastened Roofing Systems

Carlisle Insulation must be mechanically fastened to the roof deck with Carlisle Fasteners and Seam Fastening Plates or Insulation Plates as follows.

1. For minimum 1/2" thick Carlisle HP Recovery Board, minimum 1/4" thick Securock or Dens-Deck/Dens-Deck Prime, or minimum 1-1/2" thick Polyisocyanurate insulation, a minimum of 5 fasteners and plates per 4' x 8' board (1 per 6.4 square feet) is required. For 4' x 4' boards, a minimum of 4 fasteners and plates (1 per 4 square feet) shall be used. Refer to Detail Sure-Flex Mech Fast - 27 for fastening requirements.
2. For Carlisle Polyisocyanurate insulation less than 1-1/2" in thickness, a minimum of 6 fasteners and plates per 4' x 8' board (1 per 5.3 square feet) and 4 fasteners and plates per 4' x 4' board (1 per 4 square feet) must be utilized. Refer to Detail Sure-Flex Mech Fast – 27 for fastening requirements.
3. For minimum 1" thick Insulfoam SP, a minimum of 8 fasteners and plates per 4' x 8' board (1 per 4 square feet) is required. For 4' x 4' boards, a minimum of 5 fasteners and plates (1 per 3.2 square feet) shall be used. Refer to Detail Sure-Flex Mechanically Fastened - 27 for fastening requirements.
4. Gypsum board may be specified as a membrane underlayment to meet certain fire ratings. Refer to Carlisle's Sure-Flex Code Approval Guide for specific information. Gypsum board must be fastened at the same rate as Carlisle HP Recovery Board as noted above.

B. Adhered Roofing Systems

Depending on roof deck type, Carlisle insulation may be mechanically secured to the roof deck or adhered with FAST Adhesive (full-spray or ribbon applied), VersiGrip Adhesive or OlyBond 500 BA.

Note: Adhering of roof insulation directly to metal decks is not recommended unless the insulation is fully adhered with FAST Adhesive. When bead adhesive (i.e., FAST Dual Cartridge, VersiGrip or OlyBond) is specified in a multiple layer application, the first insulation layer must be mechanically secured at minimum rate of 1 fastener per 4 sq ft. Bead spacing for consecutive layers will vary depending on warranty length and wind speed coverage. Projects with standard wind speed coverage and heights up to 50' may incorporate bead spacing of 6" in perimeter areas and 12" in the field (perimeter area equals .4 building height or 10% of the lesser dimension of the roof plan, whichever is less).

Carlisle may be consulted for projects with conditions not covered above.

1. Carlisle **Insulation** must be mechanically secured to the roof deck with **one 3" plate and fastener every 2 square feet** (Sure-Flex Adhered – 27A Detail) **except as follows:**

For **structural concrete, minimum 22 gauge steel, 1" wood planks** or **15/32" thick plywood decks:**

- a. When a single or top layer of **minimum 1-1/2" thick Carlisle Polyisocyanurate** is specified, the Carlisle Insulation may be secured at the minimum rate of 1 per 3.2 square feet (**10 Carlisle Fasteners and Plates per 4' x 8' board; 5 fasteners per 4' x 4' board**). Refer to Sure-Flex Adhered – 27D Detail.
- b. When a single or top layer of **minimum 2" thick Carlisle Polyisocyanurate** Insulation is specified, the Carlisle insulation may be mechanically secured with **one Carlisle Fastener and Plate every 4 square feet**. Refer to Sure-Flex Adhered - 27B Detail.
- c. Securock, Dens-Deck Prime, 1/4" or 1/2" thick, may be fastened at the rate of 12 fasteners/plates per 4' x 8' board (1 per 2.67 square feet). Dens-Deck Prime, 5/8" thick, may be fastened at the rate of 8 fasteners/plates per 4' x 8' board (1 per 4 square feet). Refer to Sure-Flex Adhered – 27F.

Note: If a wind speed warranty greater than 55 mph is desired or a 20-year warranty is specified,

additional insulation fastening may be required. Contact Carlisle for specific requirements.

- d. **On reroof/no tearoff projects** with a maximum roof height of 40' **any Carlisle insulation** (i.e., HP Recovery Board, Polyisocyanurate Insulation less than 1-1/2" thick) may be secured at the minimum rate of **11 fasteners per 4' x 8' board (5 fasteners per 4' x 4' board)**. This option is **not applicable for 15 or 20 year Golden Seal Warranty projects** or projects where extended wind speed coverage (greater than 55 mph) is desired. Refer to Sure-Flex Adhered – 27E Detail.
2. When an approved oriented strand board (OSB) is specified as the membrane underlayment, it must be mechanically fastened to the roof deck in accordance with Sure-Flex Adhered - 27C Detail. If OSB is to be specified in conjunction with Carlisle FAST Adhesive, Versigrip Insulation Adhesive or OlyBond 500 BA (for insulation attachment), an OSB/Polyiso composite board is recommended.
3. For projects specified to achieve a Factory Mutual (FM) rating, additional insulation fasteners will be required at roof perimeter and corners. Refer to Carlisle's Sure-Flex Code Approval Guide or Factory Mutual Loss Prevention Data Sheets 1-28 and 1-29 or for specific requirements.

4. **Alternate Insulation Attachment Method**

- a. Carlisle FAST Adhesive, a spray-applied, two-component, low-rise urethane adhesive may be specified for insulation attachment in lieu of mechanical securement. Refer to Carlisle's FleeceBACK Adhered Roofing System Specification for specific installation requirements.
- b. Carlisle FAST Dual Cartridge, a two-component, low-rise insulating adhesive applied in approximately 1/2" beads spaced a maximum of 12" on center in the field of the roof and 6" on center at the perimeter (based on building height and warranty length) may be utilized. Contact Carlisle for specific requirements concerning bead spacing if this option is to be specified.

NOTE: Coverage rate is 600 sq ft per carton using 1/2" beads at 12" oc.

- c. Carlisle VersiGrip™ Insulation Adhesive, a one-component, moisture-curing, polyurethane adhesive applied in approximately 1/2" beads spaced a maximum of 12" on center in the field of the roof and 6" on center at the perimeter (based on building height) may be utilized. Contact Carlisle for specific requirements if this option is to be specified.
- d. Carlisle OlyBond 500 BA, a two-component, polyurethane adhesive applied in approximately 1/2" beads spaced a maximum of 12" on center in the field of the roof and 6" on center at the perimeter (based on building height) may be utilized. Contact Carlisle for specific requirements if this option is to be specified.
- e. The building owner or specifier may select an alternate insulation attachment method, which incorporates a solid mopping of insulation with hot asphalt (ASTM D312, Type III or type IV).

The insulation attachment with hot asphalt is typically excluded from the Membrane System Warranty. Projects where a Total System Warranty is specified must be forwarded to Carlisle for review to determine specific requirements, components and installation procedures.

Note: With the exception of FAST Adhesive, where 4' x 8' boards may be utilized, the maximum board size shall not exceed 4' x 4'. Boards may require trimming to accommodate substrate unevenness.

3.05 **MEMBRANE SECUREMENT CRITERIA**

A. **General**

1. **Ensure** that water does not flow beneath any completed sections of the membrane system by completing all flashings, terminations and daily seals by the end of each workday.

2. **Sweep** all loose debris from the substrate.

B. Mechanically Fastened Roofing Systems (membrane fastening)

1. Carlisle Fasteners and Fastening Plates must be used for membrane securement and are dependent on the roof deck type. Refer to "Attachment I," Withdrawal Resistance Criteria, at the end of this section, for specific fastener and plate requirements.
2. The **field and perimeter membrane width and fastening** requirements are **dependent** upon the project **wind zone, building height and deck type** and are outlined in "Attachment II" at the end of this section.

Note: If Factory Mutual approvals are specified, refer to Carlisle's Sure-Flex Code Approval Guide for membrane securement requirements.

3. Perimeter Membrane Securement

- a. 40.5" wide perimeter sheets shall be used around edges of the building. A minimum of two 40.5" perimeter sheets will be required with additional sheets required based on building height and location.
- b. The roof perimeter is defined as all edges of each roof section. Where multi-level roofs meet at a common wall, the adjacent edge of the upper roof is treated as a roof perimeter if the difference in height is greater than 3 feet. Perimeter sheets are not required at the base of the wall at the lower level. Refer to Sure-Flex Mech. Fast. - 2 at the end of this section for further information.

Note: Expansion joints, control joints, and fire walls in the field of the roof or roof ridges with slopes less than 3" to the horizontal foot shall not be considered as part of the roof perimeter.

4. Field Membrane Securement

- a. **Position** adjoining field membrane sheets (81" wide) to allow an approximate overlap of 5-1/2" at those locations where Fastening Plates are located (along the length of the membrane); at the same time overlap end roll sections (the width of the membrane) a minimum of 2".
- b. **Secure the membrane** at the approved fastening density with the required Carlisle Fastener and Fastening Plates.
- c. For installation of membrane with fullness, tighten the sheet between fasteners as follows:
 - 1) Unroll sheets and position.
 - 2) Place a fastener and plate in one end of the sheet on the appropriate fastener mark. Go to the opposite end of the sheet, pull it tight and place a fastener and plate at the appropriate mark. Place the remaining fasteners into the sheet.
 - 3) Proceed to weld the sheet in place and continue across the roof.

5. Prevention of membrane distortion during windy conditions:

- a. Unroll sheet approximately 5' and position edge of membrane with overlap line on adjacent sheet.
- b. Install fasteners along the 5' exposed edge.
- c. While the 5' of exposed membrane is being fastened, begin welding the overlapped edge using the Automatic Heat Welder.

- d. As sheet is being welded and fastened concurrently, unroll membrane. Unroll only enough membrane to stay a few feet ahead of welding and fastening process. This reduces amount of unsecured membrane to be distorted by wind.
- e. Continue this process for each adjoining sheet.

C. Adhered Roofing System (membrane bonding)

Maximum 81" wide Sure-Flex Membrane is fully adhered to an approved insulation or substrate with Sure-Flex Bonding Adhesive at the coverage rate shown below. The Bonding Adhesive shall be applied to both the membrane and the surface to which it is being bonded.

1. **Position** Sure-Flex PVC membrane over the acceptable substrate.
2. **Fold** membrane sheet back so half the underside is exposed.
3. **Stir** Bonding Adhesive thoroughly scraping the sides and the bottom of the can (minimum 5 minutes stirring is recommended). Bonding surfaces must be dry and clean.
4. **Apply** Bonding Adhesive to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be heat welded over adjoining sheet.

When using **Sure-Flex Bonding Adhesive**, a coverage rate of approximately 90 - 100 square feet per gallon per one surface (membrane or substrate) or approximately 45 - 50 square feet per gallon per finished surface (includes coverage on both membrane and substrate) shall be achieved. **Apply** adhesive evenly, without globs or puddles with a plastic core medium nap paint roller to achieve continuous coating of both surfaces. A 9-inch roller will easily fit into the 5-gallon containers.

A mechanical roller dispenser can be used to apply Bonding Adhesive when the continuous coating and coverage rate noted above are maintained.

CAUTION: Due to solvent flash-off, condensation may form on freshly applied Bonding Adhesive when the ambient temperature is near the dew point. If condensation develops, possible surface contamination may occur and the application of Bonding Adhesive must be discontinued. Allow the surface to dry and apply a thin freshener coat at the coverage rate which is approximately half the coverage rate stated above to the previously coated surface when conditions allow for continuing.

5. **Allow** adhesive to dry until tacky but will not string or stick to a dry finger touch.

Notes: When using Sure-Flex Bonding Adhesive, care must be exercised to ensure proper drying. Avoid thin areas of adhesive because over drying can occur and proper adhesion may not be achieved.

6. **Roll** the coated membrane into the coated substrate while avoiding wrinkles.
7. **Brush** down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.
8. **Fold** back the unbonded half of the sheet and repeat the bonding procedures. **Apply** Bonding Adhesive to the remaining exposed underside of membrane and adjacent substrate and complete this section as described above.
9. **Install** adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches to provide for a minimum 1-1/2 inch heat weld. It is recommended that all splices be shingled to avoid bucking of water.

CAUTION: If aesthetics are of concern, protect completed sections of the roof so Bonding Adhesive will not discolor the membrane surface. Do not place Bonding Adhesive containers or their lids directly on

the surface of the Sure-Flex membrane.

3.06 HEAT WELDING PROCEDURES

A. General

1. Heat weld the Sure-Flex membrane sheets using the Automatic Heat Welder or Hot Air Hand Welder and silicone roller.
2. When roof slope exceeds 5" per horizontal foot, use of the Automatic Heat Welding Machine may become more difficult; use of the Hand Held Hot Air Welder is recommended.
3. **Check the surfaces** of the Sure-Flex membrane to be heat welded to ensure they are properly prepared.

The surfaces to be heat welded must be clean. Membrane overlaps that become contaminated with field dirt must be cleaned with PVC Membrane Cleaner. PVC Membrane Cleaner should be wiped dry with a clean HP Splice Wipe prior to welding. No residual dirt or contaminants should be evident.

B. Operating Automatic Heat Welder

1. Temperature Settings

When making a Sure-Flex splice, no one temperature setting or speed can be used to describe the temperature setting or speed to set the robot. The splice must be tested to determine the quality of the splice.

Consult the respective heat welding machine manufacturer for recommendations concerning proper temperature setting and speed control of their equipment.

Typically, the colder the ambient temperature (and likewise the membrane temperature) the slower the Automatic Heat Welder speed control must be adjusted to produce proper seams.

As a general guide, Sure-Flex membrane will weld at a temperature of 1150° F and a speed of 8 feet to 12 feet per minute.

With the Leister Varimat Automatic Heat Welder, the suggested heat setting is 1148° F at 10.2' per minute. With any other brand of robot welder, the temperature should be set at the manufacturer's recommended temperature to obtain the correct splice results.

The following is a list of items to be checked to determine the temperature setting and the speed at which a splice should be completed:

- a. When the membrane is in direct sunlight, the temperature or robot speed may have to be adjusted when moving into a shaded area, check the splice results.

Remember the membrane surface in a shaded area will be cooler than a membrane surface that is in sunlight.

Darker colored membrane (such as gray) will be warmer than white and may affect the welder speed.

- b. Dampness on the membrane from dew, a passing rain shower or misting condition will reduce heat from the splice due to evaporating moisture from the membrane surface. The heat welding temperature (increased) or the robot speed (slower) will have to be adjusted to produce a good splice. Water must be wiped from the welding surface prior to welding the splice.

- c. Wind has a cooling affect as it blows over the surface. It will also affect the airflow in the splice reducing the effectiveness of the hot air gun. This will require the operator to increase heat from the hot air gun or reduce the welder speed.
- d. Substrates make a substantial difference in the amount of heat required to produce a proper heat welded splice. The robot will have to be adjusted accordingly:

Plywood and Concrete act as heat sinks and will take a higher temperature or slower speed setting than insulation.

Cool damp substrates will take a higher temperature or slower speed setting than dry substrates.

- e. Membrane “bleed-out” from sheets should occur with Sure-Flex membrane if properly welded. If bleed-out is not occurring (the underside of the membrane begins to melt and flow), the welder speed should be decreased to increase welding temperature.

2. Equipment Set-Up

Equipment set up is the responsibility of the Authorized Applicator. When poor welding is occurring check the following:

- a. If the membrane is overheated on one side or the other, check the nozzle to be sure it is distributing the heat evenly between the two sheets.
- b. If the heat is bypassing the edge of the sheet producing a cold weld along the edge of the splice, be sure the nozzle is completely under the sheet and the air dam is in place and functional.
- c. If the probed splice is tight at the edge but a cold weld is present in center of the splice (the heat is melting the edges but does not melt the center of the splice), check to be sure the robot is not running too fast.
- d. Ensure the silicone pressure wheel is intact with no voids in the silicone. If voids are present, incomplete welding will result.
- e. Be sure all wheels on the air dam are not binding. Binding wheels will cause sheet movement and distortion during the welding process.
- f. The automatic heat welder nozzle should be adjusted as close to the pressure wheel as possible. If the nozzle is too far away from the pressure wheel, distortion of the membrane may occur due to heat expansion.

Note: Adjust welder nozzle so the curved portion (heel) extending outside the seam area does not contact or drag on the exposed surface of the membrane. This portion of the nozzle should be 1/16" to 1/8" above membrane surface.

- g. Overheating the membrane will cause poor welds. It is recommended the automatic welder be run not less than 8' a minute on average temperature days.

Only on very cold days the welder should be run below this speed. The temperature and welder speeds must be determined based on test welds prior to actual sheet welding.

- h. Clean screen of dirt and debris on air inlet of heat gun every day. Accumulation of contaminants on screen will reduce air flow and heat output of welder.

3. Membrane Welding

- a. Prepare the Automatic Heat Welder and allow it to warm for approximately 5 to 10 minutes to reach operating temperature.
- b. Position the Automatic Heat Welder properly prior to seaming with the guide handle pointing in the same direction the machine will move along the seam.
- c. Lift the overlapping membrane sheet and insert the blower nozzle of the Automatic Heat Welder between the overlap. Immediately begin moving the machine along the seam to prevent burning the membrane.
- d. Weight plates provided on Automatic Welders must be utilized.
- e. Proceed along the seam ensuring that the small guide wheel in front of the machine aligns with the edge of the top membrane sheet. Guide the machine from the front only.

CAUTION: Ensure the power cord has plenty of slack to prevent dragging the machine off course (which could result from a tightly stretched cord).

- f. At all splice intersections, roll the seam with a silicone roller to ensure a continuous heat welded seam (the membrane should be creased into any membrane step-off with the edge of the silicone roller). A false weld may result due to surface irregularities created by multiple thicknesses of Sure-Flex membrane sheets.

When using **60-mil or 80-mil** Sure-Flex Membrane, a **PVC "T" Joint Cover** must be applied over all "T" joint splice intersections (refer to Sure-Flex Mech Fast -2C). The **use of Sure-Flex Non-Reinforced Flashing is not acceptable** to overlay "T" Joint splice intersections.

- g. To remove the Automatic Heat Welder from the finished splice, stop the movement of the machine and immediately remove the nozzle from the seam area.
- h. Mark the end of the heat welded seam with a water-soluble marker for easy identification. A Hand Held Welder will be necessary to complete the weld in the area between where the Automatic Heat Welder is stopped and restarted.
- i. Perform a test weld at least at the start of work each morning and afternoon. Test welds should be made if any changes in substrate or weather conditions occur.

4. Recommendation to Prevent Membrane Creeping and Movement

- a. The operator of the robot must apply foot pressure to the membrane, kicking and sliding the membrane under the robot to keep the membrane tight. Always have the operator stand on the unfastened sheet of membrane to prevent sheet movement.
- b. Do not release foot pressure from the membrane until the pressure wheel rolls over the membrane in front of the foot that is holding the membrane in place.

5. Use of Welding Tracks

Set welding tracks lengthwise along the splice, close to the Automatic Heat Welder air dam to reduce membrane movement caused by the welding process. The operator must continue to apply foot pressure to the welding tracks to help hold the membrane splice in place. Welding tracks are moved as welder progresses along seam.

Welding tracks can be:

- Sheet metal, 22 gauge – 12" wide by 10' long (with rounded corners).
- Aluminum or steel plates – 1/4" x 3", 4' to 6' long (with rounded corners).

- Wood planks – 2" x 12" X 4' to 6' long.
- Heavy plywood – 3/4" x 24" x 8' long.

6. Test Cuts

- a. Perform a test weld at least at the start of work each morning and afternoon.
- b. The test sample should be approximately 1 inch wide and longer than the width of the seam (cut across the heat welded seam).
- c. Peel the test sample apart after it has thoroughly cooled (approximately 10 minutes) and examine for a consistent 1-1/2 inch wide minimum weld. Delamination of the membrane from the scrim-reinforcement is an indication of a properly welded seam.
- d. **Identify the following seam problems to assure seam quality:**
- e. **Discolored or scorched membrane** – Increase speed or decrease temperature setting if membrane discolors.
- f. **Void and wrinkles** - A proper heat welded seam has no voids or wrinkles and must be at least 1-1/2 inches wide. Refer to Seam Probing procedures outlined below for proper inspection of seam deficiencies.

7. Hand Held Welder Settings

- a. Temperature setting for hand held welders when used for flashing should be approximately “6” (on a scale from 1 to 10).
- b. Temperature settings for hand held welders when used for membrane should be approximately “8 –10” (on a scale from 1 to 10).
- c. Exact settings will vary based on ambient temperatures, substrate and type of welder.
- d. Silicone roller should be used to apply pressure to the membrane to be welded.

8. Seam Probing

A blunt or dull cotter pin puller is recommended to probe all heat-welded seams. Probing seams must be done once heat welds have thoroughly cooled. Heat welded seams must be probed throughout the day to check seam quality and to make proper adjustments to heat welding equipment. **The repair of deficiencies must be done routinely throughout the day but no later than the end of each workday.**

- a. Allow heat-welded seams to cool thoroughly for approximately 30 minutes. Premature probing can damage warm seams.
- b. Draw probing tool tip along the edge of the heat welded seam. Apply firm pressure to probe the seam junction, but not into the bottom membrane sheet. The tool will not penetrate into the lap area of a properly welded seam.
- c. If the seam-probing tool penetrates into the lap area, mark the seam using a water-soluble marker at the beginning and the end of voids or wrinkles in the seam edge.
- d. Repair seam deficiencies as soon as possible using the hand held welder. Carlisle recommends that repairs be made the same day they are discovered.

- e. Probe **repaired seams** after they have cooled completely. If the repair is acceptable, wipe off the water soluble marker lines; if not acceptable, repair the seam using standard heat welded overlay procedures.

Note: All laps must be probed each day soon after it has cooled to verify the welder set-up is effective. Particular attention must be given to all membrane intersections and heat-welded seams at insulation joints. In addition, there should be periodic checks (including at the start of each day) to verify good peel strength.

- f. **Apply Sure-Flex PVC Cut-Edge Sealant** on all cut edges of the reinforced membrane (where the scrim reinforcement is exposed) **after seam probing** is completed. Cut-Edge Sealant is not required on vertical splices. When a 1/8" diameter bead of Cut-Edge Sealant is applied, approximately 225 – 275 linear feet of coverage per squeeze bottle can be achieved.

3.07 WELDING PROBLEMS/REPAIRS

- A. A Hand Held Hot Air Welder and a 2" wide silicone roller must be used when repairing the Sure-Flex membrane. When the **entire** heat welded **seam** is to be **overlaid**, an **Automatic Heat Welder** may be used.
- B. Prior to proceeding with any repair procedure, the area to be repaired must be cleaned with PVC Membrane Cleaner. The membrane can typically be repaired with standard cleaning methods. In cases where the standard cleaning method is not sufficient, the following procedures must be used.
 - 1. Scrub the area to be welded with a "Scotch Brite" Pad and PVC Membrane Cleaner.
 - 2. Clean all residue from the area to be welded with a Splice Wipe or a clean natural fiber (cotton) rag.
 - 3. Weld the new membrane to the cleaned area using standard welding procedures.
- C. Clean all residue from the area to be welded with a Splice Wipe or clean natural fiber (cotton) rag.
- D. Weld the new membrane to the cleaned area using standard welding procedures.
- E. Voids in welded seams can be repaired using a Hand Held Hot Air Welder and a silicone roller. Depending on conditions, a splice overlay may be required.
- F. Position the hand held welder facing into void so hot air is forced between overlapping membranes. Roll the top membrane surface using positive pressure toward the outer edge until the heated membrane surfaces are fused.
- G. Exposed scrim-reinforcement (resulting from scorching surface of membrane) and test weld areas must be repaired by overlaying the damaged area with a separate piece of Sure-Flex reinforced membrane with rounded corners. The overlay must extend a minimum of 2 inches past the area to be repaired.
- H. **Probe** all edges of the overlay once cooled to ensure a proper weld has been achieved.
- I. **Seal** all cut edges of Sure-Flex reinforced membrane with Sure-Flex Cut-Edge Sealant.

Note: The same overlay repair procedures may be used for punctures in the Sure-Flex membrane.

3.08 ADDITIONAL MEMBRANE SECUREMENT

Securement must be provided at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any inside angle change where slope exceeds 2 inches to one horizontal foot, and at all penetrations as identified on the Carlisle details.

Securement may be achieved as follows:

- A. On Mechanically Fastened Roofing Systems, Carlisle's Piranha Fastening Plates are used to secure the membrane with the appropriate Carlisle Fastener at the base of walls and penetrations and flashed as shown on the applicable Carlisle detail (excluding OSB, cementitious wood fiber and gypsum decks where the required Carlisle Fastener is installed with the associated 2" diameter plate). On **Adhered Roofing Systems**, Carlisle standard 2" diameter Seam Fastening Plates may be used in lieu of Piranha Plates.
- B. Securement of the membrane shall be a maximum of 12 inches on center. Fasteners shall be positioned 6 inches minimum to 9 inches maximum from the inside or outside corner.
- C. On Mechanically Fastened assemblies, additional membrane securement is required around pipes and sealant pockets as shown on the applicable detail. The plates must be positioned a maximum of 12" away from the penetration, spaced a maximum of 12" on center and flashed in accordance with the applicable Carlisle Detail.
- D. Refer to the "Membrane Fastener Criteria" chart in "Attachment II" at the end of this section for the required Carlisle Fastener/Plate with the corresponding deck type.
- E. After securing the membrane, flash in accordance with the appropriate detail.

3.09 FLASHING CONSIDERATIONS

A. General Flashing Conditions

- 1. The height of new wall flashing must extend above the anticipated water level or slush line.
- 2. On 15 or 20-year Warranty projects, Carlisle's Termination Bar, in conjunction with Water Cut-Off Mastic, must be specified under all metal counterflashings and surface mounted reglets.

3. On retrofit projects

Bitumen-based roof cement and asphaltic-based flashing material, if allowed to remain in contact with the Sure-Flex membrane, will cause severe membrane discoloration and promote premature plasticizer migration. Existing wall and curb flashing must be removed or concealed with a new acceptable substrate.

- a. The specifier must examine structural supports for rooftop equipment to determine if reasonable access to the membrane beneath the equipment is provided. Carlisle should be consulted for clarification when access to the membrane system will be restricted.
- b. When hot pipes or other similar penetrations exceed 120° F, they must be designed to incorporate an insulated metal collar and rain hood designed to maintain a surface temperature less than 120° F.
- 4. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using Sure-Flex **reinforced** membrane. Sure-Flex non-reinforced membrane can be used for flashing pipe penetrations, Sealant Pockets and scuppers as well as inside and outside corners when the use of pre-molded accessories is not feasible.
- 5. When possible, all reinforced membrane splices are heat welded with the Automatic Heat Welder. The Hand Held Hot Air Welder should be utilized in hard to reach areas, smaller curbs, vertical splices and when using non-reinforced membrane.
 - a. The new Sure-Flex membrane flashing must not conceal weep holes or cover existing throughwall flashing.
 - b. Install surface mounted reglets and compression bar terminations directly to the wall surface.
- 6. In areas where metal counterflashing or surface mounted reglets are used as vertical terminations, the counterflashing must be sealed with a rubber grade caulking to prevent moisture migration behind the new wall

flashing.

B. Application of Bonding Adhesive

1. Membrane shall be adhered to vertical surfaces with Sure-Flex PVC Bonding Adhesive. The Bonding Adhesive shall be applied continuously, without globs or puddles.
2. After the Bonding Adhesive has properly dried, roll the membrane into the adhesive.
3. Care must be taken when setting the flashing to avoid bridging greater than 3/4 inch at angle changes (i.e., where a parapet or roof penetration meets the roof deck). This can be accomplished by creasing the membrane into the angle change.
4. Terminate the edges of the installed membrane in accordance with Carlisle's applicable Sure-Flex Universal - 9 Termination Details.

C. Walls, Parapets, Curbs, Skylights, etc. (Sure-Flex Universal 5A, 5B, 12A through F Details)

The flashing height must be calculated so that the Sure-Flex membrane flashing includes a minimum 1-1/2 inch heat weld beyond the Fastening Plates.

1. Fasten at angle change as identified in Paragraph 3.08, Additional Membrane Securement, with the required Carlisle Fastener and plate.
2. Flash the fasteners/plates with a separate piece of Sure-Flex reinforced membrane; apply heat and crease the flashing into the angle change before attaching it to the vertical surface.

D. Metal Edge Terminations (Sure-Flex Universal 1 Details)

Factory-fabricated metal edge systems must be secured to the wood nailer as specified by the manufacturer. Shop-fabricated edging must be installed in compliance with Sure-Flex Universal 1-E Detail using Carlisle PVC Coated Metal in order to achieve ES-1 Compliance. Refer to the appropriate Sure-Flex Universal Details for other flashing options and requirements.

E. Roof Drains (Sure-Flex Universal 6 Details)

1. Sure-Flex membrane may extend into the drain sump when the slope of the sump is less than 3" to one horizontal foot. Refer to the Sure-Flex Universal 6A Detail.

When the drain sump is greater than 3" to one horizontal foot, additional membrane securement must be installed. Refer to Sure-Flex Universal 6B or 6C Detail.

2. Only drain strainers that have been approved by the specifier in accordance with applicable codes may be used.

F. Other Penetrations

On Mechanically Fastened assemblies, additional membrane securement is required around pipes and sealant pockets as shown on the applicable detail. The plates must be positioned a maximum of 12" away from the penetration, spaced a maximum of 12" on center and flashed in accordance with the applicable Carlisle Detail.

1. Pipes, Round Supports, etc.

- a. Flash pipes with Molded Pipe Flashings or Split Pipe Seals where their installation is possible. Molded pipe flashings cannot be cut and patched; deck flanges cannot be overlapped or installed over angle changes.

- b. Where Molded Pipe Flashings or Split Pipe Seals cannot be installed, APPLY FIELD FABRICATED PIPE FLASHING using Sure-Flex non-reinforced membrane. Refer to Sure-Flex Universal 8B Detail.
- 2. **Flexible Penetrations** (braided cables, conduits, wires, etc.) must be enclosed in a stable “goose neck.” Apply a Split Pipe Seal or field fabricated pipe flashing to flash the goose neck.
- 3. **Hot pipes** that exceed 120° F, must utilize an insulated metal collar and rain hood, flashed with a field fabricated pipe flashing. Refer to Sure-Flex Universal 8C Detail.
- 4. For **pipe clusters** or unusually shaped penetrations, a Molded Sealant Pocket must be utilized. Refer to Sure-Flex Universal 16 Details.
- 5. **Existing Roof Tie-Ins** (Sure-Flex Universal 13 Detail)

Total isolation between the two roofing systems is required. Refer to Sure-Flex Universal 13 Detail for installation requirements.

3.10 METAL WORK

- A. When a compression bar termination is to be specified, the use of Carlisle's Termination Bar is recommended.
 - B. Termination bars and surface mounted reglets must be installed directly to the wall surface.
 - C. Carlisle recommends Sure-Flex PVC Coated Metal, Carlisle SecurEdge™ Metal Edging/Coping, SecurEdge 1000, 2000 or 3000 Metal Edging for membrane termination. Installation instructions are available from Carlisle.
 - D. Metal work by others, when specified and approved by Carlisle, must be fastened to prevent metal from pulling free or buckling and sealed to prevent moisture from entering the roofing system or building. **Unless supplied by Carlisle, metal work securement is not included in this specification and is excluded from the Carlisle Warranty.**
- Note:** Conventional metal edging which require the flange to be “stripped in” are not acceptable.
- E. **On retrofit projects**, existing counterflashing, edging, expansion joint covers, copings, etc., shall not be reused unless investigated by the specifier to determine its compliance to Carlisle’s current details.

3.11 WALKWAYS

Walkways are required at all traffic concentration points (i.e., roof hatches, access doors, rooftop ladders, etc.), and if regular maintenance (once a month or more) is necessary to service rooftop equipment.

Walkway types:

- A. **Sure-Flex Heat Weldable Walkway Rolls** are required when walkway pads are to be specified. The Walkway Rolls are heat welded to the Sure-Flex membrane using an Automated Heat Welder or Hand-Held Heat Welder.
- B. **Concrete pavers**, when specified, must be loose laid over a slip-sheet of membrane and cannot weigh more than 80 pounds per paver for ease of removal.
- C. **Carlisle Interlocking™ Rubber Pavers**, 24" x 24" x 2", weighing approximately 6 pounds per square foot, may be loose laid directly over the membrane. Installation instructions sheets are available from Carlisle.
- D. Pavers are not recommended for use as walkways where roof slopes exceed 2" in 12".
- E. Walkways are considered a maintenance item and are excluded from the Carlisle warranty.

F. Window washing equipment will require special maintenance; runways or window washing tracks must be utilized to prevent damage to membrane or insulation. Such details must be reviewed by Carlisle to determine reasonable access to the membrane and associated insulation/underlayment components.

G. **Walkway Installation**

1. Install walkways in those locations as designated by the specifier.

2. Sure-Flex Heat Weldable Walkway Rolls

- a. Use PVC Membrane Cleaner to remove dirt or other contaminants from the area to be welded to the walkway material.
- b. Position the walkway material and cut the Walkway Rolls into maximum 10' lengths (when positioned parallel to field splices) and position with a minimum 1" gap between adjacent pieces to allow for water drainage. When walkways are to be installed perpendicular to field splices, adjust walkway length to provide a 4" - 6" minimum gap at field splices. (Because the attachment of the walkway to the membrane is permanent, this will allow access to the field seams).
- c. Using an Automatic Heat Welder, weld all 4 sides of the walkway material to the membrane. (Typically the same speed and temperature settings will be used for this procedure as for welding membrane to membrane. A test weld is always recommended prior to performing welds to the installed membrane). A hand held welder may be utilized, however, productivity will be decreased.

If, possible, allow the walkway to warm by the sun prior to welding so distortion will not occur due to expansion.

3. **Concrete Paver Blocks**

Install a slip-sheet of Sure-Flex reinforced membrane under all concrete pavers for the protection of the deck membrane. The protective layer must extend a minimum of 2" on each side of the walkway.

4. **Carlisle Interlocking Rubber Pavers**

Rubber Pavers can be loose laid directly over the membrane. Installation instruction sheets are available from Carlisle.

Note: Pavers are not recommended for walkways when slopes exceed 2" per horizontal foot.

3.12 DAILY SEAL

- A. On phased roofing, when the completion of flashings and terminations is not possible by the end of each workday, provisions must be taken to temporarily close the membrane to prevent water infiltration.
- B. Temporarily seal any loose membrane edge down slope using hot asphalt, spray urethane foam or a similar product so that the membrane edge will not buck water. Caution must be exercised to ensure that the membrane is not temporarily sealed near drains in such a way as to promote water migration below the membrane.
- C. On existing built-up roofs, remove the gravel. The surface must be clean and dry.
- D. After embedding membrane in daily seal material, CHECK FOR CONTINUOUS CONTACT. Provide weight evenly distributed along the length of the daily seal to reduce the wind effect on the continuous temporary seal.

Note: The use of rigid wood nailers is not recommended due to warping and because constant compression cannot be achieved on an uneven substrate.

- E. When work is resumed, pull the Sure-Flex membrane free; trim and remove membrane where the daily seal material was previously applied before continuing installation of adjoining sections.

3.13 CLEAN UP

If required by the specifier to ensure the aesthetics of the surface of the Sure-Flex membrane, hand prints, footprints, general traffic grime, industrial pollutants and environmental dirt may be cleaned from the surface of the Sure-Flex membrane by scrubbing with soapy (non-abrasive soap) water and rinsing the area completely with clean water. Weathered Membrane Cleaner can also be used to clean the surface of the Sure-Flex membrane.

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This specification represents the applicable information available at the time of its publication. Owners, specifiers and Carlisle Authorized Roofing Applicators should consult Carlisle or their Carlisle Manufacturer's Representative for any information, which has subsequently been made available.

Review the appropriate Carlisle warranty for specific warranty coverage, terms, conditions and limitations.

Sure-Flex™ Roofing Systems

“Attachment I”

Fasteners/Withdrawal Resistance Criteria

June 2008

A. The following chart indicates the appropriate Sure-Seal Fastener for use with the referenced roof deck and includes the **minimum pullout** and fastener penetration requirements for membrane/insulation securement on Mechanically Fastened Roofing Systems and for insulation attachment on Adhered Roofing Systems.

Deck Type	Minimum Pullout	Approved Fasteners & Plates for membrane securement on Mechanically Fastened Systems (1) and approved fasteners for insulation attachment on Adhered Systems (5)	Minimum Penetration
Steel, 22 gauge or heavier (2)	500 pounds (Mechanically Fastened)	HP-X Fasteners & Piranha Plates or HP-Xtra Fasteners & Piranha Xtra Plates	3/4"
	360 pounds (Adhered)	HP-X, HP, ASAP or InsulFast Fasteners (5)	
Steel, less than 22 gauge (3)	300 pounds (Adhered only) (3)	HP-X, HP, ASAP or InsulFast Fasteners (5)	3/4"
Lightweight Insulating Concrete over Steel (4)	360 pounds	HP-X Fasteners & Piranha Plates or HP-Xtra Fasteners & Piranha Xtra Plates (Mechanically Fastened)	3/4"
		HP-X, HP, ASAP or InsulFast Fasteners (5) (Adhered)	
Structural Concrete, rated 3,000 psi or greater	800 pounds	CD-10 or HD 14-10 Fasteners and Piranha Plates (5)	1"
Wood Planks and Plywood, min. 15/32" thick APA Grade CDX	360 pounds	HP-X Fasteners & Piranha Plates or HP-Xtra Fasteners & Piranha Xtra Plates (Mechanically Fastened)	1" (Max. 1-1/2" on wood planks)
		HP-X, HP, ASAP or InsulFast Fasteners (5) (Adhered)	
Oriented Strand Board (OSB), Min. 7/16" thick (7) APA Rated non-veneer	300 pounds (Mechanically Fastened)	HP-X Fasteners & Piranha Plates or HP-Xtra Fasteners & Piranha Xtra Plates (Mechanically Fastened)	1-1/2"
	250 pounds (Adhered)	HP-X or HP Fasteners (5)	1"
Cementitious Wood Fiber and Gypsum	300 pounds	HP-NTB Fastener with 2" diameter plates (5)	1-1/2"

Notes:

1. For membrane fastening density requirements, refer to Attachment II at the end of this section.
2. Mechanically Fastened Roofing Systems are not permitted over corrugated steel decks, regardless of gauge.
3. Mechanically Fastened Roofing Systems are not permitted over steel decks less than 22 gauge unless used in conjunction with lightweight insulating concrete and acceptable pullouts are obtained using HP-X Fasteners.
4. Fasteners are installed through the lightweight insulating concrete into the steel deck below.
5. For adhered systems, only 3" diameter insulation fastening plates can be used for insulation attachment.

B. Withdrawal resistance testing may be conducted by an independent laboratory, fastener manufacturer or a representative of Carlisle on the following roof decks. The results of the pullout tests must be documented and submitted to Carlisle when the pullout results are less than listed above.

1. Cementitious wood fiber or gypsum
2. Lightweight insulating concrete over steel decks lighter than 22 gauge

3. Minimum 7/16" thick oriented strand board (OSB)
4. For 22-gauge steel, wood plank, plywood or structural concrete decks, a withdrawal resistance test is strongly recommended.
5. **On retrofit projects**, a core cutter shall be used to remove existing roofing material prior to conducting the withdrawal resistance test (even if the existing roofing membrane is specified to remain). Existing roofing materials will contribute to a higher, misleading pullout value.
6. The following minimum trial fastener samples must be installed and tested over the roof deck at each level:
 - a. For each roof level of 5,000 square feet or less, conduct a minimum of 3 pullouts.
 - b. For each roof level greater than 5,000 square feet and less than 20,000 square feet, conduct a minimum of 10 pullouts.
 - c. For each roof level greater than 20,000 square feet and less than 50,000 square feet, conduct a minimum of 15 pullouts.
 - d. For each roof level greater than 50,000 square feet and less than 100,000 square feet, conduct a minimum of 20 pullouts.
 - e. For each roof level greater than 100,000 square feet, conduct a minimum of 1 pullout per each 5,000 square feet.

Note: On projects with multiple roof levels, when pullouts are conducted on the main roof level, smaller canopies, overhangs, penthouses, etc., of 1,000 square feet or less will not require pullout tests providing these areas consist of the same decking material as the main roof level.
7. The trial fastener installations must be tested in various locations of the roof deck including roof corners and perimeters (areas parallel to the edge of the roof with a width which is 0.4 times the building height). Designate the test locations on a roof plan and include with the submittals to Carlisle when requested.

Sure-Flex™ Mechanically Fastened Roofing Systems “Attachment II”

Membrane Securement Criteria

June 2008

- A. For designation of wind zones listed on the following chart, refer to Basic Wind Speed Map in this Attachment. If Factory Mutual approvals are specified, refer to Carlisle’s Sure-Flex Code Approval Guide for fastener/plate options and additional membrane securement requirements, which may be applicable.

To determine appropriate securement requirements, identify project wind zone from the map (at the end of this section) and select the chart based on project deck type. The building height is then used to determine membrane securement requirements for the project.

Wind Zone	Deck Type (1)	Building Height	# of Perimeter Sheets	Perimeter Membrane Securement	Field Membrane Securement
Zone 1 Up to 100 MPH	Steel, Lightweight Insulating Concrete over Steel, Structural Concrete, Plywood or Wood Planks	Up to 50'	2	12" O.C.	18" O.C.
		51'-75'		12" O.C.	12" O.C.
	Gypsum and Cementitious Wood Fiber or Oriented Strand Board (3)	Max. 50'		12" O.C.	12" O.C.
Zone 2 100-119 MPH	Steel, Lightweight Insulating Concrete over Steel, Plywood or Wood Planks	Max. 75'	3	12" O.C.	12" O.C.
	Structural Concrete	Max. 75'		12" O.C.	18" O.C.
	Gypsum and Cementitious Wood Fiber or Oriented Strand Board (3)	Max. 30'		12" O.C.	12" O.C.
Zone 3 120-129MPH (3)	Steel, Lightweight Insulating Concrete over Steel	Max. 75'	4	12" O.C.	12" O.C.
	Plywood, Wood Planks (2), Gypsum and Cementitious Wood Fiber	Max. 30'			
	Structural Concrete	Max. 75'	3		
	Oriented Strand Board	Carlisle must be contacted for fastening requirements.			
Zone 4 130 MPH or Greater	Steel or Lightweight Insulating Concrete over Steel or Plywood, Wood Planks (2),	Max. 50'	5	12" O.C.	12" O.C.
	Structural Concrete	Max. 75'			
	Oriented Strand Board, Gypsum or Cementitious Wood Fiber	NOT ACCEPTABLE			

Notes:

1. Refer to “Attachment I,” for minimum roof deck/pullout requirements and the required Carlisle Fastener.
2. On plywood or wood plank decks, if pullout tests exceed 425 pounds per fastener, the membrane securement requirements for steel decks may be followed providing the pullout tests are submitted to Carlisle for approval.
3. Areas located between wind zone contours of 120-129 MPH within 20 miles of the coastline shall be considered as a Zone 4 Wind Zone.

- B. **Perimeter sheets are required along the roof perimeter**, which is defined as all edges of each roof section. Where multi-level roofs meet at a common wall, the adjacent edge of the upper roof is treated as a roof perimeter if the difference in height is greater than 3". Perimeter sheets are not required at the base of the wall at the lower level. Refer to Detail Sure-Flex Mech Fast - 2 in Part II "Application" for further information.

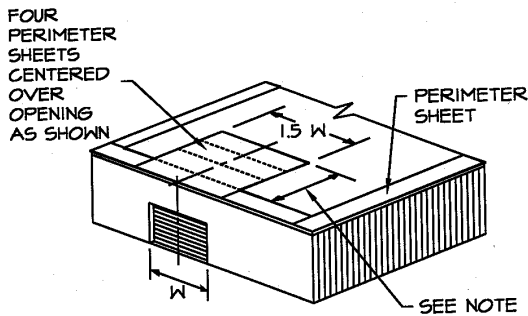
The number of perimeter sheets required is dependant on project wind zone and building height as identified on the previous chart. **At roof ridges** (when slopes exceed 3" to the horizontal foot), one perimeter membrane sheet, centered approximately over the roof ridge is required.

C. **Buildings With Large Openings and Overhangs**

When any wall contains major openings with a combined area, which exceeds 10% of the total wall area on which the openings are located, four (4) perimeter sheets (centered over the opening) must be specified as shown.

As an option to the above perimeter securement, an adhered membrane section may be used in lieu of the mechanically fastened membrane at large openings in accordance with the Carlisle Specification for Sure-Flex Adhered Roofing Systems.

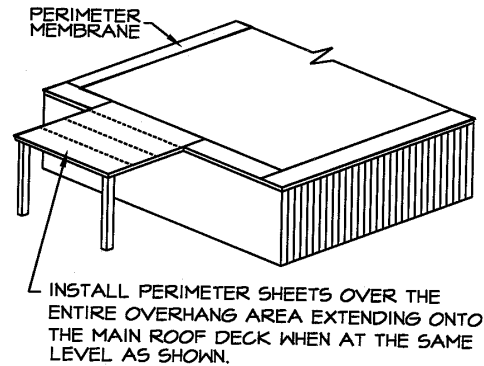
Large Openings

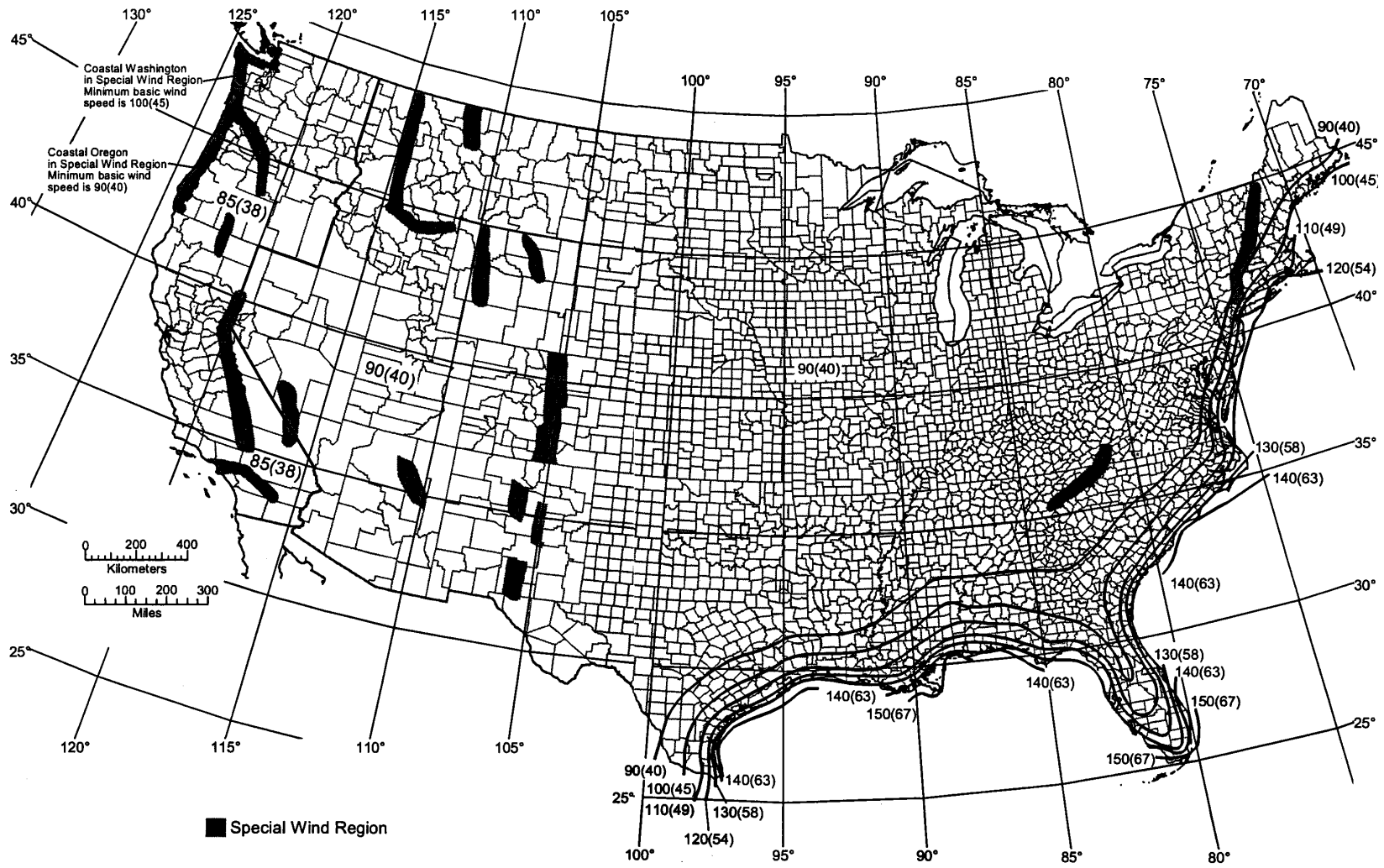


Note: Fastening plates are required at the end laps of the perimeter membrane sheets on both sides of the opened area.

Overhangs

The membrane must be specified with perimeter sheets installed over the entire overhang area extending onto the main roof deck when at the same level.

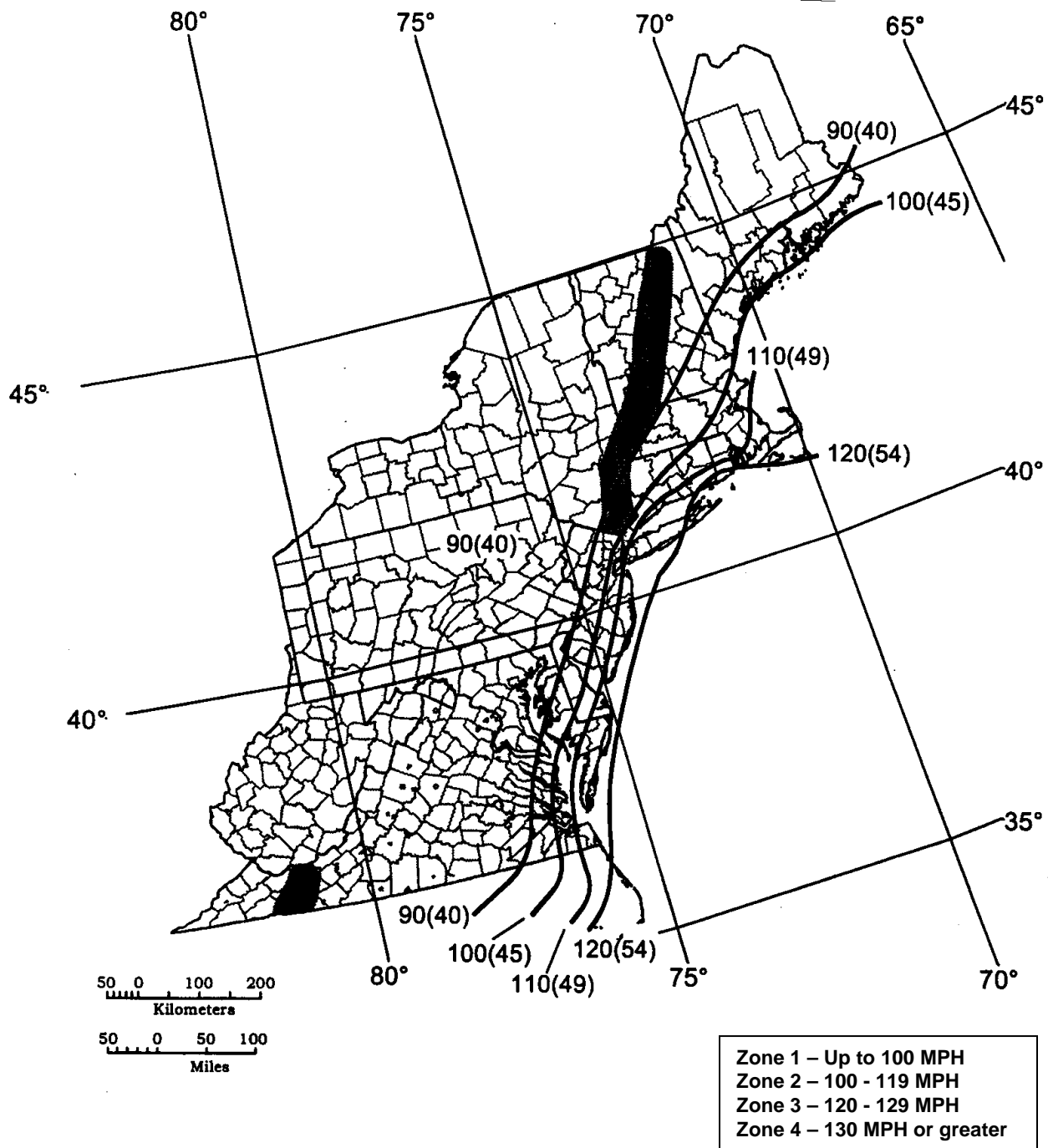




Basic Wind Speed Map
(Based on ASCE 7-02)

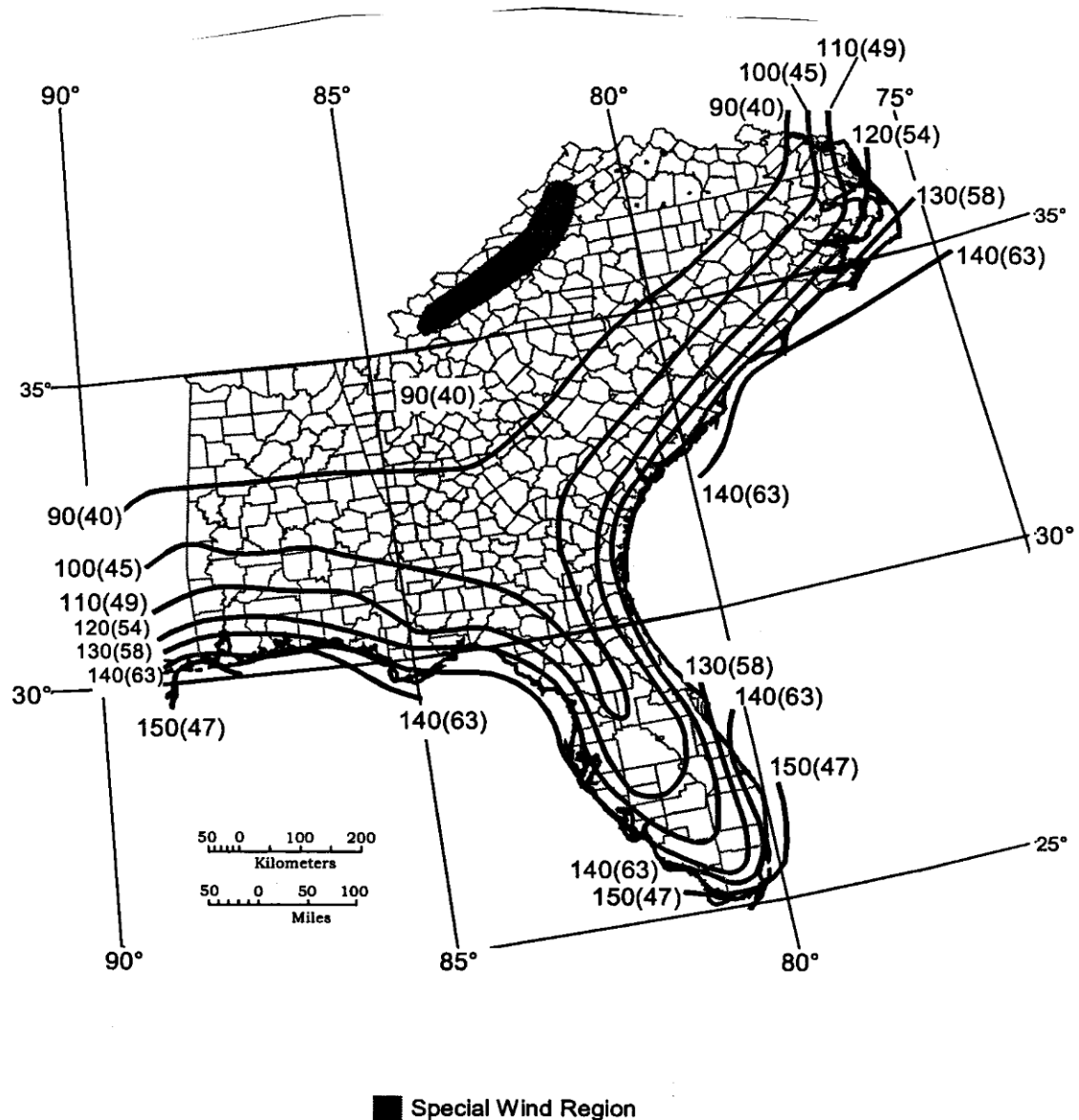
- Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33ft (10m) above ground for Exposure C category.
 2. Linear interpolation between wind contours is appropriate.
 3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
 4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions. Seek 50-yr MRI wind speed values from local building officials. As a minimum, increase the wind speed values by 10% except where minimum wind speed values are noted in Washington and Oregon

Zone 1 – Up to 100 MPH
Zone 2 – 100 - 119 MPH
Zone 3 – 120 - 129 MPH
Zone 4 – 130 MPH or Greater



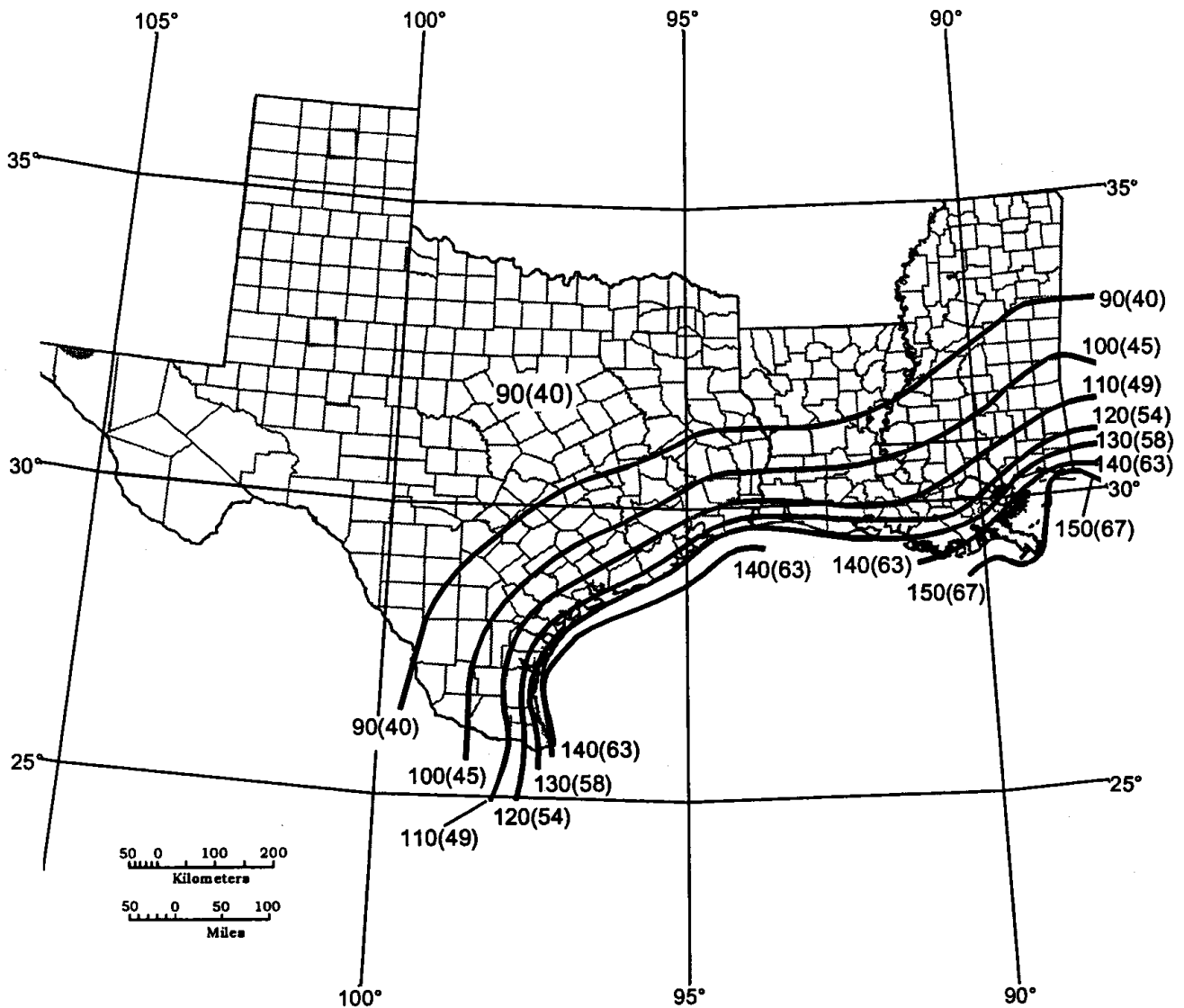
Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft. above Ground for Exposure C category.
2. Linear interpolation between wind contours is appropriate.
3. Islands and coastal areas outside the last contour shall use the wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions, Seek 50 year MRI wind speed values from local building officials. As a minimum, increase the wind speed values by 10%.



Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft. above Ground for Exposure C category.
2. Linear interpolation between wind contours is appropriate.
3. Islands and coastal areas outside the last contour shall use the wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions, Seek 50 year MRI wind speed values from local building officials. As a minimum, increase the wind speed values by 10%.

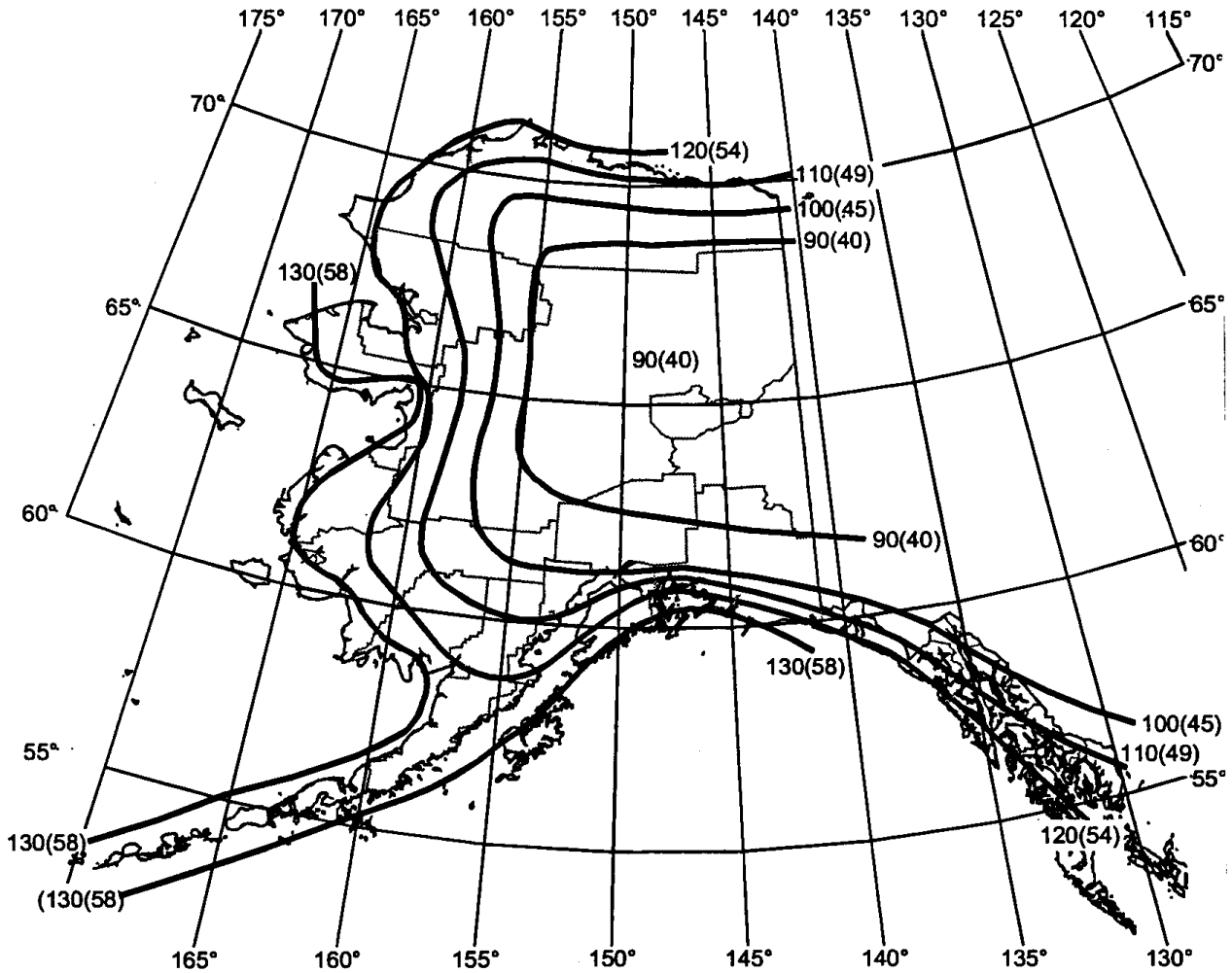


Zone 1 – Up to 100 MPH
Zone 2 – 100 - 119 MPH
Zone 3 – 120 - 129 MPH
Zone 4 – 130 MPH or greater

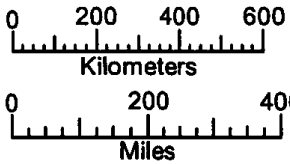
■ Special Wind Region

Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft. above Ground for Exposure C category.
2. Linear interpolation between wind contours is appropriate.
3. Islands and coastal areas outside the last contour shall use the wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions, Seek 50 year MRI wind speed values from local building officials. As a minimum, increase the wind speed values by 10%.



Zone 1 – Up to 100 MPH
Zone 2 – 100 - 119 MPH
Zone 3 – 120 - 129 MPH
Zone 4 – 130 MPH or greater



Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft. above Ground for Exposure C category.
2. Linear interpolation between wind contours is appropriate.
3. Islands and coastal areas outside the last contour shall use the wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions, Seek 50 year MRI wind speed values from local building officials. As a minimum, increase the wind speed values by 10%.



CARLISLE'S **SURE-FLEX™**

Mechanically Fastened and Adhered Roofing Systems Details

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Mechanically Fastened Roofing System

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2A	Lap Cross Section
2B	Plate and Fastener Placement
2C	Splice Intersection with 60-mil Thick Membrane
22	Ridge Membrane Attachment
27	Carlisle Insulation Attachment

Adhered Roofing System

2	Splice Intersection With 60-mil or 80-mil Thick Membrane
6	Roof Drain – Sump Greater than 3" to 1 Horizontal Foot
27A	Carlisle Insulation Attachment
27B	2" Minimum Carlisle Polyisocyanurate Insulation Attachment
27C	OSB Attachment
27D	Minimum 1-1/2" Thick Carlisle Polyisocyanurate Insulation Attachment
27E	Carlisle Insulation for Reroof/No Tearoff Projects
27F	1/4" or 1/2" thick Securock or Dens-Deck Prime

Universal

Metal Edging

1A	Carlisle SecurEdge Anchor Bar Edging
1B	Option 1 – Carlisle SecurEdge 300 Option 2 – Carlisle SecurEdge 200
1C	Metal Bar Termination
1D	Coated Metal Drip Edge
1E	PVC Coated Metal Fabrication for ES-1 Compliance

Membrane Splice

2	Lap Cross Section
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Expansion Joints

- 3A Expansion Joint Deck to Deck
- 3B Expansion Joint at Junction of Deck to Wall

Curbs

- 5A Curb Flashing
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