

EXHIBIT H
SECTION 07543
MECHANICALLY - ATTACHED
THERMOPLASTIC MEMBRANE ROOFING
FEATURING PLATES & SCREWS IN THE SEAM

PART 1 - GENERAL CONDITIONS

1.01 DESCRIPTION

A. **Scope of Work** for the **UNLV – Herman Westfall Building Re-Roof Project:**

To install a mechanically-attached 72 mil White PVC Roofing Membrane with flashings and other Manufacturer components to comprise a complete roofing system as follows:

1. Remove existing single ply roof system and all of the flashings down to the existing lightweight insulating concrete. Provide and install a new layer of $\frac{1}{2}$ " Dens Deck and a new layer of mechanically attached 72 mil PVC Roofing System.
2. Provide and Install new layer of $\frac{1}{2}$ " Dens Deck over the existing lightweight insulating concrete, Provide and install new 72 Mil PVC Membrane over new $\frac{1}{2}$ " Dens Deck and mechanically attach through to the existing metal pan/deck conforming to FM 1-75 fastening pattern and per the PVC manufacturer's standard written and detail requirements utilizing a #15 XP fastener and XPN membrane disc.
3. Flash each penetration with a cone flashing membrane per PVC manufacturer's standard written and detail requirements. Pitch pans designated by the owner, are to be removed and each penetration flashed individually.
4. Flash each mechanical curb using extender metal piece as necessary. At curbs with sheet metal pans and no units, remove metal pan and flash membrane to top of curb. Reset metal pan.
5. Flash scuppers with clad metal per PVC manufacturer's standard written and detail requirements.
6. At existing parapets, remove all flashings. Coping caps and install new membrane flashing up to the existing coping cap. Provide and install new galvanized metal extender piece at parapet transition, see manufacturer's standard details. Encapsulate walls with 72 mil PVC flashing membrane, and install new clad edge metal where required to match existing conditions.
7. Provide walk tread at roof access points and HVAC access points. Follow existing lay out of walkway. **Shall install two (2) courses wide around the entire perimeter of all mechanical equipment.**
8. Patch all T-Joints per manufacturer's standard written and detail requirements.
9. At HVAC unit, lift and flash each curb support. Replace angle plate support with stainless steel. Set attachment bolt in urethane caulking.
10. Flash heat stack per PVC manufacturer's standard detail and installation requirements.
11. Remove and dispose existing sleepers and replace with new redwood sleepers, flashing each per PVC manufacturer's standard detail and installation requirements.

B. Related Work

The work includes but is not necessarily limited to the installation of:

1. Substrate Preparation
2. Wood Blocking
3. Roof Membrane
4. Fasteners
5. Adhesive for Flashings
6. Roof Membrane Flashings
7. Walkways
8. Metal Flashings
9. Sealants
10. Separation Board

C. Upon successful completion of work the following warranties may be obtained:

1. Manufacturer's 20 Year Systems Warranty, No Dollar Limit
2. Roofing Contractor Warranty – 5 Year

1.02 QUALITY ASSURANCE

- A. This roofing system shall be applied only by a Roofing Contractor authorized by the PVC membrane manufacturer prior to bid ("Applicator"). The Roofing Contractor shall have at least 5 (five) years of documented experience as an applicator with the submitted PVC membrane manufacturer as certified by the manufacturer.
- B. Upon completion of the installation and the delivery to manufacturer by the Applicator of a certification that all work has been done in strict accordance with the contract specifications and the manufacturer's requirements, an inspection shall be made by a Technical Representative of manufacturer to review the installed roof system in the presence of the owners representative.
- C. There shall be no deviation made from the Project Specification or the approved shop drawings without prior written approval by the Owner, the Owner's Representative and the manufacturer.
- D. All work pertaining to the installation of the membrane and flashings shall only be completed by Applicator personnel trained and authorized by the manufacturer in those procedures.
- E. Membrane manufacturer to submit the consistency of formulation for the last fifteen (15) years as certified by the manufacturer.
 1. Products with Evaloy or KEE additives will not be accepted or reviewed
- F. Periodic in-progress inspections shall be performed for the duration of this project. The inspections shall be performed by a Technical Representative of the Roofing Manufacturer or the Owner's Representative.
- G. Track Record – Install only PVC Roof Systems from manufacturer's able to demonstrate the product on 5 existing functional roofs =>15 Year old roofs with the same membrane formulation in locations in a similar geographical area with substantially similar environmental conditions, including, but not limited to, extreme heat, heavy rains, exposure, temperature, gradient and other desert conditions.
- H. Use only a Manufacturer who has initiated a post consumer recycling program and can demonstrate a minimum of five projects where the existing PVC roof has been removed and recycled into new roofing membrane and/or PVC components.

1.03 SUBMITTALS

A. Submittals with bid shall include the following:

1. A list of each primary component to be used in the roof system and the Manufacturer's current literature for each component.
2. Sample copy of Roofing Manufacturer's warranty.
3. Sample copy of Contractor's warranty.
4. Letter from Roofing Manufacturer confirming that the Contractor is an authorized applicator of the specified roof system and that the manufacturer will sign the UNLV 20 System Warranty.
5. Letter from the submitted PVC membrane manufacturer documenting the contractor's five (5) years of experience installing the proposed PVC membrane, manufacturer's membrane.
6. Material Safety Data Sheets.

1.04 CODE REQUIREMENTS

The applicator shall submit evidence that the proposed roof system meets the requirements of the local building code and has been tested and approved or listed by the following test organizations. These requirements are minimum standards and no roofing work shall commence without written documentation of the system's compliance, as required in the "Submittals" section of this specification.

A. Factory Mutual Research Corporation (FM) - Norwood, MA

1. Class 1-75 (Attachment Criteria)

B. Underwriters Laboratories, Inc. - Northbrook, IL

1. Class A assembly

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All products delivered to the job site shall be in the original unopened containers or wrappings bearing all seals and approvals.

B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

C. Membrane rolls shall be stored lying down on pallets and fully protected from the weather with clean canvas tarpaulins. Unvented polyethylene tarpaulins are not accepted due to the accumulation of moisture beneath the tarpaulin in certain weather conditions that may affect the ease of membrane weldability.

D. All adhesives shall be stored at temperatures between 40° F (5° C) and 80° F (27° C).

E. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.

F. All materials which are determined to be damaged by the Owner's Representative or the manufacturer are to be removed from the job site and replaced at no cost to the Owner.

1.06 JOB CONDITIONS

- A. Membrane materials may be installed under certain adverse weather conditions but only after consultation with the manufacturer, as installation time and system integrity may be affected.
- B. Only as much of the new roofing as can be made weather-tight each day, including all flashing and detail work, shall be installed. All seams shall be cleaned and heat welded before leaving the job site that day.
- C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather. The existing building and its contents shall be protected against all risks.
- D. All surfaces to receive new insulation, membrane or flashings shall be dry. Should surface moisture occur, the Applicator shall provide the necessary equipment to dry the surface prior to the application.
- E. All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof or equipment damage.
- F. Uninterrupted waterstops shall be installed at the end of each day's work and shall be completely removed before proceeding with the next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with the finished roof as the installation progresses. Contaminated membrane shall be replaced at no cost to the Owner.
- G. The Applicator is cautioned that certain membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. Such materials shall not remain in contact with the membranes. The Applicator shall consult the manufacturer regarding compatibility, precautions and recommendations.
- H. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. A substantial protection layer consisting of plywood over felt or plywood over insulation board shall be provided for all new and existing roof areas that receive rooftop traffic during construction.
- I. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.
- J. The Applicator shall follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction.
- K. All roofing, insulation, flashings and metal work removed during construction shall be immediately taken off site to a legal dumping area authorized to receive such materials. Hazardous materials, such as materials containing asbestos, are to be removed and disposed of in strict accordance with applicable City, State and Federal requirements.
- L. All new roofing waste material (i.e., scrap roof membrane, empty cans of adhesive) shall be immediately removed from the site by the Applicator and properly transported to a legal dumping area authorized to receive such material.
- M. The Applicator shall take precautions that storage and/or application of materials and/or equipment does not overload the roof deck or building structure.
- N. Flammable adhesives and deck primers shall not be stored and not be used in the vicinity of open flames, sparks and excessive heat.
- O. All rooftop contamination that is anticipated or that is occurring shall be reported to the manufacturer to determine the corrective steps to be taken.

- P. The Applicator shall verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages in writing (letter copy to the manufacturer) to the Owner's Representative for corrective action prior to installation of the roof system.
- Q. Applicator shall immediately stop work if any unusual or concealed condition is discovered and shall immediately notify Owner of such condition in writing for correction at the Owner's expense (letter copy to the manufacturer).
- R. Site cleanup, including both interior and exterior building areas that have been affected by construction, shall be completed to the Owner's satisfaction.
- S. All landscaped areas damaged by construction activities shall be repaired at no cost to the Owner.
- T. The Applicator shall conduct fastener pullout tests in accordance with the latest revision of the SPRI/ANSI Fastener Pullout Standard to help verify condition of deck/substrate and to confirm expected pullout values.
- U. The adhered membrane shall not be installed under the following conditions without consulting the manufacturer's technical department for precautionary steps:
 - 1. The roof assembly permits interior air to pressurize the membrane underside.
 - 2. Any exterior wall has 10% or more of the surface area comprised of opening doors or windows.
 - 3. The wall/deck intersection permits air entry into the wall flashing area.
- V. Precautions shall be taken when using adhesives at or near rooftop vents or air intakes. Adhesive odors could enter the building. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.
- W. Protective wear shall be worn when using solvents or adhesives or as required by job conditions.
- X. Aesthetics and Performance are equally important. The owner's representative will require that all flashings, details, and hand welding work shall be uniform and consistent throughout the entire project. Giving the appearance that one individual performed all of the work. Any sub-standard work will be immediately corrected to the satisfaction of the Owner's Representative.

1.07 WARRANTIES

- A. State of Nevada, University of Nevada Las Vegas (UNLV) 20 Year System Warranty (only products purchased from the manufacturer are covered under System Warranty). All products needed for a complete installation shall be purchased from the membrane manufacturer, proof of purchase of all roofing products used on the project will be required by the owners representative.

Upon successful completion of the work to the Roofing Manufacturer's and Owner's satisfaction, and receipt of final payment, the twenty (20) Year Systems Warranty shall be issued. The Standard Warranty shall provide for the roof membrane, all accessories that comprise a roof system, and contractor labor. The Warranty shall be Non-Prorated, provide for No Dollar Limit (NDL), and **shall not exclude ponding water and no time limited shall be assigned for any such ponding water during the warranty period.**

B. Applicator/Roofing Contractor 5 Year Warranty

The Applicator shall supply the Owner with a separate five-year workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator warranty term, defective or otherwise not in accordance with the Contract Documents, the Applicator shall repair that defect at no cost to the Owner. The Applicator's warranty obligation shall run directly to the Owner, and a copy shall be sent to the manufacturer. **The contractor shall respond to a reported warranty roof leak with-in 24 hours of notification. Failure of the awarded installer to respond and make permanent repairs with in the 24 hour period, shall give the owner the right to make the necessary permanent repairs either in house or by another approved contractor.** Regardless of who makes the permanent repairs it will be the awarded contractor's responsibility to pay the financial cost of the repairs to the entity that made the permanent repairs. **The contractor's warranty shall cover any damages to the interior contents of the building that are a direct result of water infiltration in to the building from a roof leak.**

C. Owner Responsibility

Owner shall notify both the manufacturer and the Applicator of any leaks as they occur during the time period when both warranties are in effect.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The components/basis of design of the specified PVC mechanically-attached roof system are to be products approved PVC membrane as indicated on the Detail Drawings and specified in the Contract Documents or approved equal.
- B. Components to be used that are other than those supplied or manufactured by the approved PVC membrane manufacturer may be submitted for review and acceptance by PVC manufacturer. PVC Manufacturer's acceptance of any other product is only for a determination of compatibility with PVC products and not for inclusion in the manufacturer's warranty. The specifications, installation instructions, limitations, and/or restrictions of the respective manufacturers must be reviewed by the Owner's Representative for acceptability for the intended use with PVC manufacturer's products.
- C. Membrane shall be certified by the PVC manufacturer to be with three (3) mils of the specified membrane thickness as stated in this section. ASTM minimum standards of +/-10% will not be accepted.
- D. **Membrane shall have a minimum of thirty-four (34) mils of waterproofing polymers above the reinforcements as documented by a third party source.**

2.02 MEMBRANE

- A. Basis of Design - Sika Sarnafil® S327 polyester reinforced membrane with a factory-applied, integral lacquer coating to repel dirt and sustain reflectivity.
- B. Membrane shall conform to ASTM D4434-96 (or latest revision), "Standard for Polyvinyl Chloride Sheet Roofing," Classification: Type III.
 1. Sika Sarnafil S327, 72 mil, thermoplastic membrane with polyester reinforcement.
 2. Flex™ MF/R 72 mil, PVC thermoplastic membrane with polyester reinforcement.

C. Color of Membrane

1. EnergySmart (white), initial reflectivity of 0.83, initial emissivity 0.90, solar reflective index (SRI) of >104.

D. Typical Physical Properties

<u>Parameters</u>	<u>ASTM Test Method</u>	<u>Minimum ASTM Requirement</u>	<u>Sarnafil Typical Physical Properties</u>
Reinforcing Material	-		Polyester
Overall Thickness, min., inches (mm)	D751	0.045	[0.072 inches]
Breaking Strength, min., lbf/in. (KN/m)	D751	200 (35.0)	230 (40.0)
Elongation at Break, min.	D751	15%	20%
Seam strength*, min. (% of breaking strength)	D751	75	85
Retention of Properties After Heat Aging	D3045	-	-
Breaking Strength, min., (% of original)	D751	90	95
Elongation, min., (% of original)	D751	90	90
Tearing Strength, min., lbf (N)	D1004	45.0 (200)	50 (220)
Low Temperature Bend, -40°F (-40°C)	D2136	Pass	Pass
Accelerated Weathering Test (Xenson Arc)	D2565	5,000 Hours	10,000 Hours
Cracking (7x magnification)	-	None	None
Discoloration (by observation)	-	Negligible	Negligible
Crazing (7 x magnification)	-	None	None
Linear Dimensional Change	D1204	0.5% max.	0.1%
Weight Change After Immersion in Water	D570	± 3.0% max.	2.5%
Static Puncture Resistance, 33 lbf (15 kg)	D5602	Pass	Pass
Dynamic Puncture Resistance, 14.7 ft-lbf (20 J)	D5635	Pass	Pass

*Failure occurs through membrane rupture not seam failure. Physical Properties shown are prior to applying feltbacked, if specified.

2.03 FLASHING MATERIALS

A. Wall/Curb Flashing

1. Adhered Flashing Membrane

A fiberglass reinforced membrane adhered to approved substrate using adhesive.

2. Mechanically Attached Flashing Membrane

A polyester reinforced membrane used for mechanically-attached flashings to approved substrate using Disc.

3. Clad

A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad is a 25 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported membrane laminated on one side.

B. Perimeter Edge Flashing

1. Clad

A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad is a 25 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported membrane laminated on one side.

2. Non-Typical Edge

Project-specific perimeter edge detail reviewed and accepted for one-time use by the manufacturer's Technical Department. Consult Regional Technical Manager prior to job start for review and consideration for acceptance.

C. Miscellaneous Flashing

1. Reglet

A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs. Reglet is produced from 6063-T5, 0.10 inch - 0.12 inch (2.5 mm - 3.0 mm) thick extruded aluminum. Reglet has a 2½ inch (57 mm) deep profile, and is provided in 10 foot (3 m) lengths. Use prefabricated Reglet mitered inside and outside corners where walls intersect.

2. Stack

A prefabricated vent pipe flashing made from 0.048 inch (48 mil/1.2 mm) thick G410 membrane.

3. Circle-"G"

Circular 0.048 inch (48 mil/1.2 mm) thick G410 membrane patch welded over T-joints formed by overlapping thick membranes. **T-Joint patches are required.**

4. Corner

Prefabricated outside and inside flashing corners made of 0.060 inch (60 mil/1.5 mm) thick membrane that are heat-welded to membrane or clad base flashings.

5. Multi-Purpose Sealant

A sealant used at flashing terminations.

6. Flashing Adhesive

A solvent-based reactivating-type adhesive used to attach membrane to flashing substrate.

7. Felt

A non-woven polyester or polypropylene mat cushion layer that is necessary behind PVC Flashing Membrane when the flashing substrates are rough-surfaced or incompatible with the flashing membrane.

2.04 SEPARATION AND INSULATION BOARD

A. Dens-Deck – (1/2" minimum)

A siliconized gypsum, fire-tested hardboard with glass-mat facers. Dens-Deck is provided in a 4 ft x 8 ft (1.2 m x 2.4 m) board size and in thicknesses. Use ¼" board on horizontal application.

B. Tapered Rigid Insulation (if required)

Rigid isocyanurate foam insulation with black mat facer.

2.05 ATTACHMENT COMPONENTS

A. Insulation plate – Insulation/recovery board attachment

Used with various Fasteners to attach insulation boards to roof deck. Plate is a 3 inch (75 mm) square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating.

B. Insulation Fastener #12 – Insulation/recovery board attachment

A #12 corrosion-resistant fastener used with Plates to attach insulation boards to steel or wood roof decks. Fastener #12 has a modified buttress thread, a shank diameter of approximately 0.168 inch (4 mm) and a thread diameter of approximately 0.214 inch (5 mm). The driving head has a diameter of approximately 0.435 inch (11 mm) with a #3 Phillips recess for positive engagement.

D. Membrane Fastener XP – Membrane Attachment

A specially designed, heavy duty, corrosion resistant fastener used with a Sarnadisc XPN to attach S327 membrane to roof decks. Fastener-XP has a shank diameter of approximately 0.21 inch (5.3 mm) and the thread diameter is approximately 0.26 inch (6.6 mm). The driving head has a diameter of approximately 0.435 inch (11 mm) with a #3 Phillips recess for positive engagement.

E. Membrane Disc XPN – Membrane Attachment

A high strength plate used with the XP Fastener to attach PVC membrane to 22-24 gauge steel deck and ½-5/8 wood roof decks. The XPN disc is an 18 gauge, oblong corrosion resistant steel plate.

2.06 WALKWAY PROTECTION

A. Walk-Tred (color: Light Gray)

A polyester reinforced, 0.096 inch (96 mil/2.4 mm), weldable membrane with surface embossment. Used as a protection layer from rooftop traffic. Tread is supplied in rolls of 39.3 inches (1.0 m) wide and 32.8 feet (10 m) long.

2.07 MISCELLANEOUS ACCESSORIES

A. Aluminum Tape

A 2 inch (50 mm) wide pressure-sensitive aluminum tape used as a separation layer between small areas of asphalt contamination and the membrane and as a bond-breaker under the coverstrip at Clad joints.

2.08 MISCELLANEOUS FASTENERS AND ANCHORS

A. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors shall have a minimum embedment of 1¼ inch (32 mm) and shall be approved for such use by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch (25 mm) and shall be approved for such use by the fastener manufacturer.

2.09 RELATED MATERIALS

A. Wood Nailer

Treated wood nailers shall be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on Project Drawings. Thickness of nailers must match the insulation thickness to achieve a smooth transition. Wood nailers shall be treated for fire and rot resistance (wolmanized or osmose treated) and be #2 quality or better lumber. Creosote or asphalt-treated wood is not acceptable. Wood nailers shall conform to Factory Mutual Loss Prevention Data Sheet 1-49. All wood shall have a maximum moisture content of 19% by weight on a dry-weight basis.

B. Plywood

When bonding directly to plywood, a minimum $\frac{1}{2}$ inch (12 mm) CDX (C side out), smooth-surfaced exterior grade plywood with exterior grade glue shall be used. Rough-surfaced plywood or high fastener heads will require the use of Felt behind the flashing membrane. Plywood shall have a maximum moisture content of 19% by weight on a dry weight basis.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. The Applicator, Owner's Representative/Designer and Manufacturer(s) shall attend a pre-construction conference.
- B. The meeting shall discuss all aspects of the project including but not limited to:
 - 1. Safety
 - 2. Set up
 - 3. Construction schedule
 - 4. Contract conditions
 - 5. Coordination of the work

3.02 SUBSTRATE CONDITION

- A. Applicator shall be responsible for acceptance or provision of proper substrate to receive new roofing materials.
- B. Applicator shall verify that the work done under related sections meets the following conditions:
 - 1. Roof drains and/or scuppers have been reconditioned and/or replaced and installed properly.
 - 2. Roof curbs, nailers, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.
 - 3. All surfaces are smooth and free of dirt, debris and incompatible materials.
 - 4. All roof surfaces shall be free of water, ice and snow.

3.03 SUBSTRATE PREPARATION

The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. The Applicator shall load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight. The Owner's Representative shall ensure that the roof deck is secured to the structural framing according to local building code and in such a manner as to resist all anticipated wind loads in that location.

A. Re-Roofing with removal of existing Single Ply Roof System

All existing roofing, base flashing, deteriorated wood blocking or deteriorated metal flashings shall be removed. Remove only that amount of roofing and flashing which can be made watertight with new materials during a one-day period or before the onset of inclement weather.

1. Existing Substrate:

- a. The roof deck shall be smooth, even free of dust, dirt, excess moisture or oil and be structurally sound. Sharp ridges, other projection and accumulations of bitumen above the surface shall be removed to ensure a smooth surface before roofing. All deteriorated decking shall be brought to the attention of the owner to determine the method of treatment or replacement. Deck type shall match existing and the attachment shall conform to local code requirements.

3.04 SUBSTRATE INSPECTION

- A. A dry, clean and smooth substrate shall be prepared to receive the mechanically-attached roof system.
- B. The Applicator shall inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.
- C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.
- D. All roof surfaces shall be free of water, ice and snow.
- E. Membrane shall be applied over compatible and accepted substrates only.

3.05 WOOD NAILER INSTALLATION (if required)

- A. Install continuous wood nailers at the perimeter of the entire roof and around roof projections and penetrations as shown on the Detail Drawings.
- B. Nailers shall be anchored to resist a minimum force of 300 pounds per lineal foot (4,500 Newtons/lineal meter) in any direction. Individual nailer lengths shall not be less than 3 feet (0.9 meter) long. Nailer fastener spacing shall be at 12 inches (0.3 m) on center or 16 inches (0.4 m) on center if necessary to match the structural framing. Fasteners shall be staggered 1/3 the nailer width and installed within 6 inches (0.15 m) of each end. Two fasteners shall be installed at ends of nailer lengths. Nailer attachment shall meet this requirement and that of the current Factory Mutual Loss Prevention Data Sheet 1-49.
- C. Thickness shall be as required to match substrate or insulation height to allow a smooth transition.
- D. Any existing nailer woodwork which is to remain shall be firmly anchored in place to resist a minimum force of 300 pounds per lineal foot (4,500 Newtons/lineal meter) in any direction and shall be free of rot, excess moisture or deterioration. Only woodwork shown to be reused in Detail Drawings shall be left in place. All other nailer woodwork shall be removed.

3.06 SEPARATION/INSULATION BOARD INSTALLATION

General Criteria:

- A. Separation Board shall be installed according to insulation manufacturer's instructions.
- B. Separation Board shall be neatly cut to fit around penetrations and projections.
- C. Install tapered insulation in accordance with insulation manufacturer's shop drawings.

- D. Install tapered insulation around drains creating a drain sump.
- E. Do not install more insulation board than can be covered with membrane by the end of the day or the onset of inclement weather.
- F. Use at least 2 layers of insulation when the total insulation thickness exceeds 2½ inches (64 mm). Stagger joints at least 12 inches (0.3 m) between layers.
- G. Mechanical Attachment
 - 1. Separation Board shall be mechanically fastened to the deck with approved fasteners and plates at a rate according to the separation board manufacturer's, FM's and the membrane manufacturer recommendations for fastening rates and patterns. The quantity and locations of the fasteners and plates shall also cause the insulation boards to rest evenly on the roof deck/substrate so that there are no significant and avoidable air spaces between the boards and the substrate. Each insulation board shall be installed tightly against the adjacent boards on all sides.
 - 2. Fasteners are to be installed consistently in accordance with fastener manufacturer's recommendations. Fasteners are to have minimum penetration into structural deck recommended by the fastener and membrane manufacturers.
 - 3. Use fastener tools with a depth locator and torque-limiting attachment as recommended or supplied by fastener manufacturer to ensure proper installation.

3.07 INSTALLATION OF PVC MEMBRANE

The surface of the insulation or substrate shall be inspected prior to installation of the roof membrane. The substrate shall be clean, dry, free from debris and smooth with no surface roughness or contamination. Broken, delaminated, wet or damaged insulation boards shall be removed and replaced.

- A. General
 - 1. PVC membrane is to be attached with Fasteners and Disc according to the manufacturer and Factory Mutual's requirements.
 - 2. Membrane overlaps shall be shingled with the flow of water where possible.
 - 3. Membrane full-width (120 inch) rolls shall be fastened perpendicular to the direction of the steel deck flutes, wood plank, precast or cementitious wood fiber panel where possible.
 - 4. **Tack welding of PVC full or half-width rolls for purposes of temporary restraint during installation is not permitted.** Consult Manufacturer's Technical Department for further information.

B. Perimeter and Corner Areas

1. Over the properly installed and prepared substrate surface, PVC half-width (60 inches) rolls are to be installed parallel with the entire perimeter edge. The number of adjacent half-rolls will be determined by building height and width and other conditions according to FM guidelines and Technical requirements. Fasteners and Discs are installed along the edge of the membrane on the fastening line at a spacing determined by the manufacturer and the Owner's Representative/Designer. Discs are held-back 1 inch (25 mm) from the outer edge of the membrane. The adjacent half-roll is positioned to overlap the fastened edge of the first half-roll by 5-1/2 inches (140 mm) in accordance with the overlap lines marked on its edge. The 5-1/2 inch (140 mm) overlap will allow the top membrane to extend 2-1/2 inches (63 mm) past the Discs for heat-welding. Fasteners shall clamp the PVC membrane tightly to the substrate. In corner areas where perimeter half-rolls intersect, add rows of Fasteners and Discs over the top the half-rolls and weld a (PVC) coverstrip above them for watertightness. See Detail Drawings.

Notes:

- a) Perimeter area is defined as the outer boundary of the roof. If the roof is broken into different levels, each roof area shall be treated as an individual roof with its outer boundary being treated as a perimeter. Typically, internal expansion joints and firewalls are not considered to be full perimeters. Refer to Factory Mutual's Data Sheet 1-28 for more information.
- b) The ridge area is defined as the high point in the roof area formed by two intersecting planes. When the sum of the slopes is a minimum of 4 inches in 12 inches (30 degrees), each side of the ridge shall be treated as a perimeter area.

2. **Hot-air weld overlaps according to manufacturer's requirements. Seam test cuts shall be taken at least 3 times per day.**

C. Interior Area

1. Over the properly installed and prepared substrate surface, PVC full-width (78-5/8 inches or 2 meter) rolls are to be installed perpendicular to the steel deck flutes, wood plank or wood or concrete panels. Fasteners and Discs are installed along the edge of the membrane on the fastening line at a spacing determined by the manufacturer and the Owner's Representative/Designer. Discs are held-back 1 inch (25 mm) from the outer edge of the membrane. The adjacent full-roll is positioned to overlap the fastened edge of the first full-roll by 5-1/2 inches (140 mm) in accordance with the overlap lines marked on its edge. The 5-1/2 inch (140 mm) overlap will allow the top membrane to extend 2-1/2 inches (63 mm) past the discs for heat-welding. Fasteners shall clamp the PVC membrane tightly to the substrate. See Detail Drawings.
2. **Hot-air weld overlaps according to PVC Manufacturer's recommendations. Seam test cuts shall be taken at least 3 times per day.**

D. Securement Around Rooftop Penetrations

1. Around all perimeters, at the base of walls, drains, curbs, vent pipes, or any other roof penetrations, Fasteners and Discs shall be installed according to perimeter rate of attachment. Fasteners shall be installed according to the manufacturer's instructions. Fasteners shall be installed using the fastener manufacturer's recommended torque-sensitive fastening tools with depth locators. Fasteners shall clamp the membrane tightly to the substrate.
2. Membrane flashings shall extend 2-1/2 inches (63 mm) past the Discs and be hot-air welded to the deck membrane.

3.08 HOT-AIR WELDING OF SEAM OVERLAPS

A. General

1. All seams shall be hot-air welded. Seam overlaps should be 3 inches (75 mm) wide when automatic machine-welding and 4 inches (100 mm) wide when hand-welding, except for certain details.
2. Welding equipment shall be provided by or approved by the manufacturer. All mechanics intending to use the equipment shall have successfully completed a training course provided by a manufacturer's Technical Representative prior to welding.
3. All membrane to be welded shall be clean and dry.

B. Hand-Welding

Hand-welded seams shall be completed in two stages. Hot-air welding equipment shall be allowed to warm up for at least one minute prior to welding.

1. The back edge of the seam shall be welded with a narrow but continuous weld to prevent loss of hot air during the final welding.
2. The nozzle shall be inserted into the seam at a 45 degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to "flow," the hand roller is positioned perpendicular to the nozzle and pressed lightly. For straight seams, the 1½ inch (40 mm) wide nozzle is recommended for use. For corners and compound connections, the ¾ inch (20 mm) wide nozzle shall be used.

C. Machine Welding

1. Machine welded seams are achieved by the use of automatic welding equipment. When using this equipment, instructions shall be followed and local codes for electric supply, grounding and over current protection observed. Dedicated circuit house power or a dedicated portable generator is recommended. No other equipment shall be operated off the generator.
2. Metal tracks may be used over the deck membrane and under the machine welder to minimize or eliminate wrinkles.

D. Quality Control of Welded Seams

1. The Applicator shall check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark gray material from the underside of the top membrane. On-site evaluation of welded seams shall be made daily by the Applicator to locations as directed by the Owner's Representative or the manufacturer's representative. One inch (25 mm) wide cross-section samples of welded seams shall be taken at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.

3.09 MEMBRANE FLASHINGS

- A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:
 1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
 2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - latest issue.

- B. Metal, other than that provided by the manufacturer, is not covered under the warranty.
- C. Complete all metal work in conjunction with roofing and flashings so that a watertight condition exists daily.
- D. Metal shall be installed to provide adequate resistance to bending to allow for normal thermal expansion and contraction.
- E. Metal joints shall be watertight.
- F. Metal flashings shall be securely fastened into solid wood blocking. Fasteners shall penetrate the wood nailing a minimum of 1 inch (25 mm).
- H. Airtight and continuous metal hook strips are required behind metal fascias. Hook strips are to be fastened 12 inches (0.3 m) on center into the wood nailing or masonry wall.
- I. Counter flashings shall overlap base flashings at least 4 inches (100 mm).
- J. Hook strips shall extend past wood nailers over wall surfaces by 1½ inch (38 mm) minimum and shall be securely sealed from air entry.

3.10 WALKWAY INSTALLATION

A. Tread Walkway

Roofing membrane to receive Tread Walkway shall be clean and dry. Place chalk lines on deck sheet to indicate location of Walkway. Apply a continuous coat of approved adhesive to the deck sheet and the back of Walkway in accordance with technical requirements and press Walkway into place with a water-filled, foam-covered lawn roller. Clean the deck membrane in areas to be welded. Hot-air weld the entire perimeter of the Walkway to the membrane deck sheet. Check all welds with a rounded screwdriver. Reweld any inconsistencies. **Important:** Check all existing deck membrane seams that are to be covered by Walkway with rounded screwdriver and reweld any inconsistencies before Walkway installation. Do not run Walkway over Bars.

3.11 TEMPORARY CUT-OFF

All flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. All temporary waterstops shall be constructed to provide a 100% watertight seal. The stagger of the insulation joints shall be made even by installing partial panels of insulation. The new membrane shall be carried into the waterstop. The waterstop shall be sealed to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. The edge of the membrane shall be sealed in a continuous heavy application of sealant as described in Section 2.10. When work resumes, the contaminated membrane shall be cut out. All sealant, contaminated membrane, insulation fillers, etc. shall be removed from the work area and properly disposed of off site. None of these materials shall be used in the new work.

If inclement weather occurs while a temporary waterstop is in place, the Applicator shall provide the labor necessary to monitor the situation to maintain a watertight condition.

If any water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Applicator's expense.

3.12 COMPLETION

Prior to demobilization from the site, the work shall be reviewed by the Owner's Representative and the Applicator. All defects noted and non-compliances with the Specifications or the recommendations of the manufacturer shall be itemized in a punch list. These items must be corrected immediately by the Applicator to the satisfaction of the Owner's Representative and the manufacturer prior to demobilization.

All Warranties referenced in this Specification shall have been submitted and have been accepted at time of contract award.

END OF SECTION