

SECTION 07221 – ROOF INSULATION:

PART 1 – GENERAL

1 .1 SECTION INCLUDES: Furnish and install tapered roof insulation ($\frac{1}{8}$ " per ft. slope at full taper areas, $\frac{1}{2}$ " per ft. slope at cricket areas as shown on roof plans), with an overlay insulation board of $\frac{1}{2}$ " Dens-Deck[®] Prime over top of tapered and/or flat polyisocyanurate roof insulation, in accordance with manufacturer's recommendations.

A. General Requirements:

1. Flat and tapered insulation types and overly insulation board shall be supplied by roofing material manufacturer.
2. Insulation shall be approved by Factory Mutual and Underwriters Laboratories for use as a roofing insulation.
3. Minimum LTTR aged R-Value of polyisocyanurate only: R-6 per inch.
4. Minimum aged R-Value of $\frac{1}{2}$ " Dens-Deck[®]: R-.56.
5. Minimum Thickness: One and one-half ($1\frac{1}{2}$ ") inches at beginning of drain sump (at full taper areas).

PART 2 – PRODUCTS

2 .1 FLAT POLYISOCYANURATE ROOF INSULATION BOARD: Newton Middle School - Sections I & L; Littleton High School - Sections P, U, V, W, X, Y, Z & Z1; (**two layers of 1.5" polyisocyanurate**).

A. Flat Polyisocyanurate with Heavy Duty Facer

1. ASTM C 1289, Type II, Class 1 Standard Specification for Polyurethane and Polyisocyanurate Roof Insulation.
2. Thickness: 1.5". Flat polyisocyanurate insulation panels are to be two layers of 1.5" x 48" x 48" in size.
3. Maximum Thickness: 1.5". Each layer of flat polyisocyanurate roof insulation is to be **no** thicker than 1.5" thick.
4. Manufacturers:
 - a. Sarnafil - Sarnatherm Insulation - in 4 ft x 4 ft and specified thickness.
 - b. FiberTite - FTR Value Insulation - in 4 ft x 4 ft and specified thickness.

2 .2 FLAT POLYISOCYANURATE ROOF INSULATION BOARD: Newton Middle School - Section E; Littleton High School - Sections B & E; (**one layer of 3" polyisocyanurate**).

A. Flat Polyisocyanurate with Heavy Duty Facer

1. ASTM C 1289, Type II, Class 1 Standard Specification for Polyurethane and Polyisocyanurate Roof Insulation.

SECTION 07541 - ADHERED THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Scope - To install an adhered thermoplastic roofing membrane with flashings and other components to comprise a roofing system.
- B. Related Work - The work includes but is not necessarily limited to the installation of:
 - 1. Removal of Existing Roofing and Insulation
 - 2. Substrate Preparation
 - 3. Roof Drains
 - 4. Wood Blocking
 - 5. Insulation
 - 6. Roof Membrane
 - 7. Fasteners
 - 8. Adhesive for Flashings
 - 9. Roof Membrane Flashings
 - 10. Walkways
 - 11. Metal Flashings
 - 12. Sealants
- C. Upon successful completion of work the following warranties will be obtained:
 - 1. Manufacturer Warranty
 - 2. Roofing Contractor Warranty

1.2 RELATED SECTIONS

- A. Alterations project procedures – Division One.
- B. Wood nailers, wood/metal cementitious roof deck renovation – Section 02072.
- C. Metal flashing and other sheet metal items – Section 07620.
- D. Roof accessories – Section 07720.

1.3 ALTERNATES

- A. Alternates that may be contemplated/required for this project will comply with procedures specified in Division One.

1.4 QUALITY ASSURANCE

- A. This roofing system shall be applied only by a Roofing Contractor authorized by the roof Manufacturer prior to bid ("Applicator").
- B. A single applicator with a minimum of 5 years previous successful experience in installation of similar systems.
- C. Shall maintain a permanent office within 65 miles distance of project site to

satisfy Owner that projects can be properly serviced during guaranty phase.

- D. Upon completion of the installation and the delivery to the 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 the manufacturer to review the installed roof system.
- E. 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.
- F. All work pertaining to the installation of the manufacturer membrane and flashings shall only be completed by Applicator personnel trained and authorized by the manufacturer in those procedures.
- G. Pre-Installation Conference:
 - 1. Prior to installation of roofing system, conduct a Pre-Installation conference at the project site.
 - 2. Attendance: Owner, Roofing Consultant, Contractor, project superintendent, **project foreperson**, and **Roof Manufacturer's Technical Representative**. Allow 14 days notice to manufacturer for scheduling of their representative.
 - 3. Agenda: Refer to Division One requirements.
- H. Daily Job Reports
 - 1. Contractor is responsible for providing daily job reports which will include a minimum of the following information: Crew size, weather conditions, description of work completed, date, change order items, job problems, etc. **Contractor will turn in daily job reports weekly at the weekly project site meeting! Provide 2 copies.**

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit six (6) copies of drawing indicating roof size, location and type of penetrations, perimeter and penetration details. Indicate complete installation details of roofing and flashing, including roof slopes, flashing details, penetration details and accessories. Technical acceptance from the manufacturer.
 - 2. Sheet metal shop drawings: Submit six (6) copies of sheet metal shop drawings showing size, layout and location of all sheet metal items.
 - 3. Submit two (2) copies of MSDS data **directly to the owner** for their files, on all roofing, insulation, adhesive and other related materials.
 - 4. Submit three (3) 12" x 12" samples of thermoplastic roof membrane to be used, taken from rolls on the roof. Provide "Lot Numbers" from roll goods taken from rolls on the roof.

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- B. Product Data: Submit four (4) copies of latest edition of manufacturer's roofing and flashing specifications, including list of materials proposed for use, and manufacturer's data sheets for other products.
 - C. Progress Schedule Plan:
 - 1. Submit a complete progress schedule and phasing plan indicating complete sequence of removal and replacement of roofing for each area.
 - 2. Include roof plan with layout indicating amount of roof area included in each day's work.
 - 3. Indicate dates for beginning and completing each activity.
 - 4. Identify other related work affecting roof replacement and phasing.
 - D. Guaranty: Submit specimen copy of contractor **and** manufacturer's roofing warranty (that complies with guaranty requirements as listed in paragraph 1.10 below), with Product Data submittal, **including** evidence of application for warranty.
 - E. Manufacturer's Review: Concurrent with Shop Drawing submittal; submit (in writing) roof manufacturer's review and acceptance of Contract Documents (plans, specifications, application requirements, etc.) and approval of applicator. Certifications by manufacturers of roofing and insulating materials that all materials supplied comply with all requirements of the identified ASTM and industry standards or practices.
 - F. Certification from the Applicator that the system specified meets all identified code and insurance requirements as required by the Specification.
 - G. Maintenance Data: Compile and submit maintenance instructions in accordance with Division One. Include complete manufacturer's instructions for periodic inspection and maintenance of roofing system, including precautions and warnings to prevent damage and deterioration to roofing system.
- 1.6 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 1-90 (for high wind exposure)
 - B. Underwriters Laboratories, Inc. - Northbrook, IL
 - 1. Class A assembly
 - C. Littleton Building Department.
 - D. Uniform Building Code (latest edition).
- 1.7 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.

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- B. Handle all materials to prevent damage. A maximum of one (1) weeks worth of roof insulation and roll goods may be stored on the roof, as long as materials are on raised platforms (pallets), roof structure is **not** overloaded, and materials are covered with watertight tarpaulins. **Visqueen is not an acceptable** watertight material for protecting roof materials.
- C. Materials loaded on roof levels for immediate (within one week) use shall be:
 - 1. Distributed to prevent concentrated loads that would impose excessive strain on deck or structural members.
 - 2. Positively secured to prevent displacement by excessive wind forces.
- D. 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.
- E. Provide continuous protection of materials against wetting and absorption; site. All materials which are determined to be damaged (i.e. wet materials and marked materials that have been wet) by the Owner's Representative or the manufacturer are to be removed from the job site and replaced at no cost to the Owner.
- F. All adhesives shall be stored at temperatures between 40° F and 80° F.
- G. 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.

1.8 JOB CONDITIONS

- A. Existing Conditions: Examine existing building and existing roofing to determine existing physical conditions that affect removal of existing roofing and installation of new roofing.
- B. Only as much of the new roofing as can be made weathertight each day, including all flashing and detail work, shall be installed. Do not remove existing roofing and flashing in inclement weather or when rain is predicted (30% or more possibility). 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 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.

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- 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 roof 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 manufacturer 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 Sarnafelt 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 notify the owner's representative if any unusual or concealed condition is discovered that adversely affects the work, for determination of how to proceed.
- 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 **prior to beginning the reroof work**, and to confirm expected pullout values.
- U. 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.
- V. Protective wear shall be worn when using solvents or adhesives or as required by job conditions.
- W. Emergency Equipment: Maintain on-site equipment necessary to apply emergency temporary edge seal in the event of sudden storms or inclement weather.
- X. Restrictions:
 - 1. Comply with requirements of Division One on use of site.
 - 2. Smoking is prohibited on roof areas or in existing buildings or on grounds.
 - 3. Radios, boom boxes, etc. are not allowed on the job site.
- Y. Continuation of Services: Comply with requirements of Division One.

1.9 BIDDING REQUIREMENTS

- A. Pre-Bid Meeting: A pre-bid meeting shall be held with the Owner, Owner's Representative, Manufacturer's Representative and any other involved trades to discuss all aspects of the project. The Applicator's representative for the work shall be in attendance.
- B. Site Visit: Bidders shall visit the site and carefully examine the areas in question as to conditions that may affect proper execution of the work. All dimensions and quantities shall be determined or verified by the contractor. No claims for extra costs will be allowed because of lack of full knowledge of the existing conditions unless agreed to in advance with the Owner or Owner's Representative.

1.10 WARRANTIES

- A. Applicator/Roofing Contractor 2 Year MRCA Warranty - The Applicator shall supply the Owner with a separate materials and 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.
- B. The Manufacturer "20 Year No Dollar Limit (NDL) Total System Warranty" - Upon successful completion of the work, the Manufacturer's 20 Year No Dollar Limit (NDL) Total System Warranty shall be issued covering all materials and workmanship including the following:
 - 1. Include repairs required to maintain roof and flashing in a watertight

- condition.
2. Make repairs at no expense to Owner.
 3. Guaranty coverage to include:
 - a. All roof insulations, insulation fasteners, vapor retarders (where applicable), membrane fasteners and adhesives.
 - b. Roof membrane components and adhesives. All accessory products required for installation of membrane roofing system, including bonding adhesive, flashing membrane, stripping plies, clad metal, pipe boots, pourable sealant pockets, etc.
 4. Guaranty shall **not** exclude coverage as a result of small areas of standing or ponding water.
 5. Guaranty shall include hail (up to 1-½") coverage **or** a puncture warranty.
 6. Guaranty shall **not** exclude coverage as a result of winds less than **85 m.p.h.** Pre-Engineered metal detail shall be guaranteed by the manufacturer for 110 miles per hour.
 7. Guaranty shall not be limited by a dollar amount.
- 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

2.1 GENERAL

- A. The components of the thermoplastic Adhered roof system are to be products of **Sarnafil** or **FiberTite** as indicated on the Detail Drawings and specified in the Contract Documents.

2.2 MEMBRANE

- A. Sarnafil® G410 fiberglass reinforced membrane with a lacquer coating.
 1. Membrane shall conform to ASTM D4434-96 (or latest revision), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade I.
 2. Sarnafil G410-15, 60 mil (**minimum**), thermoplastic membrane with fiberglass reinforcement.
- B. FiberTite®-XT Dupont Dacron polyester reinforced membrane.
 1. Membrane shall conform to ASTM D6754-02 (or latest revision), "Standard for Elvaloy (KEE) Sheet Roofing". Classification: Type IV, Grade I.
 2. 8142 FiberTite-XT, 45 mil (**minimum**), ethylene interpolymer (EIP) alloy, reinforced with knitted polyester fabric.

C. Certified Polymer Thickness

1. The membrane manufacturer is to **certify that the polymer thickness** is of the polymer thickness specified (see 2.2 A.2 and 2.2 B.2). Certification is to be signed by the membrane manufacturer's quality control manager. ASTM +/- tolerance for membrane thickness is not acceptable.

D. Color of Membrane

1. EnergySmart (white), initial reflectivity of 0.83, initial emissivity 0.92, solar reflective index (SRI) of >104.

2.3 FLASHING MATERIALS

A. Wall/Curb Flashing

1. Sarnafil G410 Membrane or Sarnafil G459 Membrane
2. FiberTite XT Membrane

B. Perimeter Edge Flashing

1. Sarnaclad PVC-coated, heat-weldable sheet metal.
2. FiberClad Metal - Polymeric coated, heat-weldable sheet metal.

C. Miscellaneous Flashing

1. Termination Bar - A heavy-duty, extruded aluminum flashing termination bar used at walls and large curbs. 1/8" x 1" x 10 foot lengths.
 - a. Sarnafil - Termination Bar with Caulk Lip
 - b. FiberTite - 109 Termination Bar (Caulk Lip)
2. Prefabricated vent pipe flashing
 - a. Sarnafil - Sarnastack
 - b. FiberTite - FTR Cones
3. PVC-coated, heavy-duty aluminum roof drain insert that mechanically seals to the drainpipe interior
 - a. Sarnafil - Sarnadrain-RAC
 - b. FiberTite - U-Flow Hercules
4. T-Joint membrane patches welded over T-joints
 - a. Sarnafil - Sarnacircle "G"
 - b. FiberTite - XT Membrane
5. Urethane sealant used for pitch pocket topping
 - a. Sarnafil - Sarnafiller
 - b. FiberTite - FTR SL Sealant
6. Prefabricated outside and inside flashing corners
 - a. Sarnafil - Sarnacorner
 - b. FiberTite - FTR Corners

7. Sealant used at flashing terminations
 - a. Sarnafil - Multi-Purpose Sealant
 - b. FiberTite - FTR 101 Caulking
8. Bonding Adhesive for Field Membrane
 - a. Sarnacol 2170 Adhesive - A solvent-based reactivating-type adhesive used to attach the membrane to horizontal or near-horizontal substrates.
 - b. FiberTite - FTR 190 Adhesive: A solvent-based contact adhesive (2 sided) for vertical & horizontal surfaces.
9. Bonding Adhesive for Flashing Membrane
 - a. Sarnacol 2170 Adhesive - A solvent-based reactivating-type adhesive used to attach membrane to flashing substrate.
 - b. FiberTite - FTR 190 Adhesive: A solvent-based contact adhesive (2 sided) for vertical & horizontal surfaces.
10. A non-woven polyester or polypropylene mat cushion layer that is necessary behind Flashing Membrane when the flashing substrates are rough-surfaced or incompatible with the flashing membrane.
 - a. Sarnafil - Sarnafelt
 - b. FiberTite - 8240 FiberTite FB

2.4 INSULATION & OVERLAYMENT BOARDS (See Section 07220 & 07221)

- A. Polyisocyanurate foam insulation with black mat facers
 1. Sarnafil - Sarnatherm Insulation - in 4 ft x 4 ft and specified thickness.
 2. FiberTite - FTR Value Insulation - in 4 ft x 4 ft and specified thickness.
- B. Overlayment board
 1. Dens-Deck[®] Prime - A fire-tested, gypsum hardboard with glass-mat facers and a pre-primed surface on one side. Dens-Deck Prime is provided in a 4 ft x 8 ft in thickness of ½ inch.

2.5 ATTACHMENT COMPONENTS

- A. Membrane Adhesive
 1. Sarnafil - Sarnacol 2170 Adhesive: A solvent-based reactivating-type adhesive used to attach the roofing membrane to the roof substrate.
 - a. Do not install when air temperature is within 5° F of dew point. Solvent evaporation time increases significantly when temperatures drop. Ensure first layer of Sarnacol 2170 is fully dry before second layer is applied to the back of the membrane for proper reactivation.
 - b. Use a water-filled, foam-covered lawn roller to consistently and evenly press the membrane into the adhesive layer.
 2. FiberTite - FTR 190 Adhesive: A solvent-based contact adhesive (2 sided) for horizontal surfaces.

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- a. Do not install when air temperature is within 5° F of dew point. Solvent evaporation time increases significantly when temperatures drop.
 - b. Use a water-filled, foam-covered lawn roller to consistently and evenly press the membrane into the adhesive layer.
- B. Flashing Adhesive
1. Sarnafil - Sarnacol 2170 Adhesive: A solvent-based reactivating-type adhesive used to attach the flashing membrane to the substrate vertically.
 - a. Do not install when air temperature is within 5° F of dew point. Solvent evaporation time increases significantly when temperatures drop. Ensure first layer of Sarnacol 2170 is fully dry before second layer is applied to the back of the membrane for proper reactivation.
 2. FiberTite - FTR 190 Adhesive: A solvent-based contact adhesive (2 sided) for vertical surfaces.
 - a. Do not install when air temperature is within 5° F of dew point. Solvent evaporation time increases significantly when temperatures drop.
- C. Insulation Plates - 3 inch square or round, stamping of SAE 1010 steel with an AZ 55 Galvalume coating:
1. Sarnafil - Sarnaplate-HD/CD
 2. FiberTite - #330 FTR Insulation Plate
- D. Insulation Fasteners - A #14 (minimum) corrosion-resistant fastener with a buttress thread, used with insulation plates to attach insulation boards to steel or wood roof decks.
1. Sarnafil - Sarnafastener-HD
 2. FiberTite - FTR #14 Fastener
- E. Termination Bar - An extruded aluminum, low profile bar used with approved fasteners 1 inch wide, flat aluminum bar 1/8 inch thick that has predrilled holes every 6 inches on center.
1. Sarnafil - Sarnastop
 2. FiberTite - FTR Termination Bar
- F. Peel/batten Bar - An FM-approved, heavy-duty, 14 gauge (minimum), galvanized or stainless, roll-formed steel bar used to attach membrane to roof decks.
1. Sarnafil - Sarnabar
 2. FiberTite - FTR Termination Bar

2.6 WALKWAY PROTECTION - A layer of specified walkway installed around **all curbs and at all roof access locations**, adhered to the prepared roof surface per manufacturers requirements and specifications.

- A. Sarnafil - Sarnatred - A polyester reinforced weldable membrane with surface embossment. Used as a protection layer from rooftop traffic.
- B. FiberTite - Tuff-Trac "KEE" - A high grade vinyl walkway/protection material with ribbed "slip resistant" design. Used as a protection layer from rooftop traffic.

2.7 MISCELLANEOUS ACCESSORIES

- A. Aluminum Tape - A 2 inch 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-metal joints.
- B. Sealing Tape Strip - Compressible foam with pressure-sensitive adhesive on one side. Used with metal flashings as a preventive measure against air and wind blown moisture entry.
- C. Multi-Purpose Tape - A high performance sealant tape with used with metal flashings as a preventive measure against air and wind blown moisture entry.
- D. Solvent Cleaner - A high quality solvent cleaner used for the general cleaning of residual asphalt, scuff marks, etc., from the membrane surface. Solvent cleaner is also used daily to clean seam areas prior to hot-air welding in tear off or dirty conditions or if the membrane is not welded the same day it is unrolled.
 - 1. Sarnafil - Sarnasolv
 - 2. FiberTite - Acetone

2.8 VAPOR RETARDER

- A. Sarnavap-10 - A 10 mil thick polyethylene vapor retarder/air retarder. Sarnavap-10 is supplied in a folded panel that is rolled onto a core. The core width is 5 feet. When unrolled off the core and unfolded, the sheet dimensions are 20 feet wide by 100 feet long.

2.9 SEALANTS AND PITCH POCKET FILLERS

- A. Caulking/Sealant - (for termination details).
 - 1. Sarnafil - Multi-Purpose Sealant
 - 2. FiberTite - FTR #101 Caulking
- B. Pourable Sealant
 - 1. Sarnafil - Sarnafiller (two-part urethane filler for pitch pocket toppings).
 - 2. FiberTite - FTR SL Sealant (one component pourable sealant for pitch pocket toppings).
- C. Depending on substrates, the following sealants are options for temporary overnight tie-ins:
 - 1. Type III hot asphalt conforming to ASTM D312 (latest revision).
 - 2. Pourable Sealants.
 - 3. Multiple layers of roofing cement and felt.

4. Spray-applied, water-resistant urethane foam.
5. Mechanical attachment with rigid bars and compressed sealant.

2.10 MISCELLANEOUS FASTENERS AND ANCHOR

- 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 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 and shall be approved for such use by the fastener manufacturer.

2.11 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 ½ inch CDX © 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.
- C. Gas Pipe/Electrical Conduit Supports: Furnish and install Miro Industries gas pipe supports Model Numbers 4-RAH or 6-RAH (hot dipped galvanized) (size as required for gas pipe on roof) per manufacturer requirements and spaced a minimum of 10' o.c and at all corners. Install over an extra layer of specified walkway pad.
- D. Electrical Conduit Supports: Furnish and install Miro Industries Pillow Block Pipe Stands Model 1.5 with 1.5 Spacer (for electrical conduits 3" or less above finished roof height).

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

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

3.2 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.

3.3 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.

- A. Reroofing with Removal of Existing Bitumen Roofing
 - 1. All existing roofing, base flashing, deteriorated wood blocking or deteriorated metal flashings shall be removed down to the existing substrate. Remove only that amount of roofing and flashing which can be made weathertight with new materials during a one-day period and before the onset of inclement weather.
 - 2. Exercise care in removal so as not to damage existing roof deck or adjacent surfaces.
 - 3. **Do not stockpile** debris on roof surface. Promptly remove debris **each day**. Use chutes to transfer debris from roof surface.
 - 4. Do not haul debris over newly installed roof membranes.
 - 5. Provide a **clean tarp over the previous days roofing**, prior to tear-off start, to protect new roofing from dust, dirt, debris, etc., and from current days tear-off.
 - 6. Steel Deck:
 - a. FM Approved Steel Deck - Completely clean metal deck ribs of **all** roof debris, trash, etc. prior to installation of new roof insulation. All rusted or deteriorated decking shall be brought to the attention of the Owner's Representative and to determine method of treatment or replacement. Surface-only rusted metal shall be sanded and treated with rust-inhibiting paint. Sections that have rusted deeper than the surface or are not structurally sound shall be removed and replaced. Deck type shall match existing and shall conform to FM's recommendations as outlined in FM Loss Prevention data Sheet I-28 and local requirements.

7. Wood Deck:
 - a. Fastener heads shall be recessed into the wood surface.
 - b. Non-FM Approved Wood Deck - All rotted or deteriorated wood shall be removed and replaced. The deck thickness shall be 1½ inch (minimum) lumber or ½ (minimum) plywood or match existing deck if greater. Deck type and attachment shall conform to FM and local code requirements. Fastener heads shall be recessed into the wood surface.
8. Poured Structural Concrete Deck: The roof deck shall be smooth, even, free of dust, dirt, excess moisture or oil and be structurally sound. Sharp ridges, other projections and accumulations of bitumen above the surface shall be removed to ensure a smooth surface before roofing. Any deteriorated decking shall be repaired.
9. Poured Lightweight Concrete Substrate: The roof deck shall be smooth, even, free of dust, dirt, excess moisture or oil and be structurally sound. Sharp ridges, other projections and accumulations of bitumen above the surface shall be removed to ensure a smooth surface before roofing. Any deteriorated decking shall be repaired.
10. Precast/Prestressed Concrete Deck: The roof deck shall be smooth, even, free of dust, dirt, excess moisture or oil and be structurally sound. All joints between precast units shall be grouted. Any differentials in height between precast units shall be feathered for a smooth transition. Any deteriorated decking shall be repaired.
11. Insulating Fill Substrate: All wet or deteriorated insulating fill shall be removed and replaced. All accumulations of bitumen shall be removed and the surface of the deck shall be smooth, and free of ridges and depressions. See steel/concrete requirements.

3.4 SUBSTRATE INSPECTION

- A. A dry, clean and smooth substrate shall be prepared to receive the thermoplastic Adhered 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. The roof membrane shall be applied over compatible and accepted substrates only.

3.5 WOOD NAILER INSTALLATION

- 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 in any direction. Individual nailer lengths shall not be less than 3 feet long. Nailer fastener spacing shall be at 12 inches on center or 16 inches on center if necessary to match the structural framing. Fasteners shall be staggered 1/3 the nailer width and installed within 6 inches 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 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.

3.6 INSULATION INSTALLATION - (See Sections 07220 & 07221)

3.7 INSTALLATION OF THERMOPLASTIC MEMBRANE - The surface of the insulation or substrate shall be inspected prior to installation of the thermoplastic 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. Membrane Adhesive:

- 1. Sarnacol 2170 - Adhesive shall be applied by roller. Roller applied adhesive shall utilize a solvent resistant ¾" nap roller, spreading the adhesive to insure a smooth, even 100% coverage of the substrate and membrane. Ensure first layer of Sarnacol 2170 is fully dry before second layer is applied to the back of the membrane for proper reactivation. The membrane shall be pressed firmly into the adhesive layer with a water-filled, foam-covered lawn roller by frequent rolling in two directions.

Notes:

- a. Do not install when air temperature is within 5° F of dew point. Solvent evaporation time increases significantly when temperatures drop.
 - b. No adhesive shall be applied in seam areas. All membrane shall be applied in the same manner.
- 2. FTR 190 Adhesive - Apply a 100% continuous coat of bonding adhesive to the exposed bottom side of the membrane and a mirrored area of the substrate.
 - a. Adhesive may be applied by roller or spraying. Roller applied adhesive shall utilize a solvent resistant ¾" nap roller, spreading the adhesive to insure a smooth, even 100% coverage of the substrate and membrane. Spray applied adhesive must be spread out by roller to insure a smooth, even 100% of the substrate and membrane with no holidays, globs, puddles or similar irregularities.

- b. Allow the adhesive to dry to a point of being tacky, but not stringy to the touch. Do not allow adhesive to "dry out" completely.
- c. When sufficiently dry, carefully maneuver the glued portion of the membrane onto the glued substrate surface, avoiding any wrinkles or air pockets.
- d. The membrane shall be pressed firmly into the adhesive layer with a water-filled, foam-covered lawn roller by frequent rolling in two directions.
- e. No adhesive shall be applied to the lap "seam" areas of the membrane.

3.8 HOT-AIR WELDING OF SEAM OVERLAPS

A. General

1. All seams shall be hot-air welded. All field seams exceeding 10 feet in length shall be welded with an approved automatic welder. Seam overlaps should be 3 inches wide when automatic machine-welding and 4 inches 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 the manufacturer 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 wide nozzle is recommended for use. For corners and compound connections, the ¾ inch wide nozzle shall be used.

C. Machine Welding

1. Machine welded seams are achieved by the use of the manufacturer's automatic welding equipment. When using this equipment, The manufacturer's 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 grey 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 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.

3.9 MEMBRANE FLASHINGS - All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Owner's Representative and the manufacturer. Approval shall only be for specific locations on specific dates. 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. Flashing shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.

A. Adhesive for Membrane Flashings

1. Over the properly installed and prepared flashing substrate, approved bonding adhesive shall be applied according to instructions found on the Product Data Sheet. The bonding adhesive shall be applied in smooth, even coats with no gaps, globs or similar inconsistencies. Only an area which can be completely covered in the same day's operations shall be flashed. The bonded sheet shall be pressed firmly in place with a hand roller.
2. No adhesive shall be applied in seam areas that are to be welded. All panels of membrane shall be applied in the same manner, overlapping the edges of the panels as required by welding techniques.

B. Install termination bars and batten/peel bars according to the Detail Drawings with approved fasteners into the structural deck at the base of parapets, walls and curbs.

C. The manufacturer's requirements and recommendations and the specifications shall be followed. All material submittals shall have been accepted by the manufacturer prior to installation.

D. All flashings shall extend a minimum of 8 inches above roofing level unless otherwise accepted in writing by the Owner's Representative and the manufacturer Technical Department.

E. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the thermoplastic membrane.

F. All flashing membranes shall be mechanically fastened along the counter-flashed top edge with Sarnastop at 6-8 inches on center.

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- G. Roof flashings shall be terminated according to The manufacturer recommended details.
- H. All flashings that exceed 30 inches in height shall receive additional securement. Consult The manufacturer Technical Department for securement methods.

3.10 METAL 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 manufacturer 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 nailer a minimum of 1 inch.
- G. Airtight and continuous metal hook strips are required behind metal fascias. Hook strips are to be fastened 6 inches on center into the wood nailer or masonry wall.
- H. Counter flashings shall overlap base flashings at least 4 inches.
- I. Hook strips shall extend past wood nailers over wall surfaces by 1½ inch minimum and shall be securely sealed from air entry.

3.11 CLAD METAL EDGE METAL - All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Owner's Representative and the manufacturer. Acceptance shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing due to incomplete flashings, the affected area shall be removed and replaced at the Applicator's expense.

- A. Clad metal flashings shall be formed and installed per the Detail Drawings.
 - 1. All metal flashings shall be fastened into solid wood nailers with two rows of post galvanized flat head annular ring nails, 4 inches on center staggered. Fasteners shall penetrate the nailer a minimum of 1½ inch.
 - 2. Metal shall be installed to provide adequate resistance to bending and allow for normal thermal expansion and contraction.
- B. Adjacent sheets of clad metal shall be spaced ¼ inch apart. The joint shall be covered with 2 inch wide aluminum tape. A 4 inch minimum wide strip of roof flashing membrane shall be hot-air welded over the joint.

3.12 WALKWAY INSTALLATION

- A. Specified Walkway - Roofing membrane to receive walkway shall be clean and dry. Place chalk lines on deck sheet to indicate location of Walkway. Apply a continuous coat of bonding adhesive to the deck sheet and the back of Walkway in accordance with the manufacturer's 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 thermoplastic deck sheet. Check all welds with a rounded screwdriver. Re-weld 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 termination/batten/peel bars.

3.13 TEMPORARY CUT-OFF

- A. 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 this section. 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.
- B. 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.
- C. 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.

3.14 FIELD QUALITY CONTROL:

- A. Roofing Contractor's Quality Control:
 - 1. During construction, contractor is to provide daily supervision of the project, performed by the contractor's field superintendent (not to be confused with the project foreperson who is on site at **all** times).
 - 2. Contractor's project manager is to perform regular site inspections at the minimum rate of one site visit per week.
 - 3. Upon completion of installation, contractor is to perform their own final inspection by their quality control person to confirm that roofing system has been installed in accordance with the construction documents and manufacturer's requirements. Contractor is to produce a written punchlist and roof diagram of deficiencies found during their final inspection. A copy of this punchlist, diagram and signed completion letter, will be provided to the consultant prior to the owner and consultant performing their final inspection.

B. Manufacturer's Field Service:

1. During installation, provide for a minimum of two (2) on-site inspections of roof application by qualified technical representatives of roofing manufacturer.
2. Upon completion of installation, provide a final inspection by a technical representative of roofing manufacturer to confirm that roofing system has been installed in accordance with manufacturer's requirements. The roofing contractor, owner and roof consultant are required to be present for this inspection. The manufacturer is to produce a written punchlist and roof diagram of deficiencies found during their final inspection. A copy of this punchlist, diagram and signed completion letter, will be provided to the owner's roof consultant prior to the owner and consultant performing their final inspection.
3. The manufacturer is to perform an 18-month inspection of the entire guaranteed roof system 18 months after the guaranty issuance date. The roofing contractor, owner and roof consultant are required to be present for this inspection.

3.15 CLEANING AND PATCHING:

- A. Clean up debris, excess materials and equipment and remove from site.
- B. Remove drippage or spills of coatings, sealant, adhesives or primers from finish surfaces.
- C. Patch misaligned or inadequately lapped seams, inadequately adhered areas, punctures or other damage to membrane with a patch of membrane sheet that extends at least 6 in. in each direction from deficiency.

3.16 PROTECTION:

- A. Provide special protection (i.e. use of tarps and plywood), and avoid heavy traffic on completed work.
- B. Restore to original condition or replace work or materials damaged during handling of roofing materials.

3.17 COMPLETION

- A. 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.
- B. All punch-lists shall have been completed, and warranties referenced in this Specification shall have been delivered to the Owner's Representative prior to the Owner accepting the project for final payment.

END OF SECTION 07541

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2. Thickness: 3". Flat polyisocyanurate insulation panels are to be one layers of 3" x 48" x 48" in size.
 3. Maximum Thickness: 3". Each layer of flat polyisocyanurate roof insulation is to be **no** thicker than 3" thick.
 4. Manufacturers:
 - a. Sarnafil - Sarnatherm Insulation - in 4 ft x 4 ft and specified thickness.
 - b. FiberTite - FTR Value Insulation - in 4 ft x 4 ft and specified thickness.
- 2.3 FULL TAPER ROOF INSULATION: Euclid Middle School - Sections A & D; Newton Middle School - Sections C & J; Littleton High School - Section M (**1/8" per foot full taper**)
- A. Tapered Polyisocyanurate with Heavy Duty Facer
 1. ASTM C 1289, Type II, Class 1 Standard Specification for Polyurethane and Polyisocyanurate Roof Insulation.
 2. Starting Thickness: 1½". Tapered Insulation panels are to be pre-fabricated sloped panels with a slope of 1/8" per foot. Taper system is to use a "four-panel system" with no insulation board thicker than 2½" thick.
 3. Maximum Thickness: 2½". No tapered roof insulation is to be thicker than 2½" thick. No flat (fill board) roof insulation is to be thicker than 2" thick.
 4. Manufacturers:
 - a. Sarnafil - Sarnatherm Insulation - in 4 ft x 4 ft and specified thickness.
 - b. FiberTite - FTR Value Insulation - in 4 ft x 4 ft and specified thickness.
- 2.4 TAPERED OVERLAY CRICKETS: Where shown on drawings **and** behind high side of **all roof curbs**.
1. Tapered Polyisocyanurate Overlay Crickets:
 - a. ASTM C 1289, Type II, Class 1 Standard Specification for Polyurethane and Polyisocyanurate Roof Insulation.
 - b. Minimum Thickness: ½". Tapered Insulation panels are to be pre-fabricated sloped panels with a slope of ½" per foot (where indicated on roof plans **and** at the high side of **all curbs**). Install 6" T.E.S. (tapered edge strip) at the low side of the tapered crickets.
 2. Manufacturers:
 - a. Sarnafil - Sarnatherm Insulation - in 4 ft x 4 ft and specified thickness.

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- b. FiberTite - FTR Value Insulation - in 4 ft x 4 ft and specified thickness.

2.5 OVERLAYMENT BOARD:

1. Dens-Deck[®] Prime - A fire-tested, gypsum hardboard with glass-mat facers and a pre-primed surface on one side. Dens-Deck[®] Prime is provided in a 4 ft x 8 ft in thickness of ½ inch. Install over **all** areas receiving polyisocyanurate roof insulation.

PART 3 – EXECUTION

3.1 PREPARATION & INSTALLATION:

- A. Remove existing roofing membrane and insulation to substrate and repair substrate as required prior to installation of new roof insulation.
- B. Stagger all layers of roof insulation in both directions by minimum of 24 inches. This requirement includes tapered insulation and fill insulation.
- C. Installation of roof insulation:
 1. Metal/Wood Roof Decks: Install one-ply of specified (see Section 07541) vapor retarder over prepared roof deck prior to installation of roof insulation. Install vapor retarder with 3" minimum side-laps, and 6" minimum end laps. Over vapor retarder, install roof insulation with end joints staggered. (Stagger joints between **all** layers.) Joints shall be ⅛" or less in width. Fill all uneven or oversized insulation joints. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed. (Insulation that has become wet during storage will be marked with paint by the consultant, and removed from site.) Install insulation layers and overlayment board mechanically fastened to the substrate using manufacturer and Factory Mutual approved fasteners, fastened at a minimum rate of one fastener every two (2) square feet or as required to meet Factory Mutual (FM) I-90 and Bulletin 1-28s wind requirements, whichever is more stringent.
 2. Lightweight Concrete/Gypsum Roof Decks: Over prepared roof deck install one ply of 28 lb. modified glass fiber base sheet over roof deck, dry. Lap each sheet 4 in. over underlying sheet and lap ends 6 in. Nail each sheet at 6 in. o.c. through laps and stagger nail remainder of sheet at 9 in. o.c. Use ES nails as specified. Over top of fastened base sheet, install two-ply fiberglass felt vapor retarder in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install tapered roof insulation with end joints staggered. (Stagger joints between **all** layers.) Joints shall be ⅛" or less in width. Fill all uneven or oversized insulation joints. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed. Install insulation layers and overlayment board to base sheet and to each other, in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install insulation as required to meet FM requirement.

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3. Structural Concrete Roof Decks: Prime entire roof deck with asphalt primer per manufacturer requirements and recommendations. Over prepared roof deck install a 12" wide strip of 43 lb. organic base sheet over roof deck joints in flashing cement. Over top of prepared roof deck, install two-ply fiberglass felt vapor retarder in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install tapered roof insulation with end joints staggered. (Stagger joints between all layers.) Joints shall be $\frac{1}{8}$ " or less in width. Fill all uneven or oversized insulation joints. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed. Install insulation layers and overlayment board to prepared roof deck and to each other, in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install insulation as required to meet FM requirement.
4. Pool Roof Decks (Littleton High School - Section A): Install one layer of $\frac{1}{2}$ " Dens-Deck[®] Prime mechanically fastened to the structural roof deck with specified screws and plates one fastener every 2 square feet (with additional perimeter and corner fasteners). Prime the entire layer of Dens-Deck[®] Prime with asphalt primer per manufacturer requirements and recommendations. Over primed Dens-Deck[®] Prime, install two-ply fiberglass felt vapor retarder in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install roof insulation with end joints staggered. (Stagger joints between all layers.) Joints shall be $\frac{1}{8}$ " or less in width. Fill all uneven or oversized insulation joints. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed. Install insulation layers and overlayment board to prepared roof deck and to each other, in a continuous hot mopping of Type III asphalt, applied at a rate of approximately thirty (30) pounds per 100 square feet, per mopping. Install insulation as required to meet FM requirement.

END OF SECTION 07221