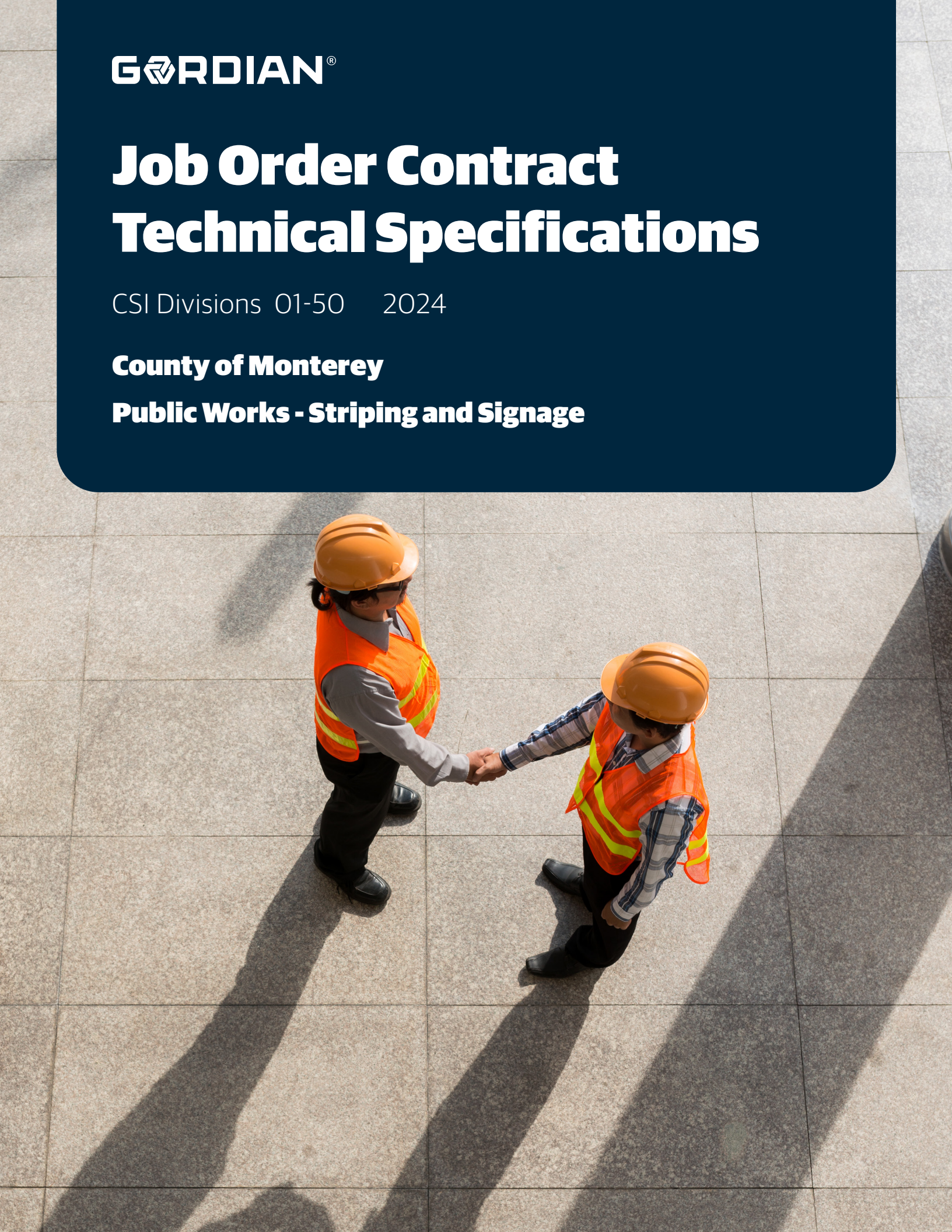
GORDIAN®

Job Order Contract Technical Specifications

CSI Divisions 01-50 2024

County of Monterey

Public Works - Striping and Signage



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01 General Requirements

10 Specialties

32 Exterior Improvements

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SECTION 01 00 00 00 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 BRACKETED OPTIONS

A. Within these Technical Specifications there are bracketed options. For example **[6ft] [12ft] [24ft]**. The final selection will be made by the Owner and set forth in the Detailed Scope of Work.

1.2 WARRANTY

A. Within these Technical Specifications there are warranty periods listed. The warranty periods listed cover both material and labor for that period. If a manufacture will warranty a material for a longer period than what is listed, the material is covered as a replacement by the manufacture for the extra period. The labor to replace will be at the installation price for the contractor.

END OF SECTION 01 00 00 00

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Task	Specification	Specification Description
01 20 00 00	01 00 00 00	General Requirements
01 22 00 00	01 00 00 00	General Requirements

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SECTION 01 22 16 00 - NO SPECIFICATION REQUIRED

1.1 GENERAL

A. A separate specification is not required for this item. The description given in the line item of the Construction Task Catalog completely defines the item.

1.2 PRODUCTS - (Not Used)

1.3 EXECUTION - (Not Used)

END OF SECTION 01 22 16 00

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Task	Specification	Specification Description
01 22 16 00	01 00 00 00	General Requirements
01 22 20 00	01 00 00 00	General Requirements
01 22 20 00	01 22 16 00	No Specification Required
01 70 00 00	01 00 00 00	General Requirements
01 71 00 00	01 00 00 00	General Requirements
01 71 13 00	01 00 00 00	General Requirements
01 71 13 00	01 22 16 00	No Specification Required
01 71 23 00	01 00 00 00	General Requirements

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SECTION 01 71 23 16 - CUTTING AND PATCHING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for cutting and patching. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes procedural requirements for cutting and patching.

C. Definitions
1. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
2. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

D. Submittals
1. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
   a. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
   b. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   c. Products: List products to be used and firms or entities that will perform the Work.
   d. Dates: Indicate when cutting and patching will be performed.
   e. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
   f. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
   g. the Owner's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

E. Quality Assurance
1. LEED Requirements for Building Reuse:
   a. Credit MR 1.1 and 1.2, **as directed**: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be removed; do not cut such existing construction beyond indicated limits.
   b. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be removed; do not cut such existing construction beyond indicated limits.
   c. Credit MR 1.2 and 1.3, **as directed**: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be removed; do not cut such existing construction beyond indicated limits.

2. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
   a. **Refer to the Owner for list of elements that might otherwise be overlooked as structural elements and that require Architect's or Construction Manager's approval of a cutting and patching proposal**.
3. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
   a. Primary operational systems and equipment.
   b. Air or smoke barriers.
   c. Fire-suppression systems.
   d. Mechanical systems piping and ducts.
   e. Control systems.
   f. Communication systems.
   g. Conveying systems.
   h. Electrical wiring systems.
   i. Operating systems of special construction in Division 13.
4. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Equipment supports.
   e. Piping, ductwork, vessels, and equipment.
   f. Noise- and vibration-control elements and systems.
5. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
6. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

F. Warranty
1. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1.2 PRODUCTS

A. Materials
1. General: Comply with requirements specified in other Sections.
2. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   a. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

1.3 EXECUTION

A. Preparation
1. Temporary Support: Provide temporary support of Work to be cut.
2. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
3. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
4. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize **OR** prevent, **as directed**, interruption to occupied areas.

B. Performance
1. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   a. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
2. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   a. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   b. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   c. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   d. Excavating and Backfilling: Comply with requirements in applicable Division 31 where required by cutting and patching operations.
   e. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   f. Proceed with patching after construction operations requiring cutting are complete.
3. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
   a. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
   b. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
      1) Clean piping, conduit, and similar features before applying paint or other finishing materials.
      2) Restore damaged pipe covering to its original condition.
   c. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
      1) Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

d. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
e. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

4. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 71 23 16

Task	Specification	Specification Description
01 71 23 16	01 00 00 00	General Requirements
01 00 00 00MOD000	01 00 00 00	General Requirements

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SECTION 10 14 53 11 - TRAFFIC SIGNS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of traffic signs. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

1.2 PRODUCT

A. Sign Foundations:
1. Replacement Foundation Footing Concrete shall be a mixture of cement complying with ASTM C 150 and aggregate complying with ASTM C 33. Compressive strength shall be 2,800 psi at 28 days.
2. Sulfur Mortar shall comply with ASTM C 287.
3. Reinforcing Steel shall comply with ASTM A 615.

B. Sign Supports shall be of the "break-away" type. Supports shall be strong enough to resist applicable wind forces without damage, but shall be designed to experience a brittle rupture type failure or a "quick separation" type joint.
1. Sign Support, Aluminum:
   a. Replacement Castings shall be Alloy A356.0-T6 in compliance with ASTM B 108.
   b. Replacement Structural Members shall comply with ASTM B 308.
   c. Replacement Bars, Rods, Shapes, and Tubes shall comply with ASTM B 221, alloy 6061-T6.
   d. Replacement Bolts, Nuts, and Screws shall match items being replaced and shall be alloy 2024-T4 with anodic coating complying with ASTM B 580, or 6061-T6 in compliance with ASTM B 211. Bolt heads shall be hexagon. Bolt threads shall be Class 2, 2A, or 2B in compliance with ANSI B18.2.1. Nuts shall be hexagon shaped in compliance with ANSI B18.2.2.
   e. Replacement washers shall be furnished from sheet metal complying with ASTM B 209, alloy Alclad 2024-T3 or T4.
2. Sign Support, Steel:
   a. Replacement Structural Members shall comply with ASTM A 36.
   b. Replacement Bars shall comply with ASTM A 108.
   c. Replacement Pipe shall comply with ASTM A 53 standard weight.
   d. Replacement Fasteners shall comply with ASTM A 307 and ASTM A 325.
   e. Replacement Anchor Bolts for anchoring base plates to concrete bases and nuts and washers shall be galvanized in compliance with ASTM A 153.
3. Sign Support, Wood:
   a. Replacement Wood Sign Post shall be of the species listed in AASHTO M168, dressed four sides and having a pyramidal top cut before being treated.
   b. Replacement Sign Post shall be pressure treated with creosote or creosote-tar solution complying with AWPB LP-55.

C. Sign Face:
1. Replacement Plywood Sign Face shall be grade HDOAB G-1 EXTERIOR, in compliance with DOC PS 1. Material shall be cut to size in compliance with ANSI D6.1E.
2. Replacement Galvanizing Steel Sign Face shall comply with USDOT FHA MUTCD.

D. Reflective Sheeting shall be enclosed lens unless otherwise directed by the Owner.

1. Enclosed Lens Reflective Sheeting shall comply with Fed. Spec. L-S-300.
2. Reflective Sheeting shall comply with FP-79 minimum reflective intensity. Measurements shall comply with Fed. Spec. L-S-300.
3. Color shall be matched visually and within the limits shown on the Color Tolerance Charts issued by the Federal Highway Administration. The diffuse day color of the reflective sheeting shall be determined in compliance with ASTM E 97.
4. Film:
   a. General: Reflective sheeting shall be sufficiently flexible to be easily cut to shape and permit application over, and conformance to, moderate shallow embossing characteristic of certain sign borders and symbols.
   b. Surface: Sheeting surface shall be smooth and flat, shall facilitate cleaning and wet performance, and shall exhibit 85 degrees glossmeter rating of not less than 40, as specified in ASTM D 523. The sheeting surface shall withstand cleaning with gasoline, VM&P Naphtha, mineral spirits, turpentine, methanol, and xylol.

E. Demountable Sign Face Materials:
1. Acrylic Plastic Reflectors: Replacement demountable sign letters, digits, arrows, borders, and alphabet accessories shall be reflectorized and shall consist of acrylic plastic reflectors supported by embossed aluminum frames. They shall comply with the Standard Alphabet for Highway Signs, of the Federal Highway Administration, Series E.
2. Design and Fabrication: The letters shall be modified as necessary to accommodate the required reflectors. All items except border strips shall be fabricated from 0.040-inch minimum sheet aluminum. Border strips shall be of 0.032-inch minimum sheet aluminum. Mounting holes shall be provided within the frames to permit the use of screws, rivets or other acceptable fasteners. The size and spacing of the reflector holes shall provide maximum night legibility and visibility of the finished cutout figure.
3. General Requirements: The reflectors shall be of acrylic plastic meeting the requirements of Fed. Spec. L-P-380, Type I, Class 3. The reflectors shall be yellow or colorless. The lens shall consist of a smooth front surface, free from projections or indentations other than for identification, and a rear surface bearing a prismatic configuration that will effect total internal reflection of light.
4. Reflective Sheeting:
   a. Demountable Sign Letters, Digits, Arrows, Borders, and Alphabet Accessories, when so specified, shall be reflectorized with reflective sheeting supported by flat aluminum backing and shall comply with the Standard Alphabet Highway Signs of the Federal Highway Administration.
   b. Design and Fabrication: Letter design shall be Series E, modified for legibility. All items except border strips shall be fabricated from 0.040-inch sheet aluminum, 6061-T6 alloy, with mounting holes to permit use of screws, rivets, or other acceptable fasteners.

F. Highway Delineators, Enclosed Lens Type: Replacement reflectors shall be of acrylic plastic and a minimum of 3 inches in diameter. They shall be mounted in a heavy-duty housing with a back plate. The reflector shall consist of a clear and transparent plastic lens, which shall be colorless, and a plastic back of the same material, fused to the lens under heat and pressure around the entire perimeter to form a homogeneous unit, permanently sealed against dust, water, and water vapor. The acrylic plastic shall comply with Fed. Spec. L-P-380, Type I, Class 3.

G. Highway Delineators, High Intensity Type:
1. Replacement Reflectorized Delineators shall consist of a reflective sheeting compound of glass spheres, embedded in a weatherproof, synthetic, noncellulose material. The overall size of the plastic reflectors shall be 4 inches by 5 inches, with a reflective area of at least 17.5 square inches.
2. Delineators shall be silver-white when viewed with reflected light.

H. Highway Delineators Including Posts and Attachments:

1. Reflective Sheeting: Replacement reflective sheeting for delineators shall match delineators being replaced.
2. Delineator Posts and Accessories shall be of steel or aluminum. They shall have the necessary holes for attachment of the delineator housing. The assembly shall be furnished with the necessary bolts, nuts, and washers for attaching to the posts.
3. Insulating Materials: Neoprene, for separation of aluminum and steel parts, shall contain at least 60 percent, by volume, of pure neoprene. Other material may be used, subject to the approval of the Owner as to pliability and ability to withstand wear caused by stretching or distortion.
4. Reflector Units for guardrail installation shall match existing reflector being replaced in size and color.
5. Highway Delineators shall be supplemented with directional guidance signs as directed by the Owner. Signs shall be the chevron alignment type and shall comply with ANSI D6.1E, Type W 1-8.

I. Painting Panels for Nonreflectorized Background:
1. Replacement Metal Panels for sign categories not required to be reflectorized shall have a nonreflectorized background composed of one spray coat of primer and two finish coats of baked enamel.
2. Finish Coats shall be baked alkyd resin enamels meeting Fed. Spec. TT-E-529, Class B, of a composition that affects the finished background surface. When thoroughly dry, the colors shall match those described in the current Highway Blue Color Tolerance Chart, PR Color No. 3, or in Highway Green Color Tolerance Chart, PR Color No. 4, of the Federal Highway Administration.
3. Wood Signs shall have two coats of oil paint complying with Fed. Spec. TT-P-52. Message paint shall be a single coat of oil paint. All colors shall comply with ANSI D6.1E.

J. Sign Wash Detergent shall comply with ASTM D 3399.

K. Street, Wayside, Utility Location, And Parking Lot Signs; Decals
1. Blanks: aluminum of type, size, and shape indicated.
2. Reflective sheeting: Type 1 sheeting having Level A reflective intensity.
3. Silk screen lettering paint and transparent process colors: as directed by the Owner.
4. Posts
   a. Drive type: as directed by the Owner.
   b. Pipe type: Two-inch inside diameter.
5. Hardware: as directed by the Owner.
6. Fabrication
   a. Dimensions, colors, and reflectorizing: As indicated, and in accordance with MUTCD.
   b. Size, style, and spacing of letters, numerals, symbols, and borders: As indicated, and the Owner; as supplemented by DOT/FHA's publication entitled Standard Highway Signs as specified in MUTCD 1978.
   c. Workmanship: as directed by the Owner.

1.3 EXECUTION

A. Footings for Signs, Posts, and Supports:
1. Backfill Material shall be at or near optimum moisture and neither dry nor saturated. It shall be tamped thoroughly in place.
2. Concrete Footings may be cast in place or precast. Hand mixing of concrete will be permitted where the quantity does not exceed one-half cubic yard.

B. Erection of Signs and Sign Supports: Sign posts shall be erected vertically. Posts erected in sleeves shall be anchored with sulphur mortar. Mortar shall comply with ASTM C 287. Sign faces shall be positioned to be generally perpendicular to the line-of-sight for the observer. Reflectorized signs shall

be inspected at night. If specular reflection is apparent on any sign, its position shall be adjusted by the Contractor to eliminate the condition.

C. Delineators and Hazard Markers: Delineator posts shall be driven to a depth of 30 inches.

D. Removal of Existing Signs and Posts:
   1. Damaged, Obsolete, or Change of Purpose Signs and Posts shall be removed and delivered to a storage area designated by the Owner. Post hole shall be backfilled, tamped, and made level with the adjacent surface. Disturbed paving, sidewalks, and grassed areas shall be replaced with matching material of same quality and quantity as existing.
   2. Signs and Posts to be Replaced shall be removed and replaced by new signs and posts in identical locations. Backfill around post shall be thoroughly compacted to hold posts securely in a vertical position.

E. Installation: Install in accordance with manufacturer's recommendations and as directed by the Owner. Unless otherwise indicated, install not more than one sign on each post.

END OF SECTION 10 14 53 11

SECTION 32 01 11 53 - TRAFFIC COATINGS

1.1 GENERAL

A. Description Of Work:
1. This specification covers the furnishing and installation of materials for traffic coating. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. This Section includes traffic coatings for the following applications:
   a. Interior and exterior pedestrian traffic.
   b. Vehicular traffic.
   c. Pavement markings.

C. Submittals
1. Product Data: For each product indicated.
2. Shop Drawings: Show extent of each traffic coating. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.
3. Samples: For each type of finish indicated.
4. Material test reports.
5. Material certificates.
6. Qualification data.
7. Maintenance data.
8. Warranty.
9. LEED Submittal:
   a. Product Data for Credit EQ 4.2: For interior field-applied traffic coatings and pavement marking paints, including printed statement of VOC content.

D. Quality Assurance
1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of traffic coatings required for this Project.
2. Fire-Test-Response Characteristics: Provide traffic coating materials with the fire-test-response characteristics as determined by testing identical products per test method below for deck type and slopes indicated by an independent testing and inspecting agency that is acceptable to authorities having jurisdiction.
   a. Class A **OR** B **OR** C, **as directed**, roof covering per ASTM E 108 or UL 790.
3. Preinstallation Conference: Conduct conference at Project site.

E. Delivery, Storage, And Handling
1. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels showing the following information:
   a. Manufacturer's brand name.
   b. Type of material.
   c. Directions for storage.
   d. Date of manufacture and shelf life.
   e. Lot or batch number.
   f. Mixing and application instructions.
   g. Color.
2. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

F. Project Conditions

1. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
   a. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
2. Do not install traffic coating until items that will penetrate membrane have been installed.

G. Warranty
1. Special Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to repair or replace traffic coatings that deteriorate during the specified warranty period. Warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new substrate cracks exceeding 1/16 inch (1.6 mm) in width, fire, vandalism, or abuse by snowplow, maintenance equipment, and truck traffic.
   a. Deterioration of traffic coatings includes the following:
      1) Adhesive or cohesive failures.
      2) Abrasion or tearing failures.
      3) Surface crazing or spalling.
      4) Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
   b. Warranty Period: Five years from date of Final Completion.

1.2 PRODUCTS

A. Materials
1. Traffic Coatings: Complying with ASTM C 957.
2. Material Compatibility: Provide primers; base, intermediate, and topcoats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. VOC Content: Provide traffic coatings and pavement marking paints, for use inside the weatherproofing system, with VOC content of 150 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Traffic Coating
1. Primer: Manufacturer's standard factory-formulated primer recommended for substrate and conditions indicated.
   a. Material: Epoxy **OR** Urethane, **as directed**.
2. Preparatory and Base Coats: Single- or multicomponent, aromatic liquid urethane elastomer.
3. Intermediate Coat: Single- or multicomponent, aromatic liquid urethane elastomer **OR** Single- or multicomponent, aliphatic liquid urethane elastomer **OR** Liquid epoxy, **as directed**.
4. Topcoat: Single- or multicomponent, aromatic liquid urethane elastomer **OR** Single- or multicomponent, aliphatic liquid urethane elastomer **OR** Single- or multicomponent, aromatic liquid urethane elastomer with UV inhibitors **OR** Liquid epoxy, **as directed**.
   a. Color: As selected by the Owner from manufacturer's full range.
5. Aggregate: Uniformly graded, washed silicon carbide sand **OR** Uniformly graded, washed silica sand **OR** Uniformly graded, washed flint shot silica **OR** Walnut shell granules **OR** Aluminum-oxide grit, **as directed**, of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.
   a. Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated, but not less than the following:
      1) Intermediate Coat: 8 to 10 lb/100 sq. ft. (3.6 to 4.5 kg/10 sq. m) **OR** To refusal, **as directed**.

2) Topcoat: 8 to 10 lb/100 sq. ft. (3.6 to 4.5 kg/10 sq. m) **OR** As required to achieve slip-resistant finish, **as directed**.

C. Miscellaneous Materials
1. Joint Sealants: As specified in Division 07 Section "Joint Sealants".
2. Sheet Flashing: Nonstaining.
a. Minimum Thickness: 60 mils (1.5 mm) **OR** 50 mils (1.3 mm), **as directed**.
b. Material: Sheet material recommended in writing by traffic coating manufacturer **OR** Uncured neoprene sheet **OR** Cured neoprene sheet, **as directed**.
3. Adhesive: Contact adhesive recommended in writing by traffic coating manufacturer.
4. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic coating manufacturer.

D. Pavement Markings
1. Pavement-Marking Paint: Alkyd-resin ready mixed, complying with AASHTO M 248, Type S **OR** N **OR** F, **as directed**.
a. Color: White **OR** Yellow **OR** As indicated, **as directed**.
1) Use blue for spaces accessible to people with disabilities.
2. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than three **OR** 45, **as directed**, minutes.
a. Color: White **OR** Yellow **OR** As indicated, **as directed**.
1) Use blue for spaces accessible to people with disabilities.
3. Glass Beads: AASHTO M 247, Type 1.

1.3 EXECUTION

A. Examination
1. Examine substrates, with Installer present, for compliance with requirements and for other conditions affecting performance of traffic coatings.
a. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
b. Verify compatibility with and suitability of substrates.
c. Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed, after unsatisfactory conditions have been corrected, and after surfaces are dry.
d. Verify that substrates are visibly dry and free of moisture.
1) Test for moisture vapor transmission by plastic sheet method according to ASTM D 4263.
2) Test for moisture content by measuring with an electronic moisture meter **OR** method recommended in writing by manufacturer, **as directed**.
e. Application of coating indicates acceptance of surfaces and conditions.

B. Preparation
1. Clean and prepare substrates according to ASTM C 1127 and manufacturer's written recommendations to produce clean, dust-free, dry substrate for traffic coating application.
2. Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.
3. Concrete Substrates: Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259. Do not acid etch.
a. Remove grease, oil, paints, and other penetrating contaminants from concrete.
b. Remove concrete fins, ridges, and other projections.
c. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
d. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

C. Terminations And Penetrations
   1. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written recommendations.
   2. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
   3. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
   4. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

D. Joint And Crack Treatment
   1. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
      a. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

E. Traffic Coating Application
   1. Apply traffic coating material according to ASTM C 1127 and manufacturer's written recommendations.
      a. Start traffic coating application in presence of manufacturer's technical representative.
      b. Verify that wet film thickness of each component coat complies with requirements every 100 sq. ft. (9 sq. m).
   2. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated, and omit aggregate on vertical surfaces.
   3. Cure traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.

F. Pavement Markings
   1. Do not apply traffic paint for striping and other markings until traffic coating has cured according to manufacturer's written recommendations.
   2. Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil- (0.38-mm-) minimum wet film thickness.
   3. Spread glass beads uniformly into wet traffic paint at a rate of 6 lb/gal. (0.72 kg/L).

G. Field Quality Control
   1. Testing: Engage a qualified testing agency to perform the following field tests and inspections and prepare test reports:
      a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of the Owner and Contractor.
      b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
      c. Testing agency shall verify thickness of coatings during traffic coating application.
      d. If test results show traffic coating materials do not comply with requirements, remove noncomplying materials, prepare surfaces, and reapply traffic coatings.
   2. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after traffic coating has completely cured. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
      a. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm).
      b. Flood each area for 24 **OR** 48 **OR** 72, **as directed**, hours.
      c. After flood testing, repair leaks, repeat flood tests, and make further repairs until traffic coating installation is watertight.
      d. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3. Final Traffic Coating Inspection: Arrange for traffic coating manufacturer's technical personnel to inspect membrane installation on completion.
   a. Notify the Owner 48 hours in advance of date and time of inspection.
4. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Protecting And Cleaning
1. Protect traffic coatings from damage and wear during remainder of construction period.
2. Clean spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 01 11 53

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SECTION 32 01 11 53a - ASPHALT PAVING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for asphalt paving. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Cold milling of existing hot-mix asphalt pavement.
b. Hot-mix asphalt patching.
c. Hot-mix asphalt paving.
d. Hot-mix asphalt paving overlay.
e. Asphalt surface treatments.
f. Pavement-marking paint.
g. Traffic-calming devices.
h. Imprinted asphalt.

C. Definition
1. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

D. Submittals
1. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
a. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
b. Job-Mix Designs: For each job mix proposed for the Work.
2. Material Certificates: For each paving material, from manufacturer.

E. Quality Assurance
1. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
2. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of State or local DOT for asphalt paving work.
a. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
3. Preinstallation Conference: Conduct conference at Project site.

F. Delivery, Storage, And Handling
1. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
2. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

G. Project Conditions
1. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
a. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
b. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).

c. Slurry Coat: Comply with weather limitations in ASTM D 3910.
d. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
e. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

2. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials **OR** 55 deg F (12.8 deg C) for water-based materials, **as directed**, and not exceeding 95 deg F (35 deg C).
3. Imprinted Asphalt Paving: Proceed with coating imprinted pavement only when air temperature is at least 50 deg F (10 deg C) and rising and will not drop below 50 deg F (10 deg C) within 8 hours of coating application. Proceed only if no precipitation is expected within two hours after applying the final layer of coating.

1.2 PRODUCTS

A. Aggregates
1. General: Use materials and gradations that have performed satisfactorily in previous installations.
2. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
3. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
a. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
4. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

B. Asphalt Materials
1. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22 **OR** PG 58-28 **OR** PG 70-22, **as directed**.
2. Asphalt Cement: ASTM D 3381 for viscosity-graded material **OR** ASTM D 946 for penetration-graded material, **as directed**.
3. Prime Coat:
a. ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70 **OR** MC-250, **as directed**.
OR
Asphalt emulsion prime coat complying with State or local DOT requirements.
4. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
5. Fog Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
6. Slurry Seal: ASTM D 3910, Type 1 **OR** Type 2 **OR** Type 3, **as directed.**
7. Chip Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application. RS-2 **OR** RS-2P **OR** CRS-2 **OR** CRS-2P **OR** HFRS-2 **OR** HFRS-**2P**, **as directed.**
8. Sand Seal: AASHTO M 140 emulsified asphalt or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application. Sand shall meet the following gradation as tested by AASHTO T27.
9. Water: Potable.
10. Undersealing Asphalt: ASTM D 3141, pumping consistency.

C. Auxiliary Materials
1. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
2. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
3. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
4. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type I **OR** Type II or III **OR** Type IV, **as directed**, hot-applied, single-component, polymer-modified bituminous sealant.
5. Pavement-Marking Paint: Color shall be White **OR** Yellow **OR** Blue, **as directed**.
   a. Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N **OR** Type F **OR** Type S, **as directed**; colors complying with FS TT-P-1952.
   OR
   MPI #32 Alkyd Traffic Marking Paint.
   OR
   Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three **OR** 45, **as directed**, minutes.
   OR
   MPI #97 Latex Traffic Marking Paint.
6. Glass Beads: AASHTO M 247, Type 1.
7. Wheel Stops:
   a. Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, 4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
   OR
   Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
   b. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 10-inch (254-mm) minimum length.
   c. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

D. Preformed Traffic-Calming Devices
1. Speed Bumps **OR** Humps **OR** Cushions, **as directed**: Solid, integrally colored, 100 percent postconsumer or commingled postconsumer and postindustrial recycled rubber **OR** plastic, **as directed**; UV stabilized. Provide holes for anchoring to substrate.
   a. Size: Modular bumps 2 inches (51 mm) high by 10 inches (254 mm) wide by 72 inches (1800 mm) long, with overall length as dimensioned on Drawings.
   b. Size: Modular assemblies 3 inches (76 mm) high by 12 feet (3.7 m) in overall width **OR** 4 inches (102 mm) high by 14 feet (4.3 m) in overall width, **as directed**, with overall length as dimensioned on Drawings.
   c. Mounting Hardware: Galvanized-steel spike, 1/2-inch (13-mm) diameter, 10-inch (254-mm) minimum length **OR** lag screw, shield, and washers; 1/2-inch (13-mm) diameter, 8-inch (203-mm) minimum length **OR** hardware as standard with device manufacturer, **as directed**.
   d. Adhesive: As recommended by device manufacturer.

E. Imprinted Asphalt Materials
1. Templates: Imprinted-asphalt manufacturer's standard flexible templates for imprinting pattern into hot asphalt paving.
   a. Pattern: Running bond brick **OR** Cobblestone **OR** Custom pattern indicated on Drawings, **as directed**.
2. Coating System: Imprinted-asphalt manufacturer's standard system formulated for exterior application on asphalt paving surfaces.
   a. Base Coating: Portland cement and epoxy-modified acrylic polymer blended with sand and aggregate, formulated for exterior application on asphalt paving surfaces.

b. Top Coating: Epoxy-modified acrylic polymer blended with sand and aggregate, formulated for exterior application on asphalt paving surfaces.
c. Colorant: UV-stable pigment blend, added to each coating layer.
d. Color: White **OR** Yellow, **as directed**.

3. Precut Marking Material: Imprinted-asphalt manufacturer's standard, reflectorized, thermoplastic, 90-mil (2.3-mm) minimum thickness, formulated for exterior application on asphalt paving surfaces, and matching the imprinted pattern of templates.

F. Mixes

1. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
   a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   b. Base Course: In accordance with state or local DOT specifications.
   c. Surface Course: In accordance with state or local DOT specifications.
2. Hot-Mix Asphalt Based on ASTM D 3515 Requirements: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."
   a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   b. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:
      1) Base Course: 1 inch (25 mm).
      2) Surface Course: 1/2 inch (13 mm).
3. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1 **OR** Type 2 **OR** Type 3, **as directed**.

1.3 EXECUTION

A. Examination

1. Verify that subgrade is dry and in suitable condition to begin paving.
2. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   a. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
   b. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
   c. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner, and replace with compacted backfill or fill as directed.
3. Proceed with paving only after unsatisfactory conditions have been corrected.
4. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

B. Cold Milling

1. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
   a. Mill to a depth of 1-1/2 inches (38 mm) **OR** 2 inches (50 mm) **OR** 3 inches (75 mm), **as directed**.
   b. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
   c. Control rate of milling to prevent tearing of existing asphalt course.
   d. Repair or replace curbs, manholes, and other construction damaged during cold milling.

e. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
f. Transport milled hot-mix asphalt to asphalt recycling facility.
g. Keep milled pavement surface free of loose material and dust.

C. Patching
1. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
2. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
   a. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
   b. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
3. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
   a. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   b. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
4. Patching:
   a. Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
      OR
      Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

D. Repairs
1. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
   a. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
2. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
   a. Clean cracks and joints in existing hot-mix asphalt pavement.
   b. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
   c. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

E. Surface Preparation
1. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
2. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
   a. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
3. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
   a. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

b. Protect primed substrate from damage until ready to receive paving.

4. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
   a. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   b. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

F. Paving Geotextile Installation
1. Apply tack coat **OR** asphalt binder **OR** asphalt cement, **as directed**, uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).
2. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).
   a. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

G. Hot-Mix Asphalt Placing
1. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   a. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
   b. Place hot-mix asphalt surface course in single lift.
   c. Spread mix at minimum temperature of 250 deg F (121 deg C).
   d. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   e. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
2. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
   a. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
3. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

H. Joints
1. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   a. Clean contact surfaces and apply tack coat to joints.
   b. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
   c. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
   d. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations" **OR** as shown on Drawings, **as directed**.
   e. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   f. Compact asphalt at joints to a density within 2 percent of specified course density.

I. Compaction
1. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

a. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

2. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
3. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   a. Average Density:
      1) 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
      OR
      92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
4. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
5. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
6. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
7. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
8. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

J. Asphalt Curbs
1. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).
   a. Asphalt Mix: Same as pavement surface-course mix.
2. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

K. Asphalt Traffic-Calming Devices
1. Construct hot-mix asphalt speed bumps, humps, cushions, and tables over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).
   a. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
   b. Asphalt Mix: Same as pavement surface-course mix.
   c. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch (25 mm) from top of pavement to a clean, rough profile.
2. Place hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

L. Installation Tolerances
1. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   a. Base Course: Plus or minus 1/2 inch (13 mm).
   b. Surface Course: Plus 1/4 inch (6 mm), no minus.
2. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
   a. Base Course: 1/4 inch (6 mm).

b. Surface Course: 1/8 inch (3 mm).
c. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

M. Surface Treatments
1. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
2. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
   a. Roll slurry seal to remove ridges and provide a uniform, smooth surface.
3. Chip Seals: Apply asphalt binder directly to the pavement followed by a layer of ¼ inch aggregate chips **OR** as directed, and roll to embed aggregate into the binder.
   a. Can be applied as double **OR** triple layers, **as directed,** which are accomplished by applying additional layers of asphaltic material and aggregate. After applying each layer of aggregate, the surface is compacted using a roller to embed aggregates in the binder.
4. Sand Seals: Spray emulsion directly to the pavement followed by a layer of sand. The sand can be spread immediately for maximum stick, **OR** wait until after the emulsion breaks and be rolled with a pneumatic tire roller, **as directed**.

N. Pavement Marking
1. Do not apply pavement-marking paint until layout, colors, and placement have been verified with the Owner.
2. Allow paving to age for 30 **OR** 90, **as directed**, days before starting pavement marking.
3. Sweep and clean surface to eliminate loose material and dust.
4. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
   a. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

O. Wheel Stops
1. Install wheel stops in bed of adhesive as recommended by manufacturer.
2. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

P. Preformed Traffic-Calming Devices
1. Install preformed speed bumps **OR** humps **OR** cushions, **as directed**, in bed of adhesive as recommended by manufacturer for heavy traffic.
2. Securely attach preformed speed bumps **OR** humps **OR** cushions, **as directed**, to pavement with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

Q. Imprinting Asphalt
1. General: Imprint asphalt according to manufacturer's written instructions, using manufacturer's recommended equipment.
2. Freshly Laid Asphalt: Immediately after asphalt has been laid and compacted but still plastic, begin the surface imprinting process.
   a. Monitor asphalt surface temperature in compliance with manufacturer's written recommendations to ensure required temperature to perform surface imprinting.
   b. Reheat asphalt if surface temperature drops below that required.
3. Reheating Asphalt: Soften asphalt pavement surface by heating to a depth of at least 1/2 inch (13 mm) without burning asphalt.

a. Heat to a temperature of 300 to 325 deg F (149 to 163 deg C) immediately before applying templates.
b. Regularly monitor the pavement temperature to prevent overheating.
c. Direct flame heaters are not permitted.
d. If pavement is overheated and begins to emit black smoke, remove damaged pavement by milling down 1 inch (25 mm) and replace removed pavement with new, compacted surface course prior to resuming imprinting work.

4. Surface Imprinting: Apply and imprint templates to a minimum depth of 1/4 inch (6 mm) **OR** as required to embed precut marking material flush or barely beneath pavement surface, **as directed**.
5. Coating Application: After imprinted surface has cooled, apply two layers of base coating followed by two layers of top coating **OR** four layers of top coating, **as directed**. Do not allow traffic until coating has completely dried and cured.
6. Precut Marking Material Application: Position precut marking material aligned with imprinted pattern and slowly heat to a temperature no higher than 325 deg F (163 deg C) until marking material begins to liquefy and flow. Do not allow traffic until installed marking material has cooled to ambient temperature.

R. Field Quality Control
1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
3. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
4. Traffic-Calming Devices: Finished height of asphalt speed bumps, humps, cushions, and tables above pavement will be measured for compliance with tolerances.
5. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
   a. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   b. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
      1) One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than 3 cores taken.
      2) Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
6. Replace and compact hot-mix asphalt where core tests were taken.
7. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

S. Disposal
1. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   a. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 01 11 53a

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SECTION 32 01 11 53b - PAVEMENT JOINT SEALANTS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for pavement joint sealants. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
a. Cold-applied joint sealants.
b. Cold-applied, jet-fuel-resistant joint sealants.
c. Hot-applied joint sealants.
d. Hot-applied, jet-fuel-resistant joint sealants.

C. Preconstruction Testing
1. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, eight, Samples of materials that will contact or affect joint sealants. Use ASTM C 1087 **OR** manufacturer's standard test method, **as directed**, to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

D. Submittals
1. Product Data: For each joint-sealant product indicated.
2. Samples: For each kind and color of joint sealant required.
3. Pavement-Joint-Sealant Schedule: Include the following information:
a. Joint-sealant application, joint location, and designation.
b. Joint-sealant manufacturer and product name.
c. Joint-sealant formulation.
d. Joint-sealant color.
4. Product certificates.
5. Product test reports.
6. Preconstruction compatibility and adhesion test reports.

E. Quality Assurance
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.
2. Preinstallation Conference: Conduct conference at Project site.

F. Project Conditions
1. Do not proceed with installation of joint sealants under the following conditions:
a. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
b. When joint substrates are wet.
c. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
d. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.2 PRODUCTS

A. Materials
1. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
2. Colors of Exposed Joint Sealants: As selected from manufacturer's full range.

B. Cold-Applied Joint Sealants
1. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
2. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
3. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

C. Cold-Applied, Jet-Fuel-Resistant Joint Sealants
1. Jet-Fuel-Resistant, Single-Component, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type S, Grade P, Class 25, for Use T.
2. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 12-1/2, for Use T.
3. Jet-Fuel-Resistant, Multicomponent, Pourable, Traffic-Grade, Modified-Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

D. Hot-Applied Joint Sealants
1. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
2. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.

E. Hot-Applied, Jet-Fuel-Resistant Joint Sealants
1. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete: ASTM D 7116, Type I.
2. Hot-Applied, Jet-Fuel-Resistant, Single-Component Joint Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.

F. Joint-Sealant Backer Materials
1. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
2. For use in joints such as contraction joints cut partially through paving material:
    a. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
    b. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
3. For use in joints such as expansion joints extending through the full depth of the pavement:
    a. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

G. Primers
1. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

1.3 EXECUTION

A. Installation Of Joint Sealants
1. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
2. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
3. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
4. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint-sealant backings.
   b. Do not stretch, twist, puncture, or tear joint-sealant backings.
   c. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
5. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   a. Place joint sealants so they directly contact and fully wet joint substrates.
   b. Completely fill recesses in each joint configuration.
   c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
6. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   a. Remove excess joint sealant from surfaces adjacent to joints.
   b. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
7. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

B. Cleaning
1. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

C. Protection
1. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Final Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 32 01 11 53b

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SECTION 32 01 11 53c - CONCRETE PAVING

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing and installation of materials for cement concrete pavement. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Summary
1. Section Includes:
   a. Driveways.
   b. Roadways.
   c. Parking lots.
   d. Curbs and gutters.
   e. Walks.

C. Definitions
1. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

D. Submittals
1. Product Data: For each type of product indicated.
2. LEED Submittals:
   a. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   b. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.
3. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
4. Samples: For each type of product or exposed finish, prepared as Samples of size indicated below:
   a. Exposed Aggregate: 10-lb (4.5-kg) Sample of each mix.
   b. Wheel Stops: 6 inches (150 mm) long showing cross section; with fasteners.
   c. Preformed Traffic-Calming Devices: 6 inches (150 mm) long showing cross section; with fasteners.
5. Other Action Submittals:
   a. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
6. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer and testing agency.
7. Material Certificates: For the following, from manufacturer:
   a. Cementitious materials.
   b. Steel reinforcement and reinforcement accessories.
   c. Fiber reinforcement.
   d. Admixtures.
   e. Curing compounds.
   f. Applied finish materials.

g. Bonding agent or epoxy adhesive.
h. Joint fillers.

8. Material Test Reports: For each of the following:
   a. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
9. Field quality-control reports.

E. Quality Assurance
1. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
2. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
3. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
4. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
5. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.
6. Preinstallation Conference: Conduct conference at Project site.

F. Project Conditions
1. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
2. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials **OR** 55 deg F (12.8 deg C) for water-based materials, **as directed**, and not exceeding 95 deg F (35 deg C).

1.2 PRODUCTS

A. Forms
1. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   a. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.
2. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

B. Steel Reinforcement
1. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Plain-Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel **OR** galvanized-steel, **as directed**, wire into flat sheets.
3. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
4. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
5. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.
6. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

7. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
8. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
9. Plain-Steel Wire: ASTM A 82/A 82M, as drawn **OR** galvanized, **as directed**.
10. Deformed-Steel Wire: ASTM A 496/A 496M.
11. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain **OR** deformed, **as directed**.
12. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating, **as directed**. Cut bars true to length with ends square and free of burrs.
13. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.
14. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
    OR
    Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
15. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
    a. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
    b. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
16. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
17. Zinc Repair Material: ASTM A 780.

C. Concrete Materials
1. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
    a. Portland Cement: ASTM C 150, gray **OR** white, **as directed**, portland cement Type I **OR** Type II **OR** Type I/II **OR** Type III **OR** Type V, **as directed**. Supplement with the following, **as directed**:
        1) Fly Ash: ASTM C 618, Class C or Class F.
        2) Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
    b. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag **OR** Type IP, portland-pozzolan, **as directed**, cement.
2. Normal-Weight Aggregates: ASTM C 33, Class 4S **OR** Class 4M **OR** Class 1N, **as directed**, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials, **as directed**.
    a. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) **OR** 1 inch (25 mm) **OR** 3/4 inch (19 mm), **as directed**, nominal.
    b. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
    a. Aggregate Sizes: 3/4 to 1 inch (19 to 25 mm) **OR** 1/2 to 3/4 inch (13 to 19 mm) **OR** 3/8 to 5/8 inch (10 to 16 mm), **as directed**, nominal.
    b. Aggregate Source, Shape, and Color: A**s required to meet Project requirements**.
4. Water: Potable and complying with ASTM C 94/C 94M.
5. Air-Entraining Admixture: ASTM C 260.

6. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   a. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   b. Retarding Admixture: ASTM C 494/C 494M, Type B.
   c. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   d. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   e. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   f. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
7. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, **as directed**, nonfading, and resistant to lime and other alkalis.

D. Fiber Reinforcement
1. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

E. Curing Materials
1. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
2. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
3. Water: Potable.
4. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
5. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
6. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

F. Related Materials
1. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
2. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
3. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
4. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
   a. Types I and II, non-load bearing **OR** Types IV and V, load bearing, **as directed**, for bonding hardened or freshly mixed concrete to hardened concrete.
5. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).
6. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
7. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch (9.5-mm) sieve and 85 percent retained on a No. 8 (2.36-mm) sieve.

G. Detectable Warning Materials

1. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
   a. Size of Stamp: One piece matching detectable warning area shown on Drawings **OR** 24 by 24 inches (610 by 610 mm) **OR** 24 by 36 inches (610 by 914 mm) **OR** 24 by 48 inches (610 by 1220 mm) **OR** 26 by 26 inches (660 by 660 mm) **OR** 26 by 36 inches (660 by 914 mm), **as directed**.
2. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

H. Pavement Markings
1. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N **OR** Type F **OR** Type S, **as directed**; colors complying with FS TT-P-1952.
   a. Color: White **OR** Yellow **OR** Blue **OR** As indicated, **as directed**.
2. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.
   a. Color: White **OR** Yellow **OR** Blue **OR** As indicated, **as directed**.
3. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three **OR** 45, **as directed**, minutes.
   a. Color: White **OR** Yellow **OR** Blue **OR** As indicated, **as directed**.
4. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
   a. Color: White **OR** Yellow **OR** Blue **OR** As indicated, **as directed**.
5. Glass Beads: AASHTO M 247, Type 1 **OR** FS TT-B-1325, Type 1A, **as directed**.

I. Wheel Stops
1. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, 4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72 inches (1820 mm) long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   a. Dowels: Galvanized steel, 3/4 inch (19 mm) in diameter, 10-inch (254-mm) minimum length.
2. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE, or commingled postconsumer and postindustrial recycled rubber or plastic; UV stabilized; 4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1820 mm) long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   a. Color: Black **OR** Yellow **OR** Gray **OR** Green **OR** Blue, **as directed**.
   b. Dowels: Galvanized steel, 3/4 inch (19 mm) in diameter, 10-inch (254-mm) minimum length.
   c. Adhesive: As recommended by wheel stop manufacturer for application to concrete pavement.

J. Preformed Traffic-Calming Devices
1. Speed Bumps **OR** Humps **OR** Cushions, **as directed**: Solid, integrally colored, 100 percent postconsumer or commingled postconsumer and postindustrial recycled rubber or plastic; UV stabilized. Provide holes for anchoring to substrate.
   a. Bump Size: Modular 2 inches (50 mm) high by 10 inches (254 mm) wide by 72 inches (1800 mm) long, with overall length as dimensioned on Drawings.
   b. Hump **OR** Cushion, **as directed**, Size: Modular assemblies 3 inches (75 mm) high by 12 feet (3.7 m) in overall width **OR** 4 inches (100 mm) high by 14 feet (4.3 m) in overall width, **as directed**, with overall length as dimensioned on Drawings.
   c. Color: Black **OR** Yellow, **as directed**.
   d. Mounting Hardware: Galvanized-steel lag screw, shield, and washers; 1/2-inch (13-mm) diameter, 8-inch (200-mm) minimum length **OR** hardware as standard with device manufacturer for use with concrete paving, **as directed**.
   e. Adhesive: As recommended by device manufacturer.

K. Concrete Mixtures
1. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   a. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   b. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
2. Proportion mixtures to provide normal-weight concrete with the following properties:
   a. Compressive Strength (28 Days): 4500 psi (31 MPa) **OR** 4000 psi (27.6 MPa) **OR** 3500 psi (24.1 MPa) **OR** 3000 psi (20.7 MPa), **as directed**.
   b. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45 **OR** 0.50, **as directed**.
   c. Slump Limit: 4 inches (100 mm) **OR** 5 inches (125 mm) **OR** 8 inches (200 mm), **as directed**, plus or minus 1 inch (25 mm).
3. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   a. Air Content: 5-1/2 **OR** 4-1/2 **OR** 2-1/2, **as directed**, percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.
   b. Air Content: 6 **OR** 4-1/2 **OR** 3, **as diredcted**, percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
   c. Air Content: 6 **OR** 5 **OR** 3-1/2, **as directed**, percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.
4. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 **OR** 0.30, **as directed**, percent by weight of cement.
5. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   a. Use water-reducing admixture **OR** high-range, water-reducing admixture **OR** high-range, water-reducing and retarding admixture **OR** plasticizing and retarding admixture, **as directed**, in concrete as required for placement and workability.
   b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
6. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 (ACI 301M) requirements for concrete exposed to deicing chemicals **OR** as follows, **as directed**:
   a. Fly Ash or Pozzolan: 25 percent.
   b. Ground Granulated Blast-Furnace Slag: 50 percent.
   c. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
7. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m) **OR** 1.5 lb/cu. yd. (0.90 kg/cu. m), **as directed**.
8. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

L. Concrete Mixing
1. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, **as directed**. Furnish batch certificates for each batch discharged and used in the Work.
   a. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
2. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
   a. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

b. For concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
c. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

1.3 EXECUTION

A. Examination
1. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
2. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
a. Completely proof-roll subbase in one direction and repeat in perpendicular direction, **as directed**. Limit vehicle speed to 3 mph (5 km/h).
b. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
c. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Division 31 Section "Earth Moving".
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation
1. Remove loose material from compacted subbase surface immediately before placing concrete.

C. Edge Forms And Screed Construction
1. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
2. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

D. Steel Reinforcement
1. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
2. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
3. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
6. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
7. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

E. Joints
1. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
a. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

2. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   a. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
   b. Provide tie bars at sides of paving strips where indicated.
   c. Butt Joints: Use bonding agent **OR** epoxy bonding adhesive, **as directed**, at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   d. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
   e. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
3. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   a. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
   b. Extend joint fillers full width and depth of joint.
   c. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
   d. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   e. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   f. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
4. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
   a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) **OR** 3/8-inch (10-mm), **as directed**, radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces, **as directed**.
      1) Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.
   b. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
      1) Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.
   c. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
   d. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) **OR** 3/8-inch (10-mm), **as directed**, radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces, **as directed**.

F. Concrete Placement
   1. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
   2. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

3. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
4. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
5. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
6. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
7. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
    a. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
8. Screed paving surface with a straightedge and strike off.
9. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
10. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
11. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
    a. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
12. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
    a. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
    b. Do not use frozen materials or materials containing ice or snow.
    c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
13. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
    a. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
    b. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
    c. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

G. Float Finishing
1. General: Do not add water to concrete surfaces during finishing operations.
2. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
    a. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

b. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
c. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

H. Special Finishes
1. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
a. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
b. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
c. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
d. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
2. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch (1.6 mm).
a. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
b. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
c. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
d. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
3. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:
a. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) **OR** 40 lb/100 sq. ft. (19.5 kg/10 sq. m) **OR** 60 lb/100 sq. ft. (29 kg/10 sq. m), **as directed**, of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
b. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
c. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
d. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.
4. Rock-Salt Finish: After initial floating **OR** troweling **OR** brooming, **as directed**, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft. (0.2 kg/10 sq. m).
a. Embed rock salt into plastic concrete with roller or magnesium float.
b. Cover paving surface with 1-mil- (0.025-mm-) thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.
c. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.
5. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

a. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m), unless greater amount is recommended by manufacturer to match paving color required.
b. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
c. After final power floating, apply a hand-trowel finish followed by a broom finish.
d. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

I. Detectable Warnings
1. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Division 32 Section "Unit Paving".
   a. Tolerance for Opening Size: Plus 1/4 inch (6 mm), no minus.
2. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
   a. Before using stamp mats, verify that the vent holes are unobstructed.
   b. Apply liquid release agent to the concrete surface and the stamp mat.
   c. Stamping: While initially finished concrete is plastic **OR** After application and final floating of pigmented mineral dry-shake hardener, **as directed**, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
   d. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
   e. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

J. Concrete Protection And Curing
1. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
2. Comply with ACI 306.1 for cold-weather protection.
3. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
4. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
5. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
   a. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      1) Water.
      2) Continuous water-fog spray.
      3) Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   b. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
   c. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to

heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

K. Paving Tolerances
1. Comply with tolerances in ACI 117 and as follows:
   a. Elevation: 3/4 inch (19 mm).
   b. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
   c. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
   d. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
   e. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
   f. Vertical Alignment of Dowels: 1/4 inch (6 mm).
   g. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
   h. Joint Spacing: 3 inches (75 mm).
   i. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
   j. Joint Width: Plus 1/8 inch (3 mm), no minus.

L. Pavement Marking
1. Do not apply pavement-marking paint until layout, colors, and placement have been verified with the Owner.
2. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
3. Sweep and clean surface to eliminate loose material and dust.
4. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
   a. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
   b. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

M. Wheel Stops
1. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
2. Securely attach wheel stops to paving with not less than two steel **OR** galvanized-steel, **as directed**, dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

N. Preformed Traffic-Calming Devices
1. Install preformed speed bumps **OR** humps **OR** cushions, **as directed**, in bed of adhesive applied as recommended by manufacturer for heavy traffic.
2. Securely attach preformed speed bumps **OR** humps **OR** cushions, **as directed**, to paving with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

O. Field Quality Control
1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   a. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) **OR** 5000 sq. ft. (465 sq. m), **as directed**, or fraction thereof of each concrete mixture placed each day.

1) When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

b. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

c. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

d. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.

e. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

f. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

1) A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

3. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

4. Test results shall be reported in writing to the Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

5. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner but will not be used as sole basis for approval or rejection of concrete.

6. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Owner.

7. Concrete paving will be considered defective if it does not pass tests and inspections.

8. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

9. Prepare test and inspection reports.

P. Repairs And Protection

1. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the Owner.

2. Drill test cores, where directed by the Owner, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

3. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

4. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Final Completion inspections.

END OF SECTION 32 01 11 53c

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SECTION 32 17 23 13 - TRACK, COURT, AND PLAYGROUND MARKINGS

1.1 GENERAL

A. Description Of Work
1. This specification covers the furnishing of materials and the installation of track, court, and playground markings. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

B. Submittals
1. Submit product data and manufacturer's recommendations for each marking to be furnished.
2. Submit sample of each marking to be furnished.
3. Submit "Line Layout Drawing" prior to installation of marking and upon completion of markings, submit three (3) certified line layout drawings indicating all lines and colors.

C. Quality Assurance: Personnel shall have a minimum of three years marking experience.

D. Delivery, Storage and Handling: Deliver paint to site in original sealed containers or drums, with labels legible, intact and unbroken. Comply with all health and fire regulations.

E. Environmental Requirements: Do not install markings on wet or frozen surfaces. Comply with manufacturer's instructions for temperature requirements.

1.2 PRODUCTS

A. Manufacturers
1. Line Paint for Resilient Surface: Aliphatic polyurethane paint, such as Hi-Build Aliphatic Polyurethane paint by Sherwin-Williams, or approved equivalent.
2. Line Paint for Asphaltic Concrete Pavement: Latex traffic marking paint, such as Setfast Latex Traffic Marking paint by Sherwin-Williams, or approved equivalent.
3. Line Paint for Athletic Wearing Surface (Plexipave): 100% acrylic latex paint, such as Plexicolor by California Products, or approved equivalent.

1.3 EXECUTION

A. Application
1. Line Painting
   a. Accurately measure and layout line markings.
   b. Apply paint with mechanical equipment.
   c. Paint lines as specified below under "Track Marking".
   d. Provide uniform straight edges.
   e. Apply not less than two coats in accordance with manufacturer's recommended rates.
   f. Lines shall be 2 in. (50 mm) wide unless otherwise specified.
2. Track Marking
   a. Employ a licensed land surveyor to accurately measure and lay out line markings in accordance with National Federation of State High School Athletic Association Regulations or other Standards set forth by the Owner.
   b. Events:
      1) 100 meter dash
      2) 200 meter dash
      3) 400 meter dash

4) 800 meter run
5) 1600 meter run
6) 3200 meter run
7) One mile run
8) 4 x 100 meter relay
9) 4 x 200 meter relay
10) 4 x 400 meter relay
11) 4 x 800 meter relay
12) 110 meter high hurdles
13) 300 meter intermediate hurdles
14) Girls 100 meter hurdles
15) Girls 300 meter hurdles

c. Hurdle location markers: yellow hash marks.
d. Lane lines: white (min. 42 in. (105 cm) apart).
e. Exchange zones:
   1) 4 x100 m green
   2) 4 x 200 m blue
   3) 4 x 400 m yellow
   4) 12 in. (305 mm) across entire lane width.
f. Lane numbers: Stenciled in three locations from inside to outside. Numbers shall be 24 in. (60 cm) high and white in color.
g. Finish line to be located near bleachers.
h. All starts and finishes to be white.

B. Cleaning: Upon completion of work, remove containers and debris and leave site in clean orderly condition acceptable to the Owner.

C. Protection
1. Erect temporary barriers to protect paint during drying period.
2. Protect markings from damage until completion of project.

END OF SECTION 32 17 23 13

Task	Specification	Specification Description
32 17 23 13	32 01 11 53	Traffic Coatings
32 17 23 13	32 01 11 53a	Asphalt Paving
32 17 23 13	32 01 11 53c	Concrete Paving
32 17 23 23	32 01 11 53	Traffic Coatings
32 17 23 23	32 01 11 53a	Asphalt Paving
32 17 23 23	32 01 11 53c	Concrete Paving
32 17 23 33	32 01 11 53	Traffic Coatings
32 17 23 33	32 01 11 53a	Asphalt Paving
32 17 23 33	32 01 11 53c	Concrete Paving

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Task	Specification(s)
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01 20 00 00	01 00 00 00
01 22 00 00	01 00 00 00
01 22 16 00	01 22 16 00, 01 00 00 00
01 22 20 00	01 00 00 00, 01 22 16 00
01 70 00 00	01 00 00 00
01 71 00 00	01 00 00 00
01 71 13 00	01 00 00 00, 01 22 16 00
01 71 23 00	01 00 00 00
01 71 23 16	01 71 23 16, 01 00 00 00
01 00 00 00MOD000	01 00 00 00
10 14 53 11	10 14 53 11
32 01 11 53	32 01 11 53, 32 01 11 53a, 32 01 11 53b, 32 01 11 53c
32 17 23 13	32 17 23 13, 32 01 11 53, 32 01 11 53a, 32 01 11 53c
32 17 23 23	32 01 11 53, 32 01 11 53a, 32 01 11 53c
32 17 23 33	32 01 11 53, 32 01 11 53a, 32 01 11 53c

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