Revise this Section by deleting and inserting text to meet Project-specific requirements.

SECTION 321726 - TACTILE WARNING SURFACING

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			2. SUMMARY
				1. Section Includes:

Surface-applied detectable warning metal tiles.

Detectable warning unit pavers.

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 321313 “Portland Cement Concrete Road Paving”.

Section 321613 “Concrete Curbs and Gutters”.

Section 321613.23 “Precast Concrete and Granite Curbing”.

* + - 1. REFERENCES
				1. American Association of State Highway and Transportation Officials

AASHTO M333 - Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test

* + - * 1. American National Standards Institute

ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar (2019)

* + - * 1. American Society of Civil Engineers

ASCE 5-11/6-11 – Building Code Requirements and Specifications for Masonry Structures

* + - * 1. ASTM International

ASTM A48 - Standard Specification for Gray Iron Castings

ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

ASTM C33 - Standard Specification for Concrete Aggregates

ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

ASTM C150 - Standard Specification for Portland Cement

ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction

* + - * 1. New York State Building Code

Chapter 11 - Accessibility

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Remove Paragraph below if Sustainable Design Submittals are not required.

* + - * 1. Sustainable Design Submittals:
				2. Samples: For each type of exposed finish; submit two samples, the same color as the material to be installed, 6 inches x 8 inches minimum.
				3. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.
			1. PROJECT CONDITIONS
				1. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

Retain "Weather Limitations for Adhesive Application" Paragraph below if using adhesive.

* + - * 1. Weather Limitations for Adhesive Application:

Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

Retain "Weather Limitations for Mortar and Grout" Paragraph below if using mortar or grout.

* + - * 1. Weather Limitations for Mortar and Grout:

Cold-Weather Requirements: Comply with cold-weather construction requirements CONTAINED IN ASCE 5-11/ASCE 6-116/TMS 402/602.

Retain "Hot-Weather Requirements" subparagraph below for detectable warning unit pavers set in mortar. Hot weather has more effect on unit paver installations than on masonry, because horizontal surfaces absorb more solar energy than vertical surfaces. Insert specific limits to suit local conditions.

Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

* + - 1. WARRANTY

When warranties are required, verify with Director’s Representative's that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Deterioration of finishes beyond normal weathering and wear.

Separation or delamination of materials and components.

Verify available Warranties and Warranty Periods for units and components.

Warranty Period: [**Five**] years from date of Substantial Completion.

1. PRODUCTS
	* + 1. TACTILE WARNING SURFACING, GENERAL

Verify Accessibility Requirements with authorities having jurisdiction. Some Projects may require compliance with multiple accessibility regulations.

* + - * 1. Accessibility Requirements: Comply with applicable provisions in the New York State Building Code for tactile warning surfaces.

For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

Source Limitations: Obtain each type of tactile warning surfacing[**, joint material**] [**, setting material**] [**, anchor**] [**, and**] [**fastener**] from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

Contract drawings must show required dimensions and shapes of tactile warning surfacing.

Shapes and Sizes: In manufacturer’s standard shapes and sizes, of suitable quantity and arrangement to set required area shown on the Contract Drawings.

Dome Spacing: 1.6-inch minimum center to center spacing, 2.4-inch maximum center to center spacing; 0.65” minimum base to base spacing.

Dome Configuration: manufacturer's standard pattern.

* + - 1. DETECTABLE WARNING TILES

Retain "Cast-in-Place Detectable Warning Metal Tiles" Paragraph below for formed- or cast-stainless-steel or cast-iron detectable warning tiles wet-set in concrete or adhered to recess in cured concrete. Retain option for tiles with permanently embedded anchors and replaceable surface; verify availability with manufacturer.

* + - * 1. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles[**with replaceable surface**] configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=9471) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

ADA Solutions, LLC., (800) 372-0519, 323 Andover St Ste 3, Wilmington, MA 01887

[Advantage Tactile Systems](http://www.specagent.com/Lookup?uid=123457127752), (800) 679-4022, 241 Main St Ste 100, Buffalo, NY 14203

[EJ](http://www.specagent.com/Lookup?uid=123457127750)., (800) 874-4100, 301 Spring Street, PO Box 439, East Jordan, MI 49727

[Neenah Foundry Company](http://www.specagent.com/Lookup?uid=123457127751), (920) 725-7000, 2121 Brooks Ave, Neenah, WI 54956

Approved equivalent.

Material:

Stainless-Steel Plate and Sheet: ASTM A 240 or ASTM A 666, [**Type 304**] [**Type 316L**].

Finish and Color:

Manufacturer's standard powder coat, [**safety yellow**] [**red brick**] [**black**] [**gray**] [**color as selected by Director’s Representative from manufacturer's full line**].

Mill finish.

Retain "Cast Iron" subparagraph below for detectable warning units made by East Jordan Iron Works or Neenah Foundry.

Cast Iron: Gray iron, ASTM A 48, CL 35.

Mounting:

Retain one of two subparagraphs below.

Permanently embedded detectable warning tile wet-set into freshly poured concrete.

Permanently embedded detectable warning tile set into formed recess in concrete and adhered with mortar.

Retain "Surface-Applied Detectable Warning Metal Tiles" Paragraph below for formed-stainless-steel detectable warning tiles adhered and fastened to existing concrete paving.

* + - * 1. Surface-Applied Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles or plates configured for fastening to surface of existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=9472) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

[Advantage Tactile Systems](http://www.specagent.com/Lookup?uid=123457127778), (800) 679-4022, 241 Main St #100, Buffalo, NY 14203

Approved equivalent.

Material: Stainless-Steel Plate and Sheet: ASTM A 240 or ASTM A 666, [**Type 304**] [**Type 316L**].

Finish and Color:

Manufacturer's standard powder coat, [**safety yellow**] [**red brick**] [**black**] [**gray**] [**color as selected by Director’s Representative from manufacturer's full line**].

Mill finish.

Retain one of two Mounting options below.

Mounting:

Replaceable surface-applied detectable warning tile fastened with permanently installed anchors to existing concrete walkway.

Permanently fixed detectable warning tile adhered [**and fastened**] to existing concrete walkway.

* + - 1. DETECTABLE WARNING UNIT PAVERS

Retain "Detectable Warning Concrete Unit Pavers" Paragraph below for granite detectable warning unit pavers set in prepared setting bed or adhered to substrate with mortar.

* + - * 1. Detectable Warning Granite Unit Pavers: Solid paving units, made from natural granite stone products, with accessible detectable warning truncated domes on exposed surface of units.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=9472) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

[Coldspring](http://www.specagent.com/Lookup?uid=123457127778), (800) 328-5040, 17482 Granite West Road, Cold Spring, MN 56320

Approved equivalent.

Requirements in "Mortar Setting Bed" Paragraph are examples; revise to suit Project.

* + - * 1. Mortar Setting Bed:

Portland Cement: ASTM C 150, Type I or Type II.

Sand: ASTM C 33.

Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed Portland cement and aggregate mortar bed, and not containing a retarder.

Thinset Mortar: Latex-modified Portland cement mortar complying with ANSI A118.4.

Water: Potable.

* + - 1. ACCESSORIES

Retain one or more of "Fasteners and Anchors," "Adhesive," and "Sealant" Paragraphs below as required for installation of tactile warning surfacing unit types selected.

* + - * 1. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

Usually retain Type 304 in first subparagraph below; retain Type 316 if required for corrosive environments.

Furnish [**Type 304**] [**Type 316**] stainless-steel fasteners for exterior use.

Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

* + - * 1. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.
				2. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.
1. EXECUTION
	* + 1. EXAMINATION
				1. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION OF TACTILE WARNING SURFACING
				1. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
				2. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

Retain one or more of "Installation of Detectable Warning Tiles," and "Installation of Detectable Warning Unit Pavers" articles below corresponding to Project requirements; coordinate with products retained in Part 2.

* + - 1. INSTALLATION OF DETECTABLE WARNING TILES

Retain one or more of "Removable Cast-in-Place Detectable Warning Tiles," and "Surface-Applied Detectable Warning Tiles" Paragraphs below corresponding to Project requirements; coordinate with products retained in Part 1.

* + - * 1. Removable Cast-in-Place Detectable Warning Tiles:

Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.

Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.

Clean tiles using methods recommended in writing by manufacturer.

* + - * 1. Surface-Applied Detectable Warning Tiles:

Lay out detectable warning tiles as indicated and mark concrete pavement.

Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

Retain first subparagraph below for metal tiles or plates configured with flanged return at edge.

Cut perimeter kerf in existing concrete pavement to receive metal tile flange.

Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.

Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.

Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

Protect installed tiles from traffic until adhesive has set.

* + - 1. INSTALLATION OF DETECTABLE WARNING UNIT PAVERS
				1. Unit Paver Installation, General:

Mix unit pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

Tolerances: Do not exceed 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

* + - * 1. Mortar Setting-Bed Applications:

Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch-thick bond coat to mortar bed or to back of each paver with a flat trowel.

Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

Joint widths in "Spaced Joint Widths" subparagraph below are examples only. Retain tolerance to suit manufacturing tolerances of pavers.

Spaced Joint Widths: Provide [**1/4-inch**] maximum joint width.

Retain "Grouted Joints" subparagraph and three following subparagraphs if mortar setting-bed application includes grouted joints.

Grouted Joints: Grout paver joints complying with ANSI A108.10. Grout joints as soon as possible after initial set of setting bed.

Force grout into joints, taking care not to smear grout on adjoining surfaces.

Tool exposed joints slightly concave when thumbprint hard.

Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

Remove excess grout from exposed paver surfaces; wash and scrub clean.

Protect installation from traffic until grout has set.

* + - 1. CLEANING AND PROTECTION
				1. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Director’s Representative. Replace using tactile warning surfacing installation methods acceptable to Director’s Representative.
				2. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726