SECTION 9XXX – RECESSED WET-REFLECTIVE TAPE PAVEMENT MARKINGS

I. DESCRIPTION - This work consists of furnishing, installing and warranting preformed wet-reflective striping tape (tape) markings as specified in the Contract Documents and as directed by the Representative. These markings must be warranted in writing by the manufacturer for a period of five years from the date of the end of the guarantee period.

II. MATERIAL -

Recessed Wet-Reflective Tape. 3M™ Stamark™ High Performance All Weather Tape Series 380AW & 381AW, & 385AW Black

or an approved equal.

Surface Preparation Adhesive. 3M™ Low VOC Surface Preparation Adhesive SPA60

or an approved equal.

III. CONSTRUCTION -

(a) General. Apply the tape markings and surface preparation adhesive according to the manufacturer's installation instructions and as directed by the Representative. Line marking configurations are according to the Standard Drawings. All lines are to be positioned 4 inches from the respective pavement joint or as otherwise indicated.

All tape markings and surface preparation adhesive must be installed by manufacturer certified installers only.

Coordinate a pre-application meeting at least 30 days prior to starting the installation of any pavement markings. At the pre-application meeting, provide the Representative with the following:

- The source of supply for the tape markings and surface preparation adhesive and the manufacturer's written instruction for use. These instructions are to include, but not limited to, the application temperatures.
- Procedures for cutting the grooves with gang-stacked diamond saw blades.
- Procedures for installing the tape markings in the diamond cut saw grooves.

(b) Equipment. Equip the grinding equipment with a free-floating cutting or grinding head to provide a consistent groove depth over irregular pavement surfaces. Equip the grinding or cutting head with gang-stacked diamond saw blades. The grinding equipment must be capable of producing a final pavement surface that is flat and free of ridges.

For dry saw blade operation, clean and remove debris and dust from the entire roadway surface by self-contained vacuuming immediately after grinding.

Wet saw blade operation is only allowed for use on concrete surfaces. When water is used, flush the groove with clean high-pressure water immediately following the cut to avoid build-up and hardening of the slurry in the groove. The concrete surface must be clean and dry before the installation of the tape markings.

Properly dispose of the waste resulting from the grinding operations. Dumping of any milling or grinding waste within the Department's right-of-way is strictly prohibited.

At any time throughout the duration of the project, provide free access to the tape application equipment for the inspection by the Representative.

(c) Manufacturer's Recommendation. Provide a copy of the manufacturer's recommendations to the Representative at least thirty (30) days prior to starting the installation of any pavement markings.

(d) Manufacturer's Certification. Provide a copy of Form CS-4171, Certificate of Compliance, including the material's date of manufacture and lot number.

(e) Surface Preparation. Clean the roadway surface where the tape markings will be applied. Remove all surface treatment, laitance, curing compound, or any other contaminants that would hinder adhesion. Clear any loose dirt and other debris from the area where the tape markings will be applied. Surface preparation is incidental to the application of tape markings, except for the removal of pavement markings which is performed and paid for under Section 963. Use material and equipment that will not damage the final pavement surface and that will show the final lines on which the pavement markings will be placed. Identify the location of the permanent pavement markings by applying spot markings on the pavement at 40-foot intervals. The Representative will approve the locations before tape markings are applied.

(f) Installation. Recess the tape markings into the final pavement surface. This includes newly paved asphalt after the final rolling of the surface, concrete pavement, concrete bridge decks and interchange ramps. Newly paved asphalt surfaces must not be grooved within 14 days of placement of the final course of pavement. Diamond cut the recessed area to a depth of 150 mils and 1 inch wider than the width of the pavement marking. For skip lines, cut the recessed area 10 feet in length with a maximum tolerance of +6 inches on either end.

If applicable, recess the black markings in accordance with the Standard Drawings. When black markings are installed at the same time as the broken white lane line markings, cut the recessed area 20 feet in length with a maximum tolerance of +6 inches on either end and a maximum 2-inch gap between the white and black marking applications. When black markings are installed for existing broken white lane line markings, cut the recessed area 10 feet in length immediately following the existing broken white markings with a maximum 6-inch gap between the white and black marking applications. If black recessed polyurea pavement markings are used, refer to Standard Special Provision Section 9XXX, Recessed Wet-Reflective Polyurea Pavement Markings.

Marking operations must not begin until applicable surface preparation work is completed and approved by the Representative. The marking must be applied on dry pavement when no rainfall has occurred for 24 hours prior to the application, the surface temperature is 70F and rising, and the air temperature is 40F and rising unless otherwise approved by the Representative and the manufacturer.

Tape markings are to be recessed in the pavement and be resistant to deformation by traffic and damage from snow removal equipment.

Surface preparation adhesive is to be applied to all tape markings according to the manufacturer's recommendations.

Cut the tape marking 1 inch away from any transverse pavement joint on both sides of the joint.

Apply tape markings in the direction of traffic.

Establish marking line points at 40 foot intervals throughout the length of the pavement as directed by the Representative.

Apply tape markings by the following simultaneous operation:

1. Clean the grooved pavement surface to remove dirt and residues.
2. Apply surface preparation adhesive to the grooved pavement surface and allow adhesive to set following the manufacturer's detailed recommendations.
3. Apply tape in the groove following the manufacturer's detailed recommendations.
4. Tamp according to (g) Tamping below.

(g) Tamping. Slowly drive over the tape marking a minimum of six tamping hits all forward passing over the surface of the new tape in the groove. The vehicle must be equipped with a pointing device to aid in keeping with vehicle tire on the tape. Tire strikes from front and rear wheels when aligned with the aid of a pointing device can be completed in 3 passes. Use a vehicle tire as recommended by the manufacturer.

Tape application in the groove will require tamping with a vehicle tire. Tamping the edges of the tape is very important. The vehicle used to tamp the tape must be recommended by the manufacturer and approved by the Representative. Do not twist or turn the vehicle tire on the tape and make sure the edges are firmly adhered.

(h) Guarantee Period. Be responsible for any defects in materials and workmanship of the tape markings for a period of 180 days from the date that the pavement area in which the markings are applied is open to traffic.

Before the end of the guarantee period, but at least 30 days after the tape markings are installed, have an independent third party inspect the pavement marking for adhesion, color and retroreflectivity, and inform the Representative in writing of the testing results. The adhesion and retroreflectivity testing by the independent third party must be performed under the direction and supervision of the Representative and testing results must be provided to the Representative within 5 days after the measurements are taken. The pavement marking will be considered failed for any of the following conditions:

- The substrate is exposed in any section of longitudinal pavement marking line.
- Inadequate adhesion or delamination as determined by the adhesion testing results.
- Insufficient depth of the groove.
- Retroreflected luminance (RL) levels are below those shown in Table 1.
- Marking is discolored based on a visual inspection. Color chips provided by the manufacturer will be used to assess discoloring**.**

Table 1. Minimum Required Retroreflectivity Levels

WHITE	**DRY**	**CONTINUOUS WET**
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
Retroreflected Luminance R_L (mcd/m^2/lx)	500	250
YELLOW	**DRY**	**CONTINUOUS WET**
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
Retroreflected Luminance R_L (mcd/m^2/lx)	300	200

Note: The test instrument must use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

Retroreflectance. Test dry and wet retroreflectivity before the end of the guarantee period, but at least 30 days after the tape markings are installed in the direction of traffic on each line (left edge, skip(s), right edge) at every whole milepost. Refer to ASTM E 1710 for retroreflective measurements under dry conditions and ASTM E 2832 for retroreflective measurements under continuous wet conditions.

Dry retroreflectivity measurements are to be taken within a 400-foot evaluation section at every whole milepost. Average a minimum of 20 retroreflectivity readings per line within the 400-foot evaluation section. Each average for each line will be used to determine a grand average for each line for the length of the project. The grand average of each line will be used to determine compliance. Directional data will be treated independently. See Figure 1 in ASTM D 7585 for an example of how to space individual readings. For dry measurements, mobile equipment can be used as a substitute for handheld equipment.

Take at least one wet retroreflectivity reading on each line at every whole milepost. The grand average for each line will be determined from the respective wet readings. The grand average of each line will be used to determine compliance. Directional data will be treated independently. Take wet readings within the same 400-foot evaluation section used to obtain dry retroreflectivity readings.

Provide reports with all dry and wet retroreflectivity readings and their averages to the Representative within 5 days after the measurements are taken.

Adhesion. Test the adhesion of the tape markings before the end of the guarantee period, but at least 30 days after the tape markings are installed on each line (left edge, skip(s), right edge) at every whole milepost using a paint scraper or other approved tool, held parallel with the highway surface. The edge of the material must be scraped lightly and there must be no dislodging of the tape. Notify the Representative to witness this procedure. Directional data will be treated independently.

(i) Defective Markings. During the guarantee period, remove and replace tape markings, which after installation are determined by the Representative to be defective and not in conformance with this specification, within 30 days of receiving written notification from the Representative at no additional cost to the Department. Work must be in conformance with the manufacturer's recommendations and as approved by the Representative before the project is accepted. The replacement markings must conform to the same requirements as the original markings. Repair defective markings to the satisfaction of the Representative as follows:

- Defect: Insufficient line width or exposed substrate; poor adhesion or delamination; insufficient groove depth; retroreflected luminance (RL) levels below those shown in Table 1; discoloration.

  Repair Method: Prepare the surface of the defective tape markings by grinding or blast cleaning. No other cleaning methods are allowed. Prepare the surface so that all of the defective tape markings are removed and a clean surface remains. Immediately after surface preparation, remove loose particles and foreign debris by vacuuming. Re-install tape markings to restore pavement marking retroreflectivity values to warranty levels or greater for the remainder of the warranty period on the cleaned surface in accordance with the requirements of this specification.

Repair or replace other defects not noted above, but determined by the Representative to need repair, as directed by and to the satisfaction of the Representative.

(j) Warranty. Provide the Department with a written five-year warranty for the tape markings within 10 business days of end of the guarantee period. The written warranty is to include but is not limited to agreement to the conditions in (h). The five-year period begins at the conclusion of the guarantee period. The warranty must cover the pavement marking materials, the work to replace the markings when necessary, and the cost to provide maintenance and protection of traffic during the reinstallation.

The manufacturer is to warrant tape markings used, will remain effective for its intended use, and will meet the minimum retained coefficient of dry retroreflection value of 100 $cd/m^2/lx$ (in accordance with ASTM E 1710).

If the pavement markings are applied in accordance with the manufacturer's application recommendations and fail by any one of the following during the warranty period:

1. Retroreflectance values drop below the minimum retained coefficient of dry retroflection value of 100 mcd/m^2/lx
2. Failure to completely adhere to the roadway
3. Failure due to complete wear-through

the manufacturer will provide and install the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater for failure areas.

If the manufacturer fails to provide and install the replacement materials that will restore the pavement marking retroreflectivity values to warranty levels or greater for failure areas, the manufacturer will provide the Department with full reimbursement for contract cost of initial installation of the tape markings and reimbursement of line painting of 2 applications per year for the remainder of the warranty period for failure areas.

(k) Warranty Inspection Procedures.

1. Routine visual inspections will be performed by Department personnel and the manufacturer to monitor the quality of the markings. Areas that appear to be below the minimum retroreflectivity values, adhesion failures, or failures due to complete wear-through will be identified by further investigation.
2. Areas identified for further investigation will be jointly reviewed by the manufacturer and the Department visually at night within 30 days of notification.
3. If retroreflectivity measurements become necessary following an investigation by the manufacturer and the Department, readings will be taken by the manufacturer in conformance with ASTM E 1710. If retroreflectivity is below accepted values, the manufacturer must replace the markings.
4. Manufacturer is to provide a contact person to the Department. The contact person for the Department is the local area District Traffic Engineer.

(l) Emergency Repair. During the warranty period, if the Department determines that emergency repairs due to tape failure are necessary, the manufacturer must respond to the Department within 24 hours of notification to develop a plan to address unsafe conditions through temporary or permanent measures. If the manufacturer fails to respond within the 24 hour period, the Department reserves the right to perform the repairs and will charge the manufacturer for all costs. The Department's determination of costs incurred is final and conclusive.

IV. MEASUREMENT AND PAYMENT -

(a) Line. Linear Foot, for the type indicated.
(b) Pavement Marking Removal. Section 963.4