
PAVEMENT MARKINGS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Permanent Pavement Markings, Symbols, and Legends
- B. Removable Pavement Markings, Symbols, and Legends
- C. Temporary Delineators
- D. Raised Pavement Markers
- E. Removal of Pavement Markings, Symbols, and Legends
- F. Grooves Cut for Pavement Markings, Symbols, and Legends

1.02 DESCRIPTION OF WORK

- A. Furnish, install, maintain, and remove permanent or temporary pavement markings, temporary delineators, and raised pavement markers, such as for:
 - 1. Diversions and on-site detours where the need for this work is anticipated as part of the traffic control plan to accommodate traffic during construction.
 - 2. Replacing markings obliterated during construction activities on roads open to public traffic.
 - 3. Changing markings on roads open to public traffic where the necessary changes result from staged construction.
 - 4. Replacing markings that are obsolete.
 - 5. Marking newly completed pavement surfaces.
 - 6. Replacing existing markings that have faded or worn away on roads open to public traffic.
- B. Permanent pavement markings are intended to remain in place after the project is completed. Temporary markings are designated for removal, will be obliterated during construction, or require changes during construction.
- C. Diversions are installations or modifications for the transfer of traffic on four lane or wider roadways to lanes that would normally carry traffic in the opposite direction. Diversions provide for continuous but restricted traffic flow from both directions for divided highways. Diversions usually include crossovers.
- D. On site detours are temporary roadways specifically constructed to accommodate traffic during construction.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants as well as the following:

- A. Submit a list of pavement marking materials proposed for use on the project.
- B. Provide the Engineer with a copy of the manufacturer's recommendations for applying the pavement marking.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. General:**

1. Painted, taped, or removed lines will be measured in stations based upon a single 4 inch width.
2. The length of each type of marking will be as specified in the contract documents and will consider measured field adjustments.
3. The measurement for dashed and dotted lines will be adjusted to exclude the skips.
4. Measured lengths of lines wider than 4 inches will be multiplied by a width factor as follows:

$$\text{Width Factor} = \text{Actual Width} / 4 \text{ inches}$$

B. Painted Pavement Markings, Solvent/Waterborne:

1. **Measurement:** Each type of painted pavement marking will be measured in stations.
2. **Payment:** Payment will be made at the unit price for each type of painted pavement marking.
3. **Includes:** Unit price includes, but is not limited to, reflectorizing spheres, layout, surface preparation, and application of marking paint.

C. Painted Pavement Markings, Durable:

1. **Measurement:** Each type of painted pavement markings will be measured in stations.
2. **Payment:** Payment will be made at the unit price for each type of painted pavement marking.
3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of marking paint.

1.08 MEASUREMENT AND PAYMENT (Continued)**D. Painted Pavement Markings, High-Build:**

1. **Measurement:** Each type of painted pavement markings will be measured in stations.
2. **Payment:** Payment will be made at the unit price for each type of painted pavement marking.
3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of marking paint.

E. Permanent Tape Markings:

1. **Measurement:** Each type of marking tape will be measured in stations.
2. **Payment:** Payment will be made at the unit price for each type of tape marking.
3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of marking tape.

F. Wet, Retroreflective Removable Tape Markings:

1. **Measurement:** Wet, retroreflective removable tape markings will be measured in stations.
2. **Payment:** Payment will be made at the unit price per station for wet, retroreflective removable tape markings.
3. **Includes:** Unit price includes, but is not limited to layout, surface preparation, application, and removal.

G. Painted Symbols and Legends:

1. **Measurement:** Each type of painted symbol and legend will be counted.
2. **Payment:** Payment will be made at the unit price for each painted symbol and legend.
3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of each symbol and legend.

H. Precut Symbols and Legends:

1. **Measurement:** Each type of precut symbol and legend will be counted.
2. **Payment:** Payment will be made at the unit price for each precut symbol and legend.
3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of each symbol and legend.

I. Temporary Delineators:

1. **Measurement:** Each temporary delineator installed and removed will be counted.
2. **Payment:** Payment will be made at the unit price for each delineator.
3. **Includes:** Unit price includes, but is not limited to, installation and removal of delineators.

1.08 MEASUREMENT AND PAYMENT (Continued)**J. Raised Pavement Markers:**

1. **Measurement:** Each raised pavement marker installed and removed will be counted.
2. **Payment:** Payment will be made at the unit price for each marker.
3. **Includes:** Unit price includes, but is not limited to, installation and removal of pavement markers.

K. Pavement Markings Removed:

1. **Measurement:** Pavement markings removed will be measured in stations. Removable marking tape or markings obliterated during construction will not be measured.
2. **Payment:** Payment will be made at the unit price for pavement markings removed.
3. **Includes:** Unit price includes, but is not limited to, pavement marking removal and waste material collection, removal, and disposal.

L. Symbols and Legends Removed:

1. **Measurement:** Each symbols or legends removed will be counted.
2. **Payment:** Payment will be made at the unit price for each symbol or legend removed.
3. **Includes:** Unit price includes, but is not limited to, symbol and legend marking removal and waste material collection, removal, and disposal.

M. Grooves Cut for Pavement Markings:

1. **Measurement:** Measurement will be in stations and will be equivalent to the quantity of pavement markings associated with the grooving.
2. **Payment:** Payment will be made at the unit price per station.
3. **Includes:** Unit price includes, but is not limited to, layout, cutting grooves, collection and disposal of removed material, and additional groove width and transition length beyond the pavement marking dimensions.

N. Grooves Cut for Symbols and Legends:

1. **Measurement:** Each symbol or legend groove will be counted.
2. **Payment:** Payment will be made at the unit price for each symbol or legend groove.
3. **Includes:** Unit price includes, but is not limited to, layout, cutting grooves, and collection and disposal of removed material.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Provide pavement marking materials that comply with Iowa DOT Section 2527.
- B. Pavement marking materials include:
 - 1. Wet, retroreflective removable tape markings
 - 2. Painted Pavement Markings:
 - a. Waterborne and solvent based paint pavement markings
 - b. Durable paint pavement markings
 - c. High-build waterborne paint pavement markings
 - 3. Regular marking tape
 - 4. Temporary delineators
 - 5. Raised pavement markers
 - 6. Channelizer markers
 - 7. Preformed polymer tape
 - 8. Removable, nonreflective preformed tape
 - 9. Profiled pavement marking tape
 - 10. Intersection marking tape

PART 3 - EXECUTION**3.01 EQUIPMENT**

A. General: Utilize equipment complying with Iowa DOT Section 2527.

B. Pavement Marking Equipment:

1. Capable of placing two lines simultaneously with either line in a solid or intermittent pattern in yellow or white.
2. Capable of applying reflectorizing spheres at the required rate with a pressurized system.
3. All guns in full view of the operator at all times.
4. Equipped with a metering device to register the accumulated length of each gun, each day.
5. Designed so the pressure gages of each proportioning pump are visible to the operator at all times during operation to monitor fluctuations in pressure.
6. Capable of applying paint without dilution.

C. Pavement Marking Removal:

1. Operates without the release of dust.
2. Recovers all removed material.
3. Includes a waste collection and transfer system and for dry wastes, ensure the system incorporates high-efficiency particulate absorption (HEPA) methods and equipment.

D. Pavement Grooving:

1. Utilize grooving equipment with stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment.
2. If pavement is grooved by dry cutting, provide equipment that is self vacuuming.
3. When requested, make available to the Engineer a caliper, depth gage, or depth plate, for use in measuring groove depth.

3.02 CONSTRUCTION

A. General:

1. Comply with the requirements of the MUTCD for traffic control during all pavement marking operations.
2. Install all pavement markings according to the product manufacturer's published recommendations.

3.02 CONSTRUCTION (Continued)

3. Ensure the following for all painted and taped pavement markings:
 - a. Uniform thickness
 - b. Uniform distribution of reflectorizing spheres throughout the line width
 - c. Line widths as specified, with a tolerance of $\pm 1/4$ inch for 4 inch lines and $\pm 1/2$ inch for wider lines
 - d. Symbols and Legends are visually proportional to contract documents with an out-to-out tolerance of ± 6 inches
 - e. Markings have sharp edges and cutoffs at the ends
 4. For all painted markings:
 - a. Apply the paint without dilution
 - b. Apply reflectorizing spheres immediately to the wet-paint with a pressurized system
 5. For all tape products, follow the manufacturer's recommendations for surface dryness, primers, adhesives, and other surface preparation requirements. Unless otherwise specified by the tape manufacturer, meet the following test for determining surface dryness before applying the tape:
 - a. In an area of direct sunlight where the tape will be applied, place an 18 inch by 18 inch piece of polyethylene (a green or black garbage bag may be used). There should not be any holes or tears in the polyethylene.
 - b. Tape down all the edges of the polyethylene sheet to seal all the edges and not allow any air movement to get under the polyethylene.
 - c. Firmly tamp the tape using the tamper cart or by foot tamping.
 - d. Allow 20 to 25 minutes for the polyethylene to be exposed to the direct sunlight.
 - e. Remove the polyethylene from the road surface. If no moisture is present on the underside of the polyethylene or on the road surface, the tape can be applied.
 - f. If any moisture is present, allow another hour to pass and repeat the test until no moisture is found.
- B. Surface Preparation:** For all pavement markings, ensure the pavement surface is dry and free from dirt, dust, oil, curing compound, and other contaminants that may interfere with markings properly bonding to the surface.
1. Clean surface to at least 1 inch wider than the anticipated marking.
 2. Unless otherwise specified, sweep the pavement surface with a rotary broom or street sweeper.
 3. Shoot an air blast on the pavement surface immediately prior to placing the new marking. The air blast is not intended to remove large amounts of dust, but only the residue that might be left from the removal and cleaning operation.
 4. When pavement markings are placed on newly constructed PCC pavements, remove the existing curing compound film from horizontal surfaces in these locations. Curing compound film need not be removed from curbs or other vertical surfaces. Remove the curing compound in a manner that does not damage the underlying pavement.

3.02 CONSTRUCTION (Continued)**C. Painted Pavement Markings:**

1. **Waterborne and Solvent Based Paint:** Apply paint and reflectorizing spheres at the nominal rates shown in the following tables.

Table 8020.01: Waterborne Paint Application Rates

Line Width	Wet-Film Thickness	Paint	Reflectorizing Spheres
4"	14 mils	343 ft of solid line per gallon of paint	9.0 lb/gal

Table 8020.02: Solvent-based Paint Application Rates

Line Width	Wet-Film Thickness	Paint	Reflectorizing Spheres
4"	16 mils	300 ft of solid line per gallon of paint	9.0 lb/gal

2. **Durable Paint Pavement Markings:**
 - a. Use the same binder thickness as applied on the National Transportation Product Evaluation Program (NTPEP) deck with a tolerance of 10%.
 - b. Bead application rate is at the discretion of the Contractor.
 - c. Construct durable pavement markings to comply with the following retroreflectivity requirements when tested according to Iowa DOT Materials I.M. 483.04.

Table 8020.03: Minimum Coefficient of Retroreflected Luminance

White line, symbols, and legends	300 mcd/ft ² /ft-cdl.
Yellow line	200 mcd/ft ² /ft-cdl.

3. **High-Build Waterborne Paint Pavement Markings:**
 - a. Provide binder thickness of 0.022 inches \pm 0.0025 inches.
 - b. Bead application rate is at the discretion of the Contractor.
 - c. Construct high-build waterborne paint pavement markings to comply with the following retroreflectivity requirements when tested according to Iowa DOT Materials I.M. 483.04.

Table 8020.04: Minimum Coefficient of Retroreflected Luminance

White line, symbols, and legends	300 mcd/ft ² /ft-cdl.
Yellow line	225 mcd/ft ² /ft-cdl.

- D. **Marking Tape:** If grooving is specified, do not inlay the tape into hot HMA.

1. **Inlaid:** When the installation of preformed polymer pavement marking material or profiled pavement marking tape is in conjunction with placement of HMA, inlay the tape by positioning it on the HMA prior to the final rolling. Perform the installation of the tape according to the manufacturer's recommendations.
2. **Grooved:** When grooving is specified, install marking tape in recessed groove according to the manufacturer's recommendations.

- E. **Temporary Delineators:** Mount temporary delineators 4 feet above the pavement on delineator posts. Install posts 2 feet from the outside edge of the shoulder at locations specified in the contract documents.

3.02 CONSTRUCTION (Continued)

F. Raised Pavement Markers: Ensure markers continually exposed to traffic do not extend more than 3/4 inch above the pavement surface.

G. Pavement Marking Layout and Location:

- 1. Permanent Markings:** Place all lines within 2 inches of reference location. The location of edge lines may be referenced to the pavement edge. The locations of other longitudinal lines may be referenced to accurately locate longitudinal joints. Where reference locations do not exist or are not reliable, locate the lines as follows:
 - a. For straight or nearly straight lines, reference the locations to a string line set between marking line points.
 - b. For curves, reference the locations to closely spaced marking line points. For sharp curves, a spacing of 10 feet may be required.
 - c. Other equally effective systems the Engineer approves.
- 2. Temporary Markings:** The location of temporary pavement marking will be specified in the contract documents or as directed by the Engineer to maximize the effectiveness of the traffic control plan.

H. Removal of Pavement Markings:

- 1. Staging:**
 - a. At the start of construction and at each change in staging, remove all existing pavement markings that conflict with the pavement marking plan.
 - b. Prior to final pavement marking, remove all temporary pavement markings.
 - c. The Engineer may designate other pavement markings for removal to maximize the effectiveness of the traffic control plan.
- 2. Process:**
 - a. Remove existing painted pavement markings so that 90% or more of the pavement is visible. Tightly adhering markings may remain in the bottom of the tining and other depressions on the pavement surface, but ensure they are not visible to the motorist during daytime or nighttime. Remove tape markings according to the manufacturer's recommendations. Ensure removal processes do not cause functional damage to the transverse or longitudinal joint sealant materials.
 - b. Conduct pavement marking removal operations in a manner so that the finished pavement surface is not damaged or left in a pattern that may mislead or misdirect the motorist. When the operations are completed, power broom the pavement surface. Remove all marking removal debris from the pavement surface before the pavement is open to public traffic.
 - c. Perform pavement marking removal to a width no less than the width of the existing or new pavement markings plus 1 inch. Remove the entire area of the existing symbol or legend in a rectangular shape so no directionality may be observed from the removed symbol or legend.
 - d. Removal of pavement markings may be performed by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high pressure water blasting. Open abrasive blasting or dry grinding without containment is not allowed.

I. Markings Obliterated During Construction:

1. On sections of pavement open to traffic, place pavement markings where construction or traffic operations have obliterated existing markings.

3.02 CONSTRUCTION (Continued)

2. Replace markings obliterated during construction within 3 calendar days after the operation that obliterated the markings has been completed. At intersections with Iowa DOT highways, replace all obliterated edge lines, lane lines, no passing zones, and centerlines prior to opening to traffic.
 3. Place symbols and legends within 3 calendar days from the day the road is open to traffic.
- J. Grooving for Pavement Markings:** When specified in the contract documents, place pavement markings in a groove cut into the pavement surface. Dry or wet cut the groove in a single pass.
1. **Groove Depth:** Construct groove according to pavement marking material manufacturer's recommendations with the following minimums.
 - a. **Paint:** Minimum groove depth of 60 mils.
 - b. **Tape:** Minimum groove depth of 100 mils.
 2. **Groove Width:** Marking width plus 1 inch with a tolerance of minus 0.0 inches and plus 0.2 inches.
 3. **Groove Length:** Full length of tape plus 3 inches minimum grooving transition on either end. Do not use a continuous groove for dash markings. When replacing existing dash markings, start cycle so most of the existing marking is removed with the groove. No additional removal of existing markings is required.
 4. **Groove Position:** Locate grooves a minimum of 2 inches from edge of longitudinal joints.
 5. **Finished Surface:** Ensure the bottom of the groove has a fine corduroy-like texture. The maximum allowable rise between the high and low points across the width of the groove is 10 mils.
 6. **Groove Cleaning:** Ensure the surface to receive the marking is free from dust, dirt, or other contaminants that may interfere with the marking properly bonding.
 - a. **Dry Cutting:** Vacuum and broom grooves using a high pressure air blast for the final cleaning.
 - b. **Wet Cutting:**
 - 1) Immediately flush the groove with high pressure water and recover the removed material.
 - 2) Allow the surface to dry a minimum of 24 hours to a visibly dry condition.
- K. Limitations:**
1. **General:**
 - a. Coordinate pavement marking application with other construction work and associated traffic control changes.
 - b. Complete the placement of pavement markings before the lane, road, on-site detour, or diversion is open to traffic.
 - c. If unavoidable circumstances result in not being able to complete the pavement marking placement or removal specified for that day, provide traffic control until the pavement marking placement or removal work is completed.
 - d. Follow the manufacturer's written recommendations for all details of application.

3.02 CONSTRUCTION (Continued)**2. Temperature Restrictions:**

- a. Waterborne and Solvent Based Paint Pavement Markings:** Comply with Table 8020.05.

Table 8020.05: Pavement Marking Temperature Restrictions

Type of Marking	Oct. 23 to April 7	April 8 to April 22	April 23 to Oct. 7	Oct. 8 to Oct. 22
Waterborne Paint	not allowed	45° F	45° F	45° F
Low Temperature Waterborne Paint with Rohm & Haas XSR Resin	35° F	35° F	35° F	35° F
Solvent Based Paint	No restrictions	No restrictions	(a)	No restrictions

(a) Only use solvent-based paint if temperature requirements for waterborne paint cannot be met.

b. Durable Paint Pavement Markings:

- 1) Air and pavement surface temperature are 40°F and rising.
- 2) The Engineer may allow placement of durable paint at temperatures below these values based on the durable paint manufacturer's written recommendations.

c. High-Build Waterborne Paint Pavement Markings:

- 1) Air and pavement surface temperature are 50°F and rising.
- 2) When temperatures are below 50°F, the Engineer may approve the use of marking products denoted by the manufacturer as "low-temperature." When approved, low-temperature paints may be applied when temperatures are between 32°F and 50°F.

d. Marking Tape Pavement Markings:

- 1) Air and pavement surface temperature are 50°F and rising.
- 2) Minimum overnight temperature of 40°F the night before application
- 3) The Engineer may allow placement of marking tape at temperatures below these values based on the marking manufacturer's written recommendations.

END OF SECTION