APPENDIX E

Example Prescriptive Special Provision for Epoxy Pavement Markings Used by the Maryland State Highway Administration

SPECIAL PROVISIONS CONTRACT NO.
1 of 5

CATEGORY 900
MATERIALS

SECTION 951 — PAVEMENT MARKING MATERIALS

951.08 LEAD FREE TWO COMPONENT EPOXY PAVEMENT MARKING MATERIALS. The white and yellow lead free epoxy pavement marking material shall consist of a 100 percent solid two-part system with glass beads embedded homogeneously throughout the depth of the film and the surface. All of these materials shall be lead free as defined herein.

951.08.01 Epoxy Physical Components.

(a) Composition.

COMPONENT A	PERCENT BY WEIGHT	
	WHITE	YELLOW
Epoxy Resin	75 - 82	75 – 79
Titanium Dioxide	18 - 25	14 – 17
Organic Yellow	—	7 – 8

The entirety of the pigment of Component A white shall consist of D 476, Type II Rutile Titanium Dioxide. No extender pigments are permitted. Yellow pigments and tinting colors shall be added in proportions which will produce a color equal to the yellow color depicted in the color box described herein. Any Titanium Dioxide used shall conform to D 476, Type II Rutile.

The epoxy system shall contain no volatile solvents. The cured film shall be no less than 99.5 percent of the wet film thickness of the panel at the time it was prepared for test.

Restrictions. The manufacturer shall certify that the combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, Atomic Absorption Spectroscopy, or a comparable method capable of this level of detection.

(b) Epoxide Number. The weight per epoxy equivalent (WPE) as determined by D 1652 for both white and yellow of Component A, on a pigment free basis, shall conform to a target value ± 50 provided by the manufacturer and approved by the Engineer.

(c) Amine Number. The amine value of the curing agent (component B) shall consist entirely of stable amines and shall be determined as specified in D 2074. The total amine value shall conform to a target value ± 50 provided by the manufacturer and approved by the Engineer.

951.08.02 Mixed Composition.

(a) Mixing Ratio. The mixing ratio for the epoxy pavement marking material shall be proportioned according to the manufacturer's recommendations. The ratio shall not vary more than 2.5 percent during any operation conducted in conjunction with these materials.

(b) Color (White and Yellow).

(1) Production. The color of the cured epoxy material film of the production sample shall essentially match the specified color chips conforming to Federal Standard 595 when visually compared or by instrumental measurement.

(2) Control. Control color matching determinations will be made using a Pacific Scientific Color Machine at an observation angle of 2 degrees, and the C.I.E. Chromatically Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured epoxy film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	± 0.020	± 0.020	± 0.030	± 0.030

(c) Yellowing Index. After curing for 72 hours, the yellowing index of the white material when tested in conformance with E 313, using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall not exceed 8.0 preceding QUV, and shall not exceed 15.0 after 72 hours in QUV.

(d) Toxicity. After heating to the application temperature, the material shall not exude fumes which are toxic or injurious to persons or property.

(e) Directional Reflectance. The directional reflectance when tested in conformance with E 1347 after QUV using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall be minimums of 80 for white and 50 for yellow.

(f) Abrasion Resistance. Abrasion Resistance of the mixed material without glass beads shall be 80 mg maximum loss when tested as specified in C 501 with a 1000 g load, 1000 cycles, CS-17 wheel and a 15 ± 0.5 mil wet film thickness on a S-16 plain steel plate.

(g) Hardness. The Type D Durometer Hardness of the material shall be a minimum of 75 when tested in conformance with D 2240. Test films shall be cast on a suitable substrate at

20 ± 1 mil wet film thickness. The film shall be cured 24 to 72 hours at 75 ± 2 F prior to testing.

(h) Tensile Strength. The average tensile strength shall be a minimum of 6000 psi when tested in conformance with D 638, Type IV molded specimens. Specimens shall be cured 24 to 72 hours at 75 ± 2 F with a relative humidity of 50 ± 3 percent prior to testing.

(i) Compressive Strength. The compressive strength of the catalyzed epoxy marking material shall be a minimum of 12 000 psi when tested in conformance with D 695. The test specimen shall be cured 72 hours at 75 ± 2 F with a relative humidity of 50 ± 3 percent prior to testing.

(j) Adhesion to Concrete. The catalyzed epoxy paint pavement marking materials, when tested in conformance with ACI Method 503, shall have a 4000 psi minimum adhesion to the specified concrete surface with 100 percent concrete failure in the performance of this test. The prepared specimens shall be conditioned for 24 to 72 hours at 75 ± 2 F prior to the performance of the tests.

(k) Infrared Spectroscopy. Both component A and component B shall be analyzed to verify for control purposes that materials submitted for use are of an identical formulation as originally approved. Deviations as determined by comparison with the original sample shall be cause for rejection.

(l) Curing. The epoxy material shall be fully cured at a surface temperature of 35 F or above. The pavement marking material shall exhibit a no-tracking time of less than 10 minutes, when mixed in the proper ratio and applied at 20 ± 1.0 mil film thickness at 75 ± 2 F and with the proper saturation of beads when tested in conformance with D 711. The manufacturer shall furnish a table depicting typical no-track time versus various temperatures in the recommended application temperature range.

951.08.03 Glass Beads Physical Requirements. Glass beads shall be colorless, clean, transparent and free of milkiness or excessive air bubbles and essentially clean from surface scarring or scratching. The beads shall be spherical in shape, and shall contain a minimum of 60 percent silica. Roundness shall be 75 percent minimum when tested in conformance with D 1155, Procedure A.

The beads shall have a minimum refractive index of 1.50 (Standard) and 1.90 (Large) when tested in conformance with MSMT 211.

Glass beads shall not absorb moisture in storage and shall remain free of clusters or lumps.

Glass beads shall conform to all the requirements of M 247, except that the moisture resistance and flotation tests shall not be required, and the following:

GRADATION SIEVE SIZE	PERCENT PASSING	
	Standard Beads	Large Beads
12 (1.70 mm)		100
14 (1.40 mm)		95 - 100
16 (1.18 mm)		80 - 95
18 (1.00 mm)		10 - 40
20 (0.85 mm)	100	0 - 5
30 (0.60 mm)	75 - 95	
50 (0.30 mm)	15 - 35	
100 (0.15 mm)	0 - 5	

951.08.04 Field Testing. Materials conforming to this Specification shall be field evaluated at the National Transportation Product Evaluation Program (NTPEP) Northeast test deck for performance. Materials performing satisfactorily throughout the test period will be placed on the Administrations Prequalified Materials List. All marking materials supplied during the Contract shall be identical in composition to the materials submitted for initial testing. Conformity with these requirements will be determined by the Office of Materials and Technology (OMT).

951.08.05 Sampling. Random testing of samples will be performed by the Administration as Quality Assurance and certification verification. Samples of each batch will be procured at the manufacturer's facility by the Administration. Each sample shall be accompanied by a certified analysis showing compliance with the physical requirements of this Specification, the recommended epoxy resin material temperature at the spray gun, and certification that any epoxy resin material supplied during the Contract period shall be identical in composition to the material submitted for initial testing. Conformity to these requirements will be determined by OMT.

Sources supplying epoxy resin materials and glass beads shall be submitted by the Contractor to the Engineer for approval in conformance with the Contract Documents.

The epoxy resin material manufacturer shall reimburse the Administration for the cost of sampling and shipment of the samples if sampled by the Administration.

(a) Epoxy Resin Components. The epoxy resin components shall be shipped in containers sealed by the manufacturer. The label on each container shall include the following information:

(1) Manufacturer's Name,

(2) Place of Manufacture,

(3) Color of Material and Component Type,

(4) Date of Manufacture (month-year),

(5) Batch or Lot Identification Number, and

(6) Size/quantity of lot represented.

(b) Glass Beads. The glass beads shall be shipped in 50 lb, moisture resistant bags with complete identification information imprinted on the outside.

The Contractor shall furnish samples of the glass beads and epoxy resin materials to the Administration's Central Laboratory. Physical testing will be performed every four months.

951.08.06 Certification. The Contractor shall furnish notarized certification as specified in TC-1.02. The manufacturer shall certify that any epoxy resin materials supplied during the Contract conforms to the identical formulation as the samples submitted for evaluation on the NTPEP Northeast test deck, and identify the formulas by referring to the code used on the deck. Epoxy resin materials which fail to conform will be rejected.

The manufacturer shall also provide the following:

(a) Material Safety Data Sheets for all materials submitted for testing and use.

(b) A facility, in operation, capable of producing the epoxy resin materials in the quantity and quality required by the Administration.

(c) A laboratory capable of performing the required tests. This laboratory will be subject to the Administration's approval.

APPENDIX F

Example Performance-Based Special Provision for Waterborne Paint Used by the Virginia Department of Transportation

Type	Class	Name
A		Traffic paint
B	I	Thermoplastic alkyd
	I	Thermoplastic hydrocarbon
	II	Polyester resin
	III	Epoxy resin
	IV	Plastic-backed preformed tape
	VI	Patterned preformed tape
D	I & II	Removable tape
E		Removable black tape (Non-Reflective)
F	I & II	Temporary markings

FIGURE F1 Virginia Department of Transportation Pavement Marking Materials. (*Source*: Virginia DOT 704 2000.)

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
SECTION 246 - PAVEMENT MARKING

July 17, 2000

SECTION 246 - PAVEMENT MARKING of the Specifications is replaced with the following:

Section 246.01 – Description

These specifications cover material for use in the various retroreflective pavement marking applications.

Section 246.02 – Detail Requirements

Materials that must be heated for application shall not exude fumes that are toxic or injurious to persons or property when heated to the application temperature.

Materials shall withstand air and roadway temperature variations from 0°F to 140°F without deforming, bleeding, staining, or discoloring and shall maintain their original dimensions and placement without chipping, spalling, or cracking. Material shall not deteriorate because of contact with sodium chloride, calcium chloride, mild alkalies and acids, or other ice control materials; oil in the pavement material; or oil and gasoline drippings from vehicles.

(a) **White and Yellow Pavement Marking Material:** White pavement marking material shall be equal to Federal Standard Color No. 595-17886, and yellow pavement marking material shall be equal to Federal Standard Color No. 595-33538.

Color determination will be made for markings and the diffuse daytime color of the markings shall conform to the below CIE Chromaticity coordinate limits. Color determination for liquid marking materials will be made without drop on beads at least twenty-four (24) hours after application. Color determination for thermoplastic will be made in accordance with the requirements of AASHTO T 250.

CIE CHROMATICITY COORDINATE LIMITS (INITIAL WITHOUT DROP-ON BEADS)										
Color	1		2		3		4		Daytime Luminance Factor Y (%)	
	x	y	x	y	x	y	x	y	Min	max
White (Types A; B - Classes I, II and III; and F)	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375	80.0	—
Yellow (Types A; B – Classes II and III; and F – except thermoplastic)	0.493	0.473	0.518	0.464	0.486	0.428	0.469	0.452	50.0	60.0
Yellow (Types B – Class I; and F - if thermoplastic)	0.499	0.466	0.545	0.455	0.518	0.432	0.485	0.454	40.0	60.0

Color readings will be determined in accordance with the requirements of ASTM E1349 using CIE 1931 2° standard observer and CIE standard Illuminant D65.

Retained daytime color of markings shall conform to the following CIE Chromaticity coordinate limits when measured on a beaded marking after a period of ninety days for construction pavement markings and one year for all other markings:

CIE CHROMATICITY COORDINATE LIMITS (RETAINED)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400

Retained color readings will be determined using a 0°/45° Hunter Labminiscan Spectro-Colorimeter or equal in accordance with the requirements of ASTM E 1349 using CIE 1931 2° standard observer and CIE standard Illuminant D65.

Initial nighttime color of thermoplastic pavement marking material shall conform to the following CIE chromaticity coordinate requirements when tested in accordance with VTM 111.

CIE CHROMATICITY COORDINATE LIMITS (INITIAL WITH DROP-ON BEADS)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	Y
Yellow	0.486	0.439	0.520	0.480	0.560	0.440	0.498	0.426

The marking material shall not be formulated with any compounds of the heavy metals listed in 40 CFR 261.24 Table 1 except that barium sulfate is allowed. Total heavy metal levels, with the exception of barium sulfate, shall not exceed 20 times the specified regulatory limits.

The amount and type of yellow pigment and inert filler for yellow material shall be at the option of the manufacturer provided the material complies with all other requirements of this specification.

(b) **Paint Pavement Marking Material (Type A):** Paint material shall be a fast drying water based, nonleaded, acrylic resin paint suitable for use on both asphalt and hydraulic cement concrete surfaces. Paint shall be selected from the Department's approved list. Paint products will be included on the approved list after the Department determines conformance to the specifications on both asphalt and hydraulic cement concrete roadways. Determination of conformance will include, but will not be limited to, the evaluation of test data from AASHTO's National Transportation Product Evaluation Program (NTPEP) or other Department approved facilities.

1. **Hiding Power:** Paint shall show a dry hiding quality that will give a contrast ratio of at least 0.96 at 0.38 mm (15 mil) wet film thickness.

2. **Settling Properties:** Settling shall be no less than a rating of 8 when tested in accordance with ASTM D869.

3. **Freeze-Thaw and Heat Stability:** Paint shall show no coagulation or change in viscosity greater than +/- five (5) KU.

4. **Water Resistance:** Paint shall show no blistering, peeling or wrinkling, softening or loss of adhesion.

5. **VOC:** The Volatile Organic Compound content shall be no greater than 150 grams/liter when tested in accordance with EPA Method 24.

6. **Flash Point:** Paint shall have a flash point of at least 140°F when tested in accordance with ASTM D93, Pensky-Martens Closed Cup.

7. **No-Track Time:** Paint shall have a 60-second maximum vehicle no-track time when measured in accordance with the NTPEP Field Test Procedures.

8. **Maintained Retroreflectivity and Durability:** Maintained retroreflectivity and durability shall conform to the following requirements after being installed on the test deck for 1 year:

   a: **Maintained Retroreflectivity:** Photometric quantity to be measured is coefficient of retroreflected luminance (R_L) in accordance with the requirements of ASTM E 1743 for 15 meter geometry and ASTM E1710 for 30 meter geometry. R_L shall be expressed in millicandelas per square foot per foot-candle and shall be at least either 150 for 15 meter or 100 for 30 meter when measured in the skipline or centerline areas.

   b. **Durability:** Paint shall have a durability rating of at least 4 when determined in the wheel path area.

APPENDIX G

Example Warranty Provisions Special Provision for Durable Permanent Pavement Markings Used by the Oregon Department of Transportation

SP00862 (9-27-01)

SECTION 00862 - DURABLE PERMANENT PAVEMENT STRIPING

Section 00862, which is not in the Standard Specifications, is included in this project by special provision.

Description

00862.00 Scope - This work consists of permanently striping the wearing surface with durable lines within the limits of the project, as shown or according to the ODOT Traffic Line Manual and the Manual of Uniform Traffic Control Devices (MUTCD).

00862.02 Pre-Striping Meeting - Prior to starting work, meet with the Engineer and striping subcontractor. At this meeting:

- Furnish a Traffic Control Plan for approval, including lane restriction time periods.
- Furnish a striping schedule indicating areas and timing of work, and placing of materials.
- Discuss placement of materials and potential problems
- Discuss work plan at off-ramps, on-ramps, and intersections.
- Discuss material handling procedures and procurement.
- Provide manufacturer's installation instructions and copies of Material Safety Data Sheets (MSDS).
- Provide a spill recovery plan including:
  - Name, address, and phone number for the Contractor's contact with the DEQ.
  - Name, address, and phone number of persons certified and on-call to do any cleanup.

00862.08 Traffic Control - Provide temporary traffic control measures according to Section 00225.

Materials

00862.10 Pavement Markings - Use marking materials from the QPL and according to the following:

(Insert in the blanks below the appropriate pay item names from 00862.90)

Durable Permanent Pavement Marking, _____ for use on yellow lines.

Durable Permanent Pavement Marking, _____ for use on white lines.

Durable Permanent Pavement Marking, _____ for use on skip stripes.

00862.11 Beads - Furnish beads from the QPL or as recommended by the manufacturer of the durable permanent pavement marking material used in the contract.

Equipment

00862.20 General - Use sprayers or extruders approved by the marking material manufacturer and made specifically for the purpose of applying beaded markings to a uniform width and thickness on the roadway surface. Hand units will not be allowed. Use automatic bead applicators that place a uniform layer of beads on the line(s).

Place double lines using equipment designed to place two parallel lines in one pass.

Construction

00862.40 General - Install the markings according to the manufacturer's recommendations and the Engineer's instructions. Lay out a continuous guideline for each line, and receive approval of the layout from the Engineer prior to striping.

For overlays and shoulder widening projects, replace striping to match existing striping unless otherwise directed by the Engineer. If the roadway has changed significantly or is a new roadway, propose variations in standard layouts to handle unusual conditions.

Place lines wider than 100 mm with one pass.

Place permanent striping prior to traffic being allowed on the pavement if the manufacturer's representative determines that the pavement has cured sufficiently. If the manufacturer's representative determines that the pavement has not cured sufficiently, install flexible pavement markers according to Section 00225 prior to final striping.

00862.41 Pavement Surface - Prepare the pavement surface as the manufacturer recommends, and as follows:

(a) New or Existing Asphalt Concrete - Apply material only when the manufacturer's representative (see 00862.48) has determined that the surface is sufficiently dry, clean and free of contaminants such as surface oils and existing road marking materials. Some products require the asphalt to cure for several weeks prior to placement of certain striping materials.

(b) Portland Cement Concrete - Apply material to concrete that has reached a minimum compressive strength of 20.7 MPa, and only when the manufacturer's representative has determined that the surface is sufficiently dry, clean and free of contaminants such as curing agents, laitance, surface oils, and road marking materials.

Remove contaminants by approved mechanical means, such as turbo blasting or grinding, and dispose of according to 00862.47.

00862.42 Application - Use the standard skip cycle of 3.0 m stripe, followed by 9.2 m with no markings until the next skip stripe. Match the new skips to pattern of the existing markings on at least one end of the project.

Monitor the bead application to ensure proper bead embedment and density. Apply reflective glass beads at a sufficient rate to obtain a minimum reflectivity reading of at least 300 millicandellas for white and 250 millicandellas for yellow.

(Delete text in parentheses as needed.)

Apply marking materials by (one or more of) the following method(s):

(Delete those methods which do not apply.)

Method A: Profile Markings - Apply profile markings as shown on Std. Drwg. TM520. Place lines and bumps straight and square.

Method B: Non-Profile Markings - Apply non-profile markings as shown on Std. Drwg. TM520. This method is designed to be done by an extrusion process. A ribbon type application will not be allowed.

Method C: Inlaid Markings - Apply inlaid markings in a square slot as shown on Std. Drwg. TM521. Overfill the slot as shown. Fill the slot edge to edge, and overfill the edges at the top by about 3 mm on each side, making the line flat or slightly convex on top, and about 106 mm wide.

Method D: Inverted Profile Markings with Bumps - Apply inverted profile markings (with bumps) as shown on Std. Drwg. TM522. Place lines and bumps straight and square.

Method E: Inverted Profile Markings without Bumps - Apply inverted profile markings (without bumps) as shown on Std. Drwg. TM522.

Method F: Spray Markings - Apply spray markings as shown on Std. Drwg. TM520. The actual thickness may vary slightly. At least two passes are required to obtain the thickness specified. Place additional passes squarely on top of the first pass, within ± 2 mm.

00862.43 Quality of Work - Place markings and beads on the roadway in proper alignment with existing markings. Make skips parallel and true to line. Make skip ends square and clean. Immediately clean up dribbling of markings beyond the cutoff.

For each project, the striping contractor shall be certified by the marking materials manufacturer to perform the applicable work, prior to beginning the work.

(a) Test Stripe - Prior to applying permanent markings, and in the presence of the Engineer, place a 50 m test stripe on roofing felt or other approved material or surface, to demonstrate the pavement marking application process. If the project involves only inlaid applications, this test stripe will not be required. Do not place permanent materials without receiving the Engineer's approval of the test performance. Repeat the performance test until the Engineer is satisfied that the Contractor has suitable skills to place the materials accurately and properly. Any delay due to this test requirement will be at the Contractor's expense.

(b) Allowable Tolerances - Record the following readings, and the locations of the readings, for evaluation by the Engineer:

- For inlay applications, record the depth of the slot every 100 m during the grinding operation.
- For all other applications, measure the thickness of the lines (above the pavement surface), at the time of application at intervals not to exceed 100 m.

Inspect the line initially, and again two weeks after placement to ensure the material has cured properly. Remove all soft spots or abnormally darkened areas and replace with specification material.

Allowable tolerances for installation are:

- Side to Side: 12 mm maximum on tangent, 25 mm on curves
- Space between parallel (double) lines: ± 10 mm
- End to End on Skips (for re-trace): 50 mm overlap
- Length of Skip: 3.00 m ± 50 mm
- Length of Gap: 9.20 m ± 50 mm
- Width of lines: -2 mm, +10 mm

If existing pavement markers are to be left in place, adjust skip spacing to place skips midway between pavement markers or as directed.

If it is determined that the material is being placed too thin, or otherwise not to specification, make immediate adjustments to correct the problem. Do not allow the top of the line to be cupped or lower than the wearing surface.

Durable permanent pavement markings applied by any method will be unacceptable if:

- The marking is not straight, not wide enough, or not true to line.
- The thickness of the line is inconsistent or less than specified.
- The top of the line is not smooth and uniform.
- Any lines or profile bumps are damaged prior to curing.
- Retro-reflectivity is too low.
- The material is uncured.
- The substrate is visible in the striped areas.

(Delete the following criteria that do not apply to the method(s) used.)

- Any profile bumps are missing or miss-shaped.
- Two or more profile bumps in a row are more than 3 mm deficient in height, measured above the wearing surface.
- Profile bump lead-in or lead-off is not present.
- The inlay slot is not ground deep enough.
- The inlay slot is not filled slightly over-full as specified.
- Grooves in inverted-profile lines are not square and properly shaped.
- Successive spray passes are not aligned over the previous pass.

(c) Retro-reflectivity - Measure the retro-reflectivity of each line, using a Mirolux 12, a 30-m retro-reflectometer, or similar device (mobile or hand-held), at intervals not to exceed 300 m of road distance. Record the location of each test. Perform testing within 48 hours of curing. Make results available to the manufacturer and the Engineer immediately.

Prior to acceptance of the project, the initial retro-reflectivity may be tested by the Engineer for compliance. This testing will occur at least two days after, but not more than ninety days after the project is complete. Notify the Engineer, as soon as possible, when the lines are ready for retro-reflectivity testing.

If the retro-reflectivity is less than 250 millicandellas for white and 200 millicandellas for yellow, the affected materials will be considered unacceptable. The Engineer may elect to use the Contractor's retro-reflectivity readings for the initial retro-reflectivity.

(d) Repairs to the Work - Perform repairs using equipment similar to the equipment initially used to place the material. Do not perform repairs in a "patch work" style. If more than one repair is required in a 100-m section, grind and repair the entire section.

00862.44 Public Safety and Convenience - Provide for the safety and convenience of the public in accordance with Section 00220 and the following:

- Be responsible for protecting all applied markings from traffic until sufficiently dry to prevent damage or tracking by traffic movements. At a minimum, place cones or tubular markers by all skips, and barricades by all areas where cross traffic is anticipated. Additional protection may be necessary and will be considered incidental to the project.

- Immediately correct striping problems that impair traffic, such as improper alignment, broken equipment or spilled product at Contractor's expense, including appropriate traffic control. Provide documentation from DEQ indicating proper cleanup. Blacking out or covering up the lines will not be allowed, except in a short-term emergency when approved by the Engineer.

- Do not open up any work area to traffic that is not adequately striped and suitable for safe driving.

(Add the following subsection 00862.45 when requested by the Project Manager.)

00862.45 Winter Activities - If the project continues for more than one construction season, and has sections of roadway that in the opinion of the Engineer are insufficiently marked to facilitate safe driving:

- Furnish and place painted permanent pavement markings according to Section 00861 to ensure safe driving conditions throughout the project, until the durable permanent striping can be placed. Temporary flexible pavement markers are not acceptable for the purposes of this subsection.

- Remove pavement markings placed under this subsection, prior to placement of the durable striping.

00862.47 Disposal of Waste - Waste material becomes the property of the Contractor. This includes all grindings or markings removed. Do not dispose of or store stripe removal waste material on Department property. Dispose of according to applicable federal, State and local regulations.

00862.48 Manufacturer's Representative - Provide a manufacturer's representative on site during this project. It is the responsibility of the manufacturer's representative to immediately alert the Contractor and the Engineer of anything that could affect the performance of the product or the warranty. The manufacturer's representative shall work

with the Contractor and the Engineer to ensure that the materials are placed in accordance with accepted procedures. The manufacturer's representative shall fill out and sign the warranty form before final payment is made.

00862.49 Warranty - Provide a manufacturer's warranty according to the following:

- For surface-mounted thermoplastic materials, provide a three-year manufacturer's warranty that all markings will stay in place, and will maintain a minimum 150 millicandellas for white and 125 millicandellas for yellow.

- For methyl methacrylate materials, provide a four-year manufacturer's warranty that all markings will stay in place, and will maintain a minimum 150 millicandellas for white and 125 millicandellas for yellow.

The Warranty period will start on the date the Engineer accepts the work and authorizes final payment.

If reflectivity becomes a concern at any time during the warranty period, the Department will measure the retro-reflectivity of the area in question, using a Mirolux 12, a 30-m retro-reflectometer (mobile or handheld), or similar device. The surfaces of the roadway will not be cleaned in preparation for taking readings, but areas of obvious contamination will be avoided.

The manufacturer will be required to repair or replace (at the discretion of the Department) all markings that drop below the required minimum retro-reflectivity during the warranty period, within 6 months of request to do so.

For the purpose of the warranty, a cumulative 5% or greater loss of line due to non-adhesion on any 100 meter segment of marking will constitute failure of the material in that segment.

Finishing and Cleaning Up

00862.70 Removal or Repair of Unacceptable Work - Remove or repair all unacceptable work and dispose of according to 00862.47, at the Contractor's expense. Repair or replace unacceptable work immediately if it causes a safety problem. Remove unacceptable materials by an effective method, such as grinding if material has hardened. The removed material becomes the property of the Contractor. If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the Department.

Measurement

00862.80 General - The quantity of durable permanent pavement marking accepted for payment will be the number of meters, to the nearest meter, complete and in place as specified. For skip stripes, measurement will be for the actual painted stripe, excluding the space between stripes. The standard application width will be 100 mm. If wider lines are specified, the length of those lines will be adjusted by converting them to an equivalent length of 100 mm line on a proportionate basis.

Temporary flexible pavement markers required under 00862.40 will be measured according to Section 00225 when a pay item for them is included in the bid schedule. When no pay

item is provided, there will be no separate measurement of temporary flexible pavement markers.

Thickness will be measured from the top of the marking to the top of the wearing surface. Marking material placed in a depression left by pavement line removal will not be included in measurement of the thickness of the line.

Payment

00862.90 General - The accepted quantities will be paid for at the contract unit price per meter for the pay items listed below when in the bid schedule:

Method A (Profile):

(a) Methyl Methacrylate, Profile, 2.3 mm, Extruded
(b) Methyl Methacrylate, Profile, 3.0 mm, Extruded
(c) Thermoplastic, Profile, 2.3 mm, Extruded
(d) Thermoplastic, Profile, 3.0 mm, Extruded

Method B (Non-Profile):

(e) Methyl Methacrylate, Non-Profile, 2.3 mm, Extruded
(f) Methyl Methacrylate, Non-Profile, 3.0 mm, Extruded
(g) Thermoplastic, Non-Profile, 2.3 mm, Extruded
(h) Thermoplastic, Non-Profile, 3.0 mm, Extruded

Method C (Inlaid):

(i) Methyl Methacrylate, Inlaid

Method D (Inverted Profile with Bumps):

(j) Thermoplastic, Inverted Profile w/ Bumps

Method E (Inverted Profile):

(k) Thermoplastic, Inverted Profile

Method F (Spray):

(l) Methyl Methacrylate, Non-Profile, 2.3 mm, Sprayed
(m) Methyl Methacrylate, Non-Profile, 3.0 mm, Sprayed
(n) Thermoplastic, Non-Profile, 2.3 mm, Sprayed
(o) Thermoplastic, Non-Profile, 3.0 mm, Sprayed

Payment for items (a) through (o) will be payment in full for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete the work as specified, and includes payment for the following:

- Laying out the alignment
- Checking dimensional tolerance

- Removing and disposing of unacceptable materials
- Furnishing a striping schedule
- Placing a test stripe
- Removing existing pavement markings and other waste materials
- Furnishing a manufacturer's representative on site
- Testing retro-reflectivity
- Furnishing the manufacturer's warranty

There will be no separate or additional payment for the following:

- Over-runs of material caused by the variation of the gradation of the asphalt
- Additional material required to install markings on open-graded mix
- Additional material placed at the top of inlay slots, for item (i)
- Disposal of stripe removal waste material

(Include the following if 00862.45 is used.)

- Furnishing, placing and removing temporary markings required by 00862.45

Temporary flexible pavement markers required by 00862.40 will be paid for according to Section 00225, if a pay item is provided. If no pay item for temporary flexible pavement markers is provided, payment will be incidental to the permanent pavement striping pay item(s) and no separate payment will be made.

Payment will be limited to 80% until the warranty is received by the Department.

Spec No.	Product Name	Category	Manufacturer
00862.10	AQUALITE	TRAFFIC LINE, DURABLE	STIMSONITE CORP 800/327-5917
00862.10	DURASTRIPE	TRAFFIC LINE, DURABLE	TMT PATHWAY
00862.10	PERMALINE	TRAFFIC LINE, DURABLE	STIMSONITE CORP 800/327-5917
00862.10	RAINLINE	TRAFFIC LINE, DURABLE	RAINLINE CORP 334/277-0237
00862.10	VIBRALINE	TRAFFIC LINE, DURABLE	BRITE-LINE 800/231-8902

FIGURE G1 Qualified durable permanent traffic markings used by the Oregon Department of Transportation. (*Source*: Oregon DOT 2002.)

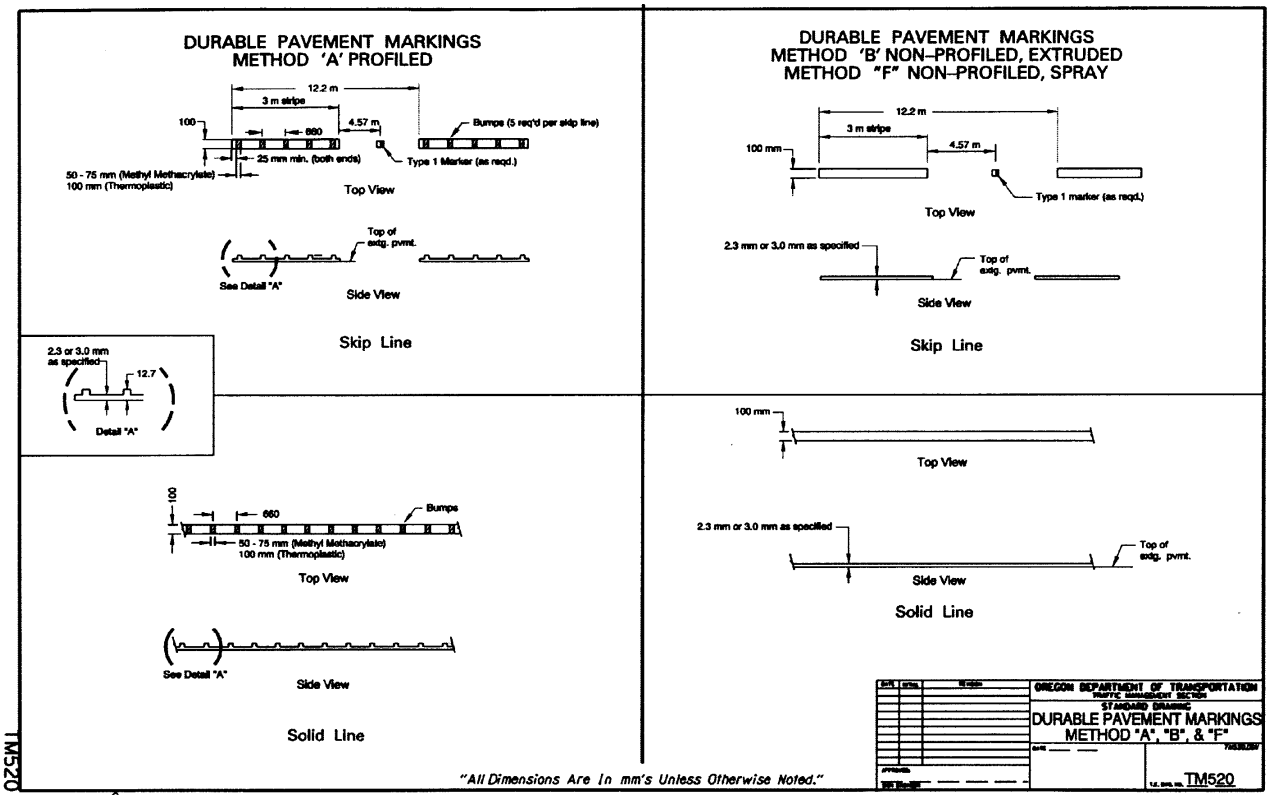

FIGURE G2 Durable permanent pavement markings used by the Oregon Department of Transportation Methods A, B, and F. (*Source*: Oregon DOT TM520 2002.)

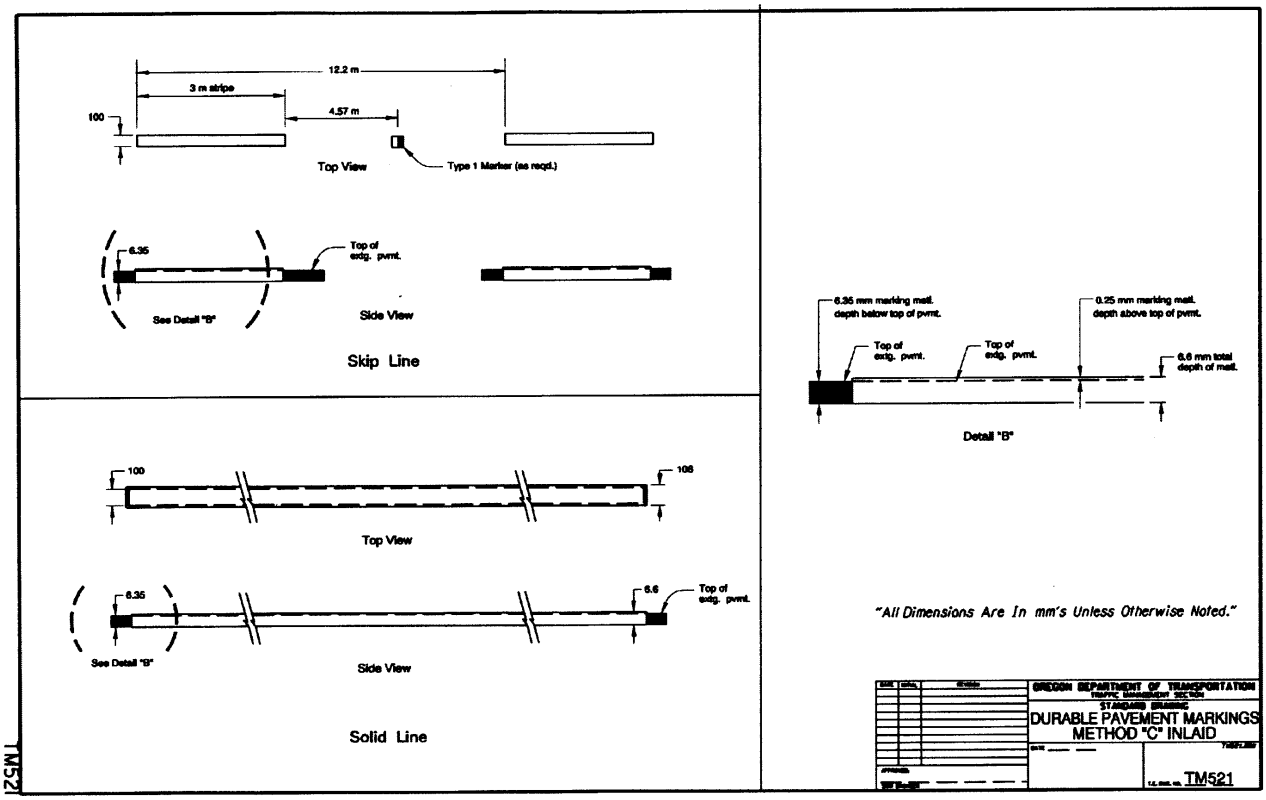

FIGURE G3 Durable permanent pavement markings used by the Oregon Department of Transportation Method C inlaid. (*Source*: Oregon TM521 2002.)

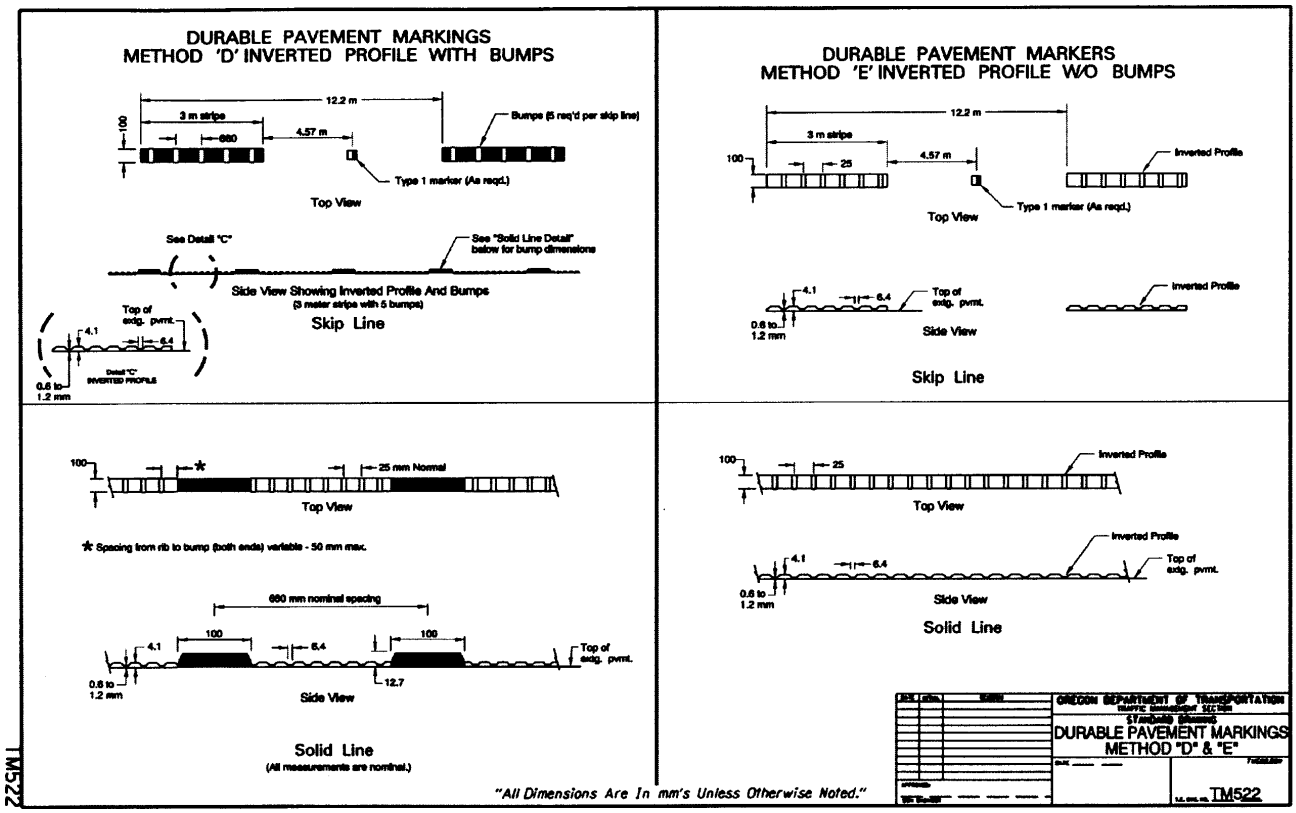

FIGURE G4 Durable permanent pavement markings used by the Oregon Department of Transportation Methods D and E. (*Source*: Oregon TM522 2002.)