SECTION 91

PAVEMENT MARKING

91.1 DESCRIPTION

A. General: This work consists of furnishing and applying pavement marking materials and surface grooving of portland cement concrete pavement or asphalt concrete pavement.

B. Related Work:

Section 90	Roadway Signs and Delineators
Section 92	Temporary Traffic Control
Section 93	Traffic Signals and Roadway Lighting
Section 203	Submittals

91.2 MATERIALS

A. Cold Applied Plastic Pavement Markings and Legends (Tape): This material shall consist of a homogeneous mixture of resins, plasticizers, fillers, pigments, and glass beads. The marking material shall be designed to adhere to portland cement concrete pavement or asphalt concrete pavement.

Reflectorized plastic pavement marking shall consist of a homogeneous, extruded, prefabricated, pliant polymer material of specified thickness and width, which shall contain abrasion resistant ceramic or ceramic coated beads bonded in a highly durable polyurethane topcoat. The material shall be fabricated with a patterned surface that presents a near vertical face to traffic to maximize retroreflectance. The pavement marking material shall be capable of being affixed to the pavement surface by means of a pre- coated, pressure sensitive adhesive.

An adhesive activator supplied by the manufacturer shall be utilized on applications of this material, except on newly installed asphalt when the surface temperature is 80˚F or above, or when the material is inlayed at the time asphalt is being installed.

Reseal Test: The plastic marking material shall reseal to itself when tested. Cut two 1 inch x 3 inch pieces of plastic. Overlap these pieces face to face for an area of 1 square inch on a flat steel plate with the adhesive backing material remaining in place. Center a 2.2 pound weight over the 1 square inch overlap area and place in an oven at 190ºF for one hour. After cooling to 77ºF, the pieces shall be inseparable without tearing.

Pull Test: The plastic shall require a pull of 8 to 20 pounds to break. The elongation shall be no greater than 50%. The specimens for this test shall be Type 1 prepared in accordance with ASTM D638. 1 square inch pieces of carborundum extra coarse

emery cloth or its equivalent may be applied at each end of the test specimens to prevent the plastic adhesive from adhering to the test equipment. The break resistance shall be based on an average of at least 3 samples, and the rate of pull shall be 1/4 inch per minute. This test shall be conducted at a temperature of 70ºF to 80ºF.

Support Test: A test specimen cut to dimension of 1 inch by 6 inch shall support a dead load of 6 pounds for 30 minutes. This test shall be conducted at a temperature of 70 to 80ºF.

Color: The plastic marking material shall meet the color specification limits and luminance factors listed in Tables 1 and 2 when tested in accordance with ASTM E1347 or ASTM E1349. The plastic marking material shall maintain the color and luminance factors provided in the following tables throughout its service life.

Table 1

	Chromaticity Coordinates (corner points)								Luminance Factor (Y %)	
	1		2		3		4			
Color	X	Y	X	Y	X	Y	X	Y	Min.	Max.
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375	35	
Yellow	0.56	0.44	0.49	0.51	0.42	0.44	0.46	0.4	25	
Red	0.48	0.3	0.69	0.315	0.62	0.38	0.48	0.36	6	15
Blue	0.105	0.1	0.22	0.18	0.2	0.26	0.06	0.22	5	14

Daytime Color Specification Limits and Luminance Factors for Pavement Markings Material with CIE 2 º Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65

Table 2

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.480	0.410	0.430	0.380	0.405	0.405	0.455	0.435
Yellow	0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490

Nighttime Color Specification Limits for Pavement Marking Retroreflective Material with CIE 2 º Standard Observer and Observation Angle = 1.05 º, Entrance Angle + 88.76 º and CIE Standard Illuminant A

B. Traffic Paint: The finished paint shall be smooth and homogeneous, free of coarse particles, skins, or any other foreign materials detrimental to the use or appearance of the paint.

Waterborne paint applied between April 15th and October 15th shall meet the following requirements per Section 91.2.B.1 – High Build Waterborne Paint. Cold weather waterborne paint shall be used between October 15th and April 15th, and shall meet the requirements of Section 91.B.2- Cold Weather Waterborne Paint.

The manufacturer shall submit a “Certificate of Compliance” for each batch of paint produced for use under this specification. The certification shall contain the manufacturer’s code number and batch number along with the test results of each

batch for weight per gallon, viscosity, drying time, percent pigment, percent vehicle, and fineness of grind.

1. **High Build Waterborne Paint:** The vehicle shall be composed of a 100% acrylic polymer such as Dow FASTRACK™ HD-21A or an approved equal.

   a) **Quantitative Requirements:** The finished paint shall meet the following quantitative requirements:

	WHITE	**YELLOW**
Lead, parts per million ASTM D3335 or X-ray fluorescence	100 max.	100 max.
Pigment, percent by weight Tested in accordance with ASTM D3723	60.0 - 62.0	58.0-62.0
The residual extracted pigment upon analysis shall conform to the following quantitative compositional requirements when tested in accordance with ASTM D1394 or ASTM D4764.		
Titanium Dioxide, pounds/gallon ASTM D 476 Type II Rutile 92% min. TiO_2 tested in accordance with ASTM D1394 or ASTM D4764	1.00 min.	0.20 min.
Total Solids, percent by weight Tested in accordance with ASTM D3723	77.0 min.	76.0 min.
Non-volatile Vehicle, percent by weight Tested in accordance with ASTM D3723 and then calculating the % total solids minus the % pigment	42.5 min.	42.5 min.
Consistency (Viscosity), KU Krebs-Stormer, equivalent units, shearing rate 200 rpm. When tested in accordance with ASTM D562, the consistency of the paint will be within the stated specification when determined a minimum 48 hours after packaging the material.	190 to 300	190 to 300
Weight per Gallon, pounds, min Tested in accordance with ASTM D1475*[2]	13.50	13.00
Fineness of Dispersion, Hegman Scale Tested in accordance with ASTM D1210 "B" Cleanliness	2 min.	2 min.
Drying Time, No Pick-Up, minutes, max Tested in accordance with ASTM D711, except the wet film thickness shall be 12.5 ± 0.5 mils.	12 max.	12 max.

*[2] In addition to compliance with the minimum, the weight per gallon shall not vary more than ± 0.3 pounds/gallon between batches.

Drying Time, Dry-through, minutes, max 120 max. 120 max.
Tested in accordance with ASTM D1640, except the wet film thickness shall be 12.5 ± 0.5 mils. A reference control paint will be run in conjunction with the candidate paint. Dow FASTRACK™ HD-21A formulation will be referenced-control paint.

*[3] If either the candidate or reference-control paint exceeds the 120 minute maximum, then the candidate paint shall not exceed the dry time of the reference-control paint by more than 15 minutes.

Directional Reflectance, min 85 50
When applied at a wet film thickness of 15 mils and when tested in accordance with ASTM E1347 using the 45/0 illumination.

pH, min 9.6 9.6
Tested in accordance with ASTM E70

Dry Opacity, Contrast ratio, min. 0.95 0.88
When applied at a wet film thickness of 6 to 7 mils and when tested in accordance with ASTM D2805

Volatile Organic Content (VOC), grams/liter 115 max. 115 max.
Tested in accordance with ASTM D3960

Flash Point, closed cup, ºF 115 min. 115 min.

Color: The paint shall meet the color specification limits and luminance factors listed in Tables 1 & 2 when tested in accordance with ASTM E1347 or ASTM E1349. The paint shall not discolor in sunlight and shall maintain the colors and luminance factors throughout the life of the paint. No Bayferrox 3950, iron oxides or other color enhancers will be permitted to achieve the color chromaticity coordinates.

Table 1*[1]

Color	Chromaticity Coordinates (corner points)								Min. Luminance Factor (Y %)
	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	35
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400	25

*[1] Daytime Color Specification Limits and Luminance Factors for Pavement Markings Material with CIE 2° Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65

Table 2*[2]

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.480	0.410	0.430	0.380	0.405	0.405	0.455	0.435
Yellow	0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490

*[2] Nighttime Color Specification Limits for Pavement Marking Retroreflective Material with CIE 2 °Standard Observer, Observation Angle = 1.05 °, Entrance Angle + 88.76° and CIE Standard Illuminant A.

b) Qualitative Requirements: The finished paint shall meet the following qualitative requirements:

Condition in Container - Storage Stability. Within a period of 12 months from the time of delivery and when examined in accordance with Federal Specification TT-P-1952F 4.3.2, the paint shall not show excessive settling in a freshly-opened full can and shall be easily redispersed with a paddle to a smooth homogeneous state. The paint shall show no undesirable characteristics to include curdling, livering, caking, gelling, or thixotropic properties, lumps, skins, or color separation. The consistency shall not change more than 5 Kreb Units from that of the original sample, the degree of settling shall have a rating of 6 or better per ASTM D869, and the drying time shall be as specified.

Skinning: The paint shall not skin within 48 hours in a three-quarter filled, tightly closed container when examined in accordance with Federal Specification TT-P-1952F 4.3.14.

Flexibility and Adhesion: The paint shall show no cracking, flaking, or chipping when tested as specified. Apply a wet film thickness of 0.005 inches with a film applicator to a 3 inch x 5 inch tin panel weighing 0.39 to 0.51 pounds per square foot, previously cleaned with benzene and lightly buffed with steel wool. Dry the paint film at 70 to 80ºF in a horizontal position for 18 hours, then bake in an oven at 122 ± 4ºF for two hours, and cool to room temperature for at least 1/2 hour. Bend over a 1/2 inch diameter rod and examine, without magnification, in accordance with ASTM D522 Test Method B.

Water Resistance: The paint shall show no softening, blistering, loss of adhesion or other evidence of deterioration, other than a slight loss in gloss when tested as specified. Apply a wet film thickness of 0.015 inches with a film applicator to a clean glass plate. Dry the paint film at 70 to 80ºF in a horizontal position for 72 hours. Immerse one-half of the painted plate in distilled water in a vertical position at room temperature (70 to 80ºF) for 18 hours in accordance with ASTM D870. Remove the painted plate from the immersion liquid, allow to air dry for 2 hours, and then examine.

Dilution Stability: The paint shall be capable of dilution with water with no separation, curdling or precipitation observed when examined in accordance with NIST 141D (Method 4203.2), such that the wet paint can be readily cleanable with only water.

Spraying Properties: The paint as received shall have satisfactory spraying and hiding properties when applied by either airless or air-assisted type traffic stripers to glass or metal plates at a wet film thickness of 0.015 inches.

Bleeding: The paint shall have a minimum bleeding ratio of 0.97 when tested in accordance with ASTM D868. The asphalt saturated felt shall conform to ASTM D 226 (Type I).

Freeze-Thaw Stability: The paint shall show no coagulation or change in consistency greater than 5 Kreb Units when tested in accordance with Federal Specification TT-P-1952 F 4.3.8.

Heat-Shear Stability: The paint shall show no gelling, signs of instability, or change in consistency greater than 5 Kreb Units when tested in accordance with Federal Specification TT-P-1952 F 4.3.13.

Abrasion Resistance: No less than 190 Liters of sand shall be required for removal of the paint film when tested in accordance with Federal Specification TT-P-1952 F 4.3.7.

2. **Cold Weather Waterborne Paint:** The vehicle shall be Dow FASTRACK™ 5408, Dow FASTRACK™ XSR™ resin binder, or an approved equal.

   a) **Quantitative Requirements:** The finished paint shall meet the following quantitative requirements:

	WHITE	
Lead, parts per million ASTM D3335 or X-ray fluorescence	100 max.	100 max.
Pigment, percent by weight; Tested in accordance with ASTM D3723	58.0 - 62.5	56.1 – 62.5
Titanium Dioxide, pounds/gallon ASTM D 476 Type II Rutile 92% min. Ti02 tested in accordance with ASTM D1394 or ASTM D4764	1.00 min.	0.20 min.
Total Solids, percent by weight Tested in accordance with ASTM D3723	75.0 min.	75.0 min.
Non-volatile Vehicle, percent by weight Tested in accordance with ASTM D3723 and then calculating the % total solids minus the % pigment		41.5 min.
Consistency, grams Krebs-Stormer Shearing rate 200 rpm.	165 to 300	165 to 300
Equivalent K.U. Tested in accordance with ASTM D562*[1]	75 to 95	75 to 95

*1The consistency of the paint shall be within the stated specification when determined a minimum 48 hours after packaging the material.

Weight per Gallon, pounds
Tested in accordance with ASTM D1475*[2]

Dow FASTRACK™ XSR	13.00 min.	13.00 min.
Dow FASTRACK™ 5408	13.00 min.	13.00 min.

*[2] In addition to compliance with the minimum, the weight per gallon shall not vary more than ± 0.3 pounds/gallon between batches.

Fineness of Dispersion, Hegman Scale Tested in accordance with ASTM D1210	2 min. "B" Cleanliness	2 min. ”B" Cleanliness
Drying Time, No Pick-Up, minutes	12 max.	12 max.

Tested in accordance with ASTM D711, except the wet film thickness shall be 12.5 ± 0.5 mils. The applied film shall be immediately placed in a laboratory drying chamber maintaining the relative humidity of 65 ± 3%, the temperature 73.5 ± 3.5ºF, and air flow less than 1 foot per minute.

Field Drying Time, Track-Free, minutes.	5 max.	5 max.

When applied under the following conditions, the line shall show no visual tracking when viewed from 50 feet after driving a passenger vehicle over the line at a speed of 25-35 mph:

15 mils wet film thickness
8 pounds of glass beads per gallon of paint
Paint temperature at nozzle between 70 to 120ºF
Pavement dry, pavement temperature 50 to 120ºF
Relative humidity of 85% maximum

Directional Reflectance When applied at a wet film thickness of 15 mils and when tested in accordance with ASTM E1347 using the 45/0 illumination.	85 min.	N/A
pH Tested in accordance with ASTM E70	9.80 min.	9.80 min.
Dry Opacity, Contrast ratio. When applied at a wet film thickness of 6 to 7 mils and when tested in accordance with ASTM D2805	0.955 min.	0.880 min.
Volatile Organic Content (VOC), grams/liter Tested in accordance with ASTM D3960	150 max.	150 max.
Flash Point, closed cup, ºF	115 max.	115 max.

Color: The paint shall meet the color specification limits and luminance factors listed in Tables 1 & 2 when tested in accordance with ASTM E1347 or ASTM E1349. The paint shall not discolor in sunlight and shall maintain the colors and luminance factors throughout the life of the paint. No Bayferrox 3950, iron oxides or other color enhancers will be permitted to achieve the color chromaticity coordinates.

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Table 1*1

Color	Chromaticity Coordinates (corner points)								Min. Luminance Factor (Y %)
	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	35
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400	25

*1 Daytime Color Specification Limits and Luminance Factors for Pavement Markings Material with CIE 2° Standard Observer and 45/0 (0/45) Geometry and CIE Standard Illuminant D65

Table 2*2

Color	Chromaticity Coordinates (corner points)							
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.480	0.410	0.430	0.380	0.405	0.405	0.455	0.435
Yellow	0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490

*2 Nighttime Color Specification Limits for Pavement Marking Retroreflective Material with CIE 2° Standard Observer, Observation Angle = 1.05°, Entrance Angle + 88.76° and CIE Standard Illuminant A.

b) Qualitative Requirements: The finished paint shall meet the following qualitative requirements:

Condition in Container - Storage Stability, Within a period of 12 months from the time of delivery and when examined in accordance with Federal Specification TT-P-1952F 4.3.2, the paint shall not show excessive settling in a freshly-opened full can and shall be easily redispersed with a paddle to a smooth homogeneous state. The paint shall show no undesirable characteristics to include curdling, livering, caking, gelling, or thixotropic properties, lumps, skins, or color separation. The consistency shall not change more than 5 Kreb Units from that of the original sample, the degree of settling shall have a rating of 6 or better per ASTM D869, and the drying time shall be as specified.

Skinning, The paint shall not skin within 48 hours in a three-quarter filled, tightly closed container when examined in accordance with Federal Specification TT-P-1952F 4.3.14.

Flexibility and Adhesion. The paint shall show no cracking, flaking, or chipping when tested as specified. Apply a wet film thickness of 0.005 inches with a film applicator to a 3 inch x 5 inch tin panel weighing 0.39 to 0.51 pounds per square foot, previously cleaned with benzene and lightly buffed with steel wool. Dry the paint film at 70 to 80ºF in a horizontal position for 18 hours, then bake in an oven at 122 ± 4ºF for two hours, and cool to room temperature for at least 1/2 hour. Bend over a 1/2 inch diameter rod and examine, without magnification, in accordance with ASTM D522 Test Method B.

Water Resistance, The paint shall show no softening, blistering, loss of adhesion or other evidence of deterioration, other than a slight loss in gloss when tested as specified. Apply a wet film thickness of 0.015 inches with a film applicator to a clean glass plate. Dry the paint film at 70 to 80ºF in a horizontal

position for 72 hours. Immerse one-half of the painted plate in distilled water in a vertical position at room temperature (70 to 80ºF) for 18 hours in accordance with ASTM D870. Remove the painted plate from the immersion liquid, allow to air dry for 2 hours, and then examine.

Dilution Stability, The paint shall be capable of dilution with water with no separation, curdling or precipitation observed when examined in accordance with NIST 141D (Method 4203.2), such that the wet paint can be readily cleanable with only water.

Spraying Properties, The paint as received shall have satisfactory spraying and hiding properties when applied by either airless or air-assisted type traffic stripers to glass or metal plates at a wet film thickness of 0.015 inches.

Bleeding, The paint shall have a minimum bleeding ratio of 0.97 when tested in accordance with ASTM D868. The asphalt saturated felt shall conform to ASTM D226 (Type I).

Freeze-Thaw Stability, The paint shall show no coagulation or change in consistency greater than 5 Kreb Units when tested in accordance with Federal Specification TT-P- 1952F 4.3.8.

Heat-Shear Stability, The paint shall show no gelling, signs of instability, or change in consistency greater than 5 Kreb Units when tested in accordance with Federal Specification TT-P-1952F 4.3.13.

Abrasion Resistance, No less than 190 Liters of sand shall be required for removal of the paint film when tested in accordance with Federal Specification TT-P-1952F 4.3.7.

C. Glass Beads: Glass beads for use with pavement marking paint shall be moisture resistant and without floatation properties. The glass beads shall have dual surface treatment consisting of a moisture resistant silicone treatment, and silane adherence surface treatment. Roundness shall be tested in accordance with SDDOT test SD510. The beads shall conform to AASHTO M247, except they shall have a minimum roundness of 80% and the following gradation:

Sieve Size	Accumulated Percent Passing
No. 18	65-80
No. 30	30-50
No. 50	0-5

91.3 CONSTRUCTION REQUIREMENTS

A. Cold Applied Plastic Pavement Marking and Legends (Tape):

1. **Prefabrication:** Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the current edition of the MUTCD.

2. **Width Tolerance:** Shall be as specified with a tolerance of ±1/8 inch.

3. **Surface and Air Temperature:** Surface and air temperature, and humidity shall be per manufactures specifications.

4. **Pavement Condition:** Pavement must be dry and free of dirt, dust, and oily substances.

5. **Application Instructions:** The manufacturer shall supply proper application instructions, and shall identify activators and adhesives which are to be used. An adhesive activator supplied by the manufacturer shall be utilized on applications of this material. On newly installed asphalt when the surface temperature is 80°F or above, adhesive may be eliminated if allowed by manufacturer. A copy of the application instructions shall be provided to the Engineer prior to use. The plastic markings shall be manufactured and packaged in a manner, which will permit storage at normal temperatures for up to one year after purchase.

6. **Lane Lines:** Shall not deviate more than 1 inch per 200 feet nor shall any deviations be abrupt.

7. **Bonding:** To insure a uniform bond of material to asphalt or concrete surfaces after initial laydown, rolling of the material with a truck wheel, car wheel, or heavy hand roller in accordance with the manufacturer's recommendations is required.

8. **Molding and Sealing:** The material shall mold to the pavement contours, breaks, and faults by the action of traffic. When old markings are not required to be removed, the new material shall have resealing characteristics, which enable the material to fuse with itself and with previously applied marking materials of the same composition without externally applied tackifiers or adhesives. In most cases previous pavement markings shall be required to be properly removed.

9. **Waste Disposal:** It shall be the responsibility of the Contractor to provide for disposal of empty material cartons, liner papers, and other waste.

B. Pavement Marking Paint and Beads: Pavement marking paint shall be applied by machine. On special areas and markings that are not adaptable to machine application, hand application will be permitted.

The paint shall be used as furnished by the manufacturer. Thinner or diluent shall not be added. The paint shall be thoroughly mixed in the original container before it is transferred to the tank of the spraying equipment. Filling tanks, pouring paint, or cleaning of equipment shall not be allowed on the pavement.

The pavement marking shall be applied during daylight hours when the ambient air temperature is above 45°F and the road surface is dry. Nighttime application shall be approved by the Engineer. Waterborne paint applied before April 15th or after October 15th shall be formulated as cold weather waterborne paint. Cold weather waterborne paint shall be applied in accordance with this section except where the manufacturer's

recommendations, including minimum temperature requirements, vary from this section. The pavement shall be cleaned of dirt, loose stones, and other foreign material before the paint is applied.

The paint applicator shall be a self-propelled or push-propelled spraying machine. Paint applicator shall be airless type. The left carriage shall simultaneously place a dashed marking, a solid marking and a dashed marking, or two solid markings as detailed in the plans. The paint shall be applied at a maximum speed as recommended by the paint applicator manufacturer. The paint applicator shall be capable of applying glass beads in a pressurized system, synchronized with the spray guns, uniformly across the entire painted line. All guns on the spray carriages shall be in full view of the operator during operation.

During pavement marking operations on sections of roadway open to traffic, the Contractor shall protect the markings from tracking either by placing suitable traffic control devices or by utilizing a shadow vehicle.

The Contractor shall take the steps necessary to ensure that the permanent pavement markings will match the markings on the existing surface.

Tolerances:

1. The length of the painted line shall not vary more than plus or minus 3 inches from the plans requirement.

2. The width of the painted line shall not vary more than plus or minus 1/2 inch from the plans requirement.

3. The length of a 40 foot cycle length consisting of a 10 foot dashed line and a 30 foot gap shall not vary more than 3 inches.

4. The alignment from the plans requirement or existing markings shall not vary more than plus or minus 2 inches.

5. The maximum longitudinal deviation from the existing markings at either end of the painted roadway segment shall not vary more than plus or minus 6 inches.

6. Lane lines shall not deviate more than 1 inch per 200 feet, nor shall any deviations be abrupt.

The Contractor may be required to remove and replace pavement markings not meeting the specifications and tolerances at no additional expense to the City. Removal methods shall minimize damage to the surface and shall be approved by the Engineer.

High build pavement marking paint shall be applied at the manufacturer’s wet thickness to achieve an equivalent dry thickness of 15-16 mils for asphalt and portland concrete pavement. Cold weather pavement marking paint shall be applied at the

manufacturer's wet thickness to achieve an equivalent dry thickness of 10 mils. Glass beads shall be applied uniformly across the wet paint line at a minimum of 8 pounds of glass beads per gallon of paint. Restriping of pavement markings to meet this requirement and to provide a quality retroreflective line shall be at the expense of the Contractor with no additional cost to the City. Sections to be restriped shall be determined by the Engineer.

The paint shall be capable of being applied at a paint temperature up to 160°F. When applied with glass beads at pavement temperatures above 45°F and at a relative humidity of up to 75%, the paint shall dry to a no-track condition within 3 minutes.

C. Grooving for Cold Applied Plastic Pavement Marking: The equipment shall be capable of performing uniform grinding for alignment and depth.

The grooving shall be performed by a self-propelled machine equipped with gang mounted specially prepared circular diamond blades on a turning head. The equipment shall be capable of grooving the total width of the groove in one pass or be capable of grooving uniform depths with multiple passes. The equipment shall be capable of grooving double lines simultaneously or parallel lines to a uniform depth with two passes.

If damage to joints, joint sealant material, backer rod, etc. occurs, the grooving operation shall be stopped and modifications shall be made to the grooving operation to prevent further damage. Damage caused to joints, the joint sealant material, backer rod, etc. shall be repaired or replaced by the Contractor, as directed by the Engineer. No additional payment will be made for the repair work or any reapplication of the pavement marking in the area of the repair.

The bottom of the groove shall be uniform and free of loose material. The groove shall be flat and of uniform depth for the entire width of the groove.

The grooving shall be performed within the following specifications and tolerances:

Description	Specification	Tolerance
Depth of Groove	120 mils	± 10 mils
Width of 4 inch Groove	4½ inches	± 1/8 inch
Width of 6 inch Groove	6½ inches	± 1/8 inch
Width of 8 inch Groove	8½ inches	±1/8 inch
Width of 12 inch Groove	12½ inches	±1/8 inch
Width of 24 inch Groove	24½ inches	± 1/8 inch
Length of Skip Lines	10 foot 6 inches	± 3 inch
Tapers at ends of lines	6 to 9 inches	
Between Double Lines	4 inches	± 1/2 inch

The grooving alignment and straightness tolerances shall be the same as required for the cold applied plastic pavement marking as specified in Section 91.3 A.6.

If the groove is exposed to traffic or adverse weather conditions overnight, the Contractor shall sand blast the groove prior to priming and applying tape.

Existing grooves not meeting the required depth shall be re-grooved to the required depth. In areas where the existing groove meets the required depth and existing markings are still in place, the Contractor shall remove the existing marking by light grinding or sand blasting or both. The grooving, light grinding, and sand blasting operations shall provide the surface preparation required for the application of the new cold applied plastic pavement markings.

91.4 METHOD OF MEASUREMENT

A. Cold Applied Plastic Pavement Marking: Of the width and color specified, will be measured by the linear foot.

B. Cold Applied Plastic Pavement Marking Arrow: Will be measured by count of each type specified.

C. Cold Applied Plastic Pavement Marking Message: Will be measured by count of each complete word specified.

D. Cold Applied Plastic Pavement Marking Area: Of the color specified, will be measured to the nearest square foot.

E. Pavement Marking Paint and Beads: Will be measured to the nearest linear foot for the width and color specified, or by gallon of paint.

F. Grooving: Will not be measured.

91.5 BASIS OF PAYMENT

A. Cold Applied Plastic Pavement Marking: Of each width and color specified, will be paid for at the contract unit price per foot. Payment will be full compensation for equipment, labor, grooving, materials, and all incidentals required.

B. Cold Applied Plastic Pavement Marking Arrow: Of the type specified will be paid for at the contract unit price per each. Payment will be full compensation for equipment, labor, grooving, materials, and all incidentals required.

C. Cold Applied Plastic Pavement Marking Message: Will be paid for at the contract unit price per each word. Payment will be full compensation for equipment, labor, grooving, materials, and all incidentals required.

D. Cold Applied Plastic Pavement Marking Area: Will be paid for at the contract unit price per square foot. Payment will be full compensation for equipment, labor, grooving, materials, and all incidentals required.

E. Pavement Marking Paint and Beads: Will be paid for at the contract unit price per linear foot or gallon for each color of pavement marking paint. Payment will be full compensation for furnishing paint and beads and for labor, equipment, and incidentals necessary.

F. Grooving: Is incidental to the associated pavement marking bid item(s).

END OF SECTION