

CITY OF ALBUQUERQUE  
STANDARD SPECIFICATIONS  
FOR PUBLIC WORKS CONSTRUCTION

TABLE OF CONTENTS

PREFACE

TABLE OF CONTENTS FOR STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION

EDITORIAL GUIDELINES

GENERAL CONDITIONS

<u>Section No.</u>	<u>Title</u>
	Table of Contents for General Conditions
1	Definitions and Terms
2	Preliminary Matters
3	Correlation, Interpretation, and Intent of Contract Documents
4	Availability of Lands; Physical Conditions; Reference Points
5	Bonds and Insurance
6	Contractor's Responsibilities
7	Work by Others
8	Owner's Responsibilities
9	Engineer's Status During Construction
10	Changes in the Work
11	Change of Contract Price
12	Change of the Contract Time
13	Warranty and Guarantee; Tests and Inspections; Corrections, or Acceptance of Defective Work
14	Payments to Contractors and Completion
15	Suspension of Work and Termination
16	Dispute Resolution
17	Miscellaneous
18	Utilities
19	Construction Traffic Control
	Alphabetical Index for General Conditions

TECHNICAL SPECIFICATIONS

SECTION 100 MATERIALS

<u>Section No.</u>	<u>Title</u>
101	Portland Cement Concrete
102	Steel Reinforcement
103	Epoxy-Coated Steel Reinforcement
105	Concrete Curing Compound
106	Cement Mortar and Grout
107	Joint Filler and Sealant Material
108	Brick
109	Riprap Stone
111	Colored Portland Cement Concrete
112	Paving Asphalt (Asphalt Cement)
113	Emulsified Asphalts
114	Asphalt Paving Hot Recycling
115	Slurry Seal Materials
116	Asphalt Concrete
117	Asphalt Rejuvenating Agents

118	Hydrated Lime Mineral Filler
119	Paving Fabrics
121	Plastic Pipe
122	Plastic Liner Plate
123	Reinforced Concrete Pipe
124	Reinforced Concrete Pressure Pipe
125	Vitrified Clay Pipe
127	Steel Water Pipe
128	Concrete Cylinder Pipe
129	Ductile Iron Pipe
130	Gray Iron and Ductile Iron Fittings
135	Corrugated Metal Pipe and Arches (Steel)
136	Structural Steel Plate for Pipe, Arches, and Pipe Arches
137	Corrugated Aluminum Pipe and Arches
138	Structural Aluminum Plate for Pipe, Arches, Pipe Arches, and Box Culverts
139	Structural and Rivet Steel, Rivets, Bolts, Pins and Anchor Bolts
143	Galvanizing
145	Lumber
146	Wood Preservatives
150	Timber Piles
151	Steel Piles
152	Concrete Piles
157	Paint
160	Steel Castings
161	Gray Iron Castings
162	Aluminum Castings
170	Electronic Marker Disks

SECTION 200 EARTHWORK

<u>Section No.</u>	<u>Title</u>
201	Clearing and Grubbing
202	Roadway Excavation
204	Fill Construction
205	Borrow Material
207	Lean Fill Construction
210	Open Area Land Leveling

SECTION 300 STREETS AND RELATED WORK

<u>Section No.</u>	<u>Title</u>
301	Subgrade Preparation
302	Aggregate Base Course Construction
304	Lime Treated Subgrade and/or Subbase
305	Cement Treated Base
306	Bituminous Stabilized Base and Surfacing
307	Plant Mix Bituminous Treated Base (Asphalt Treated Base)
308	Natural Gravel Surfacing for Unpaved Roadways
320	Utility and Monument Access Cover Adjustments
328	Quite Asphalt Concrete Pavement
329	Plant Mix Seal Coat
330	Asphalt Emulsion Slurry Seal
331	Asphalt Concrete Overlay
332	Heater-Remix Resurfacing
333	Fog Seal Coat
334	Seal Coat and Chips and Precoated Chip Seal Coat
335	Paving Fabric Installation
336	Asphalt Concrete Pavement
337	Portland Cement Concrete Pavement
340	Portland Cement Concrete Curbs, Gutters, Walks, Driveways, Alley, Intersections and Median Paving

341	Extruded Asphalt Curb
342	Soil Stabilization
343	Removal and Disposal of Existing Pavements, Curbs, Gutters, Sidewalks, and Drivepads
344	Cold Milling of Pavement Surfaces
346	Textured Concrete
347	Brick Sidewalk
348	Brick Pavement Surface
349	Concrete Curing

SECTION 400 TRAFFIC CONTROL

<u>Section No.</u>	<u>Title</u>
401	Concrete Wall and Metal Barriers
410	Fences
420	General Clauses for Traffic Signal and Street Lighting Systems
421	Signal and Lighting
422	Signal and Lighting Standards
423	Foundations for Signal and Lighting Installations
424	Electrical Conduit
425	Pull Boxes, Splice Cabinets and Manholes
426	Wiring
427	Signal Assemblies
428	Vehicle, Pedestrian, and Emergency Vehicle Detectors
429	Traffic Signal Controllers
430	Removal of Traffic Signal Pressure Detector
431	Beacons and Special Signal Equipment
432	Luminaries
440	Reflectorized Painted Pavement Markings
441	Retroreflective Preformed Plastic Pavement Markings
442	Hot Thermoplastic Pavement Markings
443	Pavement Marking Removal
450	Traffic Signs and Sign Structures

SECTION 500 STRUCTURES

<u>Section No.</u>	<u>Title</u>
501	Excavation and Backfill for Structures
502	Driving Piles
503	Subdrainage
510	Concrete Structures
511	Pneumatically Applied Concrete
512	Precast Prestressed Members
520	Steel Structures
530	Timber Structures and Timber Construction
540	Concrete Block Masonry Structures
541	Brick Masonry Structures
550	Metal Railings

SECTION 600 OPEN CHANNELS, DIKES, OR DAMS

<u>Section No.</u>	<u>Title</u>
601	Earthwork for Open Channels, Dikes or Dams
602	Portland Cement Fly Ash Concrete for Channel Lining and Dike or Dam Surfacing
603	Riprap Surface Treatment
604	Flexible Soil Matting
610	Gabions

SECTION 700 TRENCHING AND BORING FOR UTILITIES

<u>Section No.</u>	<u>Title</u>
701	Trenching Excavation and Backfill
710	Boring, Drilling and Jacking

SECTION 800 WATER TRANSMISSION, COLLECTOR, DISTRIBUTION AND SERVICE LINES

<u>Section No.</u>	<u>Title</u>
801	Installation of Water Transmission, Collector and Distribution Lines
802	Installation of Water Service Lines

SECTION 900 SANITARY AND STORM SEWER FACILITIES

<u>Section No.</u>	<u>Title</u>
901	Sanitary Sewer Collector and Interceptor Facilities
905	Sanitary Sewer Service Lines
910	Storm Sewer Pipe Installations
915	Storm Sewer Drainage Appurtenances
920	Sanitary and Storm Sewer Manholes

SECTION 1000 LANDSCAPING

<u>Section No.</u>	<u>Title</u>
1001	Landscape Irrigation
1005	Plantings
1010	Grass Sodding
1011	Turf Grass Seeding
1012	Native Grass Seeding
1015	Trash and Litter Receptacles

SECTION 1200 BARRICADING AND TEMPORARY TRAFFIC CONTROL

<u>Section No.</u>	<u>Title</u>
1200	Barricading and Temporary Traffic Control

SECTION 1500 MISCELLANEOUS ITEMS

<u>Section No.</u>	<u>Title</u>
1501	Monuments
1502	Submittals

SECTION 2000 STANDARD DETAIL DRAWINGS

<u>Section No.</u>	<u>Title</u>
2100	Standard Details for Sewer
2200	Standard Details for Drainage
2300	Standard Details for Water
2400	Standard Details for Paving
2500	Standard Details for Traffic
2600	New Mexico State Highway and Transportation Department Standard Details
2700	Standard Details for Landscaping
2800	Standard Details for Temporary Traffic Control
2900	Standard Details for Signing and Striping

SECTION 3000 BIBLIOGRAPHY

<u>Section No.</u>	<u>Title</u>
3001	American Society for Testing and Materials (ASTM)
3002	American Association of State Highway and Transportation Officials (AASHTO)
3003	American Water Works Association (AWWA)
3004	Collective Reference Groups

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RETROREFLECTORIZED PAINTED PAVEMENT MARKINGS

440.1 GENERAL: This work shall consist of furnishing and installing permanent and temporary retro-reflectORIZED painted pavement markings in substantial compliance with the specifications and details shown on the plans, at the locations shown on the plans, or as established by the ENGINEER.

440.2 REFERENCES.

440.2.1 Manual on Uniform Traffic Control Devices (MUTCD), Latest Edition

440.3 MATERIALS.

440.3.1 TRAFFIC PAINT: Traffic paint shall conform to the requirements of the City of Albuquerque for White and Yellow Traffic Line Paints Used on Construction Projects (Combination Alkyd and Hypalon - Fast Dry Type).

440.3.2 REFLECTORIZED GLASS BEADS: Provide high performance beads for improved retroreflectivity and durability for roadway markings in accordance with the following bead retained percentage table:

U.S. Mesh	Microns	% Retained
18	1000	5 - 15
30	600	20 - 35
50	300	55 - 75
100	150	0 - 5

Provide beads that are colorless/clear and free of carbon residue. Provide beads where all +20 US Mesh beads are 85% minimum rounds and overall rounds are 75% minimum. Use ASTM D 1155 test method for all beads except the +20 US Mesh which are inspected visually. Provide beads with an index of refraction minimum 1.51 by oil immersion method in accordance with ASTM D 1155. Provide beads with a resistance to acid, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.6; the beads shall not develop any surface haze or dulling. Provide beads with a resistance to calcium chloride, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.7, the beads shall not develop any surface haze or dulling. Provide beads with a resistance to sodium sulfide, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.8, the sodium sulfide solution shall not darken the beads. Provide beads with water resistance, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.9, the water shall not produce dulling or hazing of the beads, and not more than 4.5 ml of 0.1N hydrochloric acid shall be used for the titration. Provide beads with moisture resistant coating. Provide all post consumer and post industrial glass beads manufactured from North American glass waste streams. The bead manufacturer shall submit a notarized certification to the City that North American glass waste streams were used in the manufacture of product meeting this specification. Provide beads that are compatible with all binder systems, including alkyd and

hydrocarbon thermoplastic, water and solvent based paint, epoxy, and methylmethacrylate. Provide glass beads furnished in bags identifying contents, manufacturer and net weight.

440.3.3 TEMPORARY MARKING TAPE.

440.3.3.1 Temporary adhesive marking tape shall consist of weather and traffic resistant yellow or white retro-reflective marking material and shall conform to the following requirements:

440.3.3.1.1 DESCRIPTION: The adhesive pavement striping material shall consist of white or yellow retroreflective marking material on a conformable non-metallic backing coated with a pressure sensitive adhesive and designed for marking of bituminous or Portland Cement Concrete surfaces.

440.3.3.1.2 COLOR: The color of the visible surface shall be either white or yellow in accordance with the MUTCD and shall closely match the color of the paint specified in this Section 440.

440.3.3.1.3 RETROREFLECTANCE: The white and yellow markings shall have the following initial minimum retro-reflectance values at 0.2 degree and 0.5 degree observation angles and 86 degrees entrance angle as measured in accordance with the testing procedure of Federal Test Method Standard 370 unless a higher value is specified on the plans.

TEMPORARY MARKING TAPE			
Minimum Retro-reflectivity (Millicandelas Per Footcandle Per Square Foot)			
OA	EA	White	Yellow
0.2	86	1770	1310
0.5	86	1270	820

Where: OA = Observation Angle in Degrees  
EA = Entrance Angle in Degrees

440.3.3.1.4 ADHESION: The material shall have a pre-coated pressure sensitive adhesive which does not require a liner for protection from contamination, pre-adhesion, or blocking within the roll. Said material shall show no appreciable loss of adhesion after application.

440.3.3.1.5 CONFORMABILITY: The material shall be flexible and formable, shall show no cracking, flaking, or loss of reflective elements and, following application, shall remain conformed to the texture of the pavement surface.

440.3.3.1.6 PHYSICAL PROPERTIES.

440.3.3.1.6.1 DIMENSIONS: The thickness of the adhesive marking tape for normal use shall not be less than 10 mils and shall be provided in 4-inch or 6-inch width (plus or minus 1/16 inch) unless otherwise specified.

440.3.3.1.6.2 WEAR RESISTANCE: Wear resistance samples of the adhesive pavement striping material applied to standard specimen plates and tested in accordance with Federal Test Methods No. 141, Method 6192, using a CS-17 wheel and 1000 gram load shall not exhibit a significant change in color after 5000 cycles.

#### 440.3.3.1.7 REMOVABILITY.

440.3.3.1.7.1 Temporary adhesive pavement striping material shall be readily removable from the pavement by following the manufacturer's recommendations, unless otherwise specified.

440.3.3.1.7.2 Removal shall not require sandblasting, solvent or grinding methods and shall not result in objectionable staining of the pavement surface.

440.3.3.1.8 DURABILITY: The material shall be weather resistant and show no appreciable fading, lifting, or shrinkage.

#### 440.3.3.1.9 GENERAL

440.3.3.1.9.1 The materials as supplied shall be of good appearance and free from cracks, and the edge shall be true, straight, and unbroken.

440.3.3.1.9.2 The adhesive pavement striping material shall be packaged in accordance with accepted commercial standards, shall be stored at temperatures not to exceed 100 degrees Fahrenheit under normal conditions, and shall be suitable for use for a period of at least one (1) year after purchase.

440.3.4 ACCEPTANCE: Acceptance of traffic paint and temporary marking tape will be based upon receipt of certificates of compliance and documentation that the batch of paint and/or marking tape to be used has been tested by an independent laboratory and conforms with specifications.

### 440.4 CONSTRUCTION REQUIREMENTS.

#### 440.4.1 GENERAL

440.4.1.1 The traffic paint and beads shall be placed on the pavement by a spray type, self-propelled pavement marking machine, except that temporary striping during construction may be placed with other equipment designed for application of paint, or beads.

440.4.1.1.1 The machine shall be capable of applying a clear-cut 4-inch line or lines.

440.4.1.1.2 The machine shall be equipped with a mechanical device capable of placing a broken retro-reflective centerline with a 10-foot painted segment and a 30-foot gap.

440.4.1.1.3 The machine shall be equipped with an air-operated glass bead drop-in dispenser controlled by a spray gun mechanism.

440.4.1.1.3.1 The dispenser shall be capable of placing the glass beads (sphere shape) into the paint line as the paint is applied to the pavement in such a manner as to provide satisfactory marking and delineation.

440.4.1.1.4 The volume of paint and glass beads in place shall be measured by the quantity per mile method. The CONTRACTOR shall provide certification of the volume of the paint and bead tanks. The CONTRACTOR shall strap the tanks prior to beginning striping operation and again after a mile has been striped. As an alternative, the CONTRACTOR may externally mark the tanks indicating a volume equivalent to the tolerances shown in this Section 440 or have a calibrated rod marked with the equivalent volumes. The volumes shall be measured after a mile has been striped. At the option of the ENGINEER, if the striping machine is equipped with air atomized spray units, (not airless), and paint and bead gauges, the volume may be determined by utilizing said gauges.

440.4.1.1.4.1 The CONTRACTOR shall be required to restripe the roadway if 50% of the paint or beads are not placed on the roadway or if the ENGINEER determines that the striping is not adhering to the pavement or the glass beads are not adhering to the paint.

440.4.1.1.5 When paint has settled excessively, the CONTRACTOR shall re-disperse the settled pigments at the bottom of the paint drums, with a mixing device, prior to pumping or loading paint into the striping unit so excess pigments are not left on the bottom of the paint drum. Thinner shall not be allowed to be pumped into the paint tanks. If the CONTRACTOR uses thinner to clean his equipment, the CONTRACTOR shall be responsible for disposing of all debris including, but not limited to, thinner at disposal sites approved by government agencies regulating the disposal of such materials.

440.4.1.1.6 Hot retroreflective thermoplastic pavement markings will be considered by Traffic Engineering Operations Division as a substitute for cold plastic, provided that installation is carried out per the manufacturer's specifications. Hot thermoplastic shall be a minimum of 90 mil thickness for lane lines and 125 mil for transverse lines. Ten (10) pound drop-on glass beads per 100 sq. ft. is required. All markings shall be alkyd thermoplastic.

#### 440.4.2 PLACEMENT OF BEADS AND TRAFFIC PAINT

440.4.2.1 Retro-reflectorized painted markings for temporary use on final surfacing is prohibited. Pavement markings shall be applied during daylight hours when the pavement surface is dry and the weather is not foggy, rainy, excessively windy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before traffic paint or beads are applied. The CONTRACTOR shall remove dirt, debris, grease, motor oils, rocks, or chips from the pavement surface before applying markings.

440.4.2.2 The CONTRACTOR shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time. The CONTRACTOR shall submit a traffic control plan to the City's Construction Coordination Division for approval prior to the commencement of work. All damage to the pavement marking due to the CONTRACTOR's negligence or failure to maintain traffic control shall be repaired at the CONTRACTOR's expense.

440.4.2.3 Permanent retroreflectorized painted markings shall consist of two applications of markings. For painted markings on new pavement the second application of markings shall be placed no sooner than twenty-one days after placement of the first application of markings as directed by the ENGINEER.

440.4.2.4 Permanent retroreflective hot thermoplastic pavement markings shall be a minimum of 90 mil thickness for lane lines and 125 mil for transverse lines, or as directed by the ENGINEER. Ten pound drop-on glass beads per 100 sq. ft. is required. All markings shall be alkyd thermoplastic.

440.4.2.5 If paint is not adhering to the pavement, or if the glass beads are not adhering to the paint, or if the second application of pavement markings are not placed over the first application of markings in accordance with this Section 440, the CONTRACTOR will be required to remove the striping, and to restripe the roadway.

#### 440.4.3 TOLERANCE FOR PLACING PAINT & BEADS

440.4.3.1 The finished line shall be smooth, aesthetically acceptable and free from undue waviness.

440.4.3.2 Painted lines shall be 4, 6, 8, or 12 inches wide as shown on the plans with a tolerance of plus or minus 1/8 inch and shall be placed at a minimum rate of 19.75 gallons of paint per mile for a solid 4-inch line and 4.94 gallons per mile for a broken 4-inch line, based on a 10-foot stripe and a 30-foot gap (40-foot cycle). Other widths of striping shall be applied at the minimum rate that is the equivalent multiple of the above.

440.4.3.3 The length of the painted segment including the gap shall not vary more than six (6) inches in a 40-foot cycle.

440.4.3.4 The following transverse gap dimension between centerline stripes for two (2) and three (3) stripe combinations reflect a three (3) paint gun set up on the striping unit. The broken line shall be placed on the centerline of the roadway with the respective left and right no passing zones placed so a two (2) inch gap exists between the broken and solid no passing zone stripe. There shall be an eight (8) inch gap between the solid double yellow markings for no passing zones.

440.4.3.5 Glass retroreflectorizing beads shall be applied on the wet paint at a minimum rate of six (6) pounds to each gallon of paint. This translates into a minimum weight of beads of 29.6 lbs. per mile of broken line and 118.5 lbs.

per mile of solid line. For other widths of striping, glass bead rate shall be applied at the minimum rate that is the equivalent multiple of the above.

#### 440.4.4 PLACING TEMPORARY ADHESIVE MARKING TAPE

440.4.4.1 Adhesive tape marking material shall be applied as follows:

440.4.4.1.1 The CONTRACTOR shall provide the necessary personnel and equipment to warn and divert traffic during installation and removal from the area where the work is in progress as approved by the ENGINEER. The surface to which the tape is applied shall be dry and free of oils, grease, dust, dirt and other deleterious substances and shall be primed with a primer material which is recommended by the manufacturer of the tape.

440.4.4.1.2 The tape shall be rolled or tamped down immediately after application until it adheres properly and conforms to the surface of the pavement in accordance with the manufacturer's recommendation.

440.4.4.1.3 Where striping is continuous, there shall be no more than three (3) splices per 120-feet of length.

#### 440.4.5 REMOVAL OF TEMPORARY PAVEMENT MARKINGS

440.5.1 TEMPORARY ADHESIVE MARKING TAPE: All temporary pavement markings placed on the final pavement surface shall be removed by the CONTRACTOR when such temporary pavement markings are no longer required for traffic control as determined by the ENGINEER. Where temporary pavement markings, which are to be removed, consist of adhesive marking tape, the removal shall be complete with no segments or pieces of tape remaining on the pavement. The use of non-reflective black adhesive marking tape to obliterate temporary pavement markings will not be permitted. Over painting is not an acceptable method.

440.5.2 REFLECTORIZED PAINTED MARKINGS: ReflectORIZED painted markings for temporary use on final surfacing is prohibited. ReflectORIZED painted markings when used for temporary pavement markings shall be removed where required by traffic control plan in accordance with the provisions of Section 443 – Pavement Marking Removal.

440.4.6 COMPLIANCE WITH THE MUTCD: All retro reflectORIZED painted markings and temporary adhesive marking tape shall conform to the latest version of the Manual on Uniform Traffic Control Devices (MUTCD).

#### 440.5 MEASUREMENT AND PAYMENT

440.5.1 Retroreflective painted markings and hot retroreflective thermoplastic pavement markings shall be measured by the linear foot of either 4-inch, 6-inch, 8-inch, 12-inch, or 24-inch width, complete in place.



440.5.2 Temporary adhesive marking tape will be measured by the linear foot of 4-inch width, complete in place.

440.5.3 Removal of adhesive marking tape will not be measured.

440.5.4 Removal of retroreflectorized painted markings and hot retroreflective thermoplastic pavement markings will be measured by the linear foot of 4-inch width, complete in place, in accordance with the provisions of Section 443 Pavement Marking Removal.

440.5.5 The accepted quantities of retroreflectorized painted markings and temporary adhesive marking tape will be paid for at the contract unit price per unit of measurement for each of the pay items as shown on the bid proposal. The removal of retro-reflectorized painted markings will be paid in accordance with the provisions of Section 443 Pavement Marking Removal.

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RETROREFLECTIVE PREFORMED PLASTIC PAVEMENT MARKINGS

441.1 GENERAL: This work shall consist of furnishing and installing retroreflective preformed plastic pavement symbols, legends, stripes and markings in compliance with the specifications and the details shown on the plans at the locations shown on the plans, or as established by the ENGINEER.

441.2 REFERENCES.

441.2.1 American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications, Latest Edition.

441.2.2 American Society for Testing and Materials (ASTM), Latest Edition.

441.2.3 Manual of Uniform Traffic Control Devices (MUTCD), Latest Edition

441.3 MATERIALS.

441.3.1 RETROREFLECTIVE PREFORMED PLASTIC PAVEMENT MARKINGS MATERIAL

441.3.1.1 Retroreflective preformed plastic pavement marking material shall consist of white or yellow weather resistant reflective film conforming to the requirements set forth herein. The material shall be manufactured and packaged in such a manner as to permit storage at normal shelf temperature for a period of not less than two (2) years from date of purchase. Prefabricated legends and symbols shall conform to the applicable shapes, sizes, and color as outlined in the latest edition of the Manual on Uniform Traffic Control Devices.

441.3.1.1.1 COMPOSITION: The retroreflective preformed plastic markings shall consist of high quality plastic materials, pigments, and 1.51 index glass beads uniformly distributed throughout their cross-sectional area, with a reflective layer of beads embedded in the top surface. Materials will be furnished with the appropriate adhesive system recommended by the manufacturer for successful installation.

441.3.1.1.2 SKID RESISTANCE: The surface of the retroreflective preformed plastic marking material shall provide a minimum skid resistance value of 50 BPN when tested according to ASTM E 303-667.

441.3.1.1.3 COLOR: The retroreflective preformed plastic marking material shall be white or yellow in accordance with the MUTCD unless otherwise specified.

441.3.1.1.4 THICKNESS: The thickness of the retroreflective preformed plastic marking material without adhesive shall be 60 mils (0.06 inches).

441.3.1.1.5 DURABILITY AND WEAR RESISTANCE: The retroreflective preformed plastic pavement marking material, when properly applied, shall provide a neat, durable marking. The preformed plastic

marking material shall provide a cushioned resilient substrate that reduces bead crushing and loss. The film shall be weather resistant and, through normal traffic wear, shall show no appreciable fading, lifting, or shrinkage within three years after installation, and shall show no significant tearing, rollback, or other signs of poor adhesion.

441.3.1.1.6 CONFORMABILITY AND RESEALING: The retroreflective preformed plastic marking material shall be capable of conforming to pavement contours, breaks, faults, etc., through the action of traffic at normal pavement temperatures. The film shall have resealing characteristics such that it is capable of fusing with itself and previously applied marking film of the same composition under normal conditions of use.

441.3.1.1.7 TENSILE STRENGTH: Retroreflective preformed plastic marking material shall have a minimum tensile strength of 40 pounds per square inch of cross section when tested according to ASTM D 638. A test specimen six (6) inches by one (1) inch by 0.06 inch minimum thickness shall be tested at a temperature range of 70 to 80 degrees Fahrenheit, using a jaw speed of 0.25 inch per minute.

441.3.1.1.8 ELONGATION: Retroreflective preformed plastic marking material shall have a minimum elongation of 50% when tested in accordance with ASTM D 638.

441.3.1.1.9 PLASTIC PULL TEST: Retroreflective preformed plastic marking material shall support a dead weight of four (4) pounds for not less than five (5) minutes at a temperature range of 70 to 80 degrees Fahrenheit. Test specimen size shall be six (6) inches by one (1) inch by 0.06 inch minimum thickness.

441.3.1.1.10 PIGMENTATION: The pigment for retroreflective preformed plastic marking material shall be selected and blended to provide a plastic which is white or yellow, conforming to the MUTCD through the expected life of the pavement marking plastic.

441.3.1.1.11 GLASS BEADS

441.3.1.1.11.1 Provide high performance beads for improved retroreflectivity and durability for roadway markings in accordance with the following bead retained percentage table:

U.S. Mesh	Microns	% Retained
18	1000	5 - 15
30	600	20 - 35
50	300	55 - 75
100	150	0 - 5

Provide beads that are colorless/clear and free of carbon residue. Provide beads where all +20 US Mesh beads are 85% minimum rounds and overall rounds are 75%

minimum. Use ASTM D 1155 test method for all beads except the +20 US Mesh which are inspected visually. Provide beads with an index of refraction minimum 1.51 by oil immersion method in accordance with ASTM D 1155. Provide beads with a resistance to acid, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.6; the beads shall not develop any surface haze or dulling. Provide beads with a resistance to calcium chloride, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.7, the beads shall not develop any surface haze or dulling. Provide beads with a resistance to sodium sulfide, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.8, the sodium sulfide solution shall not darken the beads. Provide beads with water resistance, specifically when tested as specified in Federal Specification TT-B 1325C, 4.3.9, the water shall not produce dulling or hazing of the beads, and not more than 4.5 ml of 0.1N hydrochloric acid shall be used for the titration. Provide beads with moisture resistant coating. Provide all post consumer and post industrial glass beads manufactured from North American glass waste streams. The bead manufacturer shall submit a notarized certification to the City that North American glass waste streams were used in the manufacture of product meeting this specification. Provide beads that are compatible with all binder systems, including alkyd and hydrocarbon thermoplastic, water and solvent based paint, epoxy, and methylmethacrylate. Provide glass beads furnished in bags identifying contents, manufacturer and net weight.

441.3.2 ACCEPTANCE: Acceptance of retroreflective preformed plastic pavement marking material will be based upon receipt of certificates of compliance and documentation that the material has been tested by an independent laboratory and conforms to specifications.

#### 441.4 CONSTRUCTION REQUIREMENTS

441.4.1 The retroreflective preformed plastic pavement symbols, legends, stripes and marking shall be applied to the asphalt and/or portland cement concrete pavement at the locations shown on the plans or as designated by the ENGINEER.

441.4.2 The asphalt and/or portland cement concrete pavement surface shall be clean and free of moisture, soil or other deleterious substances. A brooming or compressed air method shall be utilized to clean the pavement surface.

441.4.3 If inlaid material is required in the plans, the reflectorized plastic marker material shall be applied to the roadway surface following the placement of bituminous pavement and before final rolling is completed at the locations shown on the plans or as designated by the ENGINEER.

441.4.4 The use of hot retroreflective thermoplastic is prohibited for pavement markings; only preformed plastic shall be used.

441.4.5 CONTRACTOR shall remove all conflicting existing pavement markings.

441.4.6 When designated on the plans, the CONTRACTOR shall provide temporary lane delineation by placing a twelve (12) inch long strip of four (4) inch wide plastic temporary lane marking, forty (40) feet on center, on each new lift of asphalt surfacing including temporary asphalt connections, asphalt treated base course, asphaltic concrete base course, and asphaltic concrete surface course to cover a lapse in time before the final surfacing course and final striping is placed. After final striping is placed, any temporary lane lines remaining on the final surface course shall be removed.

441.4.7 COMPLIANCE WITH THE MUTCD: All retroreflective preformed plastic pavement markings shall conform to the Manual on Uniform Traffic Control Devices.

#### 441.5 MEASUREMENT AND PAYMENT.

441.5.1 The retroreflective preformed plastic pavement stripes shall be measured by the linear foot of either 4-inch, 6-inch, 8-inch, 12-inch, or 24-inch width, complete in place.

441.5.2 The retroreflective preformed plastic pavement continental cross walks will be measured by the linear foot of 24-inch width, complete in place.

441.5.3 The retroreflective preformed plastic pavement stop bars will be measured by the linear foot of 12-inch or 24-inch width, complete in place.

441.5.4 The retroreflective preformed plastic pavement symbols, legends and markings will be measured per unit, complete in place.

441.5.5 The retroreflective preformed plastic pavement temporary lane lines will be measured by the linear foot of 4-inch width, complete in place.

441.5.6 The accepted quantities of retroreflective preformed plastic pavement stripes, stop bars, symbols, legends and temporary lane lines will be paid for at the contract unit price per unit of measurement for each of the pay items listed as shown on the bid proposal

## HOT THERMOPLASTIC PAVEMENT MARKINGS

442.1 GENERAL: This work shall consist of cleaning and preparing pavement surfaces and furnishing and applying either white or yellow thermoplastic reflectorized pavement markings using extrusion, ribbon or spray dispensing devices of the required shape and thickness to the prepared pavement surface at the locations and in accordance with the details shown on the project plans, the manufacturer's specifications, and the requirements of these specifications, or as established by the ENGINEER.

## 442.2 REFERENCES.

- 442.2.1 American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications, Latest Edition.
- 442.2.2 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition.
- 442.2.3 Manual on Uniform Traffic Control Devices (MUTCD), Latest Edition.
- 442.2.4 Federal Test Method Standards, Latest Edition.
- 442.2.5 New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction, Latest Edition.

## 442.3 MATERIALS.

442.3.1 GENERAL REQUIREMENTS: The thermoplastic reflectorized material shall consist of a solid mixture of heat-stable resins, white or yellow pigment, inter-mixed glass beads, filler, and other materials in granular or block form specifically compounded for reflectorized pavement markings to be applied to the pavement in a molten state. The characteristics of the liquefied material shall be such that complete and even coverage of specified areas to the required thicknesses is provided by the required application method and rate. Upon cooling to normal pavement temperature, this material shall produce an adherent reflectorized marking capable of resisting deformation and wear in the roadway.

442.3.2 COMPOSITION: The ingredients of the thermoplastic composition shall be thoroughly mixed and in a solid or sectionalized block, or free-flowing granular form. When heated in a melting apparatus, the material shall readily liquefy into a uniform solution. This solution shall be free from all skins, dirt, foreign objects or any other ingredient which would cause bleeding, staining, blotting, or discoloration when applied to the bituminous or concrete pavement surfaces. The thermoplastic composition shall conform to the following requirements:

	Percent by Weight	
	White	Yellow
Binder	20% min	20% min
Titanium dioxide (for white)	10% min	-
Yellow lead-free pigment (for yellow)	-	1.5% min
Reflective glass inter-mix beads	30- 45%	30- 45%
Calcium carbonate or equivalent filler	20- 42%	20- 42%

442.3.2.1 BINDER COMPOSITION: The thermoplastic shall be based on the following binder composition:

442.3.2.1.1 Alkyd shall consist of a mixture of synthetic resins, at least one of which is solid at room temperature, and of high-boiling-point plasticizers. At least one third of the binder composition and no less than eight percent by weight of the entire material formulation shall be solid maleic-modified glycerol ester resin or maleic modified pentaerythritol ester resin. The alkyd binder shall not contain any petroleum-based hydrocarbon resins.

442.3.2.1.2 An alkyd thermoplastic formulation may be used for symbols, legends, and transverse lines, including stop bars and crosswalks.

442.3.2.1.3 An alkyd thermoplastic formulation may be used for longitudinal lines, including lane lines and edge lines, unless otherwise shown on the project plans or specified herein. Extrusion or spray formulations shall be used in accordance with requirements of the application equipment used to install the markings.

## 442.3.2.2 REFLECTIVE GLASS BEADS.

442.3.2.2.1 The inter-mix glass beads shall conform to AASHTO M 247 Type I, and may be coated or uncoated as recommended by the manufacturer. If uncoated beads are used, the thermoplastic formulation shall be configured to minimize settling of the intermix beads when the material is heated and applied.

442.3.2.2.2 In addition to incorporating glass beads in the thermoplastic mix, glass beads shall be applied to the surface of the molten material immediately after application. The drop-on beads shall be in accordance with New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction section 704.2.2 and shall be applied at a minimum rate of 10 pounds of glass beads per 100 square feet of line (300 linear feet of four inch stripe).

442.3.2.3 FILLER: The filler shall be a white calcium carbonate or equivalent filler with a compressive strength of at least 5,000 pounds per square inch.

442.3.2.4 TITANIUM DIOXIDE: Titanium Dioxide shall conform to the requirements of ASTM D 476 for Type II (92 percent).

442.3.2.5 YELLOW PIGMENT: The yellow pigment shall be heat resistant and lead free. The type of yellow pigment shall be the manufacturer's option provided that the material conforms to all color requirements in a stable and durable fashion as specified herein.

### 442.3.3 PHYSICAL CHARACTERISTICS OF THE COMPOSITION.

442.3.3.1 GENERAL REQUIREMENTS: The thermoplastic material shall not exude fumes which are toxic, injurious, or require specialized breathing apparatus when heated to the temperature range specified by the manufacturer for application. The material shall remain stable when held for four hours at this temperature, or when subjected to four re-heatings, not exceeding a total of four hours, after cooling to ambient temperature. The temperature viscosity characteristics of the plastic material shall remain constant throughout the re-heatings and shall show like characteristics from batch to batch. There shall be no obvious change in color of the thermoplastic material as a result of reheating, and the color of the material shall not vary from batch to batch.

442.3.3.2 COLOR: The thermoplastic material, after heating for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$  and cooled to  $77^{\circ} \pm 3^{\circ}\text{F}$ , shall meet the following:

442.3.3.2.1 White: Daylight reflectance at 45 degrees - 0 degrees shall be 70% minimum. Color shall match Federal Test Standard Number 595, color chip no. 17925.

442.3.3.2.2 Yellow: Daylight reflectance at 45 degrees - 0 degrees shall be 43% minimum. Color shall match Federal Test Standard Number 595, color chip no. 13538.

442.3.3.3 RETROREFLECTANCE: The white and yellow thermoplastic materials shall have the following minimum retroreflectance values at 86.5 degrees illumination angle and 1.5 degrees observation angle as measured by a MiroLux 12 portable retroreflectometer or similar approved device within 30 days after application to the roadway surface:

Product	Retroreflectance (millicandelas)
White	300
Yellow	200

442.3.3.4 SOFTENING POINT: After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$  and testing in accordance with ASTM D 36, the materials shall have a softening point of  $215^{\circ} \pm 15^{\circ}\text{F}$ .

442.3.3.5 WATER ABSORPTION AND SPECIFIC GRAVITY: The thermoplastic material shall not exceed 0.5 percent by weight of retained water when tested in accordance with the requirements of ASTM D 570. The specific gravity of the material, as determined by Section 16 of AASHTO T 250, shall be between 1.85 and 2.15.

442.3.3.6 IMPACT RESISTANCE: After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$  and forming test specimens, the impact resistance shall be not less than 10 inch-pounds when tested in accordance with Section 9 of AASHTO T 250.

442.3.3.7 BOND STRENGTH: After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$ , the bond strength to Portland cement concrete shall be not less than 180 pounds per square inch. The bond strength shall be determined in accordance with the procedures specified in Section 7 of AASHTO T 250.

442.3.3.8 ABRASION RESISTANCE: The abrasion resistance of the thermoplastic material shall be determined by forming a representative lot of the material at a thickness of 0.125 inches on a four-inch square monel panel (thickness  $0.050 \pm 0.001$  inches), on which a suitable primer has been previously applied, and subjecting it to 200 revolutions on a Taber Abraser at  $25^{\circ}\text{C}$ , using H-22 calibrated wheels weighted to 250 grams. The wearing surface shall be kept wet with distilled water throughout the test. The maximum loss of thermoplastic material shall be 0.5 grams.

442.3.3.9 CRACKING RESISTANCE AT LOW TEMPERATURE: After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$ , applying to concrete blocks, and cooling to  $15^{\circ} \pm 3^{\circ}\text{F}$ , the material shall show no cracks when observed from a distance exceeding 12 inches. Testing for low temperature crack resistance shall be in accordance with the procedures specified in Section 8 of AASHTO T 250.

442.3.3.10 FLOWABILITY: After heating the thermoplastic material for four hours  $\pm$  five minutes at  $425^{\circ} \pm 3^{\circ}\text{F}$ , and testing for flowability in accordance with Section 6 of AASHTO T 250, the white thermoplastic shall have a maximum percent residue of 18, and the yellow thermoplastic shall have maximum percent residue of 21.

442.3.3.11 YELLOWNESS INDEX: When tested per AASHTO T250 Section 4, the white thermoplastic material shall not exceed a yellowness index of 0.10.

442.3.3.12 FLOWABILITY (EXTENDED HEATING): After heating the thermoplastic material for eight ± 1/2 hours at 425° ± 3°F, with stirring the last six hours, and testing for flowability in accordance with Section 12 of AASHTO T 250, the thermoplastic shall have a maximum percent residue of 28.

442.3.3.13 FLASH POINT: The thermoplastic material shall have a flash point not less than 475°F when tested in accordance with the requirements of ASTM D92.

442.3.3.14 STORAGE LIFE: The materials shall meet the requirements of this specification for a period of one year from the date of manufacture. The month and year of manufacture shall be clearly marked on all packages of thermoplastic material. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for this one year period. Any material which does not meet the above requirements, or which is no longer within this one year period at the time of application, shall not be used. The contractor shall replace any outdated material with material meeting the above performance and time requirements at no additional cost to the Department.

442.3.3.15 PRIMER-SEALER: Primer-sealers shall be used on Portland cement concrete, or existing hot mix

asphaltic concrete surfaces prior to application of the thermoplastic material, and shall be applied as recommended by the thermoplastic material manufacturer. The primer-sealer shall be compounded specifically for use with the specified thermoplastic material. Application of primer-sealer will not be required on newly placed hot-mix asphaltic concrete surfaces prior to application of the thermoplastic material.

442.3.3.16 COLOR STABILITY: Using accelerated weathering per ASTM G155 cycle 1, white color stability shall be measured for no color change after 500 hours of exposure, and for yellow color shall be measured for no color change after 1000 hours of exposure.

442.3.4 PHYSICAL REQUIREMENTS FOR GLASS BEADS: Drop-on beads shall conform to the requirements of New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction Section 704.2.2. If recommended by the manufacturer, the drop-on beads shall have an adherence coating.

442.3.5 QUANTITATIVE REQUIREMENTS OF MIXED PAINT: The paints shall meet the quantitative requirements specified below:

PARAMETERS	White Alkyd Thermoplastic	Yellow Alkyd Thermoplastic
Glass Bead Content, % bw	30% - 45%	30% - 45%
Binder Content, % bw	20% minimum	20% minimum
Calcium Carbonate, % bw	20% - 42%	20% - 42%
Titanium Dioxide, % bw	10% minimum	N/A
Organic Yellow Lead Free, % bw	N / A	1.5% minimum
Softening Point ( ASTM E 28)	194 °F	194 °F
Temperature vs. viscosity characteristics, up to 4 reheatings to 401 °F	Constant	Constant
Specific Gravity max	2.15	2.15
Bond Strength(psi) minimum ASTM D 4796 to unprimed portland cement,125 mils at 218 °C, test at 25 ± 2 °C	180 psi	180 psi
Brookfield thermocel viscosity (spindle # 27,20RPM@ 425 °F), poise		
Low Viscosity	<40	<40
Extruded Viscosity	45 to 100	45 to 100
Impact Resistance (inch-pound) , ASTM D 2794	>50 in-lb	> 50 in-lb
Hardness Shore A-2 Durometer	45 to 75	45 to 75
Color CIE, Brightness Y	Min. 80	45 – 60
Abrasion, max total weight loss, grams	4 to 12 g	4 to 12 g
Test Distance = 5 in		
Blast Pressure = 40 psi		
Sample Angle = 10 °		
Blast Media = 1200 grams		
Initial Retroreflectivity, min	250	175

#### 442.4 CONSTRUCTION REQUIREMENTS.

##### 442.4.1 INSTALLATION.

442.4.1.1 **MOISTURE:** All surfaces shall be inspected for moisture content prior to application of thermoplastic. Approximately two square feet of a clear plastic or tarpaper shall be laid on the road surface and held in place for 15 to 20 minutes. The underside of the plastic or tarpaper shall then be inspected for a build up of condensed moisture from the road surface. If the amount of condensed moisture is of a sufficient amount to result in water dripping from the plastic or tarpaper when held in a vertical position, thermoplastic shall not be applied. This moisture test shall be repeated until the moisture in the road surface has been allowed to evaporate to a level whereby there is not excessive build up of condensed moisture on the underside of the plastic or tarpaper.

442.4.1.2 **CLEANING:** All surfaces shall be clean and dry before thermoplastic can be applied. Loose dirt and debris shall be removed by blowing compressed air over the area to be striped. If the thermoplastic is to be applied over existing paint lines, the paint line shall be swept with a mechanical sweeper or wire brush to remove poorly adhered paint and dirt that would interfere with the proper bonding of the thermoplastic. Curing compound and loosely adhered surface film shall be removed from all new Portland cement concrete surfaces by loose grain abrasive pressure blasting or wire brushing. All dust and grinding debris must be removed completely before applying the primer. Open graded roadways (i.e., double bituminous surface treatment) require brooming to ensure cleanliness.

442.4.1.3 **LAYOUT:** The pavement markings shall be placed in proper alignment with guidelines established on the roadway. Deviation from the alignment established shall not exceed two inches per 200 feet of roadway nor shall any deviation be abrupt. Longitudinal markings shall be offset at least two inches from construction joints of Portland cement concrete surfaces and joints and shoulder breaks of asphalt surfaces.

442.4.1.4 **PRIMER APPLICATION:** When required, the primer shall be applied to the road surface in a continuous film at a thickness of 15 mils, plus or minus 2 mils. Before the thermoplastic is applied, the primer shall be allowed to dry to a tacky state. The thermoplastic shall be applied within two hours after the primer application.

442.4.1.5 **AMBIENT CONDITIONS:** The ambient air and road surface shall be 50°F and rising before application of thermoplastic can begin.

442.4.1.6 **MATERIAL REQUIREMENTS:** The pavement marking material shall be installed in a molten state by the conventional extrusion or ribbon extrusion method at a minimum temperature of 400°F and a maximum temperature of 450°F. Scorching or discoloration of material shall be cause for rejection by the ENGINEER. The machinery shall be constructed so that all mixing and conveying parts, up to and including the extrusion die, maintain the material in the molten state, at the required application temperature.

442.4.1.7 **APPLICATION FILM THICKNESS:** The pavement marking material shall be applied at a thickness of not less than 90 mils for all roads. In no case shall it exceed a thickness of 120 mils.

442.4.2 **SAMPLING AND TESTING:** Samples will be taken after delivery. Any water added to the container by the manufacturer shall be considered part of the formulation and will be mixed with the paint after delivery and prior to sampling. Paint samples will be taken in accordance with the NMDOT Traffic Paint Sampling and Testing Procedures on file with the NMDOT State Materials Bureau. The City reserves the right to have an inspector present to observe the manufacturing process. Also, the City reserves the right to require manufacturers' reports of batches delivered to field locations. All tests shall be performed according to ASTM, AASHTO, Federal Test Method Standard Number 141 or methods designated by the State.

##### 442.4.3 PACKAGING.

442.4.3.1 **CONTAINERS:** The thermoplastic material shall be delivered in cardboard containers or plastic bags of sufficient strength to permit normal handling during shipment and handling on the job without loss of material. The net weight of each container shall be approximately 50 – 55 pounds. When supplied in bags the construction of the bag shall be such that it can be placed into the melter with the thermoplastic striping material to become part of the finished product.

442.4.3.2 **LABELING:** Each container shall be clearly marked to indicate the color of the material, the process batch number, the manufacturer's product number, the manufacturer's name and address and the date of manufacture.

##### 442.5 MEASUREMENT AND PAYMENT.

442.5.1 Hot thermoplastic reflectorized pavement striping will be measured by the linear foot along the centerline of the pavement stripe and will be based on a 4-

inch wide stripe. Measurements for striping with a width greater than the basic 4-inch wide stripe, as shown on the plans or directed by the ENGINEER, will be made by the following method:

$$\frac{(\text{plan width of markings in inches}) \times (\text{linear feet})}{4 \text{ inches}}$$

442.5.2 No payment will be made for skips (spaces) in the line. No payment will be made for defective thermoplastic reflectorized pavement markings. No additional payment shall be made for repaired or replaced thermoplastic material.

442.5.3 The accepted quantities of hot thermoplastic pavement markings will be paid for at the contract unit price per linear foot which shall include the cost for furnishing all labor, materials, and equipment to satisfactorily complete the work. The cost for maintaining and protecting the markings from traffic during the marking operations shall be included in the contract unit price.

442.5.4 Hot thermoplastic pavement marking words and symbols will be paid for at the contract unit price per each which shall include the cost for furnishing all labor, materials, and equipment to satisfactorily complete the work. The cost for maintaining and protecting the markings from traffic during the marking operations shall be included in the contract unit price.

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PAVEMENT MARKING REMOVAL

443.1 GENERAL: This work consists of the removal of pavement stripes and other pavement markings composed of paint, thermoplastics, scotch tape, vinyl pads, calcined flint, or spray plastic by water blasting or surface planning, or as approved by the ENGINEER.

conduct pavement marking removal operation as to minimize the need for pavement patching.

443.2 EQUIPMENT: The CONTRACTOR shall furnish all equipment required to complete the removal of existing pavement markings identified in the plans per this section.

443.3 CONSTRUCTION REQUIREMENTS

443.3.1 MARKING REMOVAL: Existing markings may be removed by either water blasting or surface planning, or as approved by the ENGINEER.

443.3.2 ERADICATION: Existing markings identified to be removed shall be completely obliterated to a maximum depth of 0.25 inches and for a width equal to two times the width of the stripe or marking to be removed.

443.3.3 CONFLICTING MARKINGS: Should the pavement marking removal operation result in a scaring of the roadway surface greater than 0.25 inches or a condition in which the removed marking could be interpreted to be, due to the scaring of the roadway surface, a active pavement marking, the CONTRACTOR shall patch the roadway surface so that the area effected by the marking removal is similar to the surrounding pavement. Areas considered to be conflicting with roadway markings shall be determined by the ENGINEER. The CONTRACTOR shall submit a plan identifying the method of patching to the ENGINEER for approval.

443.3.4 Black paint or non-reflective black removable marking tape is not an acceptable method of obliterating pavement markings, even for a short time period, and is prohibited

443.3.5 The CONTRACTOR shall submit a traffic control plan to the City's Construction Coordination Division for approval prior to the commencement of work.

443.3.6 The CONTRACTOR shall remove and dispose of all debris arising from the stripe or pavement marking removal operation as directed by the ENGINEER.

443.4 MEASUREMENT AND PAYMENT.

443.4.1 Removal of pavement stripe will be measured by the linear foot, complete in place.

443.4.1.1 Removal of pavement markings composed of thermoplastics, vinyl pads, calcined flint, or spray plastic will be measured by the square foot, complete in place.

443.4.2 Patching of pavement to eliminate conflicts between the scared pavement and permanent striping shall be considered incidental to the cost associated with pavement marking removal. The CONTRACTOR shall

## TRAFFIC SIGNS AND SIGN STRUCTURES

450.1 2900-GENERAL: This work shall consist of furnishing and installing traffic signs and sign structures in compliance with the specifications and details shown on the plans at the locations shown on the plans, or as established by the ENGINEER.

## 450.2 REFERENCES.

- 450.2.1 Aluminum Association Standards, Latest Edition.
- 450.2.2 American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications, Latest Edition.
- M120 Zinc (ASTM B6)
- 450.2.3 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition.
- A123 Zinc (Hot Galvanized) on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
- A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- B209 Aluminum and Aluminum-Alloy Sheet & Plate
- B545 Electrodeposited Coatings of Tin
- E97 Directional Reflectance of Opaque Specimens by Fiber Photometry
- 450.2.4 Federal Highway Administration (FHWA) Standards, Latest Edition.
- 450.2.5 Manual on Uniform Traffic Control Devices (MUTCD), Latest Edition
- 450.2.6 This Publication, Latest Edition
- 450.2.7 United States Standards, Latest Edition

## 450.3 MATERIALS.

450.3.1 GENERAL: Materials shall be manufactured in conformity with the requirement of GSA L-S-300C and ASTM Standards.

## 450.3.2 REFLECTORIZED SHEETING:

450.3.2.1 Use retroreflective sheeting included in the NMDOT's Department's *Approved Products List* or approved by the ENGINEER. Provide certification that sheeting is in accordance with ASTM D 4956, current version.

All City of Albuquerque permanent signing shall consist of Type XI sheeting.

Provide sheeting that has a smooth, flat exterior film with retroreflective elements homogeneous in appearance, weather resistant, and with a protected, pre-coated adhesive backing.

## 450.3.2.2 COLORS

450.3.6.1 Provide the diffuse day color of the retroreflective sheeting in accordance with ASTM D 4956, current version, Table 13. Provide fluorescent colors that comply with the chromaticity limits in ASTM D 4956 (current version).

## 450.3.2.3 COEFFICIENT OF RETROREFLECTION

450.3.2.3.1 Provide sign sheeting with a coefficient of retroreflection, expressed as Specific Intensity per unit area, or average candlepower per foot-candle per square foot. Ensure the intensity values meet at least the minimum values at 0.2° and 0.5° observation (divergence) angles, and, when specified in the Contract, at least the minimum values at 0.1° and/or 1.0° observation angles. Ensure intensity values are in accordance with Table 1, "Type XI Sheeting—Minimum Coefficient of Retroreflection". Conduct testing methods in accordance with ASTM E 810. Provide sign sheeting with a coefficient of retroreflection, expressed as Specific Intensity per unit area, or average candlepower per foot-candle per square foot. Ensure the intensity values meet at least the minimum values at 0.2° and 0.5° observation (divergence) angles, and, when specified in the Contract, at least the minimum values at 0.1° and/or 1.0° observation angles. Ensure intensity values are in accordance with Table 1, "Type XI Sheeting—Minimum Coefficient of Retroreflection". Conduct testing methods in accordance with ASTM E 810.

Table 1 Type XI Sheeting - Minimum Coefficient of Retroreflection										
OA	EA	White	Yellow	Orange	Green	Red	Blue	Fl. Yellow-Green	Fl. Yellow	Fl. Orange
0.2	-4	570	425	213	57	114	26	455	340	200
0.2	30	215	160	80	21	43	10	170	130	75
0.5	-4	400	300	150	40	80	18	320	240	140
0.5	30	150	112	56	15	30	6.8	120	90	52

Where: OA = Observation Angle in Degrees  
EA = Entrance Angle in Degrees

450.3.2.4 RETROFLECTIVE SHEETING BACKING: Provide backing for sheeting Type XI in accordance with ASTM D 4956, current version.

450.3.2.5 RETROFLECTIVE SHEETING DURABILITY AND WORKMANSHIP

450.3.2.5.1 Use retroreflective sheeting material in accordance with ASTM D 4956, current version. Provide sheeting material sufficiently strong and flexible enough for handling, processing, and application in accordance with the manufacturer's recommendations without stretching. When processed and applied in accordance with recommended procedures, sheeting material must be weather resistant and, following cleaning, must show no discoloration, cracking, blistering, or dimensional change.

When exposed to normal traffic and weather, sheeting material must not support fungus growth or accumulate dirt that reduce brightness before cleaning to less than 75% of the brightness after cleaning, measured at 0.2° divergence and -4° incidence. Use a sheeting surface that can be refurbished by cleaning and clear over coating in accordance with manufacturer's recommendations. Apply retroreflective sheeting to a treated substrate, as recommended by the manufacturer. Ensure that layers of paint and sealer are dry before applying succeeding coats and before packaging. Ensure finished signs have a smooth and uniform surface and that letters and numbers are clean-cut and sharp. Ensure the sheeting surface is solvent resistant and can be cleaned with a soft, clean cloth dampened with VM & P naphtha or mineral spirits.

450.3.2.6 RETROFLECTIVE SHEETING DELIVERY AND HANDLING: Retroreflective sheeting shall be delivered in good condition and shall have a good appearance, free from ragged edges, cracks, and extraneous materials. When retroreflective sheeting is furnished in continuous rolls, splices shall be smooth with no discernible line of demarcation, and the sheeting shall be suitable for continuous application. Retroreflective

sheeting shall be packaged so that no damage or defacement can occur during shipment or storage. Sheeting shall be used within the time frame recommended by the manufacturer.

450.3.2.7 MULTIPLE PIECES OF SIGN SHEETING: Sign faces comprising of two (2) or more pieces or panels of retroreflective sheeting shall match in color and provide uniform appearance and brilliance by day and night. The entire face of each sign panel shall be covered with one (1) un-spliced sheet of retroreflective sheeting, except that splicing is permissible where the substrate panel exceeds 48 inches in vertical dimension. No vertical splicing of sheeting shall be used. Materials shall be color-matched and the top piece shall overlap the bottom by a minimum of 1/2 inch in order to eliminate water penetration.

450.3.2.8 SCREENING INKS AND PROCESS PASTE

450.3.2.8.1 Unless otherwise prohibited, screening inks, process pastes or film overlays can be used, in lieu of manufactured colors at the option of the sign manufacturer, to produce both the legend and background. Only the film overlays or screened colors of green, blue, red, brown and black may be used. Only those screening inks, process pastes or film overlays recommended by the retroreflective sheeting manufacturer shall be used. Said recommendations shall be obtained in writing and a copy filed in accordance with the requirements of this Section 450.

450.3.2.8.1.1 OUTDOOR WEATHERABILITY: The outdoor weatherability of the applied screening inks, process paste or film overlay shall be comparable to the outdoor durability of the retroreflective sheeting.

450.3.2.8.1.2 ADHERENCE: No screening inks, process pastes or film overlay shall be removed when tested by applying cellophane tape over a properly cured, color processed area and removing the tape with one quick motion. The tape shall be 3/4 inch wide 3M Company Scotch Brand Cellophane Tape No. 600, or approved equal.

450.3.2.8.1.3 SOLVENT RESISTANCE: After proper curing, screened sign faces shall be solvent resistant to cleaning solvents recommended by the manufacturer of the retroreflective sheeting and the screening inks, process pastes, and film overlay.

450.3.2.8.1.4 VANDAL RESISTANCE: Screened sign faces shall be resistant to aromatic type solvents. The process and materials used shall be as recommended by the manufacturers of the retroreflective sheeting, screening inks, process pastes, and film overlay in order to facilitate the removal of paints or other oil based matter sprayed or painted on signs.

450.3.2.8.1.5 COLOR: Use a sign face color in accordance with ASTM D 4956, current version.

450.3.2.8.1.6 RETROFLECTIVE INTENSITY (Transparent Colors): Process and apply transparent colored inks or transparent colored film overlays in accordance with the sheeting manufacturer's recommendations. Ensure that the transparent color area processed on white sheeting provides a minimum retroreflective intensity value of at least 70% of the values specified in Table 1, "Type XI Sheeting—Minimum Coefficient of Retroreflection", for each color at 0.2° OA and -4° EA (or 0.1° and/or 1.0° observation angles if, specified in the Contract).

#### 450.3.3 SIGN LEGENDS AND SHEETING.

450.3.3.1 A sign legend shall contain such letters, numerals, symbols, arrows, borders, and other accessories that convey the sign's message. Provide white Type XI Sheeting or better retroreflective sheeting for sign legends in accordance with Section 450.3.2, "Retroreflectorized Sheeting." Provide legends in accordance with the latest edition of the MUTCD. The legend may be:

1. 0.005 in minimum thickness integral, semi-rigid, aluminum backed sheeting;
2. Self-adhering, machine cut sheeting; or
3. Reverse screened using weatherproof screen process enamel compatible with the background that provides the designated sign colors and retroreflectorization; or a reverse film overlaid with an approved film overlay.

450.3.3.2 The City will only permit reverse screening on sign faces larger than 9 sq. ft. Apply the legends edge sealed, reverse screened, clear coated, and finished, as recommended by the reflective sheeting manufacturer.

Provide extruded panel signs with borders as follows:

1. 1 1/8 in wide with 6 in corner radii for signs under 6 ft tall;
2. 2 in wide with 9 in corner radii for signs from 6 ft to 7.5 ft tall; or
3. 3 in wide with 12 in corner radii for signs over 7.5 ft tall.

#### 450.3.4 SIGN BACKGROUNDS.

450.3.4.1 Color and configuration of sign backgrounds shall be as shown on the plans. The sign face shall provide a plane surface free from warps, dents, burrs, mars, or other defects resulting from fabrication, shipment, storage, or installation. The entire sign face may be rejected because of any of these defects or because of dirty, marred, or defective background or legend. Completed sign faces mounted in place will be inspected at night.

#### 450.3.5 ALUMINUM PANEL SIGNS.

450.3.5.1 Aluminum panel signs fewer than 24 inches in width shall be 0.080-inch minimum thickness 6061-T6 or 6062-H38 aluminum alloy. Aluminum panel signs 24 inches or more in width shall be 0.125-inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy. All aluminum alloys shall conform to the requirements of ASTM B 209 and shall be supplied as flat stock material. All aluminum panel signs shall have smooth edges and corners.

450.3.5.2 The aluminum sign blank shall be prepared for retroreflective sheeting as specified by the facing material manufacturer. Retroreflective sheeting, legend, and clear coat, shall be applied in accordance with manufacturer's recommendations, this Section 450 "Retroreflective Sheeting" and this Section 450 "Sign Legends and Sheeting". A copy of the manufacturer's recommendations shall be kept on file as specified in this Section 450 for review by the ENGINEER during the periodic inspections of the manufacture's sign shop. The aluminum sign panel shall have a square punched hole to receive a carriage bolt or a lock washer for use with a carriage bolt and tamper proof nut. Hardware for mounting aluminum panel signs shall comply with the requirements of this Section 450 "Sign Structures and Hardware".

#### 450.3.6 SIGN STRUCTURES AND HARDWARE.

450.3.6.1 Steel posts and base posts for aluminum panel signs shall be of the dimensions and cross section shown on the plans. Steel posts and base posts shall either be finished by one of the following methods:

450.3.6.1.1 Hot dipped galvanized in accordance with the requirements of ASTM A653 or ASTM A 123;

450.3.6.1.2 Hot dip galvanized zinc coating in accordance with the requirements of AASHTO M 120, followed by a chromate conversion coating and a cross-linked polyurethane acrylic exterior coating;

450.3.6.1.3 Painted with a green paint meeting the requirements of Color No. 14109. Said green paint shall be a minimum of one (1) mil in thickness.

450.3.6.2 Hardware for post assembly shall be hot dipped galvanized or cadmium plated in accordance with ASTM B766-86, stainless steel, or mechanically

galvanized in accordance with ASTM B 545 (Class Fe/Sn 20). Post assembly hardware shall be of the dimensions shown on the plans.

#### 450.3.7 BOLTS.

450.3.7.1 Size 5/16 inch-18 UNC for sign attachment shall be a tamper proof carriage bolt, either hot dipped galvanized, cadmium plated in accordance with ASTM B766-86, stainless steel, or mechanically galvanized in accordance with ASTM B 545 (Class Fe/Sn 20). Tamper resistant nuts, size 5/16 inch-18 UNC shall be used and fabricated from C1008 hot rolled steel, case hardened to R55-60, and plated with zinc yellow dichromate, 0.002 inch and 0.005 inch thick.

#### 450.4 CONSTRUCTION REQUIREMENTS.

450.4.1 CERTIFICATION OF MANUFACTURER: The CONTRACTOR shall submit, in writing, the name of the proposed sign manufacturer, project number, and certification that all sign materials comply with the specifications.

#### 450.4.2 SIGN IDENTIFICATION

450.4.2.1 The following identification labels shall be affixed to all signs and shall include the information as listed:

450.4.2.1.1 MANUFACTURING IDENTIFICATION LABELS: These labels shall include the wording; "Manufactured By", the initials of the sign fabricator, the month and year of fabrication, the initials of the reflective sheeting manufacturer, reflective sheeting type, and the wording "Theft is a Crime";

450.4.2.1.2 CONTRACTORS IDENTIFICATION LABEL: This label shall include the CONTRACTOR's name, and date installed including month and year.

450.4.2.2 The above labels may be either die stamped in 3/8 inch letters or numerals, or made with high-tack adhesive sign sheeting (reflective or non-reflective) prepared with screened ink in 1/2 inch letters and numerals.

450.4.2.3 The labels shall be placed on the lower back side of the sign, and located so as not to fall behind any post or frame member. Dye stamping shall be performed in a manner that will not damage the finished sign. The label shall have similar weather resistance characteristics as the sheeting and shall last for at least the expected service life of the sign. The labels shall be affixed at the time the sign is manufactured.

#### 450.4.3 APPROVAL OF SHOP DRAWINGS.

450.4.3.1 Standard signs shall be constructed in accordance with the detail drawing furnished to the CONTRACTOR by the City of Albuquerque. The CONTRACTOR shall submit detailed shop drawings of all special code signs (those other than the standard MUTCD coded signs) to the ENGINEER and the Traffic Engineer

for approval. The CONTRACTOR shall not begin fabrication of special coded signs until the shop drawings are approved by the ENGINEER and the Traffic Engineer. These drawings shall show the complete legend, arrangement of letters and numerals, letter and numeral height, letter series, symbols, borders, and dimensions.

450.4.3.2 The CONTRACTOR shall not install the signs until the shop drawings are approved.

450.4.3.3 The CONTRACTOR must verify the post lengths with the ENGINEER and the Traffic Engineer before installation operations begin.

#### 450.4.4 INSPECTION.

450.4.4.1 All material and furnished signs shall be subject to inspection and release or installation by the ENGINEER and the Traffic Engineer at the project site prior to installation, and shall be subject to final inspection at the project site after installation. The entire sign may be rejected if there are mars, damages, stains, discolorations, or defacements resulting from fabrication, storage, shipments or installation.

450.4.4.2 The ENGINEER and the Traffic Engineer shall at all times during work hours, have free entry to the parts of the sign manufacturing plant that are involved in the manufacture and production of the signs. Adequate facilities required for inspection shall be furnished without charge to the ENGINEER and the Traffic Engineer for inspection of signs and to verify that manufactures Quality Control Program.

450.4.4.3 Test panels, twelve (12) inches by twelve (12) inches representative of each state production, shall be furnished on request to the ENGINEER and the Traffic Engineer. These panels shall be processed along with regular production runs and witnessed by the ENGINEER and the Traffic Engineer. Should there be any question as to validity of a test panel; a completed sign shall be furnished upon request. Signs not conforming in all aspects to the requirements of these specifications may be rejected and the manufacturer's QC Program may be withdrawn. The ENGINEER may select a sign at random for submittal to the City of Albuquerque's Traffic Engineering Operations Division for further inspections. The ENGINEER will return the sign to the CONTRACTOR in time for the sign to be installed in accordance with the CONTRACTOR's schedule.

450.4.5 PACKAGING AND SHIPPING: All signs shall be suitably packaged and protected for proper shipment and storage. Signs shall be delivered undamaged to the project site.

#### 450.4.6 FABRICATION

450.4.6.1 Material 1/2 inch thick or less may be sheared, blanked, sawed, or milled. Material over 1/2 inch thick shall be sawed or milled. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be filleted by drilling prior to cutting.

Unless the plans show otherwise, flame cutting will not be permitted.

450.4.6.2 Bolt holes shall be drilled to finish sizes.

450.4.6.3 Steel surfaces to be in contact with aluminum shall be galvanized or of stainless steel.

450.4.6.4 Aluminum surfaces to be in contact with concrete or earth shall be given a heavy coat of alkali-resistant bituminous paint.

450.4.7 INSTALLATION AND REMOVAL OF SIGNS: The CONTRACTOR shall install traffic sign structures at locations shown on the plans. Existing traffic control signs removed by the CONTRACTOR shall be delivered to locations designated by the ENGINEER. The CONTRACTOR shall verify the sign locations with the ENGINEER prior to their installations.

450.4.8 USE OF CERTIFIED SIGNS ONLY: the CONTRACTOR's sign manufacturer must supply signs with identification on the back of the sign as specified in this Section 450 which matches the approved sign manufacturer identified on the documentation letter. The CONTRACTOR shall not install permanent signs until the ENGINEER has verified that the shipment of signs delivered has a manufacturer's check list and has given the CONTRACTOR authorization to begin sign installation.

450.4.9 SIGN STORAGE: The CONTRACTOR shall store material, including posts, under a roof or otherwise covered for protection against elements. Materials shall be stored so as not to be on the ground or come in contact with surface runoff water.

450.4.10 REMOVING AND RESETTING ALUMINUM PANEL SIGNS: The CONTRACTOR shall remove existing designated plywood or aluminum panel signs, sign posts, and base posts and stockpile sign posts and base posts at locations designated by the ENGINEER, or as shown on the plans. Removed aluminum panel signs shall be reset on new steel sign posts and base posts in compliance with this Section 450 and details shown on the plans.

450.4.11 SCHEDULE: A written schedule for the removal and resetting of existing traffic signs shall be submitted to the ENGINEER for approval prior to commencement of sign removal.

#### 450.5 MEASUREMENT AND PAYMENT

450.5.1 Steel posts and base or anchor posts for aluminum panel signs shall be measured per each post, complete in place.

450.5.2 Aluminum panel signs shall be measured by the square foot of sign face area mounted on drive-down posts, complete in place.

450.5.3 Removing and resetting of aluminum panel signs and sign structures shall be measured by the unit, complete in place.

450.5.4 The accepted quantities of traffic signs and sign structures shall be paid for at the contract price per unit of measurement for each of the pay items listed as shown on the bid proposal.