

SECTION 440

REFLECTORIZED PAINTED PAVEMENT MARKINGS

440.1 GENERAL: This work shall consist of furnishing and installing permanent and temporary 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 GLASS BEADS: Glass reflectorizing beads shall conform to the requirements of the City of Albuquerque for Glass Beads.

440.3.3 TEMPORARY MARKING TAPE

440.3.3.1 Temporary adhesive marking tape shall consist of weather and traffic resistant yellow or white 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 reflective 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 REFLECTANCE: The white and yellow markings shall have the following initial minimum 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 Retroreflectivity (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 precoated 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.

440.3.3.6.1 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 reflectorized centerline with a 10-foot painted segment and a 30-foot gap.

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

440.4.1.1.3.2 The dispenser shall be capable of placing the glass spheres into the paint line as the paint is applied to the pavement in such a manner as to provide satisfactory marking and delineation.

440.4.1.1.4.1 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.

440.4.1.1.4.2 The CONTRACTOR shall be required to restripe the roadway if 50% of the paint or beads is 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 redisperse 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.

440.4.2 PLACEMENT OF BEADS AND TRAFFIC PAINT.

440.4.2.1 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 reflectorized 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 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 AND 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, 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 painted segment and 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 no passing zone stripe. There shall be an eight (8) inch gap between the double yellow markings for no passing zones.

440.4.3.5 Glass reflectorizing 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.

440.4.4 PLACING TEMPORARY ADHESIVE MARKING TAPE.

440.4.4.1 Adhesive tape marking materials 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 will be no more than 3 splices per 120 feet of length.

440.4.5 REMOVAL OF TEMPORARY PAVEMENT MARKINGS

440.4.5.1 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. Overpainting is not an acceptable method.

440.4.5.2 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 MUTCD: All reflectORIZED painted markings and temporary adhesive marking tape shall conform to the Manual on Uniform Traffic Control Devices (MUTCD).

440.5 MEASUREMENT AND PAYMENT.

440.5.1 ReflectORIZED painted markings will be measured by the linear foot of 4-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 reflectorized painted 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 reflectorized 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 reflectorized painted markings will be paid in accordance with the provisions of Section 443 - Pavement Marking Removal.

SECTION 441

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 on Uniform Traffic Control Devices (MUTCD), Latest Edition

441.3 MATERIALS.

441.3.1 RETROREFLECTIVE PREFORMED PLASTIC PAVEMENT MARKING 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 years from date of purchase. Prefabricated legends and symbols shall conform to the applicable shapes, sizes, and color as outlined in 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 1.5 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 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").

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 F 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 pounds for not less than five minutes at a temperature range of 70 to 80 degrees F. 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 Manual on Uniform Traffic Control Devices through the expected life of the pavement marking plastic.

441.3.1.1.11 GLASS BEADS

441.3.1.1.11.1 The glass beads for retroreflective preformed plastic marking material shall be colorless and have a minimum index of refraction of 1.50 when tested using the liquid oil immersion method. The size and quality of the beads will be such that performance requirements shall be met.

441.3.1.1.11.2 The retroreflective preformed plastic marking material shall have glass retention qualities such that when a two (2) inch by six (6) inch specimen is bent over a ½ inch diameter mandrel with the two (2) inch dimension perpendicular to the mandrel axis, a microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

441.3.1.1.11.3 Bead adhesion shall be such that beads are not easily removed when the film surface is scratched firmly with a thumbnail.

441.3.1.1.11.4 Applied as per manufacturer's recommendations, retroreflective preformed plastic marking material shall have an effective performance life of up to three years.

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 with specifications.

441.4 CONSTRUCTION REQUIREMENTS.

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

441.4.2 The asphaltic 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 Hot plastic retroreflective pavement marking 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 plastic shall be a minimum of 90 mil thickness for lane lines and 125 mil for transverse lines. Ten pound drop-on glass beads per 100 sq. ft. is required. All markings shall be alkyd thermoplastic.

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 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 will be measured by the linear foot of either 4-inch, 8-inch, 12-inch, or 24-inch width, complete in place.

441.5.2 The retroreflective preformed plastic pavement cross walks will be measured by the linear foot of 8-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 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

SECTION 443

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.

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

443.3.5 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.

443.4.1.1 Removal of pavement stripe will be measured

by the linear foot, complete.

443.4.1.2 Removal of pavement marking composed of thermoplastics, vinyl pads, calcined flint to spray plastic will be measured by the square foot, complete.

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

SECTION 450

TRAFFIC SIGNS AND SIGN STRUCTURES

450.1 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

Highway Signs Color Specifications

450.2.5 Government Services Administration (GSA) Standards, Latest Edition

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

450.2.7 This Publication, Latest Edition

450.2.8 United States Standards, Latest Edition

Product Standard for Construction and Industrial Plywood

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 RETROREFLECTIVE SHEETING.

450.3.2.1 The CONTRACTOR shall provide certification that retroreflective sheeting complies with the requirements of GSA L-S-300C. Retroreflective sheeting shall consist of a smooth, flat exterior film with retroreflective elements having a uniform homogeneous appearance. The sheeting shall be weather resistant and shall have a protected pre-coated adhesive backing.

450.3.2.2 COLORS

450.3.2.2.1 The diffuse day color of the retroreflective sheeting shall conform to the requirements of Table I of GSA L-S-300C and shall be determined in accordance with ASTM E 97 Standard Method of Test for 45-Deg., 0-Deg. Directional Reflectance of Opaque Specimens by Filter Photometry. (Geometric characteristics must be confined to illumination incident with 10° of, and centered about, a direction of 45° from the perpendicular to the test surface; viewing is within 15° of and centered about the perpendicular to the test surface. Conditions of illumination and observation must not be interchanged.) The standards to be used for reference shall be the Musnell Papers designated in Table 1. Papers shall have been recently calibrated on a spectrophotometer.

450.3.2.2.2 The test instrument shall be one of the following:

1. Advanced retrotechnology Model G920.
2. Gardner Multipurpose Reflectometer or Model XL20 and XL23 color and color difference meter

450.3.2.2.3 Colors shall be matched visually and shall be within the limits shown on the Color Tolerance Charts issued by the Federal Highway Administration, Office of Traffic Operations. The CONTRACTOR shall provide certification that the diffuse day color of the reflective sheeting will conform to the requirements of GSA L-S-300C, Table I, determined in accordance with the requirements of ASTM E 97.

450.3.2.2.4 If a dispute arises about the results of instrumental testing using diffuse lighting and unidirectional

viewing, acceptance of the material will be based on the results of the visual test using the appropriate color tolerance chart. Daytime color and nighttime color shall conform to the Standard Highway Signs Color Specification issued by FHWA.

450.3.2.3 SPECIFIC INTENSITY

450.3.2.3.1 The sign faces shall have the minimum specific intensity per unit area (SIA) values at 0.2° and 0.5° observation (divergence) angles expressed as average candlepower per footcandle per square foot (candles per lux per square meter) of material as shown in Tables 1, 2, 3, 4, 5, and 6. Measurements shall be conducted in accordance with photoelectric testing procedures for reflective sheeting as provided in paragraph 4.4.7 of GSA L-S-300C and paragraph 441.02(a) of FHWA Specification FP-85.

450.3.2.3.2 Measurements shall be made with the entrance (incidence) and observation angles positioned in the same place.

TABLE 1
Type II Sheeting (Enclosed Lens)

MINIMUM REFLECTIVITY
(Average Candlepower Per Footcandle Per Square Foot)

OA	EA	Wht	Or	Yel	Red	Grn	Blu	Brn
0.2	-4	70. 0	25. 0	50. 0	14. 5	9.0	4.0	1.0
0.2	30	30. 0	7.0	22. 0	6.0	3.5	1.7	0.3
0.5	-4	30. 0	13. 5	25. 0	7.5	4.5	2.0	0.3
0.5	30	15. 0	4.0	13. 0	3.0	2.2	0.8	0.2

Where OA = Observation Angle in Degrees
EA = Entrance Angle in Degrees
Wht = White Or = Orange Yel = Yellow
Grn = Green Blu = Blue Brn = Brown

TABLE 2
Type II-A Sheeting (Enclosed Lens)

MINIMUM REFLECTIVITY
(Average Candlepower Per Footcandle Per Square Foot)

OA	EA	Wht	Or	Yel	Red	Grn	Blu	Brn
0.2	-4	140 .	60. 0	100 .	30. 0	30. 0	10. 0	5.0
0.2	30	60. 0	22. 0	36. 0	12. 0	10. 0	4.0	2.0
0.5	-4	50. 0	20. 0	33. 0	10. 0	9.0	3.0	2.0
0.5	30	28. 0	12. 0	20. 0	6.0	6.0	2.0	1.0

Where OA = Observation Angle in Degrees
EA = Entrance Angle in Degrees
Wht = White Or = Orange Yel = Yellow
Grn = Green Blu = Blue Brn = Brown

TABLE 3
Type III Sheeting (Encapsulated Lens)

MINIMUM REFLECTIVITY
(Average Candlepower Per Footcandle Per Square Foot)

OA	EA	Wht	Or	Yel	Red	Grn	Blu	Brn
0.2	-4	250	100	170	45	45	20	12
0.2	30	150	60	100	25	25	11	8.5
0.5	-4	95	30	62	15	15	7.5	5
0.5	30	65	25	45	10	10	5	3.5

Where OA = Observation Angle in Degrees
EA = Entrance Angle in Degrees
Wht = White Or = Orange Yel = Yellow
Grn = Green Blu = Blue Brn = Brown

450.3.2.4 RETROREFLECTIVE SHEETING ADHESIVE: Retroreflective sheeting shall include a pre-coated pressure sensitive adhesive (GSA L-S-300C, Class I) or a tack free, heat activated adhesive (GSA L-S-300C, Class II), either of which can be applied without necessity of additional adhesive coats on the sheeting or application surface. The protective liner attached to the adhesive backing shall be removable by peeling without soaking in water or other solvent and shall be easily removed after accelerated storage for four (4) hours at 150 degrees F under weight of 2.5 pounds per square inch. During removal, the liner shall not break, tear, nor adhesive be removed.

450.3.2.5 RETROREFLECTIVE SHEETING DURABILITY AND WORKMANSHIP

450.3.2.5.1 Retroreflective sheeting shall have sufficient strength and flexibility to be handled, processed, and applied according to the recommendations of the sheeting manufacturer without appreciable stretching. When processed and applied in accordance with recommended procedures, retroreflective material shall be weather resistant and following cleaning shall show no appreciable discoloration, cracking, crazing, blistering, or dimensional change. Retroreflective material, when exposed to normal traffic and weather, shall not support fungus growth or accumulate dirt to the extent that the retroreflective brightness before cleaning is less than 75 percent of the retroreflective brightness after cleaning, when measured at 0.2° divergence and -4° incidence. The sheeting surface shall be readily refurbished by cleaning and clear overcoating in accordance with the manufacturer's recommendations.

450.3.2.5.2 Retroreflective sheeting shall be applied to properly treated substrate as recommended by the sheeting manufacturer. Paints and sealers shall be dry before succeeding coats are applied and before packaging. Finished signs shall show careful workmanship and have a smooth and uniform surface. All letters and numbers shall be clean-cut and sharp.

450.3.2.5.3 The sheeting surface of Type II and Type II-A sheeting shall be solvent resistant to gasoline, VM&P naphtha, mineral spirits, turpentine and methanol.

450.3.2.5.4 The sheeting surface of Type III A, B, C and Type IV, sheeting shall be solvent resistant such that it can be cleaned with a soft, clean cloth dampened with VM&P naphtha or mineral spirits.

450.3.2.6 RETROREFLECTIVE 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 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) unspliced 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 ½ 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:

The color of the screened sign faces surface as specified shall meet all applicable requirements and shall conform to the Standard Highway Signs Color Specification issued by the FHWA.

450.3.2.8.1.6 RETROREFLECTIVE INTENSITY (Transparent Colors)

450.3.2.8.1.6.1 Transparent colored inks or transparent colored film overlays shall be processed and applied in accordance with the recommendations of the sheeting manufacturer.

450.3.2.8.1.6.2 The minimum retroreflective intensity value of the transparent color area processed on white sheeting shall be not less than those specified below in Table 7, 8, 9, 10, 11 and 12 for each color at 0.2 degrees observation and -4 degrees entrance angles, expressed in candelas per footcandle per square foot of processed area.

450.3.2.8.1.7 PROCESS COLORS ON SHEETING.

TABLE 4
Type II Retroreflective Intensity

Process Color on Type II Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
10	3	6

TABLE 5
Type II Retroreflective Intensity

Process Color on Type II-A Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
21	7	21

TABLE 6
Type III-A Retroreflective Intensity

Process Color on Type III-A Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
31.5	14	31.5

TABLE 7
Type III-B Retroreflective Intensity

Process Color on Type III-B Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
31.5	14	31.5

TABLE 8
Type III-C Retroreflective Intensity

Process Color on Type III-C Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
24.5	14	24.5

TABLE 9
Type IV Retroreflective Intensity

Process Color on Type IV Enclosed Lens Sheeting
(White Reflective Sheeting Per Retroreflective Intensity Value)

(Candelas Per Footcandle Per Square Foot)

RED	BLUE	GREEN
24.5	14	24.5

TABLE 10
Min. Color Contrast Ratios of Fully Reflectorized Sign
(For Information Only)

Sheeting Type	White/Red	White/Green	White/Blue	White/Brown
II	5:1	8:1	17:1	70:1
IIA	5:1	5:1	14:1	25:1
III	6:1	6:1	13:1	18:1

450.3.3 SIGN LEGENDS AND SHEETING.

450.3.3.1 The word "legend" used herein and on the plans indicates all letters, numerals, symbols, arrows,

borders, or other accessories that contain and convey the sign message and shall be either a sign sheeting with integral, semi-rigid, 0.005 inch minimum thickness aluminum backing, or sign sheeting applied to a demountable 0.030 inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy; or approved self-adhering machine cut sheeting. Retroreflective sheeting for legends including letters, numerals, symbols, borders and route markers, shall be white as specified in Table 3 of this Section 450. Legends shall conform with the details shown on the plans and the provisions of MUTCD. Color, reflectorization, and configuration of legends shall be as shown on the plans and herein provided:

450.3.3.1.1 PLYWOOD AND ALUMINUM SIGNS: The legend may be a sign sheeting with integral, semi-rigid 0.005 inch and minimum thickness aluminum backing; or sign sheeting applied to demountable 0.030 inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy; or approved self adhering; machine cut sheeting as specified in Table 3 of this Section 450; or reverse screened using a weatherproof screen process enamel that is compatible with the background and that will provide the designated colors and reflectorization of the sign; or reverse film overlaid with an approved film overlay. These legends shall be applied edge sealed, reverse screened, clear coated, and finished as applicable, as recommended by the manufacturer of the retroreflective sheeting.

450.2.4 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.

450.3.4.1.1 Plywood and aluminum signs shall be surfaced with Type II sheeting as specified in Table 1 of this Section 450.

450.2.5 PLYWOOD PANEL SIGNS

450.3.5.1 Plywood shall be classed as group 1, 5/8 inch thick, 5 ply, grade B-B or better, high density overlay on both sides, exterior type plywood conforming to the requirements of the current U.S. Product Standard for Construction and Industrial Plywood marked with a trademark by an approved testing agency, or Canadian Standards Association, bearing legible grade marking of the American Plywood Association or the Canadian Council of

Forest Industries.

450.3.5.1.1 Edges shall be finished to produce a smooth surface without holes. All edges and corners of the sign panels shall be rounded to eliminate edge sharpness and chipping. All edges shall receive two thick coats of exterior type, polysilicone alkyd resin base enamel paint or one thick coat of ready-mixed polysilicone alkyd resin primer followed by one thick coat of polysilicone alkyd resin base enamel. The paint must be thick enough so the individual plys are not visible. The first coat of paint or primer shall be either white or yellow and the second coat shall be either brown or black.

450.3.5.1.2 All painting shall be completed before the retroreflective sheeting is placed.

450.3.5.1.3 The plywood 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. Hardware for mounting plywood panel signs shall comply with the requirements of this Section 450.

450.2.6 ALUMINUM PANEL SIGNS.

450.2.6.1 Aluminum panel signs under 24 inches in width shall be 0.080-inch minimum thickness 6061-T6 or 6062-H38 aluminum alloy. Aluminum panel signs 24 inches and over 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.

450.3.6.2 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 manufacturers 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.

450.3.7 SIGN STRUCTURES AND HARDWARE

450.3.7.1 Steel posts and base posts for plywood or 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:

450.3.7.1.1 Hot dipped galvanized in accordance with the requirements of ASTM A 525 or ASTM A 123;

450.3.7.1.2 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;

450.3.7.1.3 Painted with a green paint meeting the requirements of GSA 595-A, (Color No. 14109). Said green paint shall be a minimum of one (1) mil in thickness.

450.3.7.2 Hardware for post assembly shall be hot dipped galvanized or cadmium plated in accordance with ASTM A 165, 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.

450.3.8 BOLTS: 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 A 165, 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 and the wording "Theft is a Crime";

450.4.2.1.2 CONTRACTORS IDENTIFICATION LABEL: This label shall include the CONTRACTOR's Name, Date Installed, Month and Year.

450.4.2.2 The above labels may be either die stamped in 3/8 inch letters and 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. Die 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 erect 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 are started.

450.4.4 INSPECTION

450.4.4.1 All material and finished 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 after installation. The entire sign may be rejected if there are mars, damages, stains, discolorations, or defacements resulting from fabrication, storage, shipment 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 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 the manufacturer's Q.C. Program.

450.4.4.3 Test panels, twelve (12) inches by twelve (12) inches representative of each state of production, shall be furnished on request, to the ENGINEER and the Traffic Engineer. These panels shall be processed along with regular production run 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 respects to the requirements of these specifications may be rejected and the manufacturer's Q.C. Program may be withdrawn. The ENGINEER may select a sign at random for submittal to Traffic Engineering Operations Division for further inspection. 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 ½ inch thick or less may be sheared, blanked, sawed, or milled. Material over ½ 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 an alkali-resistant bituminous paint.

450.4.7 INSTALLATION AND REMOVAL OF SIGNS: The CONTRACTOR shall erect 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

an 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 installations. The CONTRACTOR must use the manufacturer for which certification was requested.

450.4.9 SIGN STORAGE: The CONTRACTOR shall store material, including posts, under a roof or otherwise covered for protection against the 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 PLYWOOD OR 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 in the plans. Removed plywood or 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 plywood or aluminum panel signs will be measured per each post, complete in place.

450.5.2 Plywood or aluminum panel signs will 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 plywood or aluminum panel signs and signs will be measured by the unit, complete in place.

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