

SECTION 700

DIVISION 700 -- MATERIALS

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SECTION 702 – BITUMINIOUS MATERIALS
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Asphalt Cement

Test	VISCOSITY GRADE					
	AC-2.5	AC-5	AC-10	AC-20	AC-30	AC-40
Viscosity, 60°C (140° F), poises	250 + 50	500 + 100	1000 + 200	2000 + 400	3000 + 600	4000 + 800
Viscosity, 135°C (275° F), Cs-minimum	125	175	250	300	350	400
Penetration, 25°C (77° F), 100g, 5 second – minimum	220	140	80	60	50	40
Flash Point, COC, °C (°F)-minimum	163 (325)	177 (350)	219 (425)	232 (450)	232 (450)	232 (450)
Solubility in trichloroethylene, percent minimum	99.0	99.0	99.0	99.0	99.0	99.0
Tests on residue from Thin Film Oven Test:						
Loss on heating, percent-maximum ³		1.0	0.5	0.5	0.5	0.5
Viscosity, 60°C (140° F), poises – maximum	1000	2000	4000	8000	12000	16000
Viscosity, 25°C (77° F), 5 cm per minute, cm - minimum	100 ¹	100	75	50	40	25
Spot test (when and as specified) ² with:						
Standard naphtha solvent	Negative for all grades					
Naphtha Xylene-solvent, % Xylene	Negative for all grades					
Heptane-Xylene-solvent, % Xylene	Negative for all grades					

¹ If ductility is less than 100, material will be accepted if ductility at 15.6° C (60° F) is 100 minimum.
² The use of the spot test is optional. When it is specified, the Engineer shall indicate whether the standard naphtha solvent, naphtha xylene-solvent, heptane-xylene-solvent will be used in determining compliance with the requirement, and also, in the case of xylene solvent, the percentage of xylene used.
³ The use of loss on heating is optional.

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Table 702-2

Anionic Asphalt Emulsions

Type Grade	Rapid Setting				HFMS-2		MS-4		MS-5	
	RS-1 min	RS-1 max	RS-2 min	RS-2 max	min	max	min	max	min	max
Tests on emulsions:										
Viscosity, Saybolt Furol at 77° F (25° C), s	20	100			100 (1)		50	500	50	500
Viscosity, Saybolt Furol at 122° F (50° C), s			75	400						
Storage stability test, 24 hour, %		1		1		1		1		1
Coating ability and water resistance:										
Coating, dry aggregate						good		75+		75+
Coating , after spraying						fair		see (2)(3)(4)		see (2)(3)(4)
Coating, wet aggregate						fair				
Coating , after spraying						fair				
Sieve test, %						0.10		0.10		0.10
Oil Distillate, %		0.10								
Residue by Distillation, %	55		63		65		2.0 65	7.0	0.0 65	3.0
Tests on residue from distillation test:										
Penetration, 77° F (25° C), 100g, 5s	100	200	100	200	100	200	200		150	250
Ductility, 77° F (25° C), 5 cm/min, cm	40		40		40					
Solubility in trichloroethylene, %	97.5		97.5		97.5		97.5		97.5	
Float test, 140° F (60° C), s					1200		50		100	

(1) 50+ when material is used for sealing

(2) Wet Coating: Weight 100 ±0.5 gms. of aggregate, 20 to 30 mesh standard Ottawa sand, into a 600 ml. Glass beaker and add soft tap water, approximately twice the volume of that of sand. Weigh into the beaker containing the sand and water 8 ± 0.2 gms. of the emulsion at room temperature and mix for 2 minutes with a stiff spatula. Cover the mixture with approximately twice its own volume of tap water and pour the water off without further mixing. Repeat this process. After the second rinse, at least 75 percent of the sand shall remain coated.

(3) Stripping: After evaluating the wet coating, place the mixture into a clear 600ml. glass beaker, cover the mixture with tap water, let stand for 12 to 16 hours and examine. At least 75 percent of the sand shall remain coated.

(4) The coating and stripping test may be waived when MS-5 is used for sealing.

SECTION 703 -- AGGREGATES

Table 703-1 -- Required Grading, Graded Course Aggregate

Standard Stone Size	#4	#357	#467	#57	#67	#7	#89
Min to Max	3/4" to 1-1/2"	No. 4 to 2"	No. 4 to 1-1/2"	No. 4 to 1"	No. 4 to 3/4"	No. 4 to 1/2"	No. 16 to 3/8"

Sieve Size	Percentage by Weight Passing						
2-1/2"	-----	100	-----	-----	-----	-----	-----
2"	100	95-100	100	-----	-----	-----	-----
1-1/2"	90-100	-----	95-100	100	-----	-----	-----
1"	20-55	35-70	-----	95-100	100	-----	-----
3/4"	0-15	-----	35-70	-----	90-100	100	-----
1/2"	-----	10-30	-----	25-60	-----	90-100	100
3/8"	0-5	-----	10-30	-----	20-55	40-70	90-100
No. 4	-----	0-5	0-5	0-10	0-10	0-15	20-25
No. 8	-----	-----	-----	0-5	0-5	0-5	5-30
No. 16	-----	-----	-----	-----	-----	-----	0-10
No. 50	-----	-----	-----	-----	-----	-----	0-5

SECTION 707 -- CEMENT MORTAR**Description**

1.1 Cement mortar shall consist of either portland cement or masonry cement, mortar sand, and water.

Materials

2.1 Portland cement shall conform to 520.2.1.

2.2 Masonry cement shall be a portland-cement meeting the requirements of AASHTO M 150.

2.3 Mortar sand shall meet the requirements of AASHTO M 45 except as shown in Table 707-1.

Table 707-1 -- Gradation of Mortar Sand

Sieve Size	Percent by Wt. Passing
No. 8	100
No. 16	60 – 100
No. 50	15 – 35
No. 100	2 – 15
No. 200	0 – 5

NOTE: In lieu of the above, fine aggregate graded in accordance with 520.2.2.2.2 may be used in mortar for mortar rubble masonry and with concrete blocks for catch basins and drop inlets.

2.3.1 Test for impurities shall comply with AASHTO T 21 and darker than the standard shall be cause for rejection, except as provided in 2.3.1.1.

2.3.1.1 Sand for mortar not conforming to 2.3.1 shall be tested in accordance with AASHTO T 71 and it shall meet the requirements of 5.2.3 of AASHTO M 45.

2.4 Water shall meet the requirements of 520.2.5.

Proportions and Procedures

3.1 Mortar shall be composed of 1 part by volume of either portland cement or masonry cement, except as specified in 3.4, combined with 2 parts, by volume, of damp loose mortar sand with water as necessary to obtain required consistency.

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3.2 Hand mixing shall require the thorough mixing of the dry cement and damp sand, in a clean, tight mortar box until the mixture is of a uniform color. Water shall be added in such quantity as to form a mortar having the desired consistency.

3.2 Hand mixing shall require the thorough mixing of the dry cement and damp sand, in a clean, tight mortar box until the mixture is of a uniform color. Water shall be added in such quantity as to form a mortar having the desired consistency.

3.3 Machine mixing of mortar shall require adding and mixing dry cement and damp sand, then add water to an approved mixer, for not less than 3 minutes to reach workability.

3.4 Cement for mortar in ashlar or for mortar squared stone masonry shall consist of portland cement only.

3.5 Mortar shall be used within 2-1/2 hours after original mixing when the air temperature is 80 degrees F or higher and within 3-1/2 hours when the air temperature is below 80 degrees F. Mortar not used within these time limits shall be discarded.

3.6 Mortars shall be used and placed in final position within 2-1/2 hours after mixing.

SECTION 708 -- PAINTS

708.01 Description. These specifications are intended to specify paints that will meet service requirements for highway construction.

Paint shall be homogeneous, free of contaminant, and of a consistency suitable for use in the capacity for which it is specified. Finished paint shall well ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint. The dispersion shall be of such nature that the pigment does not settle badly, does not cake or thicken in container, and does not become granular or curdled. It shall be easily broken up with a paddle to form a smooth uniform product of the proper consistency and shall possess satisfactory properties in all respects which affect its application and curing.

The color shall match the established standard. The hiding power shall be sufficient to obtain complete hiding of the preceding coat when applied at normal spreading rates. The primer and intermediate coat shall dry with a dull gloss; the finish coat with a full gloss unless otherwise specified.

In these paint specifications, unless otherwise stated, all references to percentages refer to percentages by weight.

708.02 Packaging. All paint furnished must be shipped in strong new containers having a capacity of not more than 5 gallons each. The containers shall be equipped with a lever-type ring seal or lug-type cover and wire bails. Each container shall be so filled that the net weight of the material in the can shall be the product of the weight per gallon determined at 75-80 degrees F and the specified gallon capacity of the can.

All containers of paint shall be clearly labeled with the following information:

- New Hampshire Paint Number, Name and Color
- Lot Number
- Date of Manufacture
- Volume of Contents
- Names and Address of Manufacturer

708.03 Identification. To provide a means of identification, the applicable number and name taken from the following list, unless otherwise specified, shall be printed on the label.

- **NH 4.11 White Traffic Paint**
- **NH 4.12 Yellow Traffic Paint**

1. General. This specification covers white and yellow traffic paint which may be used as a base for drop-on reflecting glass beads, or for use as a plain non-reflective traffic paint. It shall be suitable for either bituminous or concrete surfaces.

2. Paint. The white and yellow traffic paint shall meet the requirements of AASHTO M 248, Type N for Regular Dry and Type F for Fast Dry.

NH 4.13 Glass Spheres for Traffic Paints

1. General. The glass spheres shall be clean, moisture- resistant, water white, transparent, and free from milkiness, pits and excessive air bubbles and they shall meet the requirements of AASHTO M 247.

Traffic Paints

NH 4.11 White Bead Binder (*)

NH 4.12 Yellow Bead Binder (*)

NH 4.13 Glass Spheres for Traffic Paint

NH 4.31 White Curb Paint

(*) Specifications will be furnished if required.

NH 4.31 White Curb Paint

1. General. This specification covers a paint for use on bituminous curb. It shall be a binder suitable for the addition of reflectance type glass beads at the time of application.

2. Type. The paint shall be a 100 percent acrylic emulsion type containing no alkyds, butadiene styrene, or vinyls, and shall be thinned with water.

3. General Requirements.

A. The paint shall be suitable for use over all types of bitulithic surfaces.

B. When applied over emulsified asphalt or tar surfaces, the paint shall not cause lifting, crazing, peeling, or other damage to the base.

C. The material shall be approved by the Bureau of Materials and Research before use.

4. Formulation.

A. Pigment. Rutile titanium dioxide: 2.5 gallon minimum.

B. Vehicle. The vehicle shall consist of 100 percent acrylic polymer dispersed in water together with the minimum amounts of necessary additives, such as pigment dispersants, anti-foaming agents, and preservatives. Not driersd shall be used.

C. Paint. The paint shall meet the following requirements:

	<u>Min.</u>	<u>Max.</u>
Pigment		33%
Total solids	50%	
Fineness of grind (North Standard)	4	
Viscosity (Stormer--Krebs Units)	70	85

5. Characteristics. The paint shall brush easily and have good flowing, leveling, and spreading characteristics, and shall be suitable for application by spray equipment.

6. Testing. The paint shall meet the following solvents resistance test:

Use a sample of unreduced paint for a draw down on 0.0003 inch wet film thickness on glass, and air-dry for 24 hours. Remove the dried paint film in sheets from the glass and weigh out one gram. Place one gram of paint film in 50 millimeter beaker and add 20 grams of paint film in a 50 millimeter beaker and add 20 grams of toluol (TT-T-548). Cover the beaker and observe effect of solvent.

The beaker shall be rotated periodically during the test period. The paint film shall not crumple, cloud the liquid, or otherwise disintegrate in the liquid 48 hours and toluol shall remain clear and colorless throughout the test. Failure of the film to pass this test shall disqualify the product. Procedures for all other test shall be as described in FSS-TT-P-19.

SECTION 711 -- PREFORMED RETROREFLECTIVE PAVEMENT MARKING TAPE

Description

1.1 Description. Preformed retroreflective pavement marking tape shall be either removable or non-removable as specified. Removable tape shall be capable of being removed intact or in large strips. Non-removable tape is designed to remain in place.

1.2 General. Tape shall consist of glass spheres of a high quality imbedded into a binder on a suitable backing that is pre-coated with a pressure sensitive adhesive. The spheres shall be of uniform gradation and distributed evenly over the surface of the tape. The color of the tape shall conform to FHWA color standards for pavement markings and shall be readily visible when viewed under automotive headlights at night.

1.2.1 The marking tape, when applied in accordance with the manufacturer's recommended procedures shall be weather resistant and shall show no appreciable fading, lifting, or shrinkage during the useful life of the marking. The tape, as applied, shall be of good appearance, free of cracks, and the edges shall be true, straight and unbroken.

Materials

2.1 Short Term Pavement Marking Tape-Removable.

2.1.1 Composition. The removable preformed pavement markings shall not contain metallic foil and shall consist of a mixture of high quality polymeric materials and pigments, with glass beads throughout the pigmented portion of the film, and a reflective layer of beads bonded to the top surface. The films shall be precoated with a pressure-sensitive adhesive. A non-metallic medium shall be incorporated to facilitate removal.

2.1.2 General. The glass beads shall not be easily removed when the material surface is scratched with a thumbnail. Tape shall be precoated with a pressure-sensitive adhesive and it shall be capable of being adhered to hot bituminous pavement in accordance with the manufacturer's instructions without the use of heat, solvents, or other additional adhesive means. It shall be immediately ready for traffic after application.

2.1.3 Reflectance. The white and yellow films shall have the following initial minimum reflectance values at 0.2 and 0.5 degrees observation angles and 86.0 degree entrance angle as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per footcandle (mcd/ft²/fc-1). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft rectangle (0.61 x 0.76m). The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the

geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

	<u>White</u>		<u>Yellow</u>	
Observation Angle (degrees)	0.2	0.5	0.2	0.5
SL (mcd/ft ² /fc-1)	1770	1270	1310	820

2.1.4 Adhesion. The manufacturer shall be required to demonstrate that the properly applied pavement marking adheres to the roadway under climatic and traffic conditions normally encountered in the construction work zone.

2.1.5 Skid resistance. The surface of the markings shall provide an initial minimum skid resistance value of 50 BPN when tested according to ASTM E 303-74.

2.1.6 Removability. The marking film shall be removable from asphalt and portland cement concrete intact or in large pieces, either manually or with a roll-up device, at temperatures above 40 degrees F (4 degrees C) without use of heat, solvents, grinding, or blasting. The manufacturer shall be able to show that the marking film has met this requirement after the following minimum traffic exposure based on transverse test decks with rolling traffic:

1. Time in Place: 632 days
2. ADT per Lane: 9,000 (23% Trucks, 3.5 axles/unit)

2.2 Short Term Pavement Marking Tape Non-Removable.

2.2.1 Composition. Preformed pavement marking tape shall consist of retroreflective films on a conformable backing, precoated with pressure-sensitive adhesive. This tape is not readily removed and it is intended to be obliterated by over-paving or removal of pavement on which it is placed.

2.2.2 General. The glass beads shall not be easily removed when the material surface is scratched with a thumbnail. Tape shall be precoated with a pressure-sensitive adhesive and it shall be capable of being adhered to hot bituminous pavement in accordance with the manufacturer's instructions without the use of heat, solvents, or other additional adhesive means. It shall be immediately ready for traffic after application.

2.2.3 Reflectance. The white and yellow films shall have the following initial minimum reflectance values at 0.2 and 0.5 degrees observation angles and 86.0 degree entrance angle as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per footcandle (mcd/ft²/fc-1). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft rectangle (0.61 x 0.76m). The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc.

The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

	<u>White</u>		<u>Yellow</u>	
<u>Observation Angle (degrees)</u>	<u>0.2</u>	<u>0.5</u>	<u>0.2</u>	<u>0.5</u>
SL (mcd/ft ² /fc-1)	1360	760	820	510

2.2.4 Adhesion. The manufacturer shall be required to demonstrate that the properly applied pavement marking adheres to the roadway under climatic and traffic conditions normally encountered in the construction work zone.

2.2.5 Skid resistance. The surface of the markings shall provide an initial minimum skid resistance value of 35 BPN when tested according to ASTM E 303-74.

2.2.6 Abrasion resistance. Samples of the test material shall not wear through to the conformable backing surface in less than 125 cycles when tested in accordance to Federal Test Method Standard 141, Method 6192, except using an H-22 wheel and 250 gm. load.

2.3 Pavement Marking Tape, 60 mil, Type I.

2.3.1 Composition. The retroreflective pliant polymer pavement marking film shall consist of a mixture of high quality polymeric materials, pigments, and glass beads distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top surface.

2.3.2 The film shall have glass bead retention qualities such that when a 2" x 6" sample is bent over a 1/2 inch diameter mandrel, with the 2 inch dimension perpendicular to the mandrel axis, 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%.

2.3.2.1 The size, quality, and refractive index of the glass beads shall be such that the performance requirements

for the markings shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched with a thumbnail.

2.3.2.2. Preformed words and symbols shall conform to the applicable shapes and sizes as outlined in the current edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways", or as modified.

2.3.3 Reflectance. The white and yellow films shall have the following initial minimum reflectance values at 0.2 and 0.5 degrees observation angles and 86.0 degree entrance angle as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per footcandle (mcd/ft²/fc-1). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance

shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft rectangle (0.61 x 0.76m). The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

	<u>White</u>		<u>Yellow</u>	
<u>Observation Angle (degrees)</u>	<u>0.2</u>	<u>0.5</u>	<u>0.2</u>	<u>0.5</u>
SL (mcd/ft ² /fc-1)	550	380	410	250

2.3.3.1. Reflectivity retention. To have a good, effective performance life, the glass beads must be strongly bonded and not be easily removed by traffic wear. The following test shall be employed to measure reflectivity retention:

Taber Abraser Simulation Test

Using a Taber Abraser with an H-18 wheel and a 125 gram load, the sample shall be inspect at 200 cycles, under a microscope, to observe the extent and type of bead failure.

No more than 15% of the beads shall be lost due to popout and the predominant mode of failure shall be "wear down" of the beads.

2.3.4 Adhesion. The preformed markings shall be capable of being adhered to asphalt concrete or portland cement concrete by a precoated pressure-sensitive adhesive. A primer may be used to precondition the pavement surface. The preformed marking shall mold itself to pavement contours by the action of traffic. The dense, and open graded asphalt concrete wearing courses during the paving operation in accordance with the manufacturer's instructions. After application the markings shall be immediately ready for traffic. The manufacturer, when bidding, shall identify proper solvents and/or primers to be applied at the time of application, all equipment necessary for proper application, and recommendations for application that will assure an effective performance life. When stored in a cool, dry area indoors the materials shall be suitable for use for one year after the date of purchase.

2.3.5 Skid resistance. The surface of the retroreflective pliant polymer film shall provide an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303-74.

2.3.6 Patchability. The pavement marking film shall be capable of use for patching worn areas of the same type film in accordance with manufacturer's instructions.

2.3.7 Tensile strength and elongation. The film shall have a minimum tensile strength of 40 pounds per square inch of cross-section when tested according to ASTM D 638-76, except that a sample 6 inches x 1 inch shall be tested at a temperature between 70 degrees F and 80 degrees F using a jaw speed of 10 to 12 inches per minute. The sample shall have a minimum elongation of 75% at break when tested by this method.

2.3.8 Effective performance life. The film, when applied according to the recommendations of the manufacturer, shall provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. Although reflectivity is reduced by wear, the pliant polymer 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 throughout the useful life of the marking, and shall show no significant tearing, roll back, or other signs of poor adhesion.

2.4 Pavement Marking Tape, 25 mil, Type II.

2.4.1 Composition. The retroreflective pavement marking material shall consist of glass beads embedded in a film with a thin, flexible conformable backing which is precoated with a pressure sensitive adhesive.

2.4.2 The film shall have glass bead retention qualities such that when a 2 inch x 6 inch sample is bent over a 1/2 inch diameter mandrel, with the 2 inch dimension perpendicular to the mandrel axis, 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%.

2.4.2.1 The size, quality, and refractive index of the glass beads shall be such that the performance requirements for the markings shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched with a thumbnail.

2.4.2.2 Preformed words and symbols shall conform to the applicable shapes and sizes as outlined in the current edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways", or as modified.

2.4.3 Reflectance. The white and yellow films shall have the following initial minimum reflectance values at 0.2 and 0.5 degrees observation angles and 86.0 degree entrance angle as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per footcandle (mcd/ft²/fc-1). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft rectangle (0.61 x 0.76m). The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

	<u>White</u>		<u>Yellow</u>	
Observation Angle (degrees)	0.2	0.5	0.2	0.5
SL (mcd/ft ² /fc-1)	960	760	680	510

2.4.4 Adhesion. The preformed markings shall be capable of being adhered to asphalt concrete or portland cement concrete by a precoated pressure-sensitive adhesive. A primer may be used to precondition the pavement surface. The preformed marking shall mold itself to pavement contours by the action of traffic. The pavement marking films also shall be capable of application to new, dense and open graded asphalt concrete wearing courses during the paving operation in accordance with the manufacturer's instructions. After application the markings shall be immediately ready for traffic. The manufacturer, when bidding shall identify proper solvents and/or primers to be applied at the time of application, all equipment necessary for proper application, and recommendations for application that will assure an effective performance life. When stored in a cool, dry area indoors the materials shall be suitable for use for one year after date of purchase.

2.4.5 Skid resistance. The initial minimum skid resistance values shall be 45 BPN as measured by the British Portable Skid Tester in accordance with ASTM E 303-74.

2.4.6 Acid resistance. The beads shall show resistance to etching, hazing, or delamination of bead surface after exposure to a 1% solution of sulfuric acid. The test shall preformed as follows:

Soak 1 gram of beads in 100 cc of a 1% H₂SO₄ solution for 100 hours, then decant the acid solution and dry the beads at 100 degrees C. Microscopic examination of a sample of the beads shall show no more than 5% of the beads altered by the acid.

SECTION 718 -- REFLECTIVE SHEETING

718.01 Description. Reflective sheeting shall consist of a retroreflective lens system having a smooth outer surface. When adhesive backing is used, the sheeting shall have a precoated adhesive on the backside protected by an easily removable liner. Types specified refer to levels of performance in terms of reflective intensity.

718.02 Color Requirements. The colors specified shall conform to the applicable requirements of AASHTO M268 except modified as follows:

- Silver is an acceptable color designation for white.
- Table 2 shall be used for the Type-A orange sheeting
- Minimum reflectance limit for the color orange in table 2 shall be 12.

The Engineer may accept colors by Certificate of Compliance or may require the Contractor to provide copies of laboratory test reports to substantiate compliance with contact color requirements.

718.03 Reflective Intensity. The reflective sheeting shall have minimum specific intensity per unit area (SIA) as shown in Tables I, II, III or IV expressed as "candelas per footcandle per square foot".

718.04 Specular Gloss. The reflective sheeting shall have an 85 degree specular gloss of not less than 40 for Types II and II-A, and not less than 50 for types III and IV, when tested in accordance with ASTM D523.

718.05 Color Processing. The sheeting shall permit cutting color processing with compatible transparent and opaque process inks in accordance with the manufacturers recommendation at temperatures of 60 degrees F to 100 degrees R and relative humidity of 20 to 80 percent. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures as recommended by the manufacturer. Color processing for Type III material shall be restricted to sheeting with heat activated adhesive backing unless otherwise recommended by the manufacturer.

718.06 Shrinkage. A 9 inch by 9 inch reflective sheeting specimen with liner shall be conditioned a minimum of 1 hour at 72 degrees F and 50 percent relative humidity. The liner shall be removed and the specimen placed on a flat surface with the adhesive side up. Ten minutes after liner is removed and again after 24 hours, the specimen shall be measured to determine the amount of dimensional change. The reflective sheeting shall not shrink in any dimension more than 1/32 inch in 10 minute nor more than 1/8 inch in 24 hours.

718.07 Flexibility. Type II and Type IIA Sheeting Material: The sheeting, applied according to the manufacturer's recommendations to a clean, etched 0.020 inch by 2 inch by 8 inch aluminum panel of alloy 6061-T6 conditioned a minimum of 48 hours and tested at 72 degrees F and 50 percent relative humidity shall be sufficiently flexible to show no

cracking when bent around a 3/4 inch mandrel. Type III and Type IV Sheeting Material: The sheeting, with the liner removed and conditioned for 24 hours at 72 degrees F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when slowly bent, in one second's time, around a 1/8 inch mandrel with adhesive contacting the mandrel. Non-adhesive sheetings shall show no signs of cracking or crazing when flexed repeatedly over a 1/16 inch mandrel to 180 degrees at 72 degrees F.

718.08 Adhesive. The reflective sheeting shall include a precoated pressure sensitive adhesive backing (Class 1) or a tack-free heat activated adhesive backing (Class 2) either of which may be applied without necessity of additional adhesive coats on either the reflective sheeting or application surface. The Class 1 adhesive shall be a pressure sensitive adhesive of the aggressive tack type requiring no heat solvent or other preparation for adhesion to smooth clean surfaces. The Class 2 adhesive backing shall be a tack-free adhesive activated by applying heat in excess of 175 degrees F to the materials as in the heat-vacuum process of sign fabrication. The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solvents without breaking, tearing, or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at 160 degrees F under a weight of 2.5 pounds per square inch. The adhesive backing of the reflective sheeting shall produce a bond to support a 1.75 pound weight for 5 minutes, without the bond peeling for a distance of more than 2.0 inches when applied to a smooth aluminum surface.

718.09 Impact Resistance. Type II, Type II-A, and Type III reflective sheeting material, applied according to the manufacturer's recommendations to a cleaned, etched aluminum panel of alloy 6061-T6, 0.04 inches by 3 inches by 5 inches and conditioned for 24 hours at 72 degrees F and 50 percent relative humidity, shall show no cracking when the face of the panel is subjected to an impact of 2.0 pound weight with a 5/8 inch rounded tip, dropped from a 10 inch-pound setting on a Gardner Variable Tester, 1G-1120. For Type IV material a 100 inch-pound setting should be used.

718.10 Accelerated Weathering. When applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning in accordance with manufacturer's recommendations, shall show no appreciable discoloration, cracking, blistering, or dimensional change. Following exposure, the panels shall be washed with a 5 percent HCl solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth, brought to equilibrium at standard conditions and tested. It shall have not less than the percent of the minimum SIA specified in the table below when subjected to accelerated weathering in accordance with ASTM G 23, Type E or EH weatherometer with the humidifier off.

Type of Material	Hours Tested	Minimum Specific Intensity Per Unit Area
II	1000	50 percent of Table I
II-A	2200*	65 percent of Table II

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III 2200* 80 percent of Table III

IV 250 50 percent of Table IV

*For orange material having glass bead retroreflective elements, the hours tested shall be 500.

718.11 Intended Use. The reflective sheeting specified herein is intended for use on surfaces of highway signs and other traffic control devices to assure their optimum visibility by day, and at night when exposed to a light source, and whether dry or totally wet by rain.

718.12 Reference Source. This specification is taken from, and is intended to conform to, Federal Highway Administration publication, Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects.

TABLE 718-1

**Minimum Specific Intensity Per Unit Area (SIA)
(Candelas Per Footcandle Per Square Foot)**

Type II Sheeting

Observation Angle (o)	Entrance Angle (o)	White	Red	Orange	Brown	Yellow	Green	Blue
0.2	-4	70	14.5	25.0	2.0	50	9.0	4.0
0.2	+30	30	6.0	7.0	1.0	22	3.5	1.7
0.5	-4	30	7.5	13.5	1.0	25	4.5	2.0
0.5	+30	15	3.0	4.0	0.5	13	2.2	0.8

TABLE 718-2

**Minimum Specific Intensity Per Unit Area (SIA)
(Candelas Per Footcandle Per Square Foot)**

Type II-A Sheeting

Observation Angle (o)	Entrance Angle (o)	White	Red	Orange	Brown	Yellow	Green	Blue
0.2	-4	140	30	60	5	100	30	10
0.2	+30	60	12	22	2	36	10	4
0.5	-4	50	10	20	2	33	9	3
0.5	+30	28	6	12	1	2	6	2

TABLE 718-3

**Minimum Specific Intensity Per Unit Area (SIA)
(Candelas Per Footcandle Per Square Foot)**

Type III Sheeting

A -- Glass Bead Retroreflective Element Material

Observation Angle (o)	Entrance Angle (o)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45	20.0
0.2	+30	150	25	60	100	25	11.0
0.5	-4	95	12	30	62	15	7.5
0.5	+30	65	10	25	45	10	5.0

B -- Prismatic Retroreflective Element Material

Observation Angle (o)	Entrance Angle (o)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45.0	100	170	45.0	20.0
0.2	+30	95	13.3	26	64	11.4	11.0
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	10.0	25	45	10.0	5.0

TABLE 718-4

**Minimum Specific Intensity Per Unit Area (SIA)
(Candelas Per Footcandle Per Square Foot)**

Type IV Sheeting*

Observation Angle (o)	Entrance Angle (o)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	35.0	70	170	30.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	8.4	17	40	7.2	4.8

TABLE 401-2 - COMPOSITION OF MIXTURES

SIEVE SIZE ITEM NO. ITEM NO.	304.1 SAND	304.2 GRAVEL	304.3 CR. GRAVEL
6"	100	---	---
5"	---	---	---
4"	---	---	---
3-1/2"	---	---	---
3"	---	---	100
2"	---	---	95-100
1-1/2"	---	---	---
1"	---	---	---
3/4"	---	---	---
#4	70-100	25-70	27-52
#200 (IN SAND PORTION)*	0-12	0-12	0-12
#200 (IN TOTAL SAMPLE)	---	---	---

*% FRACTION PASSING THE #4 SIEVE

304.3 MODIFIED CR. GRAVEL	304.33 CR. AGGREGATE FOR SHOULDERS	304.4 CR. STONE (FINE)	304.5 CR. STONE (COARSE)
---	---	---	---
---	---	---	---
---	---	---	---
---	---	---	100
100	---	---	85-100
95-100	---	100	---
---	100	85-100	60-90
---	90-100	---	---
---	---	45-75	40-70
27-55	30-65	20-45	15-40
0-12	---	---	---
---	0-10	0-5	0-5