

SUPPLEMENTAL SPECIFICATIONS
INDIANA DEPARTMENT OF TRANSPORTATION
1999 STANDARD SPECIFICATIONS

September 1, 2004

REVISION TO 1999 STANDARD SPECIFICATIONS

SECTION 901, LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 901 – ~~HYDRAULIC CEMENT AND POZZOLANS~~ *PCC MATERIALS*

SECTION 901, BEGIN LINE 86, DELETE AND INSERT AS FOLLOWS:

- (1) For the initial qualification, the manufacturer shall provide to the Materials and Tests Division ~~an outline of their quality control procedure including a QCP in accordance with the applicable requirements of ITM 806. The QCP shall also include~~ the location and type of samples taken, and a monthly summary of mill test data for the previous years production. A current Material Safety Data Sheet shall be submitted as an integral part of the initial qualification package.

SECTION 901, BEGIN LINE 104, DELETE AND INSERT AS FOLLOWS:

- (1) For the initial qualifications, the manufacturer and distributor shall provide to the Materials and Tests Division ~~an outline of their quality control procedures including a QCP in accordance with the applicable requirements of ITM 806. The QCP shall also include~~ the location and type of samples taken, and a summary of complete test results from the proposed cement source. A current Material Safety Data Sheet shall be submitted as an integral part of the initial qualification package. ~~The quality control procedure QCP must~~ explain the linkage between the cement being furnished and the manufacturer's/distributor's quality control data, relative to ship-loads, barge-loads, railroad car-loads, etc.

SECTION 901, BEGIN LINE 174, DELETE AS FOLLOWS:

On days when fly ash is being accumulated for use as a pozzolan, the supplier shall obtain a minimum of one sample per day and furnish test results for moisture content, loss on ignition, sulfur trioxide and 45 μ m (No. 325) sieve residue for each sample. ~~A specific gravity determination shall be performed on at least one sample per week.~~

SECTION 901, BEGIN LINE 218, DELETE AND INSERT AS FOLLOWS:

- c. The fly ash suppliers shall furnish a ~~quality control program which ensures~~ *QCP in accordance with the applicable requirements of ITM 806. The QCP shall ensure* the Department of a continuous supply of fly ash complying with the requirements. This ~~program~~ *QCP* will be reviewed to determine its adequacy.

SECTION 901, BEGIN LINE 303, DELETE AND INSERT AS FOLLOWS:

- c. The ground granulated blast furnace slag suppliers shall furnish a ~~quality control program which ensures QCP in accordance with the applicable requirements of ITM 806.~~ The QCP shall ensure the Department of a continuous supply of ground granulated blast furnace slag which is in accordance with the requirements. This ~~program~~ QCP will be reviewed to determine its adequacy.

SECTION 901, BEGIN LINE 328, DELETE AND INSERT AS FOLLOWS:

901.04 ~~Microsilica~~ Silica Fume Used As a Pozzolan Mineral Admixture.

(a) **General.** ~~Microsilica~~ Silica fume will be accepted from one of the suppliers on the Department's list of approved pozzolanic suppliers. ~~Microsilica~~ Silica fume from more than one of these suppliers shall not be mixed or used alternately in the same construction unless authorized in writing. ~~Microsilica~~ Silica fume will be subject to random assurance sampling and testing by the Department. Failure of the random samples to meet the specified requirements will be cause for suspension of the ~~microsilica silica fume~~ supplier's approval.

(b) **Acceptance Criteria.** Acceptance of ~~microsilica~~ silica fume will be based on the manufacturer's documented ability to consistently furnish material in accordance with the specified requirements.

1. Requirements. The ~~microsilica~~ silica fume shall be in accordance with AASHTO M 307 with the following exceptions:

- a. ~~Loss on ignition, maximum 6.0%~~
- b. ~~Fineness, percent retained on the 45 μ m (No. 325) sieve, maximum 10%.~~
 - a. Reactivity with cement alkalies shall not be required.
 - b. The oversize, amount retained on the 45 μ m (No. 325) sieve, in accordance with ASTM C 1240, shall be conducted.
 - c. The oversize, amount retained on the 45 μ m (No. 325) sieve, shall not be more than 10%.
 - d. Accelerated pozzolanic activity index, in accordance with ASTM C 1240, shall be conducted in lieu of strength activity index.

- e. *The accelerated pozzolanic activity index shall be a minimum of 85% at seven days.*
- f. *The increase of drying shrinkage of mortar bars at 28 days shall be conducted in accordance with ASTM C 1240.*
- g. *The increase of drying shrinkage of mortar bars at 28 days shall not be more than 0.10%.*

2. Frequency of Testing.

- a. The manufacturer shall obtain a minimum of one sample ~~per day or one sample~~ for each 400 Mg (400 \mp \bar{n}) of material produced, ~~whichever is most frequent~~. Test results for ~~fineness~~, moisture content, ~~specific gravity~~, and loss on ignition, and ~~soundness~~ shall be furnished for each sample.
- b. For each 2000 Mg (2000 \mp \bar{n}) produced, a complete AASHTO M 307 analysis shall be performed on a sample composed randomly from daily samples. The method of randomization shall be subject to approval by the Department. The optional chemical and physical requirements identified in AASHTO M 307 shall be reported in addition to *the increase of drying shrinkage of mortar bars as well as* the standard chemical and physical requirements.

3. **Test and Calibration Procedure.** The minimum frequencies for calibration of test equipment shall be as follows:

- ~~a. The 45 μ m (No. 325) sieve shall be calibrated every 100 determinations or every six months, whichever comes first.~~
- b. The analytical balances and scales shall be calibrated annually.
- c. The concrete compression machine shall be calibrated annually.
- d. The Blaine apparatus shall be calibrated annually.
- e. All instrumentation used for rapid chemical analysis shall be in accordance with AASHTO T 105.

4. **Documentation.** ~~Microsilica~~ *Silica fume* suppliers requesting approval shall supply the following to the Materials and Tests Division:

- a. For initial approval, a current Material Safety Data Sheet and a summary of results for all specified tests for six consecutive months shall be submitted. No test results shall be more than one year old at the time of the request.
- b. To maintain approval, a summary of results for all specified tests shall be submitted monthly. ~~The results of daily tests shall be available by telephone during normal working hours.~~
- c. ~~A quality control program which ensures QCP in accordance with the applicable requirements of ITM 806 shall be submitted. The QCP shall ensure the Department a~~ continuous supply of ~~microsilica silica fume~~ complying with the material requirements and calibration procedures ~~shall be submitted~~. This ~~program QCP~~ will be reviewed by the Materials and Tests Division to determine its adequacy.
- d. Certification:
 - (1) For approval, the supplier shall furnish a certification indicating the name, location, and type of manufacturing facility, which includes the metallurgical process and furnace. It shall state that the ~~microsilica silica fume~~ shipped for use on Department projects will be produced under appropriate quality control and shall be in accordance with the specified requirements. A sample certification is set out in ITM 804.
 - (2) For certification of test reports, the results generated in accordance with 901.04(b) shall be summarized and submitted monthly. The reports shall state the name and location of the testing facility, and shall be signed by the chemist or technical manager. This certification shall also identify the concrete plants receiving ~~microsilica silica fume~~ represented by these results.

901.05 Chemical Anchor Systems. *Chemical anchor systems shall be furnished from the Department's list of approved Chemical Anchor Systems. Chemical anchor systems may be added to the approved list by completing the requirements in ITM 806, Procedure F and passing required laboratory testing.*

(a) Requirements. *Chemical anchor systems shall be in accordance with the following:*

- 1. *Chemical anchor systems shall be two part systems which are capable of anchoring deformed steel reinforcing bar and grouting load transfer dowels.*

2. *Chemically anchored steel reinforcing bar shall be capable of withstanding a tensile load equal to the yield strength of a #22 (#7), grade 400 (60), epoxy coated, deformed steel reinforcing bar.*
3. *Chemical anchor systems shall be capable of filling the entire annular space between the concrete and the steel reinforcing bar or dowel and remain in place until the chemical anchor is completely cured.*

(b) Laboratory Testing. The Department will test chemical anchor systems in accordance with ITM 807.

901.06 PCC Sealer/Healers. *PCC sealer/healers shall be furnished from the Department's list of approved PCC Sealer/Healers. PCC sealer/healers may be added to the approved list by completing the requirements in ITM 806, Procedure F and passing required laboratory testing.*

(a) Requirements. PCC sealer/healers shall be in accordance with the following:

1. *PCC sealer/healers shall be two part systems, capable of sealing and healing cracks in PC pavement.*
2. *PCC sealer/healers shall be capable of restoring the original integrity of a PCC beam broken in flexure.*
3. *All four beams used for testing sealer/healers shall break at a location different from the original break or with a flexural strength greater than or equal to 3800 kPa (550 psi).*
4. *The viscosity of PCC sealer/healers shall be sufficient to penetrate a crack 0.8 mm (1/32 in.) wide and 150 mm (6 in.) in depth.*

(b) Laboratory Testing. The Department will test PCC sealer/healers in accordance with ITM 808.

901.07 Rapid Setting Patch Materials. *Rapid setting patch materials shall be selected from the Department's list of approved Rapid Setting Patch Materials. A rapid setting patch material may be added to the list by completing the requirements in ITM 806, procedure F.*

(a) Normal Weather Mixes. Normal weather rapid setting patch materials shall be used for ambient temperatures of 0 - 30°C (32 - 85°F).

(b) Hot Weather Mixes. Hot weather rapid setting patch materials shall be used for ambient temperatures above 30°C (85°F).

(c) Requirements. Rapid setting patch materials shall be capable of being utilized in patches ranging from 25 mm (1 in.) to full depth without bonding agents, no curing material shall be required, and shall be capable of being surface sealed with an epoxy sealer.

These products shall not contain soluble chlorides as an ingredient of manufacture nor shall they require chemical additives. The color shall be similar to PCC.

They shall be single packaged dry mix requiring only water just prior to mixing. They shall be packaged in 18 - 27 kg (40 - 60 lb) bags with a neat yield of approximately 0.011 m³ (0.40 yd³) and shall allow at least a 50% extension, by mass, (weight) with a 10 mm (3/8 in.) or a 13 mm (1/2 in.) round aggregate. The minimum shelf life shall be twelve months.

Mixing shall be conducted with small concrete mixers or with a drill or paddle mixer and shall be suitable for finishing with hand tools.

Rapid setting patch materials shall be in accordance with ASTM C 928 with the following exceptions.

<i>Physical Test</i>	<i>Specification</i>	<i>Requirement</i>
<i>Setting Time</i>	<i>ASTM C 266</i>	
<i>Normal Weather</i>		
<i>Initial at 22°C (72°F)</i>		<i>10-20 min</i>
<i>Final at 22°C (72°F)</i>		<i>12-35 min</i>
<i>Hot Weather</i>		
<i>Initial at 35°C (95°F)</i>		<i>10-20 min</i>
<i>Final at 35°C (95°F)</i>		<i>12-35 min</i>
<i>Compressive Strength, Min.*</i>	<i>AASHTO T 109</i>	<i>22°C (72°F), Normal</i>
<i>1 h</i>		<i>14 MPa (2000 psi)</i>
<i>2 h</i>		<i>21 MPa (3000 psi)</i>
<i>24 h</i>		<i>34.5 MPa (5000 psi)</i>
<i>28 day</i>		<i>55 MPa (8000 psi)</i>
<i>Compressive Strength, Min.*</i>	<i>ASTM C 109</i>	<i>35°C (95°F), Hot</i>
<i>3 h</i>		<i>21 MPa (3000 psi)</i>
<i>24 h</i>		<i>34.5 MPa (5000 psi)</i>
<i>28 days</i>		<i>55 MPa (8000 psi)</i>
<i>Relative Dynamic Modulus</i>	<i>ASTM C 666</i>	
<i>Procedure B 300 cycles</i>		<i>95% Min.</i>

<i>Slant Shear Bond Strength, Min</i>	<i>ASTM C 882</i>	
<i>28 days</i>		<i>17 MPa (2500 psi)</i>
<i>Flexural Strength, 24 h</i>	<i>ASTM C 78</i>	
<i>mortar only</i>		<i>3.5 MPa (500 psi)</i>
<i>mortar - aggregate extension</i>		<i>4.0 MPa (600 psi)</i>
<i>Shrinkage, Max.</i>	<i>ASTM C 157</i>	
<i>28 days</i>		<i>0.03 %</i>
<i>Scaling Resistance</i>	<i>ASTM C 157</i>	
<i>5 cycles</i>		<i>0 rating, No scale</i>
<i>25 cycles</i>		<i>0 rating, No scale</i>
<i>50+ cycles</i>		<i>1.5 rating, Lt. Scale</i>

** Material used shall be neat rapid setting patch material mixed in accordance with the manufacturer's installation instructions.*

All rapid setting patch materials complying with the specified physical requirements will be subjected to a field performance demonstration. The field performance demonstration will take place as directed. Rapid setting patch materials shall be used to patch a designated site, typical of a standard repair. The site will be evaluated after one year's exposure. Approval will be based on visible signs of distress, such as cracking, crazing, scaling, spalling, wearing, edge fraying, corner cracking, or debonding.

(d) Test Report. Testing shall be performed by a recognized laboratory in accordance with ITM 806. Test reports shall not be more than five years old on January first of the approval year.

SECTION 902, DELETE LINES 1 THROUGH 284.

SECTION 902, AFTER LINE 285, INSERT AS FOLLOWS:

SECTION 902 – ASPHALT MATERIALS

290 *902.01 Asphalt. Asphalt is defined as a cementitious material obtained from petroleum processes. Asphalts shall be sampled and tested in accordance with the applicable requirements of 902.02.*

(a) Performance Graded Asphalt Binders. Performance graded asphalt binders shall be supplied by an approved supplier in accordance with ITM 581.

Performance graded, PG asphalt binders shall be in accordance with the following:

GRADE	PG 58-28	PG 64-22	PG 64-28	PG 70-22	PG 70-28	PG 76-22
ORIGINAL BINDER						
Flash Point, minimum °C		230				
Viscosity, maximum, 3 Pa·s, Test Temp., °C		135				
DSR, $G^*/\sin \delta$ (delta), minimum, 1.00 kPa, Test Temp. @ 10 rad/s, °C	58	64	64	70	70	76
ROLLING THIN FILM OVER RESIDUE						
Mass Loss, maximum, %		1.00				
DSR, $G^*/\sin \delta$ (delta), minimum, 2.20 kPa, Test Temp. @ 10 rad/s, °C	58	64	64	70	70	76
PRESSURE AGING VESSEL (PAV) RESIDUE						
PAV Aging Temperature °C (Note 1)	100	100	100	100	100	100
DSR, $G^*/\sin \delta$ (delta), maximum, 5000 kPa, Test Temp. @ 10 rad/s, °C	19	25	22	28	25	31
Physical Hardening (Note 2)		Report				
Creep Stiffness, S, maximum, 300 MPa, m-value, minimum, 0.300 Test Temp. @ 60 s, °C	-18	-12	-18	-12	-18	-12

NOTES 1. Oven temperature tolerance shall be $\pm 0.5^\circ\text{C}$.

2. Physical Hardening is performed on a set of asphalt beams according to AASHTO T 313, Section 12.1, except the conditioning time is extended to 24 h \pm 10 min at 10°C above the minimum performance temperature. The 24 h stiffness and m-value are reported for information purposes only.

1. Appeals. If the Contractor does not agree with the acceptance test results for the lot, a request may be made in writing for additional testing. The appeal shall be submitted within 30 calendar days of receipt of the Department's written results. The basis of the appeal shall include complete AASHTO M 320 test results for the specific subplot in question plus test values from all other sublots for the parameters being disputed.

If an appeal is accepted, the Department will randomly select two additional subplot samples if available from the lot in question. The additional subplot samples if available and the backup sample will be tested in an AASHTO accredited laboratory for the failing test parameters. The backup and additional test results for each test will be averaged. The average value for each test will be considered the final lot value. The Contractor will be notified in writing of the additional test results, the final lot values, and the appeal conclusions.

If the appeal is not accepted, the Department will respond to the Contractor stating the grounds for the denial.

(b) Asphalt Emulsions. Asphalt emulsions shall be composed of an intimate homogeneous suspension of a base asphalt, an emulsifying agent, and water. Asphalt emulsions may contain additives to improve handling and performance characteristics. Failure of an emulsion to perform satisfactorily in the field shall be cause for rejection, even though it passes laboratory tests. The grade used shall be in accordance with the table for asphalt emulsions as shown herein.

330 *AE-90 is a medium-breaking, moderate penetration, high-asphalt content type, intended for hot and cold plant mixing, road mixing, and seal coats or as otherwise specified.*

AE-90S is a rapid setting, anionic type emulsion for seal coat applications.

AE-150 is a medium-breaking, moderately soft penetration type, intended for use in surface treating, tack coats, and coating open and dense graded aggregate, or as otherwise specified.

340 *AE-150-L is a medium-breaking, relatively low-viscosity type. It may be specified in lieu of AE-T or AE-150 when a softer asphalt or greater aggregate penetration is desired. AE-150-L is suitable for sand seals.*

AE-PL is a medium-slow-breaking, low-viscosity, low-asphalt content type, intended for use as a prime or as dust palative.

AE-T is a medium-breaking, comparatively low penetration type, intended for tack coats, seed mulching, or as otherwise specified.

350 *HFRS-2 is a quick-breaking, high-viscosity, high-float, relatively high asphalt content type, intended for seal coats.*

RS-2 is a quick-breaking, high-viscosity, relatively high-asphalt content type, intended for seal coats.

AE-PMP is a polymerized modified asphalt emulsion intended for use as a prime coat material.

AE-PMT is a polymerized modified asphalt emulsion intended for use as a tack coat material.

360 *The requirements for asphalt emulsions shall be in accordance with the following:*

Characteristic (1) (2)	Test Method	RS-2	HFRS-2	AE-90	AE-90S	AE-T	AE-150	AE-150L	AE-PL	AE-PMT (6)	AE-PMP (6)
<i>Test on Emulsion</i>											
<i>Viscosity, Saybolt Furol at 25°C, min.</i>	AASHTO T 72			50			50				20+
<i>Viscosity, Saybolt Furol at 25°C, max.</i>	AASHTO T 72					100		100	115	100	
<i>Viscosity, Saybolt Furol at 50°C, min.</i>	AASHTO T 72	75	75		50		75				
<i>Viscosity, Saybolt Furol at 50°C, max.</i>	AASHTO T 72	400	400				300				
<i>Demulsibility w/35 mL, 0.02N CaCl₂, %, min.</i>	AASHTO T 59	50	50		30						
<i>Demulsibility w/50 mL, 0.10N CaCl₂, %, min.</i>	AASHTO T 59			75		75				25+	25+
<i>Oil Distillate by Distillation, mL/100 g Emul. (3)</i>	AASHTO T 59	4.0	4.0	4.0	3.0	4.0	7.0	7.0	3.0	3.0	3.0
<i>Residue by Distillation, %, min.</i>	AASHTO T 59	68	68	68	65 (5)	54	68	60	30		
<i>Residue by Distillation, %, max.</i>	AASHTO T 59					62		65			
<i>Sieve Test, %, max.</i>	AASHTO T 59	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
<i>Penetrating Ability, mm, min.</i>	902.02(w)								6		
<i>Stone Coating Test, %</i>	902.02(t)3a			90			90	90			
<i>Settlement, %, max.</i>	AASHTO T 59	5	5	5							
<i>Storage Stability, %, max.</i>	AASHTO T 59				1						
<i>Asphalt Content by Distillation at 204°C, %, min.</i>										54	45
<i>Asphalt Content by Distillation at 204°C, %, max.</i>										62	
<i>Tests on Residue</i>											
<i>Penetration (0.1 mm) at 25°C, 100g, 5 s, min. (4)</i>	AASHTO T 49	100	100	100	90	50				50	300+
<i>Penetration (0.1 mm) at 25°C, 100g, 5 s, max. (4)</i>	AASHTO T 49	200	200	200	150	200				200	
<i>Penetration (0.1 mm) at 25°C, 50g, 5 s, min. (4)</i>	AASHTO T 49						100	100			
<i>Penetration (0.1 mm) at 25°C, 50g, 5 s, max. (4)</i>	AASHTO T 49						300	300			
<i>Ductility at 25°C, mm, min.</i>	AASHTO T 51	400	400	400		400					
<i>Solubility in Org. Sol., %, min.</i>	AASHTO T 44	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5
<i>Float Test at 50°C, s, max. (4)</i>	AASHTO T 50										
<i>Float Test at 60°C, s, min. (4)</i>	AASHTO T 50		1200	1200	1200	1200	1200	1200			
<i>Force Ratio</i>	AASHTO T 300				0.3						
<i>Elastic Recovery, at 4°C</i>	AASHTO T 301				58						
<i>Polymer Content by Infrared</i>										1.5+	1.5+

NOTES: (1) Broken samples or samples more than 10 days old will not be tested.

(2) Combined percentage of the residue and oil distillate by distillation shall be at least 70% (note the different units – ml for oil and % for residue).

(3) Oil distillate shall be in accordance with ASTM D 396, table 1, grade no. 1.

(4) The Engineer may waive the test.

(5) Maximum temperature to be held for 15 minutes $200 \pm 5^{\circ}\text{C}$.

(6) Asphalt shall be polymerized prior to emulsification.

370 **(c) Cutback Asphalts.** Cutback asphalts shall be composed of an intimate homogeneous mixture of an asphalt base and a suitable distillate designed for medium, or slow curing. Cutback asphalts may also contain an additive as an aid in uniformly coating wet, damp, or dry aggregates used in patching mixtures or HMA pavements. These asphalts shall not contain more than 0.3% water as determined by AASHTO T 55, shall not separate when allowed to stand, and shall not foam when heated to permissible temperatures. When an additive is used, it shall be incorporated homogeneously in the asphalt at the point of manufacture. The temperature of the cutback asphalt shall not be higher than shown for that grade in 902.03.

380 **1. Medium Curing Asphalts With and Without Additives.** Medium curing asphalts with and without additives shall be in accordance with the following:

Characteristics	Grades			
	MC-70 MCA-70	MC-250 MCA-250	MC-800 MCA-800	MC-3000 MCA-3000
Flash Point (Open Tag.), °C ⁽⁴⁾	38+	66+	66+	66+
Kinematic Viscosity at 60°C (cSt.) ⁽²⁾	70-140	250-500	800-1600	3000-6000
Saybolt-Furol Viscosity at 50°C (s)	60-120	125-250	100-200	300-600
Saybolt-Furol Viscosity at 60°C (s)				
Saybolt-Furol Viscosity at 83°C (s)				
Distillation ⁽¹⁾				
Distillate (% of total distillate to 360°C MC-70 @ 225°C):				
to 225°C	0-20	0-10		
to 260°C	20-60	15-55	35+	15+
to 316°C	65-90	60-87	45-80	15-75
Residue from distillation to 360°C (volume % by difference)	55+	67+	75+	80+
Tests on Residue from Distillation: ⁽¹⁾				
Penetration, 25°C, 100 g, 5 s - (0.1 mm)				
(without additive)	120-250	120-250	120-250	120-250
(with additive)	120-300	120-300	120-300	120-300
Ductility, 25°C (10 mm) ⁽³⁾	100+	100+	100+	100+
Solubility in organic solvents, %	99.5+	99.5+	99.5+	99.5+

(1) Test may be waived when approved.

(2) Viscosity may be determined by either the Saybolt-Furol or Kinematic test. In case of dispute, the Kinematic viscosity test shall prevail.

(3) If the ductility at 25°C is less than 100, the material will be acceptable if its ductility at 16°C is 100+.

(4) Flash point by Cleveland Open Cup may be used for products having a flash point greater than 80°C.

390 **2. Slow Curing Asphalts With and Without Additives.** Slow curing asphalts with and without additives shall be in accordance with the following:

Characteristics	Grades			
	SC-70 SCA-70	SC-250 SCA-250	SC-800 SCA-800	SC-3000 SCA-3000
Flash Point (Cleveland Open Cup), (°C)	66+	79+	93+	107+
Kinematic Viscosity at 60°C (cSt) ⁽²⁾	70-140	250-500	800-1600	3000-6000
Saybolt-Furol Viscosity at 50°C (s)	60-120	125-250	100-200	300-600
Saybolt-Furol Viscosity at 60°C (s)				
Saybolt-Furol Viscosity at 83°C (s)				
Distillation ⁽¹⁾				
Total Distillate to 360°C (% by volume)	10-30	4-20	2-12	5
Float Test of Distillation Residue at 50°C (s)	20-100	25-110	50-140	75-200
Ductility of Asphalt Residue at 25°C (10 mm) ⁽¹⁾	100+	100+	100+	100+
Solubility in organic solvents, % ⁽¹⁾	99.5+	99.5+	99.5+	99.5+

(1) Test may be waived when approved.

(2) Viscosity may be determined by either the Saybolt-Furol or Kinematic test. In case of dispute, the Kinematic viscosity test shall prevail.

(d) Utility Asphalt. The asphalts shall be uniform in character and shall not foam when heated to 177°C (350°F). Utility asphalts shall be in accordance with the following:

Characteristics/Grades	UA-I	UA-II	UA-III
Softening Point (Ring & Ball), °C	46-63	63-85	79.5-96
Penetration of Original Samples ⁽¹⁾ (0.1 mm)			
at 4°C, 200 g, 60, s Min.	10	10	10
at 25°C, 100 g, 5 s	50-100	25-45	15-35
at 46°C, 50 g, 5 s	100 Min.	130 Max.	90 Max.
Ductility @ 25°C, 50 mm/min, 10 mm, Min. ⁽¹⁾	30	10	2.5
Solubility in Organic Solvents, percent, Min. ⁽¹⁾	99.0	99.0	99.0
Flash Point (Cleveland Open Cup), °C, Min. ⁽¹⁾	225	225	225
Penetration of Residue from Thin Film Oven Test, 25°C, 100 g, 5 s, (0.1 mm) Min. ⁽¹⁾	30	15	10

(1) Test will be performed when complete physical characteristics are needed or desired.

(e) Asphalt for Coating Corrugated Metal Pipe. Asphalt for coating corrugated metal pipe shall be in accordance with the following:

Physical Properties	Minimum	Maximum
Softening Point (Ring & Ball), °C	93	110
Penetration of Original Samples (0.1 mm)		
at 4°C, 200 g, 60 s, Min.	20	
at 25°C, 100 g, 5 s	35 ⁽¹⁾	
Solubility In Organic Solvents, %	99.0	
Flash Point (Cleveland Open Cup), °C	232	
Flow Test, mm		6.4
Shock Test	3 of 4 specimens shall pass	

(1) May be 30 minimum provided all four shock test specimens pass.

902.02 Sampling and Testing Asphalt Materials. The tests and AASHTO reference are as follows:

- 410 (a) *Sampling Bituminous Materials*..... AASHTO T 40
 The following exceptions to AASHTO T 40 shall apply:
1. *Samples may be obtained at any time before material is incorporated into the work.*
 2. *Samples for all grades of asphalt emulsion shall be a minimum of 1.9 L (1/2 gal.). The size of samples of other liquid material may be 1.0 L (1 qt).*
- 420 3. *Samples of liquid materials shall be obtained as follows at one of the following:*
- a. *bulk storage tanks from ~~approved~~ sampling valves located in the tank or line and asphalt plant storage tanks from ~~approved~~ sampling valves located in the tank*
 - b. *transports from ~~approved~~ sampling valves*
 - c. *distributors from ~~approved sampling~~ valves*
 - d. *other storage or locations as approved*
 - e. *sampling by other recognized devices may be approved*
- 430
- (b) *Water in petroleum products, except the solvent or carrier may be toluene* AASHTO T 55
- (c) *Density, Specific Gravity, or API Gravity of Crude Petroleum and Liquid Products by Hydrometer Method* AASHTO T 227
- 440
- (d) *Specific Gravity of Semi-Solid Bituminous Materials* AASHTO T 228
- (e) *Specific Gravity of Solid Pitch and Asphalt* AASHTO T 229
- (f) *Flash and Fire Points (Open Cup)*
1. *When the flash point is higher than 79°C (175°F), “Flash and Fire Points by Cleveland Open Cup”* AASHTO T 48
- 450

	2. When the flash point is 79°C (175°F) or lower, “Flash Point with Tagliabue Open Cup”	AASHTO T 79
	(g) Softening Point of Bituminous Materials, Ring and Ball.....	AASHTO T 53
460	(h) Penetration of Bituminous Materials	AASHTO T 49
	(i) Loss on Heating	AASHTO T 47
	(j) Solubility in Organic Solvents, except the solvent may be 1,1,1,-Trichloroethane	AASHTO T 44
	(k) Inorganic Matter or Ash.....	AASHTO T 59
	(l) Saybolt-Furol Viscosity	AASHTO T 72
470	(m) Ductility of Binder Material, except that the conditioning period of the specimens may be shortened, and that only one normal test will be required. Shortened conditioning period: The specimen shall be allowed to cool in air for at least 30 min. It shall then be trimmed and placed in the water bath for a period of 60 to 90 min before testing. In case of failure or dispute, three normal tests will be required and specimens shall be conditioned as in AASHTO T 51	
	(n) Distillation of Cutback Asphaltic Products, except the length of condenser tube may be 400 mm ± 24 mm	AASHTO T 78
480	(o) Float Test for Bituminous Materials	AASHTO T 50
	(p) Kinematic Viscosity of Asphalts.....	AASHTO T 201
	(q) Absolute Viscosity of Asphalts.....	AASHTO T 202
	(r) Effect of Heat and Air on Asphalt Materials, Thin-Film Oven Test	AASHTO T 179
490	(s) Effect of Heat and Air on a Moving Film of Asphalt, Rolling Thin Film Oven Test	AASHTO T 240
	(t) Testing Asphalt Emulsions.....	AASHTO T 59
	The following exceptions to T 59 shall apply:	
	1. For the Residue by Distillation test, the specified aluminum alloy still shall be the referee still.	

- 500 2. *When tests on the residue are not required, the percent of residue for emulsion grades RS-2, AE-90, AE-90S, and AE-T only, may be determined by the Residue by Evaporation test of AASHTO T 59. The percent of residue shall be determined by the Residue of Distillation test in all cases of failure or dispute.*
3. *The stone coating test shall be performed as follows on a mixture of 465 ± 1 g of reference stone and 35.0 ± 0.1 g of asphalt emulsion:*
- 510 a. *For AE-90 and AE-90S, the mixture of stone and asphalt shall be mixed vigorously for 5 min. At the end of the mixing period, the mix shall be rinsed by running sufficient tap water at the side of the container to completely immerse the mix. The tap water shall then be poured off and the rinsing step repeated as necessary until the rinse water pours off essentially clear. The stone shall remain a minimum of 90% coated.*
- 520 b. *For AE-150 and AE-150-L, the mixture of stone and asphalt shall be mixed vigorously for 5 min and then allowed to stand for 3 h. At the end of this time, the mixture shall again be mixed vigorously for 5 min. At the end of the mixing period, the mix shall be rinsed by running sufficient tap water at the side of the container to completely immerse the mix. The tap water shall then be poured off and the rinsing step repeated as necessary until the rinse water pours off essentially clear. The stone shall remain a minimum of 90% coated for AE-150 and AE 150-L.*
4. *For the Demulsibility test, normally only one test will be required. In case of failure or dispute, the specified procedure in AASHTO T 59 will be followed.*
- 530 5. *For oil portion from Residue by Distillation, report the number of milliliters of oil per 100 g of emulsion.*
- 540 (u) *For coating test for cutback asphalts with additive, 20 g of 20 to 30 mesh Ottawa sand shall be placed in a clean 60 mL (2 oz) wide-mouthed jar and covered with 25 g of distilled water at room temperature. One gram of the liquid asphalt to be tested shall be placed gently upon the surface of the water so that it floats and does not contact the sand. The lid shall then be placed on the jar and tightened securely. If the liquid asphalt to be tested is grade 70 or 250, the jar and contents shall be shaken vigorously for 30 s. If the grade is 800 or 3000, the jar and contents shall be immersed in a 46°C (115°F) water bath for 5 min to bring the contents of the jar to a temperature of approximately 38°C (100°F). The jar shall then be shaken vigorously for 30 s. After shaking, the asphalt coating on the sand shall be observed under a constant, strong light. Complete coating of the sand is required.*

(v) *Stripping tests for HMA mixtures using binder materials, with or without additives, shall be performed as follows:*

550 *1. Test 1. A sample of produced mixture, 500 g, minimum, shall be obtained for testing. The size of test specimen and the amount of distilled water shall be:*

	<i>Approximate Size of Aggregate</i>	<i>Minimum Weight of Test Specimen</i>	<i>Amount of Distilled Water</i>
	<i>Sand</i>	<i>100 g</i>	<i>400 mL</i>
	<i>12</i>	<i>100 g</i>	<i>400 mL</i>
560	<i>11</i>	<i>150 g</i>	<i>600 mL</i>
	<i>9</i>	<i>200 g</i>	<i>600 mL</i>

Place the specimen in the boiling distilled water and stir with a glass rod at the rate of one revolution per second for 3 min. The aggregate shall retain a minimum of 90% of its asphalt film compared with the remainder of the sample, upon completion of this procedure.

570 *2. Test 2. Approximately 500 g of produced mixture shall be heated to 121°C (250°F) in a laboratory oven for 2 h; stirred and cooled to 92.5°C (200°F). Then a portion of the mix shall be placed in boiling distilled water, quantity of mix and quantity of boiling water shall be as specified in Test 1, and stirred with a glass rod at the rate of one revolution per second for 3 min. The aggregate shall retain a minimum of 90% of its asphalt film compared with the remainder of the sample, upon completion of this procedure.*

580 *Note: The purpose of these tests is to determine the relative compatibility of the aggregate and asphalt, and to detect tendency of Asphalt Emulsions to reemulsify. Test 2 may be performed as a method of determining whether compatibility can be achieved, Test 1 having given unsatisfactory results.*

(w) *Penetrating Ability of AE-PL.*

1. Apparatus and Equipment:

a. Sand mixture:

- 590 (1) *Dry Standard Ottawa Sand (AASHTO T 106) 90 parts*
- (2) *Dry Reference Limestone Dust, portion passing 300 mm (#50) sieve only. Reference Limestone Dust used by the Department is Limestone Calcium Carbonate manufactured by France Stone Co. The Department will furnish approximately 2.3 kg (5 lb) of Reference Limestone Dust upon request..... 10 parts*

(3) Water 3 parts

b. Container, 170 g (6 oz) ointment tin

600

c. Ruler or other measuring device

d. Timing device readable in seconds

e. Compacting Device. Rimac Spring Tester or other device suitable for compacting sand by applying a 140 kPa (20 psi) load. The compacting device shall include an adapter consisting of two metal discs slightly smaller in diameter than a 170 g (6 oz) ointment tin separated by a spacer 25 to 50 mm (1 to 2 in.). The 65 mm (2.5 in.) diameter discs used in determining weight of coating in AASHTO T 65 or ASTM A 90 are satisfactory.

610

f. Small, square ended spatula or putty knife

2. Procedure:

Thoroughly mix Standard Ottawa Sand, Reference Limestone Dust, and water. Weigh 190 ± 1 g of sand mixture into a 170 g (6 oz) ointment tin. Level surface of sand with a spatula. Place the compacting adapter on the sand surface and slowly, over a period of about 5 s, compact the sand until the 140 kPa (20 psi) load is achieved, which is approximately 45 kg (100 lb) on the Rimac Spring Tester. Remove the compacting device, avoiding disturbance to the sand surface. Quickly pour 12 g of the emulsion from a height of about 100 mm (4 in.) onto top of sand mixture. Start timer at start of pour. Stop timer when all emulsion penetrates into sand mixture. Delay 2 min, then remove sand and mixture from one side of ointment tin, about 1/2 of mixture. Measure to determine average depth of penetration into sand mixture. Penetration time shall be 100 s or less; penetration depth shall be 6 mm (1/4 in.) or more.

620

(x) Flow Test for Asphalt for Coating Corrugated

Metal Pipe AASHTO M 190

(y) Shock Test for Asphalt for Coating Corrugated

Metal Pipe AASHTO M 190

(z) Viscosity Determinations of Unfilled Asphalts

Using the Brookfield Thermosel Apparatus AASHTO T 316

640

(aa) Determining the Rheological Properties of Asphalt

Binder Using a Dynamic Shear Rheometer AASHTO T 315

(bb) *Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel AASHTO R 28*

(cc) *Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer... AASHTO T 313*

650 **902.03 Application Temperatures.** *Binder materials for the several applications indicated in the specifications shall be applied at temperatures not to exceed those shown in the following:*

<i>Type and Grade of Material</i>	<i>Maximum Application Temperature °C (°F)</i>	
	<i>Spray</i>	<i>Mix</i>
<i>MC-70, MCA-70</i>	<i>66 (150)</i>	
<i>MC-250, MCA-250</i>	<i>107 (225)</i>	<i>93 (200)</i>
<i>MC-800, MCA-800</i>	<i>121 (250)</i>	<i>107 (225)</i>
<i>MC-3000, MCA-3000</i>	<i>135 (275)</i>	<i>121 (250)</i>
<i>SC-70, SCA-70.....</i>	<i>93 (200)</i>	
<i>CS-250, SCA-250.....</i>	<i>107 (225)</i>	<i>107 (225)</i>
<i>SC-800-3000, SCA-800-3000</i>	<i>121 (250)</i>	<i>121 (250)</i>
<i>All Emulsions.....</i>	<i>71 (160)</i>	<i>82 (180)</i>
<i>All Penetration and Viscosity, Utility and Pipe Coating</i>	<i>177 (350)</i>	<i>163 (325)</i>
<i>PG Binders</i>	<i>Note (1)</i>	<i>Note (1)</i>

Note (1): In accordance with manufacturer's recommendations.

SECTION 904, DELETE LINES 1 THROUGH 429.

SECTION 904, AFTER LINE 430, INSERT AS FOLLOWS:

SECTION 904 – AGGREGATES

904.01 Aggregates. *Aggregates shall consist of natural or manufactured materials produced from but not limited to limestone, dolomite, gravels, sandstones, steel furnace slag (SF), air-cooled blast furnace slag (ACBF), granulated blast furnace (GBF), wet bottom boiler slag, or other geologic rock types approved by the Engineer.*

440 *A source will not be considered for acceptance of material until a preliminary investigation has been made. As part of this investigation, samples will be obtained and tests conducted to determine the quality and classification of the aggregates in accordance with ITM 203.*

Two types of samples are required for the preliminary investigation; ledge samples for crushed stone sources and production samples for crushed stone, natural sand and gravel, and slag sources.

Ledge samples will be obtained from bedrock units as they naturally occur in the proposed working face of the quarry. Ledges will be identified by their differences in color, texture, geological formation, etc.

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Production samples will be obtained from stockpiles of finished materials.

Aggregates, except those used for precast concrete units or fine aggregates used for snow and ice abrasive, shall be supplied by a Certified Aggregate Producer in accordance with 917. Structure backfill may be obtained from a non-CAPP source in accordance with 211.02.

Dolomite aggregates are defined as carbonate rock containing at least 10.3% elemental magnesium when tested in accordance with ITM 205.

460

Polish resistant aggregates are defined as those aggregates in accordance with ITM 214. Aggregates meeting these requirements will be maintained on the Department's list of approved Polish Resistant Aggregates.

Sandstone aggregates shall only be used in HMA surface mixtures. Sandstone aggregates are defined as a sedimentary rock composed of siliceous sandgrains containing quartz, chert, and quartzose rock fragments in a carbonate matrix or cemented with silica, calcite, or dolomite. The Materials and Tests Division will determine identification of sandstone.

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Steel furnace (SF) slag shall only be used in aggregate shoulders, HMA surface mixtures, dumped riprap, and snow and ice abrasives.

Adjustments in mass (weight) shall be made to compensate for the difference in specific gravity of slag compared to natural aggregate when payment is on a mass (weight) basis. The following typical values for specific gravity will be used: natural aggregate both fine and coarse, 2.6; ACBF slag coarse aggregate, 2.3; ACBF slag fine aggregate, 2.6; GBF slag fine aggregate, 2.1; and SF slag both fine and coarse, 3.4. The contract quantity shall not be adjusted on any pay item less than 500 Mg (500 t).

480

When slag is furnished as an aggregate, the approximate quantity of megagrams (tons) to be supplied will be determined by multiplying the pay item quantity of megagrams (tons) by the specific gravity of slag divided by 2.6. The adjusted contract quantities will be determined by multiplying the accepted quantity of megagrams (tons) by 2.6 divided by the specific gravity of the slag.

At time of use, aggregates shall be free from lumps or crusts of hardened or frozen materials.

490

904.02 Fine Aggregates. *Fine aggregates are defined as 100% passing the 9.5 mm (3/8 in.) sieve and a minimum of 80% passing the 4.75 mm (No.4) sieve. Characteristics of fine aggregates are as follows:*

<i>Characteristic</i>	<i>PCC</i>	<i>HMA</i>
<i>Physical</i>		
<i>Organic Impurities, AASHTO T 21, lighter than or equal to, Color Standard (Note 1)</i>	<i>3</i>	
<i>Acid Insoluble, ITM 202 (Note 2)</i>		<i>40</i>
<i>Soundness</i>		
<i>Freeze and Thaw, AASHTO T 103, Method A, % Max. (Note 3)</i>	<i>10%</i>	<i>10%</i>
<i>Brine Freeze-and-Thaw, ITM 209, % Max. (Note 3)</i>	<i>12%</i>	<i>12%</i>
<i>Sodium Sulfate Soundness, AASHTO T 104, % Max. (Note 3)</i>	<i>10%</i>	<i>10%</i>

NOTES: 1. When subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be tested for effect of organic impurities on strength of mortar in accordance with AASHTO T 71. If the relative strength at seven days is less than 95% it shall be rejected.

2. For ACBF or GBF slag sands, the minimum acid insoluble content shall be 25%. Acid insoluble requirements shall not apply to crushed limestone or dolomite sands.

3. AASHTO T 104 and ITM 209 may be run at the option of the Engineer, in-lieu of AASHTO T 103.

(a) For Portland Cement Concrete. Fine aggregate for use in PCCP or bridge decks shall be natural sand. Fine aggregate for other PCC shall be natural sand or crushed limestone, dolomite, gravel, or ACBF.

Natural sand which has been used as foundry sand when tested in accordance with ITM 215, and complying with IDEM Class III or Class IV in accordance with 329 IAC 10-7-4 may be used in precast concrete units or precast concrete pipe. When foundry sand is used, the precast concrete manufacturer shall maintain a copy of the Waste Classification issued by IDEM and an indemnification statement shall accompany the precast items to each contract.

(b) For HMA Mixtures. Fine aggregate for use in HMA shall be natural sand or crushed limestone, dolomite, gravel, or ACBF. SF sand may be used only when the coarse aggregate is SF. The amount of crushed limestone sand shall not exceed 20% of the total aggregate used in HMA surface mixtures with ESAL equal to or greater than 3,000,000, except limestone sands manufactured from aggregates on the Department's list of approved Polish Resistant Aggregates will not be limited. If soundness testing cannot be conducted, the aggregate shall come from a Category I source in accordance with ITM 203.

The fine aggregate angularity value of the total blended aggregate material from the fine and coarse aggregates, and recycled materials shall meet or exceed the minimum values for the appropriate ESAL category and position within the pavement structure as follows:

<i>FINE AGGREGATE ANGULARITY</i>		
<i>TRAFFIC, ESAL</i>	<i>DEPTH FROM SURFACE</i>	
	<i>≤ 100 mm</i>	<i>> 100 mm</i>
<i>< 300,000</i>		
<i>300,000 to < 3,000,000</i>	<i>40</i>	<i>40</i>
<i>3,000,000 to < 10,000,000</i>	<i>45</i>	<i>40</i>
<i>10,000,000 to < 30,000,000</i>	<i>45</i>	<i>40</i>
<i>≥ 30,000,000</i>	<i>45</i>	<i>45</i>

530 *Fine Aggregate Angularity, Method A.....AASHTO T 304*

The clay content of the blended aggregate material from the fine and coarse aggregates shall meet or exceed the minimum values for the appropriate ESAL category as follows:

<i>CLAY CONTENT</i>	
<i>TRAFFIC, ESAL</i>	<i>SAND EQUIVALENT, MINIMUM</i>
<i>< 300,000</i>	<i>40</i>
<i>300,000 to < 3,000,000</i>	<i>40</i>
<i>3,000,000 to < 10,000,000</i>	<i>45</i>
<i>10,000,000 to < 30,000,000</i>	<i>45</i>
<i>≥ 30,000,000</i>	<i>50</i>

Clay Content, Sand EquivalencyAASHTO T 176

540 *(c) For Pneumatically Placed Mortar. Fine aggregate shall be natural sand suitable for use with a pneumatic cement gun. Fine aggregate shall be size No. 15, or size PP in accordance with 904.02(g), or an approved gradation from a CAPP source.*

(d) Mortar Sand. Fine aggregate for mortar shall consist of uniformly graded natural sand in accordance with gradation requirements of 904.02(g) for size No. 15 or an approved gradation from a CAPP source.

(e) Blank.

550 *(f) Snow and Ice Abrasives. Snow and ice abrasives shall be fine aggregates or cinders in accordance with the gradation requirements of 904.02(g) for size S&I.*

When steel slag is used as snow and ice abrasives, and payment is on a tonnage basis, the pay quantity shall be adjusted in accordance with 904.01.

(g) Sizes of Fine Aggregates.

<i>Sieve Sizes</i>	<i>SIZES (PERCENT PASSING)</i>					
	<i>23 Note 1</i>	<i>24 Note 1</i>	<i>15 Note 1</i>	<i>16</i>	<i>PP</i>	<i>S&I</i>
<i>9.5 mm (3/8 in.)</i>	<i>100</i>	<i>100</i>				<i>100</i>
<i>4.75 mm (No. 4)</i>	<i>95-100</i>	<i>95-100</i>			<i>100</i>	
<i>3.35 mm (No. 6)</i>			<i>100</i>			
<i>2.36 mm (No. 8)</i>	<i>80-100</i>	<i>70-100</i>	<i>90-100</i>		<i>85-95</i>	
<i>1.18 mm (No. 16)</i>	<i>50-85</i>	<i>40-80</i>				
<i>600 μm (No. 30)</i>	<i>25-60</i>	<i>20-60</i>	<i>50-75</i>	<i>100</i>	<i>50-65</i>	
<i>300 μm (No. 50)</i>	<i>5-30</i>	<i>7-40</i>	<i>15-40</i>		<i>15-25</i>	<i>0-30</i>
<i>180 μm (No. 80)</i>				<i>95-100</i>		
<i>150 μm (No. 100)</i>	<i>0-10</i>	<i>1-20</i>	<i>0-10</i>		<i>0-10</i>	
<i>75 μm (No. 200)</i>	<i>0-3</i>	<i>0-6</i>	<i>0-3</i>	<i>65-100</i>		<i>0-7</i>

Note 1: The fine aggregate shall have not more than 45% retained between any 2 consecutive sieves.

560 **(h) Sampling and Testing.** Sampling and testing shall be conducted in accordance with the following AASHTO and ITMs:

570 *Acid Insoluble Content..... ITM 202*
**Amount of Material Finer than*
75 μm (No. 200) sieve AASHTO T 11
Brine Freeze-and-Thaw Soundness ITM 209
Control Procedures for Classification of Aggregates ITM 203
Mortar Strength AASHTO T 71
Organic Impurities AASHTO T 21
Sampling Aggregates AASHTO T 2
Sampling Stockpiled Aggregates ITM 207
**Sieve Analysis of Aggregate..... AASHTO T 27*
**Soundness.....AASHTO T 103, T 104*
Specific Gravity and Absorption, Fine Aggregate..... AASHTO T 84
**Except as noted in 904.06.*

904.03 Coarse Aggregates. Coarse aggregates are defined as having a minimum of 20% retained on the 4.75 mm (No.4) sieve. Coarse aggregates shall not contain adherent fines that are detrimental to the end product as defined in ITM 211.

580 The coarse aggregate shall comply with the quality requirements and the additional requirements in accordance with 904.03(a). However, coarse aggregate may be rejected based on previous performance service records. Class AP is defined as the highest classification and Class F the lowest. Blending of material for compliance with gradation or crushed particle requirements may be permitted when requested in writing. Blending of aggregate products to improve the quality classification of the finished product will not be permitted.

(a) Classification of Aggregates.

<i>Characteristic Classes</i>	<i>AP</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Quality Requirements							
Freeze-and-Thaw Beam Expansion, % Max. (Note 1).....	.060						
Los Angeles Abrasion, %, Max. (Note 2)	40.0	40.0	40.0	45.0	45.0	50.0	
Sodium Sulfate Soundness, %, Max. (Note 3).....	12.0	12.0	12.0	16.0	16.0	20.0	25.0
Brine Freeze-and-Thaw Soundness, % Max. (Note 4).....	30	30	30	40	40	50	60
Absorption, %, Max. (Note 5).....	5.0	5.0	5.0	5.0			
Additional Requirements							
Deleterious, %, Max.							
Clay Lumps and Friable Particles.....	1.0	1.0	1.0	2.0	4.0		
Non-Durable (Note 6).....	4.0	4.0	4.0	6.0	8.0		
Coke.....				(See	Note 7)		
Iron.....				(See	Note 7)		
Chert (Note 8).....	3.0	3.0	5.0	8.0	10.0		
Mass Per Cubic Meter for Slag, kg	1200	1200	1200	1120	1120	1120	
Weight Per Cubic Foot for Slag, (lbs), Min	(75.0)	(75.0)	(75.0)	(70.0)	(70.0)	(70.0)	
Crushed Particles, %, Min. (Note 9)							
Asphalt Seal Coats.....		70.0	70.0				
Compacted Aggregates		20.0	20.0	20.0	20.0		

- NOTES: 1. Freeze-and-thaw beam expansion shall be tested and retested in accordance with ITM 210.
2. Los Angeles abrasion requirements shall not apply to BF.
3. Aggregates may, at the option of the Engineer, be subjected to 50 cycles of freezing and thawing in accordance with AASHTO T 103, Procedure A, and may be accepted, provided they do not have a loss greater than specified for Sodium Sulfate Soundness.
4. Brine freeze-and-thaw soundness requirements are subject to the conditions stated in Note 3.
5. Absorption requirements apply only to aggregates used in PCC and HMA mixtures except they shall not apply to BF. When crushed stone coarse aggregates from Category I sources consist of production from ledges whose absorptions differ by more than two percentage points, the absorption test will be performed every three months on each size of material proposed for use in PCC or HMA mixtures. Materials having absorption values between 5.0 and 6.0 that pass AP testing may be used in PCC. If variations in absorption preclude satisfactory production of PCC or HMA mixtures, independent stockpiles of materials will be sampled, tested, and approved prior to use.
6. Non-durable particles include soft particles as determined by ITM 206 and other particles which are structurally weak, such as soft sandstone, shale, limonite concretions, coal, weathered schist, cemented gravel, ocher, shells, wood, or other objectionable material. Determination of non-durable particles shall be made from the total mass (weight) of material retained on the 9.5 mm (3/8 in.) sieve. Scratch Hardness Test shall not apply to crushed stone coarse aggregate.
7. ACBF and SF coarse aggregate shall be free of objectionable amounts of coke and iron.
8. The bulk specific gravity of chert shall be based on the saturated surface dry condition. The amount of chert less than 2.45 bulk specific gravity shall be determined on the total mass (weight) of material retained on the 9.5 mm (3/8 in.) sieve for sizes 2 through 8, 43, 53, and 73, and on the total mass (weight) of material retained on the 4.75 mm (No. 4) sieve for sizes 9, 11, 12, and 91.
9. Crushed particle requirements apply to gravel coarse aggregates used in compacted aggregates, and seal coats except seal coats used on shoulders. Determination of crushed particles shall be made from the weight (mass) of material retained on the 4.75 mm (No. 4) sieve in accordance with ASTM D 5821.

(b) Coarse Aggregate Angularity. The coarse aggregate angularity (CAA) value of the total blended aggregate material, including recycled materials, shall meet or exceed the minimum values for the appropriate ESAL category and position within the pavement structure as follows:

<i>COARSE AGGREGATE ANGULARITY</i>		
<i>TRAFFIC, ESAL</i>	<i>DEPTH FROM SURFACE</i>	
	<i>≤ 100 mm (4 in.)</i>	<i>> 100 mm (4 in.)</i>
<i>< 300,000</i>	<i>55</i>	
<i>300,000 to < 3,000,000</i>	<i>75</i>	<i>50</i>
<i>3,000,000 to < 10,000,000</i>	<i>85/80*</i>	<i>60</i>
<i>10,000,000 to < 30,000,000</i>	<i>95/90*</i>	<i>80/75*</i>
<i>≥ 30,000,000</i>	<i>100/100*</i>	<i>100/100*</i>

** Denotes two faced crush requirements*

Coarse Aggregate Angularity ASTM D 5821

Coarse aggregate angularity requirements do not apply to 4.75 mm HMA mixture designation.

630 *(c) Flat and Elongated. The coarse aggregate shall contain 10% or less flat and elongated particles. A flat and elongated piece is defined as a particle having a ratio of length to thickness greater than five. Determination of flat and elongated particles shall be made from the weight (mass) of material retained on the 9.5 mm (3/8 in.) sieve and each sieve size greater than the 9.5 mm (3/8 in.) sieve.*

Flat and Elongated ASTM D 4791

Flat and elongated requirements do not apply to 4.75 mm HMA mixture designation.

640 *(d) Surface Aggregate Requirements. The surface mixture aggregate selection shall be based on the ESAL category as follows:*

<i>Coarse Aggregate Type</i>	<i>Traffic ESAL</i>		
	<i>< 3,000,000</i>	<i>< 10,000,000</i>	<i>≥ 10,000,000</i>
<i>Air-Cooled Blast Furnace Slag</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Steel Furnace Slag</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Sandstone</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Crushed Dolomite</i>	<i>Yes</i>	<i>Yes</i>	<i>Note 1</i>
<i>Polished Resistant Aggregates</i>	<i>Yes</i>	<i>Yes</i>	<i>Note 1</i>
<i>Crushed Stone</i>	<i>Yes</i>	<i>No</i>	<i>No</i>
<i>Gravel</i>	<i>Yes</i>	<i>No</i>	<i>No</i>

Note 1. Polish resistant aggregates or crushed dolomite may be used when blended with ACBF or sandstone but cannot exceed 50% of the coarse aggregate by mass (weight), or cannot exceed 40% of the coarse aggregate by mass (weight) when blended with steel furnace slag.

(e) Sizes of Coarse Aggregates.

Sieve Sizes	COARSE AGGREGATE SIZES (PERCENTS PASSING)									
	COARSE GRADED								DENSE GRADED	
	2	5	8	9	11	12	43 ⁽¹⁾	91	53 ⁽¹⁾	73 ⁽¹⁾
100 mm (4 in.)										
90 mm (3 1/2 in.)										
63 mm (2 1/2 in.)	100									
50 mm (2 in.)	80-100									
37.5 mm (1 1/2 in.)		100					100		100	
25 mm (1 in.)	0-25	85-98	100				70-90	100	80-100	100
19 mm (3/4 in.)	0-10	60-85	75-95	100			50-70		70-90	90-100
12.5 mm (1/2 in.)	0-7	30-60	40-70	60-85	100	100	35-50		55-80	60-90
9.5 mm (3/8 in.)		15-45	20-50	30-60	75-95	95-100				
4.75 mm (No. 4)		0-15	0-15	0-15	10-30	50-80	20-40		35-60	35-60
2.36 mm (No. 8)		0-10	0-10	0-10	0-10	0-35	15-35		25-50	
600 µm (No. 30)						0-4	5-20		12-30	12-30
75 µm (No. 200) ⁽²⁾							0-6.0		5.0-10.0 ⁽⁴⁾	5.0-12.0
Decant (PCC) ⁽³⁾		0-1.5	0-1.5	0-1.5	0-1.5	0-1.5		0-1.5		
Decant (Non-PCC)	0-2.5	0-2.5	0-3.0	0-2.5	0-2.5	0-2.0		0-2.5		

NOTES: 1. The fraction passing the 75 µm (No. 200) sieve shall not exceed 2/3 the fraction passing the 600 µm (No. 30) sieve. The liquid limit shall not exceed 25 (35 if slag) and the plasticity index shall not exceed 5. The liquid limit shall be determined in accordance with AASHTO T 89 and the plasticity index in accordance with AASHTO T 90.

2. Includes the total amount passing the 75 µm (No. 200) sieve as determined by AASHTO T 11 and T 27.

3. Decant may be 0-2.5 for stone and slag

4. When slag is used for separation layers as defined in 302.01, the total amount passing the 75 µm (No. 200) sieve shall be 10.0 to 12.0.

(f) Sampling and Testing. Sampling and testing shall be in accordance with the following AASHTO, ASTM, and ITMs:

Abrasion AASHTO T 96

* Amount of Material finer than 75 µm (No. 200) Sieve AASHTO T 11

Brine Freeze-and-Thaw Soundness ITM 209

Clay Lumps and Friable Particles..... AASHTO T 112

Control Procedures for Classification of Aggregates ITM 203

Crushed Particles..... ASTM D 5821

Dolomite Aggregates ITM 205

Flat and Elongated Particles..... ASTM D 4791

Freeze-and-Thaw Beam Expansion ITM 210

* Lightweight Pieces in Aggregates..... AASHTO T 113

Polished Resistant Aggregates ITM 214

* Sampling Aggregates AASHTO T 2

Sampling Stockpiled Aggregates ITM 207

Scratch Hardness ITM 206

* Sieve Analysis AASHTO T 27

* Soundness AASHTO T 103, T 104

* Specific Gravity and Absorption AASHTO T 85

Unit Weight and Voids in Aggregates..... AASHTO T 19

*Except as noted in 904.06.

904.04 Riprap. Riprap shall consist of SF for dumped riprap only, sound stone, stone masonry, or other approved material, free from structural defects and of approved quality. Stone containing shale, unsound sandstone, or other material that will disintegrate readily, shall not be used.

690 (a) **Dumped Riprap.** Dumped riprap shall be broken concrete, masonry, or stone removed from an old structure; broken pieces removed from concrete pavement, base, or monolithic brick pavement; or broken rock from class X, class Y, unclassified excavation, or solid rock excavation. Material provided from sources outside the right-of-way shall be coarse aggregate, Class F or higher.

(b) **Grouted Riprap.** Grouted riprap material shall be in accordance with Dumped riprap or Revetment riprap.

(c) **Revetment, Class 1, and Class 2 Riprap.** The material shall be coarse aggregate, Class F or higher. Gradation shall be in accordance with 904.04(e).

700 (d) **Uniform Riprap.** The material shall be coarse aggregate, Class F or higher in accordance with 904.03(a). Gradation shall be in accordance with 904.04(e). Either type A or type B may be utilized.

(e) **Sizes of Riprap.**

GRADATION REQUIREMENTS					
Percent Smaller					
Size, mm (in.)	Revetment	Class 1	Class 2	Uniform A	Uniform B
750 (30)			100		
600 (24)		100	85-100		
450 (18)	100	85-100	60-80		
300 (12)	90-100	35-50	20-40		
200 (8)				100	
150 (6)	20-40	10-30	0-20	35-80	95-100
75 (3)	0-10	0-10	0-10		35-80
25 (1)				0-20	0-20
Depth of Riprap, minimum	450 mm (18 in.)	600 mm (24 in.)	750 mm (30 in.)		

The maximum dimension of individual pieces shall not be greater than three times the minimum dimension. The riprap will be visually inspected for size, shape, and consistency.

710

904.05 Structure Backfill. The material shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter. It shall consist of suitable sand, gravel, crushed stone, ACBF, or GBF. Coarse aggregate used for backfilling end bents on beam structures shall be No. 8 or No. 9 crushed stone or BF slag, Class D or higher, in accordance with 904. Structure backfill shall be in accordance with one of the following gradations.

Sieve Sizes	NOMINAL SIZES AND PERCENTS PASSING					
	50 mm (2 in.)	37.5 mm (1 1/2 in.)	25.0 mm (1 in.)	12.5 mm (1/2 in.)	4.75 mm (No. 4)	600 μ m (No. 30)
63 mm (2 1/2 in.)	100					
50 mm (2 in.)	90-100	100				
37.5 mm (1 1/2 in.)	70-100	90-100	100	100		
25.0 mm (1 in.)	55-95	70-100	85-100			
19.0 mm (3/4 in.)	45-90	55-95	70-100			
12.5 mm (1/2 in.)	35-85	40-90	55-95	85-100	100	100
4.75 mm (No. 4)	20-65	20-70	25-75	45-85	90-100	
2.36 mm (No. 8)	10-50	10-55	15-60	25-75	75-100	
600 μ m (No. 30)	3-35	3-35	3-35	5-45	15-70	70-100
75 μ m (No. 200)	0-8.0	0-8.0	0-8.0	0-8.0	0-8.0	0-8.0

904.06 Exceptions to AASHTO Standard Methods.

720

(a) Exceptions to AASHTO T 2. Stockpile sampling shall be in accordance with ITM 207, unless otherwise permitted.

(b) Exceptions to AASHTO T 11, T 27, and T 37.

1. *When tests are performed in the field where ovens are not available, test samples may be dried in suitable containers over open flame or electric hot plates with sufficient stirring to prevent overheating, then cooled to constant mass (weight).*

730

2. *The balance shall be a Class G2 general purpose balance in accordance with AASHTO M 231.*

(c) Exceptions to AASHTO T 27 for Coarse Aggregates.

The size of test samples for coarse aggregate shall be as follows:

Aggregate Size	Minimum Mass (Weight) of Test Sample
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740

No. 2.....	11.3 kg (25 lb)
No. 5, 8, 43, 53, 73, and 91	6-8 kg (13-18 lb)
No. 9.....	4-6 kg (9-13 lb)
* Subbase.....	4-6 kg (9-13 lb)
* B Borrow.....	4-6 kg (9-13 lb)

** The minimum mass (weight) of the test sample for 4.75 mm (No. 4) and 600 μ m (No. 30) B borrow shall be 300 grams (10 oz).*

750 *(d) Exceptions to AASHTO T 85. The in-water mass (weight) shall be determined following the 15 h soaking period prior to determining the SSD mass (weight).*

(e) Exceptions to AASHTO T 103 and T 104.

- 760
1. *Counting the number of individual particles coarser than the 19.0 mm (3/4 in.) sieve will not be required.*
 2. *For testing ledge rock, the ledge samples shall be crushed to obtain test samples for the designated increments passing the 37.5 mm (1 1/2 in.) sieve and retained on the 4.75 mm (No. 4) sieve. The factors used to calculate the weighted average loss are 30%, 40% and 30% of the 37.5 mm (1 1/2 in.) - 19.0 mm (3/4 in.), 19.0 mm (3/4 in.) - 9.5 mm (3/8), and 9.5 mm (3/8) - 4.75 mm (No. 4) increments, respectively.*
 - 770 3. *In the case of ledge rock, modify sections 3.3 and 6.2 of AASHTO T 103 and AASHTO T 104 respectively. When the sample received is deficient in material of a component size of any test portion, that material will be supplemented with the available component size to provide the test portion.*
 4. *Modify section 8 of AASHTO T 103 and section 10 of AASHTO T 104. For materials designated as a coarse aggregate, the weighted loss will be calculated considering the material retained on the 4.75 mm (No. 4) sieve as 100% of the sample, and only the total weighted loss reported. In AASHTO T 104 sections 10.1.3.2 and 10.1.3.3 shall not apply, and unless otherwise noted only new solution will be used.*

SECTION 905, AFTER LINE 22 INSERT AS FOLLOWS:

905.04 Precast Concrete Riprap. *Precast concrete riprap shall consist of unreinforced concrete units of the thickness specified and shall be in accordance with the details shown on the plans. The precast concrete units shall be in accordance with ASTM C 139 except the fine aggregates shall be in accordance with 904.02(a) and the coarse aggregates, class A or higher, shall be in accordance with 904.03. The minimum compressive strength shall be 17 MPa (2500 psi) for an average of three units and 16 MPa (2300 psi) for individual units. The maximum water absorption shall be 190 kg/m³ (12 lb/cu ft) for an average of three units.*

905.05 Detectable Warning Elements. *Detectable warning bricks used in sidewalk curb ramps shall be in accordance with ASTM C 902, Class SX, Type II. The color shall approximate 30109 or 30166 in accordance with Federal Standard No. 595a. The color shall be consistent throughout the brick. The truncated domes shall be as shown on the plans. The minimum dimensions of the brick shall be 60 mm (2 1/4 in.) thick by 90 mm (3 5/8 in.) wide by 195 mm (7 5/8 in.) long. The minimum thickness shall not be measured within the area of the domes.*

SECTION 906, BEGIN LINE 3, DELETE AS FOLLOWS:

906.01 Joint Fillers. Joint fillers shall be preformed materials intended to be used in ~~cement concrete pavement~~ *PCCP* and bridge joints or as otherwise specified. Joint fillers shall be in accordance with AASHTO M 153, ~~or AASHTO M 213.~~ However, the asphalt content will be determined by ITM 801, rather than by AASHTO T 42.

SECTION 906, BEGIN LINE 40, DELETE AND INSERT AS FOLLOWS:

40

~~d. Certification. The manufacturer of the joint sealant shall furnish a type A certification in accordance with 916 for each lot of the joint sealant material furnished to the contract. Each lot of the~~ *The* sealant shall be delivered in containers plainly marked with manufacturer's name or trade mark, lot number, and date of manufacture. The basis of use will be the manufacturer's certification.

2. Hot Poured Joint Sealant.

a. General Requirements. The sealant shall be in accordance with AASHTO M 301. The material shall be tested in accordance with ASTM D 3407 *5329* except that after blotting, the surface of the blocks shall be blown surface dry with compressed air.

SECTION 906, BEGIN LINE 68, DELETE AND INSERT AS FOLLOWS:

3. Preformed Elastomeric Joint Seals. This joint seal shall be in accordance with AASHTO M 220. Joint seals furnished under this specification shall be covered by a type A certification in accordance with 916. *03(b)*. ~~Sampling of joint seals in accordance with AASHTO M 220 will be required.~~ The lubricant-adhesive shall be covered by a type C certification in accordance with 916. *03(d)*.

SECTION 906, BEGIN LINE 89, DELETE AND INSERT AS FOLLOWS:

906.04 Rubber Type Gaskets. Ring gaskets for pipe shall be in accordance with AASHTO M 198 *315*, type A. Material furnished under this specification shall be covered by a type B certification in accordance with 916.

906.05 Bituminous Mastic Pipe Joint Sealer. This is a cold applied, mineral filled, joint sealing compound for joints of bell and spigot or tongue and groove concrete or clay pipe. ~~It shall be a steam refined petroleum asphalt, plasticized to a homogeneous consistency with mineral fillers.~~ *Joint sealing compound shall be in accordance with AASHTO M 198.*

(a) **General Requirements.** This sealer shall be a smooth uniform mixture, not thickened or livered, and shall show no separation which cannot be overcome easily by stirring. The material shall be of such consistency and proportions that it can be applied readily with a trowel, putty knife, or caulking gun without pulling or drawing. It shall exhibit good adhesive and cohesive properties when applied to metal, concrete, or vitrified clay surfaces. It shall not be damaged by exposure to below freezing temperatures and shall be applicable when the temperature of the air is between -7EC (20EF) and 38EC (100EF).

(b) Detail Requirements.

1. ~~When applied in a layer 1 mm (1/16 in.) to 3 mm (1/8 in.) thick on a tinned metal panel and cured at room temperature for 24 h, the bituminous mastic pipe joint sealer shall set to a tough plastic coating free from blisters.~~

Min. Max.

2. ~~Grease cone penetration unworked, 150 g,
25°C, 5 s., ASTM D 217, mm/10 125 225~~
3. ~~Non Volatile, 10 g, 105°C 110°C, 24 h, % 75~~
4. ~~Ash, by ignition, % 15 45~~
5. ~~Flash Point (ASTM D 92), °C (°F) (38) 100~~
6. ~~Fire Point (ASTM D 92), °C (°F) (66) 150~~
7. ~~Cold Temperature Flexibility @ 12°C (10°F) shall not crack. Test: Trowel joint mastic approximately 6 mm (1/4 in.) thick on heavy kraft paper or very light gage sheet metal. Condition in a freezer at 12°C (10°F) for 3 h. Bend the sample over a 25 mm (1 in.) diameter pin or mandrel.~~
8. ~~High Temperature Resistance @ 60°C (140°F), 10 h no sag. Test: Trowel joint mastic approximately 12.5 mm (1/2 in.) thick on a porous concrete slab or piece of concrete block. Place in oven at 60°C (140°F) for 10 h.~~

(e) (b) **Certification.** Material furnished under this specification shall be covered by a type C certification in accordance with 916.

906.05.1 Joint Membrane System for Precast Reinforced Concrete Box Sections. The Contractor may elect to use an approved self-adhering membrane system in lieu of the detail shown on the plans.

Approved *Joint* membrane systems shall be in accordance with the following requirements.

PROPERTY	TEST METHOD	REQUIREMENT
Thickness	ASTM D 3767 Procedure A	1.5 mm Min.
Tensile Strength	Grab Tensile Strength, ASTM D 4632	650 N Min.
Elongation	Grab Tensile Strength, ASTM D 4632	20% Min.
Bursting Strength	Mullen Burst, ASTM D 3786	2.0 MPa Min.
Peel Strength	ASTM D 903	850 N/m Min.
Permeance	ASTM E 96, Water Method	60 ng/m ² s Pa Max.

The membrane system shall be supplied in roll widths of at least 300 mm (12 in.). The membrane shall be a composite sheet material composed of a non-woven fabric and a polymer membrane material. The membrane shall be protected by a release paper. ~~The alternate membrane systems to be used shall be selected from the List of Approved Membrane Systems for Precast Reinforced Concrete Box Sections.~~

~~Requests for adding membrane systems to the approved list must be supported by a type B certification documenting compliance with the above requirements and a sample. The certification shall be prepared by the manufacturer in accordance with the applicable requirements of 916. No relabeled materials will be considered for approval. A specified material on the approved list will not be listed under more than one name.~~

~~When a product is determined to be acceptable, it will be added to the approved list and it may be used upon publication of the list.~~

Material furnished under this specification shall be covered by a type B certification in accordance with 916.

SECTION 906, BEGIN LINE 107, DELETE AND INSERT AS FOLLOWS:

(b) Detail Requirements.

1. When applied in a layer 1 mm (1/16 in.) to 3 mm (1/8 in.) thick on a tinned metal panel and cured at room temperature for 24 h, the bituminous mastic pipe joint sealer shall set to a tough plastic coating free from blisters.

	Min.	Max.
2. Grease cone penetration unworked, 150 g, 25°C, 5 s, ASTM D 217, mm/10.....	125	225
3. Non-Volatile, 10 g, 105°C-110°C, 24 h, %	75	-
4. Ash, by ignition, %	15	45
5. Flash Point (ASTM D 92), °C (°F)	(38) (100)	-
6. Fire Point (ASTM D 92), °C (°F)	(66) (150)	-

SECTION 906, BEGIN LINE 183, DELETE AND INSERT AS FOLLOWS:

The elastomer shall be neoprene in accordance with ASTM D 3542 5973 except that the physical requirements in Table 1 for low temperature recovery, high temperature recovery, and compression-deflection properties will not apply.

SECTION 906, BEGIN LINE 191, DELETE AND INSERT AS FOLLOWS:

(b) **Type BS2, BS6, BS8, BS9, and BS11, and 1-A.** Materials shall be in accordance with ASTM D 3542. The dimension and tolerance requirements shall be as specified in the following table for the type or types of joints specified.

EXPANSION JOINT TYPE	SEAL WIDTH	SEAL HEIGHT	JOINT WIDTH @ INSTALLATION
BS2	41 mm (1 5/8 in.) ± 3 mm (± 1/8 in.)	41 mm (1 5/8 in.) ± 3 mm (± 1/8 in.)	22 mm (7/8 in.) + 3 mm, - 6 mm (+ 1/8 in., - 1/4 in.)
BS6	64 mm (2 1/2 in.) - 0, + 6 mm (- 0, + 1/4 in.)	64 mm (2 1/2 in.) + 10 mm, - 3 mm (+ 3/8, - 1/8 in.)	38 mm (1 1/2 in.) + 3 mm, - 6 mm (+ 1/8 in., - 1/4 in.)
BS8	76 mm (3 in.) - 0, + 6 mm (- 0, + 1/4 in.)	83 mm (3 1/4 in.) ± 6 mm (± 1/4 in.)	48 mm (1 7/8 in.) + 3 mm, - 6 mm (+ 1/8 in., 1/4 in.)
BS9	100 mm (4 in.) - 0, + 6 mm (- 0, + 1/4 in.)	111 mm (4 3/8 in.) ± 10 mm (± 3/8 in.)	64 mm (2 1/2 in.) + 3 mm, - 6 mm (+ 1/8 in., - 1/4 in.)
BS11	127 mm (5 in.) - 0, + 6 mm (- 0, + 1/4 in.)	128 mm (5 1/8 in.) ± 6 mm (± 1/4 in.)	75 mm (3 in.) + 3 mm, - 6 mm (+ 1/8 in., - 1/4 in.)
1-A	16 mm (5/8 in.) ± 2 mm (± 1/16 in.)	17 mm (11/16 in.) ± 3 mm (± 1/8 in.)	6 mm (1/4 in.) - 0, + 3 mm (- 0, + 1/8 in.)

SECTION 907, BEGIN LINE 25, DELETE AND INSERT AS FOLLOWS:

- (a) The ~~pipe has been manufactured~~ *placement of the steel reinforcement is* in accordance with ~~these~~ *the* Standard Specifications.

SECTION 907, AFTER LINE 200, INSERT AS FOLLOWS:

907.24.1 Thermoplastic Pipe Liners. *Thermoplastic pipe liners shall be high density polyethylene or polyvinyl chloride pipe with sufficient rigidity to withstand the installation operation and shall exhibit a minimum amount of distortion. The liner shall be free from visible cracks, holes, foreign inclusions, or other defects. Thermoplastic pipe liners may be added to the Department's approved list by completing the requirements of ITM 806, Procedure A.*

(a) Solid Wall HDPE Pipe Liner. *Solid wall HDPE pipe liner shall be in accordance with ASTM F 714. The maximum standard dimension ratio, SDR, for the liner as defined in ASTM F 412 shall be 32.5. The resin used in the fabrication of the liner shall have a minimum cell classification of 345464C as shown in ASTM D 3350.*

A 300 mm (12 in.) section of the liner shall show no evidence of splitting, cracking, or breaking when compressed between parallel plates to 40% of its outside diameter within 2 to 5 min.

(b) Profile Wall HDPE Pipe Liner. *Profile wall HDPE pipe liner shall be in accordance with ASTM F 894. The minimum liner ring stiffness constant, RSC, shall be 100. The resin used in the fabrication of the liner shall have a minimum cell classification of 345434C as shown in ASTM D 3350.*

(c) Profile Wall PVC Pipe Liner. *Profile wall PVC pipe liner shall be in accordance with ASTM F 949, with the exception that PVC material with a minimum cell classification of 12454B as shown in ASTM D 1784 is added to the list of acceptable PVC materials.*

SECTION 908, LINE 97, DELETE AND INSERT AS FOLLOWS:

The asphalt material for coating shall be in accordance with ~~902.02~~ 902.01(e).
Samples of

SECTION 909, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 909 – PAINT AND LIQUID EPOXY

909.01 General Requirements. All necessary facilities for inspection of materials and manufacture of *coatings*, paints, ~~enamels, varnish~~, and ingredients shall be granted. Free access to all parts of the premises where any or all of these products are being prepared shall be allowed. Material Safety Data Sheets shall be provided.

Paints and coatings shall be furnished ready for use without modification and shall not settle, cake, curdle, liver, gel, or develop excessive change in viscosity between time of manufacture and time of use. It shall remain capable of being readily dispersed with a paddle, or other approved methods, to a consistency appropriate for the intended use. Paints and coatings may be sampled and tested at any time prior to use. If, for any reason, re-sampling and retesting following initial or prior approval is indicated, the latest test results shall prevail over all previous tests for material that has not been used. Previously approved paint ~~which is later~~ or coating that are stored for future use may be re-sampled and retested.

Paints and coatings shall be delivered in new containers of such strength, durability, design, fabrication, and material that the paint shall be suitably protected in transit and in storage against any change in characteristics which would cause rejection on the basis of laboratory or field evaluation. Each container shall bear a label which shows the name and address of the manufacturer, kind of paint or coating, formula identification date of manufacture, and lot or batch number. The mass per volume (weight per gallon) kg/L (lb per gal.) of the paint shall be accurately determined at 25°C (77°F). The container shall be so filled that the net mass (weight) of the material in the container shall be the product of the mass per volume (weight per gallon) at 25°C (77°F) and the stated number of liters (gallons) in the container.

~~All labels shall be~~ containers shall be labeled in accordance with the OSHA requirements for labeling of hazardous chemicals as described in the Hazardous Communications Standard.

909.02 For Metal. Paints for metal surfaces shall be in accordance with the requirements shown below.

(a) Zinc Primers.

1. ~~Two-Component and Multi-Component Inorganic Zinc Silicate Primer.~~

These ~~paints~~ primers shall be of the self-cure type which, when mixed and applied in accordance with these specifications, shall cure without the use of a separate curing solution. The multi-component inorganic zinc silicate primers shall have a maximum of three components. The components of each ~~type of paint~~ primer shall be packaged in such proportions that when the full quantity of each component is mixed together, the specified mixed ~~paint~~ primer shall be yielded.

These ~~paints~~ inorganic primers shall be in accordance with the following requirements AASHTO M 300.

- ~~a. Two component solvent based primer shall be in accordance with AASHTO M 300 Type I.~~
- ~~b. Multi component solvent based primer, with low volatile organic compounds for shop painting, shall be in accordance with AASHTO M 300 Type IA.~~
- ~~c. Two component water based primer shall be in accordance with AASHTO M 300 Type II.~~

2. ~~Single Package Inorganic Zinc Silicate Primer.~~ The Inorganic Zinc Silicate Primer shall be a single package, self curing type which, when stirred and applied in accordance with these specifications, cures without the use of a separate curing solution. It shall be in accordance with AASHTO M 300 Type III.

3 2. Organic Zinc Primer. Organic zinc primer shall be a self-curing type ~~paint primer~~. It shall be in accordance with SSPC paint specification No. 20 type II with exceptions as follows:

SECTION 909, BEGIN LINE 65, DELETE AND INSERT AS FOLLOWS:

Table I, total zinc dust, percent by mass (weight) of pigment requirement shall be a minimum of ~~87~~ 84% metallic zinc. Table I, total zinc dust, percent by mass (weight) of total solids requirement shall be a minimum of 72% metallic zinc. *The viscosity variation in Krebs Units in Section 6.2 shall be ± 10 .*

SECTION 909, BEGIN LINE 95, DELETE AND INSERT AS FOLLOWS:

4 3. Approval of Formulation. The manufacturer shall obtain approval of the formulation prior to furnishing the primers. ~~To obtain approval, the manufacturer shall submit to the Division of Materials and Tests the following: Only zinc primers from the Department's list of approved Coating Formulations shall be used. Zinc primers will be placed and maintained on the Department's list of approved Coating Formulations in accordance with ITM 606.~~

- ~~a. A certified test report from an approved independent testing laboratory showing specific test results for all applicable quantitative requirements and resistance test requirements in these specifications. The report shall state the manufacturer's name, brand name of paint including formulation number, date of manufacture, number of the batch tested, beginning and ending dates of resistance tests, and, for the 2 component or multi component paints, the exact mass (weight) ratio of each component used in the mixed paint tested.~~
- ~~b. A certification, in accordance with the applicable requirements of 916, indicating compliance with the requirements for the specific primer set out in these specifications.~~
- ~~c. A current material safety data sheet shall be submitted with the initial formulation approval package.~~

5. Reapproval of Formulation. ~~Reapproval will be required:~~

- ~~a. every five years;~~
- ~~b. each time there is a change in formulation or the manufacturing process;~~
- ~~c. if three consecutive years elapse without furnishing material;~~
- ~~d. it may be required when test of material furnished indicate non-conformance with any of the specified requirements.~~

SECTION 909, BEGIN LINE 138, DELETE AND INSERT AS FOLLOWS:

Set-to-touch, ASTM D 1640, ~~175~~ 150 μm (6 mils) wet film *thickness*,
25 \pm 1°C, Max.4 h

SECTION 909, BEGIN LINE 157, DELETE AND INSERT AS FOLLOWS:

Set-to-touch, ASTM D 1640, 127 μm (5 mils) wet film *thickness*,
 25 \pm 1°C, 50 \pm 10% relative humidity, Min. 30 min
 Total Solids ASTM D 2369, Min. 70%
 Specular gloss, 60°, ASTM D 523, Min. 75
 Viscosity, ASTM D 562, Kneb Units, Max. 100
 Contrast ratio, ASTM D 2805, 127 \pm 13 μm (5 \pm 0.5 mils) wet
 film thickness
 dried 24 h @ 25 \pm 2°C on Leneta Form 2A or 2C, Min. 0.95
 Dry hard, ASTM D 1640, 127 μm (5 mils) wet film *thickness*,
 25 \pm 1°C, 50 \pm 10% relative humidity, Max. 24 h

SECTION 909, BEGIN LINE 194, DELETE AND INSERT AS FOLLOWS:

Total solids, % by mass (weight), ASTM D 2369, Min. 50 48
 Vehicle solids, % of vehicle by mass (weight), Min. 40 37.5
 Dry time, ASTM D 1640, 75 μm (3 mils) wet film *thickness* on a tin
 coated steel panel @ 25 \pm 1°C and 50 \pm 5% relative
 humidity, Max:
 Set-to-touch, h 1
 Dry hard, h 24
~~Hiding power, 150 μm 6 (mils) wet film on most~~
~~black and white chart paper, dry film hiding Complete~~
 Contrast ratio, ASTM D 2805, 125 \pm 13 μm (5 \pm 0.5 mils) wet film *thickness*
 dried 24 h @ 25 \pm 2°C on Leneta Form 2A or 2C, Min. 0.97
 Specular gloss, 60°, 250 \pm 13 μm (10 mils \pm 0.5 mils) wet film *thickness*
 on a tin
 coated steel panel, dried 48 h @ 25°C and 50 \pm 5% relative
 humidity, ASTM D 523, Max. 15—25 30

SECTION 909, BEGIN LINE 203, DELETE AND INSERT AS FOLLOWS:

Specular gloss, 60°, 250 μm (10 mils) wet film on a tin
 coated panel, dried 48 h @ 25°C and 50 \pm 5% relative
 humidity, ASTM D 523, Max. 15—25 30

SECTION 909, BEGIN LINE 224, DELETE AND INSERT AS FOLLOWS:

5. Approval of Formulation. The manufacturer shall obtain approval of the
 formulation prior to furnishing the waterborne finish paint. ~~The formulation approval shall~~
~~be in accordance with 909.02(a)4 and 909.02(a)5. Only waterborne finish paint from the~~
Department's list of approved Coating Formulations shall be used. Waterborne finish paint
formulations will be placed and maintained on the list of approved Coating Formulations
in accordance with ITM 606.

SECTION 909, BEGIN LINE 228, DELETE AND INSERT AS FOLLOWS:

(e) Finish Coat for Weathering Steel. The finish coat shall be an aliphatic
 polyurethane or a waterborne acrylic paint. It shall be suitable for use as a finish coat
 over epoxy intermediate paint. The mixed paint shall be in accordance with the
 requirements as follows:

Specular gloss, 60°, ASTM D 523, Max.	6.0 25.0
Viscosity, ASTM D 562, Kneb Units, Max.	100
Mass (weight)/volume variance from the initially approved batch, ASTM D 1475, 25°C, Max.	0.048 kg/L
Total solids variance from the initially approved batch, ASTM D 2369, Max.	2.0%
Volatile Organic Compounds, ASTM D 3690 3960 Max.	336 g/L

The dried paint film shall match color number ~~30045~~ 20045 of Federal Standard 595a.

SECTION 909, BEGIN LINE 261, DELETE AND INSERT AS FOLLOWS:

(c) Approval of Structural Steel Coating System. The manufacturer shall obtain approval of each structural steel coating system prior to furnishing any of these coatings. ~~An approved list of Structural Steel Coating Systems will be maintained by the Department. The list will specify the manufacturer's designation of each coating of structural steel coating system. Manufacturers who desire to have products added to the list of Structural Steel Coating Systems shall submit the following documentation to the Materials and Tests Division. Only structural steel coating systems from the Department's list of approved Structural Steel Coating Systems shall be used. Structural steel coating systems will be placed and maintained on the Department's list of approved Structural Steel Coating Systems in accordance with ITM 606.~~

SECTION 909, DELETE LINES 268 THROUGH 313.

SECTION 909, BEGIN LINE 334, DELETE AND INSERT AS FOLLOWS:

909.05 White and Yellow Traffic Paint.

(a) ~~Standard Traffic Paint~~ Blank.

SECTION 909 DELETE LINES 337 THROUGH 409.

SECTION 909, BEGIN LINE 411, DELETE AND INSERT AS FOLLOWS:

(b) Fast Dry Traffic Paint.

1. General Requirements. The general requirements specified for standard traffic paint in 909.05(a) ~~1~~ 909.01 shall apply except as modified herein.

White and yellow traffic paint shall be used on pavements for centerlines, lane lines, or as otherwise specified. In addition to its other requirements, when glass beads are applied, it shall be such that it shows capillary action in the interstices and voids existing between the beads sufficient to cause the level of the paint to be raised approximately 2/3 the diameter of the beads to provide anchorage and refraction. The capillary action shall be such that it does not cause complete envelopment. The paint, as furnished, shall contain no glass beads.

The paint shall be ground to a uniform consistency, and it shall permit satisfactory application by the pressure spray type of painting machine ~~currently in use by the Department~~. This painting equipment is designed to apply reflectorized lines, using a

SECTION 909, BEGIN LINE 463, DELETE AND INSERT AS FOLLOWS:

~~Luminous Directional Reflectivity, ASTM E 308~~
~~or E 97, percent~~
C.I.E. illuminant C, 2° standard observer, ASTM E 1349, percent
 White 84 ---
 Yellow 50 ---
 Color, yellow only, x-y C.I.E. coordinates for
 green limit, FHWA color chart of June 1965
C.I.E. illuminant C, 2° standard observer Match the
 green limit $\pm 8\%$

SECTION 909, BEGIN LINE 566, DELETE AND INSERT AS FOLLOWS:

~~Luminous directional reflectivity~~ *Reflectance Factor, Y,*
C.I.E. illuminant, C, 2° standard observer,
 ASTM E 97 1349, ~~ASTM E 308~~, 380 μm (15 mils)
 wet film thickness, air dried a minimum
 of 16 h, %

White	84	--
Yellow	50	57
Color, yellow only, x & y C.I.E. Coordinates for the strong limits of FHWA color chart PR1, 380 μm (15 mils) wet film thickness, air dried a minimum of 16 h, measured on white background, <i>C.I.E. illuminant, C,</i> <i>2° standard observer, % deviation</i>	Match the strong limits	± 6.00

SECTION 909, BEGIN LINE 627, DELETE AND INSERT AS FOLLOWS:

3. Formulation Approval. The manufacturer shall obtain approval of the waterborne traffic paint formulations prior to furnishing the paints. ~~To obtain approval, the manufacturer shall submit the following to the Materials and Tests Division:~~ *Only waterborne traffic paints from the Department's list of approved Coating Formulations shall be used. Waterborne traffic paint formulations will be placed and maintained on the Department's list of approved Coating Formulations in accordance with ITM 606.*

SECTION 909, DELETE LINES 630 THROUGH 677.

SECTION 909, BEGIN LINE 681, DELETE AND INSERT AS FOLLOWS:

909.07 Miscellaneous Paints and Ingredients *Blank.*

SECTION 909, DELETE LINES 682 THROUGH 688.

SECTION 909, BEGIN LINE 706, DELETE AND INSERT AS FOLLOWS:

~~Mineral fillers, non-~~ *Non-volatile*, or non-reactive extenders shall *will* not be permitted in either component. Each component shall have a usable shelf life of at least six months from the date of delivery.

SECTION 909, BEGIN LINE 721, DELETE AND INSERT AS FOLLOWS:

Neither component shall contain a residual constituent which is unreactive with the epoxy resin. ~~Mineral fillers, non-~~Non-volatile extenders ~~shall~~ *will* not be permitted in either component. Each component shall have a usable shelf life of at least six months from the date of delivery.

SECTION 909, BEGIN LINE 730, DELETE AND INSERT AS FOLLOWS:

(c) Specific Requirements. Specific requirements for each type of sealer shall be as shown in the table.

Property	Polysulfide Type	Unmodified Type	Test Method
RESIN			
Epoxide Equivalent	180-195	180-195	ASTM D 1652
Viscosity @ 25°C, (77°F) Poises	5-7	100-180	ASTM D 2393 <i>2196, Method A</i>
Color (Gardner) Max.	5	5	ASTM D 1544
COMPONENT A			
Viscosity @ 25°C, (77°F) cps, Max.	40	40	ASTM D 2393 <i>2196, Method A</i>
Mass (Weight) per Epoxy Equivalent	180-195	180-195	ASTM D 1652 Corrected to 100% Solids Basis
Color	Clear Amber	Clear Amber	Visual
Infra Red Spectrum	Shall Essentially Match Std. Spectrum	Shall Essentially Match Std. Spectrum	AASHTO T 237
COMPONENT B			
Viscosity @ 25°C, (77°F) cps, Max.	40	40	ASTM D 2393 <i>2196, Method A</i>
Color	Clear Amber	Clear Amber	Visual
Infra Red Spectrum	Shall Essentially Match Std. Spectrum	Shall Essentially Match Std. Spectrum	AASHTO T 237
Total Sulfur, % Min. Corrected to 100% Solid Basis	11.0		ASTM E 443, or other Approved Method
Mercaptan, % Min.	1.8		ITM 602
Ratio of Total Sulfur % to Mercaptan %	6.2-8.0		

1/1 VOLUME MIXTURE OF A AND B			
Viscosity @ 25°C, (77°F) cps, Max.	40	40	ASTM D 2393 <i>2196, Method A</i>
Total Solid, %, Min.	50	50	ASTM D 1644 (Note 1)
Ash %, Max.	0.5	0.5	ASTM D 482
Flexibility	No Breaking or Cracking of film	No Breaking or Cracking of Film	ITM 604
Moisture Perme- ability, %, Max.	0.8	0.8	ITM 605
Color	Clear Amber	Clear Amber	Visual (Note 2)
Set to Touch, Hrs. Max.	4 (Note 3)	4 (Note 3)	FED. Test Method Std. 141 (Note 4)

(Note 1) Method A, except sample size shall be 3.0 grams \pm 0.1 gram.

(Note 2) Poured on glass plate, and cured 48 h @ 21°C to 27°C (70°F to 80°F).

(Note 3) Applied to tin-coated steel panel, approximately 20 ga., previously warmed to 32°C \pm 1°C (90°F \pm 2°F).

(Note 4) Method 4061.1, applied at mixture temperature of 32°C \pm 1°C (90°F \pm 2°F).

The polysulfide polymer used in formulation of polysulfide sealer shall be a difunctional mercaptan made from 98 mole percent of bis, 2-chlorethyl, formal and 2 mole percent of trichloropropane, and shall be in accordance with the following requirements:

Property	Requirements	Test Method
Specific Gravity @ 20/20°C	1.24-1.30	ASTM D 1963
Viscosity at 25°C, Poises	7-12	ASTM D 2393 <i>2196, Method A</i>
PH pH, Water Extract	6.0-8.0	AASHTO T 200
Moisture Content, %	0.1 Max.	Fed Test Method Std. 141A Method 4082
Pour Point CE	-26.8 Max.	ASTM D 97
Molecular Mass Av.	1000 Max.	Empirical Formula
Flash Point, (Cleveland) C°	200 Min.	AASHTO T 48
Sulfur, %	36-40	ASTM D 1552
Color, Hellige	9-12	Fed Test Method Std. 141A Method 4242

SECTION 909, BEGIN LINE 765, DELETE AND INSERT AS FOLLOWS:

(f) Approval of Formulation. Prior to furnishing any material, the manufacturer shall ~~submit the following to the Division of Materials and Tests:~~ *obtain approval of formulation. Only epoxy penetrating sealers from the Department's list of approved Coating Formulations shall be used. Epoxy penetrating sealers will be placed and maintained on the Department's list of approved Coating Formulations in accordance with ITM 606.*

SECTION 909, DELETE LINES 767 THROUGH 823.

SECTION 909, AFTER LINE 824, INSERT AS FOLLOWS:

909.10 Proprietary PCC Sealers. *Proprietary PCC sealers shall be selected from the Department's Approved List of Other Concrete Sealers. A proprietary PCC sealer may be added to the approved list by completing the requirements in accordance with ITM 806, Approved List Procedure C.*

(a) Properties. *The proprietary PCC sealer shall be in accordance with NCHRP 244, Series IV, Southern Climate Weathering Test and possess the following properties.*

<u>Property</u>	<u>Requirement</u>
<i>Reduction of Chloride Ion Content</i>	<i>90% of the Control</i>
<i>Active Ingredients, Minimum</i>	
<i>Silane Based</i>	<i>20%</i>
<i>Siloxane Based</i>	<i>15%</i>
<i>Others</i>	<i>10%</i>

(b) Test Report. *Testing shall be performed by a recognized laboratory in accordance with ITM 806.*

The proprietary PCC sealers shall be delivered to the jobsite in unopened containers with the manufacturer's numbered seal intact.

SECTION 910, BEGIN LINE 5, DELETE AS FOLLOWS:

(a) General. Unless otherwise specified, bars for concrete reinforcement shall be deformed billet steel, grade 420 (60). ~~The bars for cement concrete pavement shall be deformed billet steel, except tie bars that shall be bent and subsequently straightened during construction shall be deformed bars in accordance with ASTM A615/A615M, grade 300 (40).~~ Tie bar assemblies used in lieu of bent tie bars shall be in accordance with the minimum total ultimate strength and minimum total yield strength requirements specified for bent tie bars; bend test and elongation will not be required.

SECTION 910, BEGIN LINE 114, DELETE AND INSERT AS FOLLOWS:

length of either crack does not exceed 6 mm (1/4 in.) The coating thickness shall be ~~150 to 300~~ 200 to 325 μm (~~6 to 12~~ 8 to 13 mils) after cure. The

SECTION 910, BEGIN LINE 139, DELETE AND INSERT AS FOLLOWS:

- c. the coating thickness shall be ~~150 to 300 μ m (6 to 12 mils)~~ *150 to 500 μ m (6 to 20 mils)* after cure. The thickness measurements shall be made in accordance with ASTM G 12.

SECTION 910, BEGIN LINE 447, DELETE AS FOLLOWS:

~~(a) Steel Beam Rail.~~ Steel beam rail shall be galvanized, corrugated, sheet steel beams in accordance with AASHTO M 180 as modified herein. The rails, including

SECTION 910, BEGIN LINE 468, DELETE AS FOLLOWS:

Construction details for the rails and channels shall be as shown on the plans. Whenever field fabrication, as approved, requires cutting or drilling, the cut or drilled member shall be coated with a high zinc dust zinc oxide paint in accordance with ~~of~~ Federal Specification TT-P-641, type II, or Military Specifications DOD-P-21035. When spray paints are used, two coats shall be applied.

~~(b) Aluminum Rail.~~ Aluminum rail shall be semi-elliptical, extruded aluminum rail, in accordance with ASTM B 221M (ASTM B 221), alloy 6061 T6 or 6351 T5. Details shall be as shown on the plans. Curved rail shall be in accordance with 909.11(b).

SECTION 910, BEGIN LINE 478, DELETE AS FOLLOWS:

910.10 Guardrail Posts. Guardrail posts shall be either steel, ~~aluminum~~, or wood as specified and shall be in accordance with the following requirements.

SECTION 910, BEGIN LINE 484, DELETE AS FOLLOWS:

However, the mass (weight) of zinc coating per square meter (square foot) of actual surface shall not average less than 610.3 g (2.0 oz) for an individual post.

SECTION 910, BEGIN LINE 496, DELETE AND INSERT AS FOLLOWS:

~~(b) Aluminum Guardrail Posts.~~ The aluminum guardrail posts shall be extruded aluminum, in accordance with ASTM B 221M (ASTM B 221), alloy 6061 T6 or 6351 T5. Dimensions and construction details shall be as shown on the plans.

(e) (b) Wood Guardrail Posts. The wood guardrail posts shall be in accordance with 911.02(d). Dimensions and construction details shall be as shown on the plans.

SECTION 910, BEGIN LINE 515, DELETE AS FOLLOWS:

brackets shall be galvanized in accordance with 910.10(a). Plate washers shall be galvanized after fabrication in accordance with ASTM A 153. The mass (weight) of the W6 x 15 post bracket shall be in accordance with 910.10(a).

SECTION 910, BEGIN LINE 546, DELETE AS FOLLOWS:

6. For breakaway cable terminal, *and cable terminal anchor system*, the rail element, standard bolts, nuts, and washers shall be in accordance with 910.09(a) and requirements 1 and 3 of 910.11(a).

7. *For cable terminal anchor system, the anchor bracket, end plate, soil plate, bearing plate, strut and yoke shall be in accordance with AASHTO M 270M grade 250. They shall be zinc coated after fabrication in accordance with AASHTO M 111. The steel tube shall*

be in accordance with ASTM D 500 grade B and zinc coated in accordance with AASHTO M 111. The post sleeve shall be in accordance with ASTM A 53 grade B and zinc coated in accordance with AASHTO M 111. The stud shall be in accordance with ASTM F 568 class 8.8, and zinc coated in accordance with AASHTO M 111. The threads shall be in accordance with ANSI B1.13M and shall be M24 x 3 class 6g pitch. The swaged fitting shall be in accordance with ASTM A 576 grade 1035, zinc coated in accordance with AASHTO M 111, and shall be annealed for cold swaging. A lock pin hole to accommodate a 6 mm (1/4 in.) plated spring-steel pin shall be drilled through the head of the swaged fitting.

SECTION 910, BEGIN LINE 577, DELETE AND INSERT AS FOLLOWS:

The wire rope used in the cable ~~assembly~~ *assemblies* shall be in accordance with AASHTO

M 30 and shall be 19 mm (3/4 in.) preformed, 6 by 19, wire strand core or independent wire rope core (IWRC), galvanized, right regular lay, manufactured of improved plow steel, with a minimum specified breaking strength of 190 kN (42,800 lb~~f~~). The swaged

SECTION 910, DELETE LINES 584 THROUGH 605.

SECTION 910, LINE 607, DELETE AND INSERT AS FOLLOWS:

(e) (b) For Steel Tube Guardrail.

SECTION 910, BEGIN LINE 633, DELETE AND INSERT AS FOLLOWS:

910.12 ~~Samples and Certification of Guardrail, Posts, Accessories, Fittings, and Hardware Suppliers.~~ All samples required for testing purposes shall be furnished free of charge. General requirements for sampling are as follows:

~~(a) Control Procedure for Furnishing Steel Beam Guardrail and Accessories.~~

~~All steel beam guardrail and accessories shall be subject to one of the two control procedures as follows:~~

- ~~1. installers on a certification basis with random in place testing of guardrail;~~
- ~~2. installers not qualifying or not desiring certification basis with job control sampling.~~

~~Installers~~ *Suppliers* desiring to be on certification status will be approved upon request ~~and added to the Department's list of approved Certified Guardrail Suppliers.~~ The ~~written request need not be in writing, but it shall be requested through the Division of~~ *shall be submitted to the Materials and Tests Division.* ~~A 6-digit~~ *An* approval number will be assigned to each ~~installer supplier~~ to be used for identification acceptability of material.

The ~~installer~~ *supplier* shall perform testing or shall obtain documentation to ensure the quality of the material incorporated into the work.

The installer shall prepare and attach to each monthly material record a certification in accordance with ~~916.02(d)~~ *916.02(e)*. Such certification shall contain the contract number; ~~installer's~~ *supplier's* name; ~~installer's~~ *supplier's* approval number; month of installation; rail manufacturer; bolt manufacturer; quantities of rail, channel, posts, block, and paddle posts incorporated into the work; quantities of sawed timber posts and blocks for thrie-beam and W-beam guardrail incorporated into the work; and a notarized statement sworn by a person having legal authority to bind the company preparing the certification that the materials furnished are in accordance with 910.09 through 910.12.

The Department will inspect the steel beam guardrail on a randomly selected contract for compliance with specifications for a minimum of one time per year per ~~installer~~ *supplier*. ~~The inspections will be performed before the contract is certified by the Division of Materials and Tests. Various dimensional checks, various coating thickness determinations, proper identification checks for rail and bolts, bore cores for determination of preservative retention, and penetration for sawed timber posts and blocks for end sections will be performed.~~

~~Randomly selected~~ *Selected* contracts with failing results will be issued a ~~Failed Materials Report~~. ~~Failed materials will be subject to action by the Failed Materials Committee adjudicated as a failed material in accordance with normal Department practice.~~

If the ~~installer~~ *supplier* shows negligence or the inability to ensure the delivery of specified materials, the ~~installer's~~ *supplier's* immediate usage status may be removed.

~~Suppliers not desiring to retain their certification or who lose status will have their material sampled at the project site after delivery. No material may be used until it has been tested and approved.~~

~~Samples will be obtained from materials after delivery to the jobsite or while being held in inventory at the Contractor's yard, if it is located in an area normally serviced by the Department.~~

~~(b) Aluminum Guardrail. Rails, posts, accessories, fittings, and hardware will be accepted based on a visual inspection confirming the physical dimensions conform to the requirements as shown on the plans and a type C certification in accordance with 916.~~

SECTION 910, BEGIN LINE 773, INSERT AS FOLLOWS:

made. However, the tests must have been made within 90 days of shipment. Posts, *except those used for temporary construction signs, temporary traffic signs, and temporary panel signs*, shall be

certified by a type B certification in accordance with 916. The certification shall include the above three test results and the elastic section modulus value in accordance with 910.14(a)3.

SECTION 910, BEGIN LINE 840, DELETE AND INSERT AS FOLLOWS:

250 (ASTM A 709 grade 36). Fuse plates shall be in accordance with the requirements of ASTM A 441 and ~~ASTM A 709M grade 345W (ASTM A 709 grade 50W) 36M (ASTM A 36)~~ and shall be galvanized in accordance with ASTM A 123. All bolts, nuts, and washers shall be high

SECTION 910, BEGIN LINE 849, INSERT AS FOLLOWS:

(c) Structural Steel Posts. Steel members for the support of signs shall be standard shapes as specified and shall be in accordance with 910.02(a). These members shall be galvanized in accordance with ASTM A 123. Material furnished under this specification, *except that used for temporary construction signs, temporary traffic signs, and temporary panel signs*, shall be covered by a type C certification in accordance with 916.

SECTION 910, BEGIN LINE 854, INSERT AS FOLLOWS:

(d) Structural Aluminum Posts. These posts shall be standard shapes as specified and shall be aluminum in accordance with ASTM B 221M (ASTM B 221) alloy 6061-T6. Material furnished under this specification, *except that used for temporary construction signs, temporary traffic signs, and temporary panel signs*, shall be covered by a type C certification in accordance with 916.

(e) Square Steel Posts. *Square steel sign post, except that used for temporary construction signs, temporary traffic signs, and temporary panel signs, shall be covered by the type of certification specified in the Frequency Manual and A-type-C certification shall be required* in accordance with 916.

SECTION 910, AFTER LINE 874, DELETE AND INSERT AS FOLLOWS:

- c. *ASTM A 653, cold rolled high strength steel, 1.90 mm (0.75 in.) with minimum yield strength of 414 MPa (60,000 psi). The ultimate tensile strength shall not exceed 550 MPa (79,800 psi) or have an elongation measured over 50 mm (2 in.) greater than 20%. This requirement shall apply to the 50 mm x 50 mm (2 in. x 2 in.) size posts only.*

Yield strengths and chemical composition shall be determined from the three latest test results performed by the steel manufacturer. These test results may not be determined on materials from which the delivered posts were made. However, the tests shall have been performed within 90 days of shipment. The certification shall include the range of test results and the section modulus value in accordance with 910.14(a)3.

2. Fabrication. The posts shall be corner welded and scarfed as necessary to allow sections to telescope within each other. *The finished posts shall be machine straightened and have a smooth uniform finish free from cracks, flaws, injurious seams, laps, blisters, and edges which are ragged, sharp, and imperfect, or other defects affecting their strength, durability, or appearance. The maximum variation in straightness shall be no more than 6.3 mm (1/4 in.) in any 1.52 m (5 ft.) of length. Cut holes or knockout holes of 11 mm*

(7/16 in.) diameter shall be spaced on 25 mm (1 in.) centers, on the centerlines of all four sides in true alignment, and opposite to each other *for back to back applications*. All holes and sheared ends shall be free from burrs.

3. Protective Coating. The protective coating shall be applied using one of the following:

- a. ~~Both inside and outside surfaces shall be galvanized or coated in accordance with ASTM A 525. Before fabrication, both sides of the rolled sheet steel shall be galvanized in accordance with ASTM A 653M, coating designation Z 275 (ASTM A 653, coating designation G 90).~~
- b. After fabrication, a triple coating system ~~with a zinc coating on the outside of the posts consisting of galvanizing with zinc which is in~~ accordance with AASHTO M 120, weighing ~~190 mL/m²~~ $183 \pm 46 \text{ g/m}^2$ ($0.60 \pm 0.15 \text{ oz/ft}^2$) ~~shall be applied to the outside of the post,~~ followed by a chromate conversion coating ~~of 0.02 $\mu\text{g/mm}^2$~~ weighing $0.02 \pm 0.006 \text{ g/m}^2$ (15 ± 5 ~~micrograms per~~ $\mu\text{g/in.}^2$) and a clear organic exterior coating ~~of 5 μm with a dry film thickness of $5 \pm 2.5 \mu\text{m}$~~ ($0.2 \pm 0.1 \text{ mil}$). The interior surface *of the posts* shall receive a double in-line application of a full zinc based rich organic coating ~~of 30 μm with a total dry film thickness of $30 \pm 15 \mu\text{m}$~~ ($1.2 \pm 0.6 \text{ mil}$). ~~Such interior coating shall be tested in accordance with ASTM B 117. The dried zinc rich organic coating film shall contain a minimum of 77% total zinc. Samples from the posts which use these protective coatings shall be exposed to salt fog testing in accordance with ASTM B 117 for a total of 500 h. The samples shall be examined at both 100 and 500 h of salt fog testing and rated for corrosion. At 100 h the corrosion rating shall be a minimum of 9 and at 500 h the corrosion rating shall be a minimum of 6 when determined in accordance with ASTM D 1654.~~

(f) Portable Construction Sign Trailer. The portable construction sign trailer, not including the signs and lights, shall weigh no more than 140 kg (300 lb) and shall not be fabricated with heavier than 75 x 75 mm (3 x 3 in.) angles, 63 mm (2 1/2 in.) pipe, or 75 x 50 mm (3 x 2 in.) rectangular tubing. The rim size of the wheels shall not exceed 300 mm (12 in.). Axle assemblies with differential housings shall not be used.

SECTION 910, BEGIN LINE 896, DELETE AND INSERT AS FOLLOWS:

910.15 Delineator Posts. Posts shall be ~~made from open hearth, basic oxygen, or electric furnace steel rolled from new billets or standard tee rails and have the mechanical and chemical properties set out for sign post in accordance with 910.14(a)1. The post shall be a uniform, modified, flanged channel or U section such that the area of contact between the post and reflector is symmetrical with the vertical axis of both reflector and post.~~

Physical requirements for ~~steel~~ *the finished* delineator posts shall be: ~~width of flange face 50 mm to 60 mm (2 to 2 3/8 in.); width of back 19 mm to 22 mm (3/4 to 7/8 in.); depth from face of flange to back 22 to 29 mm (7/8 to 1 1/8 in.); length 2.1 m \pm 25 mm (7.0 ft \pm 1 in.). Mass (Weight) of the finished post shall be not less than 1.5 nor more than 2.2 kg/m (1.0 nor more than 1.5 lb/ft).~~

Width of flange face 50 to 60 mm (2 to 2 3/8 in.)
Width of back 19 to 22 mm (3/4 to 7/8 in.)
Depth from face of flange to back 22 to 29 mm (7/8 to 1 1/8 in.)
Length 2.1 m \pm 25 mm (7.0 ft \pm 1 in.)
Mass (Weight) 1.5 to 2.2 kg/m (1.0 to 1.5 lb/ft)

Delineator posts shall be punched with a minimum of twenty-four 6 mm (1/4 in.) holes on the centerline spaced on 25 mm (1 in.) centers beginning 25 mm (1 in.) from the top. ~~The finish, straightness, and coating of the delineator posts shall be in accordance with the applicable requirements of 910.14(a)1. Post with 9.5 mm (3/8 in.) holes may be used on contracts let prior to January 1, 1992.~~

SECTION 910, BEGIN LINE 919, DELETE AND INSERT AS FOLLOWS:

tolerances. ~~It~~ *The sample* shall withstand being bent cold through an angle of 180 degrees flat upon

920 itself, without failure of the outside of the bent portion. *The type of certification for copper flashing will be covered by the Frequency Manual and shall be in accordance with 916.*

SECTION 910, BEGIN LINE 1175, DELETE AND INSERT AS FOLLOWS:

Tri-cord truss, cantilever, and monotube structures shall be made of tapered tubular members in accordance with either ASTM A 595 or ASTM A 572M, *grade 345* (ASTM A 572 *grade 50*), ~~grade 50~~, or of constant cross section tubular members in accordance with API High Test Line Pipe, grade X-52. Members shall have a minimum yield strength of 345 MPa (50,000 psi). Structures shall be galvanized after fabrication in accordance with ASTM A 123.

Strain poles shall be anchor bolt type complete with hand-holes and pole top or cap. They shall meet the requirements set out above for cantilever sign structures. Each pole is to include 3 band type attachments for span wire clamps. The band shall be from material in accordance with ASTM A 572M, *grade 345* (ASTM A 572, *grade 50*), ~~grade 50~~; ASTM A 606; or approved equal. The bands shall not be of the U-bolt type. The poles shall have maximum deflections as shown below when loaded 450 mm (18 in.) from the top with a 445 N (100 lb) load:

Pole Size

Deflection

380 mm x 910 mm (15 in. x 30 in.) 4.1 mm (0.16 in.)

356 mm x 790 mm (14 in. x 26 in.) 3.0 mm (0.12 in.)

The steel flanges at the center of the cross beam and at the ends of the horizontal arms shall be fastened to the tapered or straight sections by means of two circumferential welds. One of the circumferential welds shall weld the outside of the flange firmly to the tube. The flange connection shall develop fully the strength of the tubular sections being joined together by means of the flange connections.

Gusset, flange, and base plates shall be in accordance with ASTM A 36M (ASTM A 36) and shall be galvanized after fabrication in accordance with ASTM A 123. Base plates for upright poles shall develop the full strength of the poles. Castings for the vertical pole top and horizontal arm and cap shall be in accordance with ASTM A 126 and shall be galvanized with a minimum coating of 610.0 g/m² (2 oz/sq ft). Bolts, except anchor bolts, and nuts shall be in accordance with ASTM A 307. Two nuts for use in plumbing upright poles shall be furnished with each anchor bolt. Anchor bolts, except for box truss structures, shall be in accordance with ASTM A 675M, *grade 620* (ASTM A 675, *grade 90*), ~~grade 90~~; ASTM A 576 modified to 379 MPa (55,000 lb/sq in.) minimum yield strength; or ASTM A 307, grade A modified to 379 MPa (55,000 pounds per square inch) minimum yield strength. Anchor bolts for box truss structures shall be in accordance with 910.19(a). Steel bolts, nuts, washers, and threaded ends of anchor bolts shall be coated in accordance with ASTM A 153 or be mechanically galvanized and conform to the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Welding shall be in accordance with 711.32.

SECTION 910, LINE 1225, DELETE AND INSERT AS FOLLOWS:

910.20 ~~Blank~~ Steel Bridge Railing Components. *Materials for steel bridge railing components shall be in accordance with the following.*

- (a) Railing tubing shall be in accordance with ASTM A 500, Grade B.*
- (b) Posts, connection plates, splice bars, base plates, and anchor channel bars shall be in accordance with ASTM A 36M (ASTM A 36).*
- (c) Steel bolts, nuts, and cap screws shall be in accordance with ASTM A 307.*
- (d) Railing end caps shall be steel castings in accordance with ASTM A 27M, grade 485-250 (ASTM A 27, grade 70-36).*
- (e) Threaded rods, nuts, and washers shall be in accordance with AASHTO M 164.*
- (f) Steel washers shall be standard round cut or lock washers, as shown on the plans.*

- (g) *Cap screws shall be stainless steel in accordance with ASTM A 276, type 304, 305, or 430.*
- (h) *Anchor bolts shall be stainless steel in accordance with ASTM A 276, type 305 or 430. However, they shall have a minimum ultimate strength of 690 MPa (100 ksi). Threads may be cut or rolled.*
- (i) *Railing tubing, posts, connection plates, splice bars, base plates, anchor channel bars, and railing end caps shall be galvanized after fabrication in accordance with AASHTO M 111.*

Bolts, nuts, cap screws, washers, and lock washers shall be galvanized after fabrication in accordance with AASHTO M 232.

- (j) *Anchor bolts furnished under this specification shall be covered by a type A certification in accordance with 916. All other components furnished under this specification shall be covered by a type C certification in accordance with 916.*

SECTION 910, AFTER LINE 1230, INSERT AS FOLLOWS:

910.22 Welding Supplies.

(a) Aluminum Alloy Base Metals.

1. Bare Wire Electrodes and Welding Rods. *Bare wire electrodes for use with the gas metal arc welding process and welding rods for use with the gas tungsten-arc welding process shall be in accordance with the Specifications for Aluminum and Aluminum Alloy Welding Rods and Bare Electrodes, ASTM B 285 or AWS A5.10. Tungsten electrodes for the gas tungsten-arc welding process shall be in accordance with the Specifications for Tungsten-Arc Welding Electrodes, ASTM B 297 or AWS A5.12.*

2. Filler Metal. *Filler metals to be used with particular base metals shall be as shown in the table below. Other filler metals may be used if approved.*

<u>Base Metal</u>	<u>Filler Metal</u>
3003 to 3003	ER1100
3004 to 3004	ER4043
5052 to 5052	ER5356*
5083 to 5083	ER5183
5086 to 5086	ER5356*
5456 to 5456	ER5556
6061 to 6061	ER5356*
6063 to 6063	ER5356*
356.0 to 6061	ER4043
356.0 to 6063	ER4043

**ER5183, ER5356, and ER5556 may be used interchangeably for these base metals.*

Filler metals shall be kept covered and stored in a dry place at relatively uniform temperatures. Original rod and wire containers shall not be opened until time to be used. Rod and wire shall be free of moisture, lubricant, or other contaminants. Spools of wire temporarily left unused on the welding machine shall be kept covered to avoid contamination by dirt and grease collecting on the wire. If a spool of wire is to be unused for more than a short length of time, it shall be returned to the carton and the carton tightly sealed.

3. Shielding Gases. *Shielding gases shall be welding grade or better. Shielding gas for gas metal-arc welding shall be argon, helium, or an approximate 75% helium and 25% argon mixture. Shielding gas for gas tungsten-arc welding done with alternating current shall be argon. Shielding gas for gas tungsten-arc welding done with direct current, straight-polarity, shall be helium.*

Hose used for shielding gases shall be made of synthetic rubber or plastic. Hose which has been previously used for acetylene or other gases shall not be used.

SECTION 911, LINE 261 DELETE AND INSERT AS FOLLOWS:

b. **Checks.** Checks shall be in accordance with ~~910.02(f)2b~~
911.02(f)2b.

SECTION 911, DELETE LINES 364 THROUGH 365.

SECTION 912, AFTER LINE 24, INSERT AS FOLLOWS:

(f) Polyethylene Film *The sheeting shall be in accordance with AASHTO M 171.*

SECTION 912, BEGIN LINE 62, DELETE AND INSERT AS FOLLOWS:

912.03 Admixtures for Use in Concrete. *Admixtures for use in PCC shall be selected from the Department's Approved List of Admixtures for PCC. An admixture may be added to the approved list by completing the requirements in ITM 806, Procedure D. Admixtures containing chloride added as an ingredient of manufacture are unacceptable.*

(a) Air Entraining Admixtures. Air entraining admixtures are materials to be added to ~~portland cement concrete~~ PCC mixtures at the mixer for the purpose of entraining air. ~~These admixtures shall be in accordance with AASHTO M 154.~~

(b) Chemical Admixtures for Concrete. Chemical admixtures are materials to be added to ~~portland cement concrete~~ PCC mixtures at the mixer for the purpose or purposes indicated below. The admixtures shall be in accordance with AASHTO M 194 for their respective types.

1. **Type A.** Type A is a water reducing admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

2. **Type B.** Type B is a retarding admixture that retards the setting of concrete.

3. **Type C.** Type C is an accelerating admixture that accelerates the setting and early strength development of concrete.

4. **Type D.** Type D is a water reducing and retarding admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and retards the setting of concrete.

5. **Type E.** Type E is a water reducing and accelerating admixture that reduces the quantity of mixing water required to produce concrete of a given consistency and accelerates the setting and early strength development of concrete.

6. **Type F.** Type F is a high range water reducing admixture, HRWR, that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

7. **Type G.** Type G is a high range water reducing admixture, HRWRR, that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

8. **High Range Water Reducing and High Range Water Reducing and Retarding Admixture Systems.** HRWR and HRWRR admixture systems typically utilize an air entraining agent; a type A or type D chemical admixture; and a type F chemical admixture, for HRWR, or a type G chemical admixture, for HRWRR.

SECTION 912, DELETE LINES 103 THROUGH 170.

SECTION 912, AFTER LINE 171, DELETE AND INSERT AS FOLLOWS:

(c) Test Report. *Testing shall be performed by a recognized laboratory in accordance with ITM 806 for their respective types.*

1. *Air entraining admixtures shall be in accordance with AASHTO M 154.*

2. *Chemical admixtures shall be in accordance with AASHTO M 194 for their respective types except that the test report for HRWR and HRWRR admixture systems shall be in accordance with the following additional requirements:*

a. ~~(1)~~ The HRWR or HRWRR admixture system shall be used in the test concrete.

~~(2) The control concrete shall contain the same air entraining agent used in the HRWR or HRWRR admixture system.~~

b. ~~(3)~~ The six month and one year compressive strength testing will be waived and flexural strength testing will not be required.

c. ~~(4)~~ Uniformity and equivalence testing will not be required.

d. ~~(5)~~ Testing for length change ~~shall~~ will not be required.

- e. (6) A sample of the test concrete containing the HRWR or HRWRR admixture system shall be tested for hardened concrete air void system analysis in accordance with ASTM C 457. The sample for hardened concrete air void system analysis shall indicate an air content of at least 4.5% for class C, and 5.2% for class A; a voids per millimeter (inch) parameter of at least 0.0492 (1.25) times the air content; a spacing factor of 0.254 mm (0.010 in.) or less; and a specific surface of 19.685 mm²/mm³ (500 in.²/in.³).

SECTION 912, DELETE LINES 194 THROUGH 230.

SECTION 912, BEGIN LINE 232, DELETE AND INSERT AS FOLLOWS:

~~5.3. The tests shall be performed by a recognized laboratory which is a state highway agency testing laboratory, or a cement or concrete laboratory regularly inspected by the CCRL. Proof of such inspection shall be furnished on request. The test report shall be dated to establish when the testing was started. Test reports shall not be more than five years old on January 1 of the approval year will be unacceptable. New submittals of AASHTO M 194 test reports more than five years old will be accepted if all subsequent 5 year limited retest reports are submitted. Subsequent limited retest results shall comply with the dating and age requirements specified above and shall include the following AASHTO M 194 tests as a minimum requirement for compliance:~~

- a. *infrared analysis, residue by oven drying, and specific gravity;*
- b. *water content and time of setting as referenced in AASHTO M 194;*
- c. *flexural strength at three, seven, and 28 days;*
- d. *relative durability.*

SECTION 912, DELETE LINES 238 THROUGH 264.

SECTION 912, DELETE LINES 274 THROUGH 276.

SECTION 913, BEGIN LINE 31, DELETE AND INSERT AS FOLLOWS:

913.04 Hydrated Lime. Hydrated Lime shall be in accordance with ASTM C 207, Type N ~~a hydrated lime when used in masonry or a hydrated lime, quicklime or lime by-product when used for soil modification.~~

(a) Hydrated Lime for Masonry. Hydrated lime used in masonry shall be in accordance with ASTM C 207, Type N.

(b) Lime for Soil Modification.

1. Hydrated Lime and Quicklime. *Hydrated lime and quicklime shall be in accordance with AASHTO M 216.*

2. Lime By-Products. *Lime by-products shall be hydrated lime or quicklime by-products in accordance with ASTM C 25 having the following requirements:*

- a. The lime by-products shall contain a minimum of 60% total available calcium and magnesium oxides (non-volatile basis).*
- b. Available calcium hydroxide plus magnesium oxide calculated as calcium hydroxide shall be a minimum of 30%.*
- c. Sieve analysis shall be performed in accordance with ASTM C 110. The lime by-products gradation shall be as follows:*

<i>Sieve</i>	<i>% Passing</i>
<i>4.75 mm (No. 4)</i>	<i>95-100</i>
<i>600 μm (No. 30)</i>	<i>90-95</i>
<i>150 μm (No. 100)</i>	<i>70-80</i>

SECTION 913, BEGIN LINE 51, DELETE AND INSERT AS FOLLOWS:

913.07 Flexible Delineator Posts. Flexible delineator posts shall be made of ~~flexible plastic material~~ *high density polyethylene plastic in accordance with ASTM D 5203*. The post shall be straight *along its center line* and have a smooth surface free from cracks, flaws, seams, laps, blisters, and edges affecting the strength, durability, or appearance. The cross section ~~of the post may be round, oval, or T shaped and the width shall not exceed 150 mm (6 in.). They shall be white, yellow, or orange in color as determined by the location in which they are used.~~

The reflective ~~device~~ *sheeting* on these posts the *post* shall be ~~reflective sheeting matching the color of the posts,~~ in accordance with ~~912.10(d)4,~~ *913.10(b)* and shall have minimum dimensions of 75 mm (3 in.) by 200 mm (8 in.). ~~The reflective device~~ *Reflective sheeting* shall be applied directly to the post and protected in a manner that minimizes ~~the damage to the sheeting~~ upon impact.

The color of the post and the reflective sheeting shall match the color of the adjacent edgeline.

When installed, the flexible post shall withstand, without damage, ~~repeated five vehicle impacts from a motor vehicle's front bumper at speeds up to 80 km/hr (50 mph) at ambient air temperatures from 7°C (20°F) to 49°C (+120°F) of 0°C (32°F) and at 30°C (85°F)~~

each. The vehicle impacts shall include both bumper and tire impacts. It shall be able to bend to an angle of

85 degrees from vertical and right itself to within 10 degrees of the vertical immediately and stand erect within 4 h within the same ambient air temperature range.

~~Manufacturers of flexible delineator posts shall prequalify for supply by providing the Operations Support Division with posts for field evaluation to determine acceptability. The Department will maintain a list of approved flexible delineator posts.~~

Only flexible delineator posts from the Department's list of approved Flexible Delineator Posts shall be used. Flexible delineator posts will be placed and maintained on the Department's approved list in accordance with ITM 806, procedure G.

913.07.1 Flexible Channelizer and Flexible Tubular Marker. The vertically placed portion of ~~each~~ *this* device shall consist of high density polyethylene plastic in accordance with ASTM D 5203. The base material shall be butyl rubber in accordance with ASTM D 5900 *or high impact polystyrene in accordance with ASTM D 4549*. Epoxy material used to attach the base to the roadway surface shall be in accordance with the manufacturer's recommendations. The tubular portion ~~of the flexible tubular marker~~ shall be covered with high intensity reflective sheeting in accordance with 913.10(~~d~~ *h*).

913.08 Delineators.

(a) Acrylic Plastic Delineators. ~~These units~~ *Acrylic plastic delineators* shall consist of a hermetically sealed optical system with a circular plastic face and prismatic molded rear surface. The optical system shall have a minimum diameter of 75 mm (3 in.) with a minimum area of approximately 4520 mm² (7 in.²). The trademark of the manufacturer shall be molded legibly into the face of the lens. Color shall be clear (~~crystal or silver~~), *red*, or yellow in daylight as well as when viewed by reflected light at night. Photometric or optical requirements shall equal or exceed the following minimum values:

Observation Angle Degrees	Entrance Angle Degrees	Specific Intensity <i>Candelas/lux (candle power/footcandles)</i>		
		Clear	Yellow	<i>Red</i>
0.1	0	1281 11.1 (119)	850 7.3 (79)	<i>2.6 (28)</i>
0.1	20	506 4.4 (47)	301 2.6 (28)	<i>1.0 (11)</i>

Note: The observation angle is the angle at reflector between the observer's line of sight and direction of light incident on reflector. The entrance angle is the angle at the reflector between the direction of light incident on it and the direction of reflector axis. The specific intensity is the candlepower returned at the chosen observation angle by a reflector or reflective surface for each lux (footcandle) of illumination at the reflector.

The opaque backing shall be made from aluminum sheet having a minimum thickness of 0.50 mm (0.02 in.). The backing shall form an integral part of the delineator and shall retain the optical system securely. ~~Mounting shall be provided by a single~~

~~aluminum~~ *A single aluminum grommited hole incorporated as part of the backing and shall be in the center of the reflector in the center of the reflector shall be provided for mounting.* The inside diameter of the grommet hole shall be 5 mm (3/16 in.).

Only acrylic plastic delineator models and colors from the Department's list of approved Delineators shall be used. Acrylic plastic delineators will be placed and maintained on the Department's approved list in accordance with ITM 806, procedure G.

~~For qualification or approval of the manufacturer, 100 delineators of each color which the manufacturer proposes to supply shall be submitted for tests. The delineators shall pass the test to determine adequate seal in accordance with 913.10(e)2. After qualification or approval of the manufacturer, a type C certification in accordance with 916 will be required.~~

(b) Reflective Sheeting Delineators. ~~Single units~~ *Reflective sheeting delineators* shall consist of reflective sheeting affixed to an aluminum ~~backplate~~ *backing material*. The ~~unit~~ *white delineator* shall be 75 mm by 200 mm (3 in. by 8 in.) in size, with a tolerance of ± 3 mm ($\pm 1/8$ in.) ~~for the white (silver) delineator.~~ Each multiple unit, ~~The amber or interstate (yellow), delineator~~ shall consist of reflective sheeting affixed to an aluminum backplate *be* 125 mm by 125 mm (5 in. by 5 in.) square with a tolerance of ± 3 mm ($\pm 1/8$ in.). ~~The square unit shall be mounted as a diamond with one mounted at the top of the post and the other placed in a vertical row immediately below. The backplate backing material shall be fabricated from sheet aluminum alloy 6061-T6 or 5154-H38, ASTM B 209M (ASTM B 209), with a in accordance with 913.10(a) except the minimum thickness of shall be 1.626 mm (0.064 in.). Reflective sheeting shall be in accordance with 913.10(d)3(b).~~

~~Two~~ *There shall be two mounting holes, 5 mm (3/16 in.) in diameter, shall be provided, with one at the top and one at the bottom. The holes shall be 150 mm (6 in.) ± 2 mm (1/16 in.) center to center for the rectangular shape. Holes shall be 125 mm (5 in.) ± 2 mm (1/16 in.) center to center and in the corners of the square units so as to mount as a diamond. The face of the unit shall be coated after the fabrication. Completed delineators shall be dip coated with a high gloss clear finish coat as specified and supplied by the sheeting manufacturer. The finished units shall be clean cut, sharp, and have essentially a plane surface.*

Material furnished under this specification shall be covered by a type C certification in accordance with 916.

(c) Barrier Delineators. The delineators shall consist of a transparent acrylic plastic face, herein referred to as the lens, and an opaque back fused to the lens under heat and pressure around the entire perimeter to form a unit permanently sealed against dust, water, and water vapor. The reflector lens shall be colorless.

The lens shall consist of a smooth front surface free from projection or indentations other than for purposes of identification or orientation of the reflector. The rear surface shall have a prismatic configuration such that it will effect total internal reflection of light. The manufacturer's trademark shall be molded legibly into the face of the lens.

The reflector lens, having a minimum effective reflex area of 4194 mm² (6.5 in²), shall be methyl methacrylate in accordance with Federal Specification LP-380C, type 1, Class 3. Photometric or optical requirements shall equal or exceed the following minimum values *in 913.08(a)*.

Observation Angle Degrees	Entrance Angle Degrees	Specific Intensity lux (footcandles)	
		Clear	Yellow
0.1	0	1281 (119)	850 (79)
0.1	20	506 (47)	301 (28)

~~The entrance angle is the angle at the reflector between the direction of light incident on it and the direction of reflector axis. The observation angle is the angle at reflector between the observer's line of sight and direction of light incident on reflector. The specific intensity is the candlepower returned at the chosen observation angle by a reflector or reflective surface for each lux (footcandle) of illumination at the reflector.~~

~~Barrier delineators shall be initially approved for use with a type A certification and, if accepted, the product will be added to the Department's List of Approved Barrier Delineators. Following initial approval, material furnished under this specification shall be covered by a type C certification in accordance with 916. Only barrier delineator models and colors from the Department's list of approved Delineators shall be used. Barrier delineators will be placed and maintained on the Department's approved list in accordance with ITM 806, procedure G.~~

SECTION 913, DELETE LINES 150 THROUGH 195.

SECTION 913, AFTER LINE 196, DELETE AND INSERT AS FOLLOWS:

(d) Temporary Barrier Delineator. *Temporary barrier delineators shall consist of a type III sheeting in accordance with 913.10(b)1 affixed to a reboundable substrate. The delineator shall be 200 by 300 mm (8 by 12 in.) vertically mounted. The mounting bracket used to affix the delineator to the barrier shall not be more than 75 mm (3 in.) vertical.*

913.09 Glass Beads. *Glass beads shall be in accordance with AASHTO M 247, Type I except sampling shall be in accordance with the frequency manual. The beads shall have a moisture resistant coating.*

913.10 Traffic Signs. ~~Traffic signs shall be designed to conform with applicable requirements of AASHTO Specifications for Highway Signs, Luminaries, and Traffic~~

~~Signals, and in accordance with the MUTCD. If there is a conflict for Interstate signs, the AASHTO requirements shall prevail.~~

~~Overlap~~ *Panel sign fabrication shall not utilize overlapping or butt splicing of reflective sheeting. by the sign fabricator is not permitted on panel signs. Splices* *Roll splices*, as supplied on the roll of sheeting by the sheeting manufacturer, ~~hereafter referred to as roll splices~~, are permitted subject to the following conditions:

(a) a maximum of one roll splice per panel, and

(b) a maximum of three roll splices per sign ~~is permitted on a panel sign.~~

Exit panels are considered as part of the signs *to which* they are attached ~~to~~ when fabricated under the same contract. If the exit panels are ~~to be~~ made for separate installation, only one roll splice is permitted on the entire sign.

Overlap splices on sheet signs ~~shall~~ *will* be permitted only because of insufficient sheeting width on signs whose smaller dimension exceeds 1220 mm (48 in.) The overlap splice shall be installed in a shingle-type manner using a horizontal lap. The lap width shall be a minimum of 6 mm (1/4 in.). ~~Butt slices are not permitted by the fabricator splices shall not be used.~~ Roll splices are permitted on sheet signs but shall not exceed one splice per sign.

All signs shall be packed for shipment and handled during construction in accordance with ~~802.01 the manufacturer's recommendations.~~ ~~Any~~ All sign or sign face damaged prior to acceptance shall be replaced or repaired. ~~If replacement is required the~~ *Damaged* sheet signs shall be replaced in *their* entirety. ~~and the~~ *Damaged* panel signs shall have the affected panels replaced *or repaired.* ~~Repairs to the reflective sheeting shall be~~ in accordance with the manufacturers' recommendations.

Repaired areas on panel signs shall not be larger than 75 mm by 75 mm (3 in. by 3 in.). Repaired areas of 25 mm by 25 mm (1 in. by 1 in.) or less shall be limited to a maximum of 3 per panel and a maximum of 6 per panel sign. Repaired areas of larger than 25 mm by 25 mm (1 in. by 1 in.) ~~but no more than 75 by 75 mm (3 in. by 3 in.)~~ shall be limited to one per panel and a maximum of three per panel sign. ~~Repaired~~ *The maximum number of repaired areas shall be three* on a panel or *six* on a panel sign ~~shall be limited to the maximum number of small repaired areas and the maximum number of larger repaired areas or any combination thereof.~~ No more than 20% of the total number of panel signs may be patched. ~~Signs in excess of 20% shall have damaged panels replaced.~~ Panels with sheeting cracked at the bend around the panel edge shall be replaced.

~~Repaired areas on sheet signs shall be less than 25 mm by 25 mm (1 in. by 1 in.) and shall be limited to one per sign. No more than 10% of the sheet signs may be patched. All damaged sheet signs in excess of 10% shall be replaced.~~

A sign with the metal face damaged greater than superficial deformation shall be replaced.

(a) ~~Sheet Signs~~ **Backing Material.** *Fabrication, including cutting and punching of holes but excluding holes for demountable copy, shall be completed prior to surface treatment. Material shall be cut to size and shape and shall be free from buckles, warp, dents, cockles, burrs, and defects resulting from fabrication. The surface shall be a plane surface.*

Metal sign base material shall be cleaned and prepared to receive the sheeting material in accordance with the sheeting manufacturer's recommendation.

1. Sheet Signs. The backing material for *permanent* sheet signs ~~may~~ shall be ~~made from~~ sheet aluminum in accordance with ASTM B 209M (ASTM B 209), alloy 5052H38, *or* alloy 6061-T6; ~~sheet steel in accordance with ASTM A 653M (ASTM A 653), grade A, stretcher leveled with an extra smooth commercial coating of the galvanized bonderized process, and a minimum Rockwell hardness of 65; or fiberglass reinforced plastic in accordance with 913.10(g).~~

The minimum thickness of the sheet shall be as shown for the appropriate sign width.

<i>Width, mm (in.)</i>	<i>Thickness, mm (in.)</i>
<i>Up to 750 (30)</i>	<i>2.00 (0.080)</i>
<i>775 to 1500 (31 to 60)</i>	<i>2.50 (0.100)</i>
<i>1525 and over (61 and over)</i>	<i>3.20 (0.125)</i>

~~Temporary~~ **Backing material** for temporary ground mounted signs ~~may~~ shall be of aluminum, steel, *fiberglass, reinforced plastic*, or plywood, unless otherwise ~~provided~~ *approved*.

SECTION 913, DELETE LINES 250 THROUGH 285J.

SECTION 913, BEGIN LINE 287, DELETE AND INSERT AS FOLLOWS:

(b) **2. Panel Signs.** ~~Aluminum-extruded~~ *Extruded aluminum* panels shall be in accordance with

ASTM B 221M (ASTM B 221), alloy 6063-T6, and be ~~230 or 305~~ 300 mm (~~9 in. or 12 in.~~) in

width. Extruded aluminum panels shall be flat and straight within tolerances established by the aluminum industry. ~~Typical~~ *The mass* (weights) ~~per meter (linear foot)~~ for panels shall be:

~~230 mm (9 in.), 0.28 kg (2.00 lb); or 305 mm (12 in.), 0.34~~ 3.70 kg/m (2.48 lb/ft).

~~Aluminum post~~

SECTION 913, DELETE LINES 292 THROUGH 442.

SECTION 913, AFTER LINE 443, DELETE AND INSERT AS FOLLOWS:

Trim molding shall be of the same material and thickness as the panels to which it is attached.

Panel bolts, flat washers, and lock-nuts shall be in accordance with ASTM B 211M (ASTM B 211), alloy 2024-T4. Panel bolts shall be 10 by 19 mm (3/8 by 3/4 in.) standard hex head. Lock-nuts shall be standard hex head.

3. Demountable Letters, Numbers, and Symbols. *Backing material for letters, numerals, and symbols shall be 1.0 mm (0.040 in.) thick aluminum sheets in accordance with ASTM B 209M (ASTM B 209), alloy 3003-H14. Borders shall be 0.8 mm (0.032 in.) thick aluminum sheet in accordance with ASTM B 209M (ASTM B 209), alloy 6061-T6.*

(b) Sheeting Material. *Only sheeting materials from the Department's list of approved Sign Sheeting Materials shall be used. Sheeting materials will be placed and maintained on the Department's approved list in accordance with ITM 806, procedure G.*

(d) 1. Reflective Sheeting. ~~Three types of reflective~~ *Reflective* sheeting shall be used for signs and channelizing devices *shall be in accordance with AASHTO M 268. Enclosed lens (engineer grade) and encapsulated lens (high intensity) Type I, II, III, or IV* reflective sheeting shall be used on signs, and delineators, and barricades.

Type V reflective sheeting may be used on delineators. Type VI reflective sheeting shall be used for temporary roll up signs, traffic cone collars, and post bands. Type III, Class I, reboundable flexible encapsulated lens reflective sheeting shall be used on plastic drums, flexible delineator posts, and other flexible channelizers.

SECTION 913, DELETE LINES 449 THROUGH 479.

SECTION 913, BEGIN LINE 481, DELETE AND INSERT AS FOLLOWS:

~~**e. Adhesive.** The reflective sheeting shall include a precoated, pressure sensitive an 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 or Class 2 in accordance with AASHTO M 268.~~

SECTION 913, DELETE LINES 485 THROUGH 791.

SECTION 913, AFTER LINE 792, DELETE AND INSERT AS FOLLOWS:

2. Nonreflective Sheeting. *Nonreflective sheeting shall be in accordance with AASHTO M 268 except that the sheeting shall not incorporate optical elements. The color shall be black in accordance with Federal Standard 595 a, Color No. 17038.*

3. Transparent Sheeting. *Transparent sheeting shall be of a material recommended by the background sheeting manufacturer.*

(e) (c) Letters, Numerals, Symbols, and Accessories. *Letters, numbers, symbols, and accessories shall be demountable.*

1. Embossed Reflective Sheeting Type. ~~Embossed reflective sheeting type shall be in accordance with the AASHTO standards for use on the National System of Interstate and Defense Highways. The reflective sheeting shall be of the same type as used on the background and mechanically applied to the properly prepared aluminum with the equipment and in a manner prescribed by the sheeting manufacturer. Letters, numerals, and symbols shall be 1.02 mm (0.040 in.) thick aluminum sheets in accordance with ASTM B 209M (ASTM B 209), alloy 3003 H14. Borders shall be 0.81 mm (0.032 in.) thick aluminum sheet in accordance with ASTM B 209M (ASTM B 209), alloy 6061 T6. All units shall have an embossed height of approximately 3 mm (1/8 in.). Spacing of mounting holes for screws, bolts, or rivets shall be determined by character size and shape but in no case shall not be more than 20 mm (8 in.) on center.~~

Each demountable legend unit, supplemental panel, and border frame shall be supplied with mounting holes and shall be secured to the sign face with aluminum rivets with aluminum mandrels. Adhesives that, when removed, may damage the sign face, legend unit, or border shall not be used to hold the unit in place.

Completed demountable units shall be dip coated with a ~~full~~ *high glossy clear finish* coat of ~~finishing clear~~ as specified and supplied by the sheeting manufacturer. The finished units shall ~~show careful workmanship and~~ be clean cut, sharp, and have essentially a plane surface.

(d) Fasteners.

1. Sheet Signs. *The bolts, steel flat washers, and lock-nuts used to attach sheet signs to posts shall be stainless steel in accordance with ASTM A 276, or type 304 carbon steel in accordance with ASTM A 307, grade A. Carbon steel hardware shall be galvanized in accordance with ASTM A 153. Lock washers and hex nuts shall be used in lieu of the lock-nuts when carbon steel hardware is furnished.*

The bolts shall be 8 mm by 75 mm (5/16 in. by 3 in.) hex head, full threaded. The steel flat washers shall be size no. 1/4, 19 mm (0.738 in.) outside diameter, 8.1 mm (0.317 in.) inside diameter, and 1.2 to 2.0 mm (0.051 to 0.08 in.) thick and in accordance with Military Specifications MS 15795-811. Nylon flat washers shall be 22 mm (7/8 in.) outside diameter, 8.1 mm (0.317 in.) inside diameter, and shall be 0.81 mm (0.032 in.) thick.

2. Panel Signs and Temporary Panel Signs. *The aluminum post clips shall be in accordance with ASTM B 26M (ASTM B 26) or ASTM B 108M (ASTM B 108), alloy 356.0-T6 and as shown on the plans. Aluminum post clip bolts shall be as shown on the plans and in accordance with ASTM B 211M (ASTM B 211), alloy 2024-T4. Lock-nuts shall be in accordance with ASTM B 211M (ASTM B 211), alloy 2017-T4.*

Flat washers shall be in accordance with ASTM B 209M (ASTM B 209), alloy Alclad 2024-T4.

3. Aluminum Rivets. *Aluminum rivets shall be determined by character size and shape but shall not be more than 20 mm (8 in.) on center. All rivets shall be color matched to the legend or supplemental panel being installed.*

SECTION 913, DELETE LINES 811 THROUGH 944.

SECTION 913, BEGIN LINE 946, DELETE AND INSERT AS FOLLOWS:

~~(g) Samples and Tests.~~

~~1. Reflective Sheeting.~~ Each series and color of reflective sheeting will be tested, evaluated, and approved prior to use. A list of approved manufacturers' series and colors will be maintained by the Department. Only reflective sheeting series and colors from the List of Approved or Prequalified Materials in effect as of the date of letting shall be used in the contract. Manufacturers desiring evaluation of their reflective sheeting material shall contact the Evaluation Unit at the Procurement and Distribution Division to make arrangements to begin the evaluation process.

~~Reflective sheeting which is furnished under this specification shall be covered by a type C certification in accordance with 916.~~

2. Traffic Signal Materials (e) Basis for Use. Materials furnished under this specification, *except that used for temporary construction signs, temporary traffic signs, and temporary panel signs, with the exception of fiberglass reinforced plastic sign panels,* shall be covered by a type C certification in accordance with 916. ~~Fiberglass reinforced plastic sign panels shall be covered by a type B certification in accordance with 916.~~

SECTION 913, BEGIN LINE 1089, INSERT AS FOLLOWS:

4. Galvanized Steel Lighting Standards. The pole and base plate shall be fabricated from steel in accordance with ASTM A 572M (ASTM A 572), ~~or A 595, or A 1011~~ with a minimum yield of 345 MPa (50,000 psi). Single member mast arms and the upper

SECTION 913, BEGIN LINE 1574, DELETE AND INSERT AS FOLLOWS:

913.12 Construction Warning Lights. *Construction warning lights shall be self-illuminated by means of an electric lamp behind the lens. Types A and C shall also be externally illuminated by reflex-reflective elements built into the lens to enable it to be seen by the light from the headlights of oncoming traffic.*

The batteries shall be entirely enclosed in a case. The case shall be secured by a locking device which can be opened with a special tool.

~~(a) Types of Warning Lights.~~

~~1. Type A.~~ Type A shall be a low intensity flashing barricade warning light.

~~2. Type B. Type B shall be a high intensity flashing barricade warning light.~~

~~3. Type C. Type C shall be a steady burn barricade warning light.~~

~~(b) General Requirements. The light shall be self illuminated by means of an electric lamp behind the lens. Types A and C also shall be externally illuminated by reflex reflective elements built into the lens to enable it to be seen by reflex reflection of the light from the headlights of oncoming traffic.~~

~~When the unit is to be operated by batteries, the batteries shall be entirely enclosed in a case. The case shall be secured by a locking device which can be opened by a special wrench or tool.~~

~~When the unit is to be operated by a 120 volt, 60 cycle power supply, the unit shall be supplied with a separate ground wire and be protected with suitable fuses. The connections and equipment used shall be in accordance with the pertinent current standards of the Institute of Electrical and Electronic Engineers, the ASTM, and the National Board of fire Underwriters. In those areas where there are pertinent local ordinances and requirements, the wiring, materials, and installation procedures shall be in accordance with them.~~

~~(c)~~ (a) Flash Requirements.

1. **Flash Rate.** The light from types A and B shall have a flash rate of 65 \pm 10 pulsations per minute from -29°C (-20°F) to + 66°C (150°F) regardless of power source.

2. **On-Time.** *On-time is defined as the period of the flash when instantaneous intensity is equal to or greater than the effective intensity as specified in 913.12(b)1.*

~~a. Definition. On time is defined as the period of the flash when instantaneous intensity is equal to or greater than the effective intensity as specified in 913.12(d)1.~~

~~b~~ a. **Type A.** The light shall have an on-time of no less than 10% of the flash cycle.

~~e~~ b. **Type B.** The light shall have an on-time of no less than 8% of the flash cycle.

~~(d)~~(b) Optical Requirements.

1. **Effective Intensity.** The light beam projected upon a surface perpendicular to the axis of the light beam shall produce a lighted area within the solid angle bounded by the two vertical planes nine degrees from the vertical plane through

the axis of the optical system and two planes five degrees above and below the horizontal plane through the optical axis of the system.

For type A, the effective intensity shall not drop below *4.0 cd* (4.0 candles) within the area specified herein during the first 336 h of continuous flashing.

For type B, the effective intensity shall not drop below *35 cd* (35 candles) within the area specified herein during the first 168 h of continuous flashing.

For type C, the ~~beam-candle-power~~ *effective intensity* shall not drop below *2.0 cd* (2.0 candles) within the area specified herein during the first 168 h of continuous burning.

2. Lens Illumination. The illuminated lens shall be uniformly bright in appearance over its entire illuminated surface when viewed from any point within the angle defined in ~~912.12(d)~~ *913.12(b)*.

3. Reflex-Reflective Performance. For types A and C the specific intensity of the lens when acting as a reflex-reflector at an observation angle of 0.2 of a degree shall be no less than the following:

Entrance Angle (degrees)	Specific Intensity Candelas per lux (Candles per Footcandle)
0	1.67 (18)
10	1.40 (14)
20	0.65 (7)

4. Testing Procedure. The effective intensity of types A and B lights shall be calculated using the Guide for Calculating the Effective Intensity of flashing Signal Lights as approved by the Illuminating Engineering Society, June, 1961. The intensity of the type C light shall be tested in accordance with SAE Standard J 575d, Lighting Equipment and Photometric Tests. Reflex-reflection shall be tested in accordance with SAE Standard J 594d.

~~(e)~~(c) Lens Requirements.

1. Size of Lens. The lens shall be no less than 175 mm (7 in.) in diameter including for ~~types A and C~~ a reflex-reflector ring of 13 mm (1/2 in.) minimum width around the periphery *for types A and C*.

2. ~~Number of~~ Directional Lenses. Unless otherwise directed, types A, B, and C shall have uni-directional lenses.

3. Lens Chromaticity. If the light uses an incandescent lamp, the chromaticity of the lens color shall be defined by the tri-stimulus coordinates of the

Commission International d'Eclairage Standards. When tested with illuminants from 2856 K to 2366 K, the lens color shall fall within the area of the chromaticity diagram in accordance with the 1931 Commission International d'Eclairage Standard Observer as defined by the following coordinates:

X	Y	Z
0.543	0.452	0.005
0.548	0.452	0.000
0.584	0.411	0.005
0.589	0.411	0.000

If the light uses other than an incandescent lamp, the light output shall be in the same range as the light obtained with the incandescent lamp and the specific lens.

4. Lens Luminous Transmittance. The minimum relative luminous transmittance of the lens with illuminant at 2856 K shall be 0.440.

5. Lens Material. The lens shall be plastic of one piece construction. ~~The lens material~~ and shall meet the test requirements in accordance with SAE J 576b, except that the exposure time and condition, paragraph 3.4.3, for the purposes of this standard shall be one year.

(f)(d) Head and Housing Case.

1. Swivel Head. If swivel capabilities as described herein are not incorporated in the device used to mount a type A or C light on a barricade or sign, the head shall be mounted on the housing in a manner permitting it to be swiveled through a minimum 90 degrees arc in a horizontal plane. If swiveling is accomplished by rotation of the head, construction shall be such that the head rotation ~~will~~ *shall* not damage the wiring.

~~**2. Housing.** Housing shall be the case containing the batteries and circuitry. The housing shall be constructed of No. 1.2 mm (18 gage) steel or other approved material.~~

~~**3. Weatherproofing**~~ **2. Case.** The case shall be so constructed and closed as to exclude moisture that would affect the specified operation of the light. The case shall have a weep hole to allow the escape of moisture from condensation.

~~**(g)(e) Photoelectric Controls.**~~ Photoelectric controls, if provided on types A or C lights, shall keep the light operating whenever the ambient light falls below 215 lux (20 footcandles).

~~(h) Basis For Use. A type C certification in accordance with 916 shall be provided for construction warning lights, except it shall be prepared by the Contractor, and not a manufacturer.~~

SECTION 913, DELETE LINES 1724 THROUGH 1729.

SECTION 913, AFTER LINE 1730, INSERT AS FOLLOWS:

An indicator light shall be provided on the back of the sign to provide confirmation that the flashing arrow sign is operating. The indicator light shall be visible for 150 m (500 ft).

(a) Solar Powered. Solar power assisted units shall incorporate a target sight device and leveling mechanism to aid the user for positioning of the unit prior to use. The device shall be attached to the elevated portion of the flashing arrow sign and not to the fixed support frame.

The lamps shall be electronically operated by means of a solid state controller. An automatic lamp intensity regulator shall hold the lamp output constant with varying battery voltage. The control system shall incorporate a full time tracking system designed to track ambient light for 24 h a day. The control system shall adjust lamp intensity to provide maximum system efficiency. The controller shall be in a weatherproof, ventilated, lockable enclosure.

The lamps shall provide amber beams with a minimum of a 20° horizontal and 6° vertical field of view. The minimum effective luminance within the required beam shall not be less than one half the effective luminance at the beam center.

The battery bank shall consist of 12 v, deep cycle, batteries. The battery bank shall be of sufficient capacity to power the unit for 15 days with no assistance from the sun. A battery condition indicator and a test switch shall be provided to monitor the system's battery charge. The batteries shall be secured in a well-ventilated, weatherproof lockable housing. A low battery charge indicator which shall be visible to maintenance personnel driving past the sign shall be provided to indicate the need to recharge the batteries. The battery bank shall be at full charge when delivered to the project site.

The unit shall be equipped with a sign/solar panel lifting mechanism. The lifting mechanism shall be designed to safely carry the capacity of the sign's load. The lifting mechanism shall incorporate a positive locking device to secure the panel in a raised or lowered position.

Solar power assisted flashing arrow signs to be used shall be selected from the Department's list of Approved Solar Power Traffic Control Devices.

(b) Diesel Powered. Flashing arrow sign shall be fueled by diesel fuel only.

(c) AC Powered. When connected to an AC electrical power source, provisions shall be made to prevent electrocution.

FLASHING ARROW SIGN GENERAL SPECIFICATIONS

	<i>TYPE A</i>	<i>TYPE B</i>	<i>TYPE C</i>	<i>SOLAR POWER ASSISTED</i>
<i>Minimum Board Size</i>	<i>0.6 m (2 ft) high x 1.2 m (4 ft) wide**</i>	<i>See Note Below</i>	<i>1.2 m (4 ft) high x 2.4 m (8 ft) wide</i>	<i>1.2 m (4 ft) high x 2.4 m (8 ft) wide</i>
<i>Minimum No. of Lamps</i> <i>Flashing Arrow</i> <i>Flashing Double Arrow</i> <i>Sequential Chevron</i> <i>(3 Heads Minimum)</i>	<i>5 in head, 5 in shaft*</i> <i>5 in head, 4 in shaft*</i> <i>5 in head</i>		<i>Same as Type A</i>	<i>5 in head, 5 in shaft*</i> <i>5 in head, 3 in shaft*</i> <i>7 in shaft</i>
<i>Lamp Type</i>	<i>Sealed Beam - 12.8 V, not to exceed 3 A</i> <i>Ave. rated life - 300 h. Min.</i> <i>Candlepower - 1000 cd (1000 candles) Min.</i> <i>9700 cd (9700 candles) Max.</i>		<i>Same as Type A</i>	<i>Sealed beam - 12.8 V, not to exceed 3 A</i> <i>Average rated life - 300 h Min.</i> <i>Candlepower - 600 cd (600 candles) at normal voltage and</i> <i>> 250 cd (250 candles) at low voltage</i>
<i>Lens Color</i>	<i>Amber</i>		<i>Amber</i>	<i>Amber</i>
<i>Board Color</i>	<i>Flat Black</i>		<i>Flat Black</i>	<i>Flat Black</i>
<i>Flashing Rate</i>	<i>30-50 F.P.M.</i> <i>(50% on time)</i>		<i>30-50 F.P.M.</i> <i>(50 % on time)</i>	<i>25-40 F.P.M.</i> <i>(50% on time)</i>
<i>Message (Left or Right)</i>	<i>Flashing Arrow, Flashing</i> <i>Double Arrow, or Sequential Chevron</i>		<i>Flashing Arrow, Flashing Double</i> <i>Arrow</i>	<i>Flashing Arrow, Flashing Double Arrow, or Warning Bar</i>
<i>Minimum mounting height</i> <i>(to bottom of board)</i>	<i>2.1 m (7 ft)</i>		<i>2.1 m (7 ft)</i>	<i>2.1 m (7 ft)</i>
<i>Where Permitted</i>	<i>Where normal speed limit is less than 40 mph</i>		<i>All rural & urban locations</i>	<i>Stationary Operations</i> <i>Tangent Sections (See 801.15(a))</i>
<i>Required Minimum</i> <i>Visibility</i>	<i>0.8 km (0.5 mi)</i>		<i>1.6 km (1 mi)</i>	<i>1.6 km (1 mi)</i>

* When flashing a single or double arrow(s), the lamp(s) nearest the arrow points shall not be illuminated.

** Either rectangular or arrow shaped black background sign will be permitted.

Note: General specifications for a type B flashing arrow sign are shown in the Federal MUTCD.

913.13.1 Temporary Worksite Speed Limit Sign Assembly. *The temporary worksite speed limit sign assembly shall be an all-weather, self-contained unit designed to display speed limit signs in accordance with the MUTCD and as shown on the plans. The signs shall be installed on frangible posts or mounted on movable stands or trailers in accordance with 910.14(f). The power source shall be capable of operating the strobe lights, without service, for the period which the sign is in effect. An on/off switch will be required.*

SECTION 913, DELETE LINES 1737 THROUGH 1831.

SECTION 913, AFTER LINE 1832, INSERT AS FOLLOWS:

1. Thermoplastic. *This material shall be in accordance with AASHTO M 249.*

SECTION 913, BEGIN LINE 1841, DELETE AND INSERT AS FOLLOWS:

The plastic material shall be capable of being affixed to either ~~bituminous concrete pavement HMA~~ or ~~cement concrete pavement PCCP~~ by means of the precoated adhesive and, following the initial application of pressure, shall mold itself to pavement contours, breaks, and faults by traffic action at normal pavement temperatures.

SECTION 913, BEGIN LINE 1901, INSERT AS FOLLOWS:

c. Basis For Use. A type C certification in accordance with 916 shall be furnished for the preformed plastic material *except materials used for temporary pavement markings.*

SECTION 913, BEGIN LINE 1992, INSERT AS FOLLOWS:

d. Basis For Use. Pavement marking material, except glass beads *and material used for the temporary pavement markings,* furnished under this specification shall be covered by the type A certification in accordance with 916. A type A certification shall be furnished for each batch supplied. The material manufacturer shall perform all tests included elsewhere herein on each batch and shall provide these test results as part of the type A certification.

SECTION 913, BEGIN LINE 2022, DELETE AND INSERT AS FOLLOWS:

~~Type I tape shall be prequalified for use and each manufacturer shall provide the Procurement and Distribution Division with samples for field evaluation. The Department will maintain a list of approved type I tape.~~

Type I tape shall be selected from the Department's list of approved Temporary Pavement Marking Tape, Type I. Temporary pavement marking tape type I will be placed and maintained on the Department's approved list in accordance with ITM 806.

Type I ~~and type II~~ tape furnished under this specification shall be covered by a type C certification in accordance with 916.

SECTION 913, BEGIN LINE 2073, DELETE AS FOLLOWS:

A steel wool abrasion test shall be performed by forming a 25 mm (1 in.) diameter flat pad using No. 3 coarse steel wool ~~in accordance with Federal Specification FF-W-1825~~. The steel wool pad shall be placed on the reflector lens, a load of 22.7 kg (50 lbs) shall be applied, and the entire lens surface shall be rubbed 100 times.

SECTION 913, LINE 2081F, DELETE AND INSERT AS FOLLOWS:

HORIZONTAL INCIDENT ANGLE	MINIMUM REFLECTIVE INTENSITY
0E	0.279 cd/lx (3.0 Candlepower/footcandle)
20E	0.1115 cd/lx (4/2 1.2 Candlepower/footcandle)

SECTION 913, BEGIN LINE 2292, DELETE AND INSERT AS FOLLOWS:

~~d. Acceptance Evaluation. Markers shall be prequalified for use and each manufacturer shall provide the Procurement and Distribution Division, Evaluation Unit with samples for a field evaluation. The Department will maintain a list of approved temporary raised pavement markers. Markers shall be selected from the Department's list of approved Temporary Raised Pavement Markers. Temporary raised pavement markers will be placed and maintained on the approved list in accordance with ITM 806.~~

~~e. Basis for Use. Grade 1 and grade 2 markers furnished under this specification shall be covered by a type C certification in accordance with 916.~~

SECTION 913, BEGIN LINE 3823, INSERT AS FOLLOWS:

h. Certification. Unless otherwise specified, all materials covered herein shall be covered by a type C certification in accordance with ~~915~~ 916.

SECTION 913, BEGIN LINE 3965, DELETE AND INSERT AS FOLLOWS:

(2) Roadway Loop Wire. Roadway loop wire shall be 14 AWG gauge
IMSA ~~51-5~~ 51-7 duct-loop wire with polyvinyl chloride outer jacket of 6.3 mm (1/4 in.) diameter.

SECTION 913, BEGIN LINE 4144, DELETE AS FOLLOWS:

~~The geotextile to be used shall be selected from the list of approved Geotextiles for Use with Underdrains.~~ A manufacturer, requesting that a geotextile be added to the approved list, shall provide a certification documenting compliance with the above requirements and a sample to the Materials and Tests Division. The certification shall be

SECTION 913, DELETE LINES 4197 THROUGH 4240.

SECTION 913, AFTER LINE 4241, INSERT AS FOLLOWS:

913.21 Geogrid. *Geogrid shall be on a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding material. The geogrid structure shall be dimensionally stable and shall be able to retain its geometry under construction stresses. The geogrid structure shall have resistance to damage during construction, ultraviolet degradation, and all forms of chemical and biological degradation encountered in the soil being placed on.*

Geogrid shall be in accordance with the property requirements as specified in the Geosynthetic Research Institute Standard Test Methods GG1, GG3, GG4, and ASTM D 5262.

During periods of shipment and storage, the geogrid shall be protected from temperatures greater than 60°C (140°F), mud, dirt, dust, and debris. Each geogrid roll shall be labeled or tagged to provide product identification. The manufacturer's recommendations shall be followed with regard to protection from direct sunlight. At the time of installation, the geogrid will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. All damaged portions of geogrid for the entire width shall be replaced.

Only geogrids selected from the Department's list of approved Geogrids shall be used. Geogrids will be placed and maintained on the Department's list in accordance with ITM 806, procedure P. No relabeled materials will be considered for approval. A specified material shown on the approved list will not be listed under more than one name.

The geogrid shall be in accordance with the property requirements for the type specified as follows:

(a) Type I.

<i>PROPERTY</i>	<i>TEST METHOD</i>	<i>UNIT</i>	<i>VALUE, Min.</i>
<i>Aperture</i>	<i>Calibered</i>	<i>mm (in.)</i>	<i>13 x 13 (0.5 x 0.5)</i>
<i>Open Area</i>	<i>COE, CWO2215</i>	<i>percent</i>	<i>>50.0, ≤ 80.0</i>
<i>Tensile Modulus, machine direction</i>	<i>GRI, GG1^{1, 3, 4}</i>	<i>N/m (lb/ft)</i>	<i>146,000 (10,000)</i>
<i>cross machine direction</i>	<i>GRI, GG1^{1, 3, 4}</i>	<i>N/m (lb/ft)</i>	<i>146,000 (10,000)</i>

<i>Ultimate Strength, machine direction</i>	<i>GRI, GG1^{2, 3, 4}</i>	<i>N/m (lb/ft)</i>	<i>11,670 (800)</i>
<i>cross machine direction</i>	<i>GRI, GG1^{2, 3, 4}</i>	<i>N/m (lb/ft)</i>	<i>11,670 (800)</i>

1. Secant modulus at 5% elongation measured by Geosynthetic Research Institute Test Method GG1, Geogrid Tensile Strength. No offset allowance shall be made in calculating secant modulus.
2. Ultimate strength measured by Geosynthetic Research Institute Test Method GG1, Geogrid Tensile Strength.
3. Results for machine direction, MD, and cross machine direction, CMD, are required.
4. Minimum average roll values shall be in accordance with ASTM D 4759.

(b) Type II.

<i>PROPERTY</i>	<i>TEST METHOD</i>	<i>UNIT</i>	<i>VALUE, Min.</i>
<i>Open Area</i>	<i>COE, CWO2215</i>	<i>percent</i>	<i>> 50.0, ≤ 80.0</i>
<i>Tensile Modulus, machine direction</i>	<i>GRI, GG1^{1, 4}</i>	<i>N/m (lb/ft)</i>	<i>720,000 (49,300)</i>
<i>Creep Limited Strength, machine direction at 5% strain</i>	<i>GRI, GG3^{2, 3}-87 or ASTM D 5262</i>	<i>N/m (lb/ft)</i>	<i>16,000 (1090)</i>

1. Secant modulus at 2% elongation measured by Geosynthetic Research Institute Test Method GG1, Geogrid Tensile Strength. No offset allowance shall be made in calculating secant modulus.
2. Long term load capacity measured by through the junction tensile creep testing to 10,000 hours in accordance with Geosynthetic Research Institute Test Method GG3, Creep Behavior and Long Term.
3. The Long Term allowable design strength, LTADS, is determined in accordance with GRI-GG4, Determination of the Long Term Design Strength of Stiff Geogrids.
4. Minimum average roll values shall be in accordance with ASTM D 4759.

SECTION 914, LINE 19, DELETE AND INSERT AS FOLLOWS:

914.02 Blank Temporary Seed. Temporary seed will be approved for use by visual inspection of the Engineer. Temporary seed may be purchased from any commercial source provided the seed's package is clearly marked and labeled by the manufacturer as to its content and weight.

SECTION 914, DELETE LINES 88K AND 88L.

SECTION 914, DELETE LINES 89J AND 88K.

SECTION 914, DELETE LINES 90K AND 90L.

SECTION 916, BEGIN LINE 247, INSERT AS FOLLOWS:

(f) Sample Asbestos Exclusion Letter. Prior to acceptance of work and final payment, the Contractor shall submit to the Engineer for each building or bridge, on the Contractor's letterhead, a signed, dated copy of the following *letter*. *The Engineer will be responsible for the distribution of the letter.*

ASBESTOS EXCLUSION LETTER

Date

work address of Engineer for
Indiana Department of Transportation

Att.: _____
Name, *Project Engineer/Supervisor*

Re: Asbestos Exclusion
Location/Description.....
Contract Number
Bridge Structure Number
Contractor's Name

Dear Engineer:

I hereby certify that to the best of my knowledge no asbestos containing material was used as a building material in this project.

Very truly yours,

signature of Contractor official

title of Contractor official

cc: *District Bridge Inspection Engineer*
Environment, Planning and Engineering Division Chief
Project File