

3101 PORTLAND CEMENT

3101.1 SCOPE

Provide portland cement material for use in concrete applications.

3101.2 REQUIREMENTS

Supply portland cement from the certified source listed on the Approved/Qualified Products List, meeting the requirements of AASHTO M 85, and in accordance with the following modifications:

- (1) If using low alkali cement as required by the contract, do not allow greater than 0.60 percent total alkalis in the portland cement ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$) or greater than 5.0 lb per cu. yd [3.0 kg per cu.m] total alkalis in the cementitious material.
- (2) Include the following standardized cement certification statement with delivery invoices: “(insert company name) certifies that the cement produced at (insert plant and location) conforms to AASHTO M 85 and Mn/DOT Specification 3101 for Type (insert type) cement.”

Do not change the source or color, or both, of cement on a project without the written approval of the Engineer.

3101.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the Schedule of Materials Control. Measure fineness in accordance with the air permeability test in AASHTO M 85.

3102 GROUND GRANULATED BLAST-FURNACE SLAG

3102.1 SCOPE

Provide ground granulated blast-furnace slag material for use in concrete applications.

3102.2 REQUIREMENTS

Provide slag from the certified source listed on the Approved/Qualified Products List, meeting the requirements of AASHTO M 302, and the following modifications:

- (1) Provide Grade 100 or Grade 120 slag classifications, and

- (2) Include the following standardized slag certification statement with delivery invoices: “(insert company name) certifies that the slag produced at (insert plant and location) conforms to AASHTO M 302 and Mn/DOT Specification 3102 for grade (insert grade) slag.”

Do not change the source or color, or both, of slag on a project without the written approval of the Engineer.

3102.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the Schedule of Materials Control.

3103 BLENDED HYDRAULIC CEMENT

3103.1 SCOPE

Provide blended hydraulic cement material for use in concrete applications.

3103.2 REQUIREMENTS

Provide blended hydraulic cement from the certified source listed on the Approved/Qualified Products List, meeting the requirements of AASHTO M 240, Type IS or Type IP, and the following modifications:

- (1) Fly ash constituent of the blended cement no greater than 25 percent,
- (2) Slag constituent of blended cement no greater than 35 percent,
- (3) Silica fume constituent of blended cement no greater than 7 percent,
- (4) Total alkalis in the blended cement no greater than 5.0 lb per cu. yd [3.0 kg per cu. m], and
- (5) Include the following standardized cement certification statement with delivery invoices: “(insert company name) certifies that the cement produced at (insert plant and location) conforms to AASHTO M 240 and Mn/DOT Specification 3103 for type (insert type) cement.”

Do not change the source or color, or both, of cement on a project without the written approval of the Engineer.

3103.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the Schedule of Materials Control.

**3105 BAGGED PORTLAND CEMENT CONCRETE PATCHING MIX
GRADE 3U18**

3105.1 SCOPE

Provide dry, bagged concrete patching mix for repairing portland cement concrete pavement.

3105.2 REQUIREMENTS

A Materials

Provide materials for patching mix meeting the following requirements:

- A.1 Cement..... 3101**
- A.2 Fine Aggregate 3126**
- A.3 Coarse Aggregate..... 3137**

Provide materials with the patching mix to make concrete meeting the following requirements:

- A.4 Water 3906**
- A.5 Admixtures 3113**

B Gradation

Blend the coarse and fine aggregate at a 50-50 ratio by volume and meet the following gradation requirements:

Table 3105-1 3U18 Gradation Requirements	
Sieve Size	Percent Passing
$\frac{3}{8}$ in [9.5 mm]	100
No. 4 [4.75 mm]	80 – 100
No. 8 [2.3 mm]	40 – 80
No. 16 [1.18 mm]	25 – 50
No. 30 [600 μ m]	15 – 35
No. 50 [300 μ m]	0 – 18
No. 100 [150 μ m]	0 – 8
No. 200 [75 μ m]	\leq 2.3

C Mix Proportions

Proportion the mix in accordance with Table 3105-2 per 75 lb [34.1 kg] bag of dry mix. Proportion other bag sizes of 3U18 mix in accordance with Table 3105-2.

Table 3105-2 Mix Proportions	
Material	Weight, lb [kg]
Type I Cement	17.8 [8.1]
Coarse Aggregate	28.3 [12.9]
Fine Aggregate	28.9 [13.1]

D Blending

Provide a blending device meeting the following characteristics and requirements:

- (1) Capable of producing the required mix proportions within ± 2 percent,
- (2) Contains a proportioning device equipped with a warning device to indicate when the system is out-of-tolerance,
- (3) Capable of stopping the flow of cement to allow sampling of the blended coarse and fine aggregate, and
- (4) Designed to allow cement and aggregate to run out separately for checking material weights and ensuring that the blending proportions meet mix requirements.

Before blending with the cement, dry the coarse and fine aggregates as approved by the Engineer. Blend the cement and aggregate before bagging the mix.

E Bags and Batch Identification

Provide moisture-proof bags resistant to tearing.

Print the following on the bags:

- (1) The phrase, "Mn/DOT GRADE 3U18 CONCRETE PATCH MIX",
- (2) Weight of the bag in pounds [kilograms],
- (3) Mix date, and
- (4) The instructions for mixing into concrete.

3105.3 SAMPLING AND TESTING

Sample individual materials and the aggregate blend in accordance with an approved Quality Control Program before blending at the bagging site.

3106 HYDRATED LIME

3106.1 SCOPE

Provide hydrated lime for use in soil drying or stabilization and for use in mortar for non-sewer applications or road pavement mixes.

3106.2 REQUIREMENTS

A Soil Drying/Stabilization

Provide hydrated lime for use in soil drying or stabilization meeting the requirements of AASHTO M 216.

B Mortar For Other Applications

For use in mortar, provide Type S hydrated lime meeting the requirements of ASTM C 207.

3106.3 SAMPLING AND TESTING

Provide sample at rates and sizes as required by the Schedule of Materials Control and the contract.

3107 MASONRY MORTAR

3107.1 SCOPE

Provide masonry mortar for use in sewer and other applications.

3107.2 REQUIREMENTS

A Sewer Application

Provide either bag mix or site mixed mortar meeting the following requirements:

A.1 Bag Mix

Provide a dry, pre-blended, air-entrained, Type S or Type M bagged mortar mix meeting the requirements of ASTM C 270 and containing an air content of at least 8 percent.

A.2 Site Mixed

Provide a mortar consisting of one part Type S or Type M masonry cement meeting the requirements of ASTM C 91 blended with from two and one-quarter parts

to three parts of mortar sand in accordance with 3128, "Aggregate for Use in Masonry Mortar."

B Other Applications

For applications other than for sewers, provide masonry mortar in accordance with ASTM C 270 based on the type of mortar required by the contract.

3107.3 SAMPLING AND TESTING

For bag mixed masonry mortar, provide a statement of compliance meeting the requirements of ASTM C 270 for air-entrained mortar. Label the type of mortar mix, either Type S or Type M, on each bag.

For site mixed masonry mortar, provide a statement of compliance meeting the requirements of ASTM C 91. Label the type of mortar mix, either Type S or Type M, on each bag. Provide samples for site mixed masonry mortar meeting the requirements of the Schedule of Materials Control and as required by the contract.

For applications other than for sewer applications, provide samples meeting the requirements of the Schedule of Materials Control and as required by the contract.

3113 ADMIXTURES FOR CONCRETE

3113.1 SCOPE

Provide admixtures for use in concrete applications.

3113.2 GENERAL

Provide admixtures in accordance with the following:

A Class I — Accelerating, Retarding, and Water-Reducing Admixtures

- (1) Type A — Water-reducing
- (2) Type B — Retarding
- (3) Type C — Accelerating
- (4) Type D — Water-reducing and retarding
- (5) Type E — Water-reducing and accelerating
- (6) Type F — Water-reducing, high range
- (7) Type G — Water-reducing, high range and retarding
- (8) Type S — Specific performance admixtures

B Class II — Air-Entraining Admixtures

C Class III — Calcium Chloride

3113.3 REQUIREMENTS

A Materials

Provide Class I admixtures from the Approved/Qualified Products List meeting the requirements of ASTM C 494. Provide Class II admixtures meeting the requirements of AASHTO M 154, except the tests for bleeding, bond strength, and volume change are not required.

Provide Class III admixtures from the Approved/Qualified Products List meeting the requirements of AASHTO M 144.

B Acceptance

Submit certified test reports including a print of the materials safety data sheet (MSDS), infrared spectrum and one-quart sample for the proposed Class I or Class II admixture from a CCRL Laboratory for each admixture. The Department will use the certified test results to determine if the admixtures meet the requirements of this section.

3113.4 SAMPLING AND TESTING

Take samples as specified in the Schedule of Materials Control.

The Department may perform tests on samples taken from the product proposed or on samples submitted and certified by the manufacturer as representative of the admixture to be supplied.

3115 FLY ASH FOR USE IN PORTLAND CEMENT CONCRETE

3115.1 SCOPE

Provide fly ash for use in concrete applications.

3115.2 REQUIREMENTS

Provide fly ash from the certified source listed on the Approved/Qualified Products List, meeting the requirements of ASTM C 618, Class F or Class C, except as modified by the following table:

Table 3115-1 Mn/DOT Modified Fly Ash Requirements		
Requirement	Class F	Class C
Chemical requirements:		
CaO	$\leq 30.0 \%$	$\leq 40.0 \%$
Loss on ignition	$\leq 2.0 \%$	$\leq 2.0 \%$
Available alkalis as Na ₂ O	$\leq 3.0 \%$	$\leq 3.0 \%$
Physical requirements:		
Fineness: Air permeability	≥ 650 sq. mm/kg	≥ 650 sq. mm/kg
Fineness: Quantity retained when wet sieved on a No. 325 [45 μ m] sieve	$\leq 30.0 \%$	$\leq 30.0\%$
Water requirement, as a percent of control	$\leq 100 \%$	$\leq 100 \%$
Specific gravity, maximum variation from established value *	$\leq \pm 0.12$	$\leq \pm 0.12$
* The established value for specific gravity is that value which is stated in the source approval given by the Materials Manufacturer.		

Do not use fly ash produced at plants where the limestone injection process is used for controlling air pollutants with portland cement concrete.

Ensure the following standardized Fly Ash Certification Statement is included with delivery invoices: “(insert company name) certifies that the fly ash produced at (insert power plant and location) conforms to ASTM C 618 and Mn/DOT Specification 3115 for Class (insert class) fly ash.”

Do not change the source or color, or both, of fly ash on a project without the written approval of the Engineer.

The Department will consider fly ash meeting the requirements of both Class C and Class F as Class C fly ash.

3115.3 SAMPLING AND TESTING

Provide samples for testing meeting the requirements of the Schedule for Materials Control.

3126 FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

3126.1 SCOPE

Provide fine aggregate for use in portland cement concrete.

3126.2 REQUIREMENTS

A General

Provide fine aggregate consisting of clean, sound, durable particles, uniform in quality and free from wood, bark, roots and other deleterious material.

The Engineer may consider the following as the basis for acceptance of fine aggregate for portland cement concrete:

- (1) Results of laboratory tests,
- (2) Behavior under natural exposure conditions,
- (3) Behavior of other portland cement concrete with aggregate from the same or similar geological formations or deposits, and
- (4) Any other tests or criteria as deemed appropriate by the Engineer in conjunction with the Concrete Engineer.

B Composition

Provide fine aggregate from natural sand. If producing fine and coarse aggregates simultaneously from natural gravel deposits during the same operation, the Contractor may provide fine aggregate containing particles of crushed rock.

C Washing

Wash the fine aggregate.

D Deleterious Material

Provide fine aggregate containing a cumulative quantity of deleterious materials in accordance with Table 3126-1.

Quality Test	Maximum Percent by Weight
Shale, Alkali, Mica, and Soft and Flaky Particles, Cumulative Total	2.5
Coal and Lignite, Cumulative Total	0.3

E Organic Impurities

Provide fine aggregate free of injurious quantities of organic impurities. The Engineer will reject aggregates that produce a color darker than the standard color when tested in accordance with AASHTO T 21, unless the mortar specimens pass the mortar strength requirements specified in 3126.2.F, "Structural Strength."

F Structural Strength

The Engineer will test the structural strength of fine aggregate in mortar specimens in accordance with AASHTO T 71 and Table 3126-2. The Engineer will prepare control mortar specimens using Ottawa sand with a Fineness Modulus (FM) from 2.30 to 2.50.

Table 3126-2	
Structural Strength in Fine Aggregate	
Mortar Specimens Containing:	Compressive Strength
Type I/II Portland Cement	≥ 90% of control at 7 days
Type III Portland Cement	≥ 90% of control at 3 days

G Gradation Requirements

Produce fine aggregate in accordance with the gradation requirements in Table 3126-3.

Table 3126-3	
Fine Aggregate Gradation Requirements	
Sieve Size	Percent Passing*
¾ in [9.50 mm]	100
No. 4 [4.75 mm]	95 – 100
No. 8 [2.36 mm]	80 – 100
No. 16 [1.18 mm]	55 – 85
No. 30 [600 µm]	30 – 60
No. 50 [300 µm]	5 – 30
No. 100 [150 µm]	0 – 10
No. 200 [75 µm]	0 – 2.5
* Percent passing by weight through square opening sieves.	

H Requirements for Uniformity of Grading

The uniformity of grading is determined by the Fineness Modulus (FM) of the fine aggregate.

Both the Engineer and Contractor will determine the FM of fine aggregate by adding the cumulative percent passing the following sieves, dividing by 100, and subtracting from 7:

- (1) ¾ in [9.50 mm],
- (2) No. 4 (4.75 mm),
- (3) No. 8 [2.36 mm],
- (4) No. 16 [1.18 mm],
- (5) No. 30 [600 µm],

- (6) No. 50 [300 μm], and
- (7) No. 100 [150 μm].

Do not allow the material to deviate from the FM by greater than 0.20. Contact the Engineer, in conjunction with the Concrete Engineer, for an adjustment if the FM approaches the tolerance limit.

3126.3 SAMPLING AND TESTING

Provide fine aggregates in accordance with Table 3126-4.

Table 3126-4 Preliminary Fine Aggregate Testing	
Aggregate	Notification and Testing Required
New source	Notify the Engineer at least 1 month before use. Perform new source concrete aggregate testing.
Previously tested aggregate	Notify the Engineer at least 2 weeks before use. Perform additional testing as required by the Engineer in conjunction with the Concrete Engineer.

Sample and test fine aggregate in accordance with Table 3126-5.

Table 3126-5 Fine Aggregate Test Methods	
Test	Testing Method
Sampling	Concrete Manual
Sieve analysis	Concrete Manual
Deleterious substances	Laboratory Manual Method 1207
Quantity of material passing the No. 200 [75 μm] sieve	Concrete Manual
Organic impurities (color plate)	AASHTO T 21
Structural strength	AASHTO T 71
Specific gravity and absorption	Laboratory Manual Method 1205
Alkali silica reactivity	Laboratory Manual Method 1222

3127 FINE AGGREGATE FOR BITUMINOUS SEAL COAT

3127.1 SCOPE

Provide fine aggregate for use in bituminous seal coat.

3127.2 REQUIREMENTS

A Composition

Provide aggregate for use in bituminous seal coat meeting the following requirements:

- (1) Consisting of sound, durable particles of sand, gravel or crushed stone,
- (2) Clean,
- (3) Uniform in quality,
- (4) Free of deleterious materials, and
- (5) Meeting the requirements of Class A, Class C, or Class D in accordance with 3137.2.B, "Classification."

For Class C aggregates, provide the plus No. 4 [4.75 mm] fraction having at least 80 percent crushed one face, from mechanical methods or naturally occurring, meeting the requirements of Laboratory Manual Method 1214.

B Gradation and Quality

Provide fine aggregate for bituminous seal coat meeting the following gradation requirements:

Table 3127-1						
Fine Aggregate for Bituminous Seal Coat, % Passing by Weight						
Sieve Size	FA-1	FA-2	FA-2½	FA-3	FA-3½	QC Range, %
½ in [12.5 mm]	100	100	100	100	100	—
⅜ in [9.5 mm]	100	100	100	100	90 – 100	± 5
¼ in [6.3 mm]	100	100	0 – 80	0 – 70	0 – 70	± 7
No. 4 [4.75mm]	0–100	0 – 100	0 – 50	0 – 25	0–25	± 7
No. 8 [2.36mm]	—	0 – 40	0 – 12	0 – 5	0 – 5	± 4
No. 16 [1.18 mm]	0 – 30	0 – 10	0 – 5	—	—	± 4
No. 50 [300 µm]	0 – 15	0 – 5	—	—	—	± 4
No. 100 [150 µm]	0 – 5	—	—	—	—	± 4
No. 200 [75 µm]	0 – 1	0 – 1	0 – 1	0 – 1	0 – 1	—

Provide fine aggregate for bituminous seal coat meeting the following test requirements:

Table 3127-2 Fine Aggregate Durability for Bituminous Seal Coat Meeting the Requirements of AASHTO T96 as Modified by Mn/DOT					
Material Tests	FA-1	FA-2	FA-2½	FA-3	FA-3½
Shale, % *	≤ 5	≤ 5	≤ 5	≤ 3	≤ 2
Flakiness index, %	—	≤ 25	≤ 25	≤ 25	≤ 25
Los Angeles Rattler, % loss	—	—	—	≤ 35	≤ 35
* In accordance with Laboratory Manual Method 1209. Meeting the requirements of FHL T 508. Test aggregate retained on each sieve, if weight of retained aggregate comprises at least 4 percent of the total sample weight.					

3127.3 SAMPLING AND TESTING — (BLANK)

3128 AGGREGATE FOR USE IN MASONRY MORTAR

3128.1 SCOPE

Provide fine aggregate for use in masonry mortar.

3128.2 REQUIREMENTS

Provide aggregate for use in masonry mortar meeting the requirements of ASTM C 144. The gradation requirements of ASTM C 144 are shown in Table 3128-1.

Table 3128-1 Mortar Aggregate Gradation Limits	
Sieve Size	Percent Passing
No. 4 [4.75 mm]	100
No. 8 [2.36 mm]	95 – 100
No. 16 [1.18 mm]	70 – 100
No. 30 [600 µm]	40 – 75
No. 50 [300 µm]	10 – 35
No. 100 [150 µm]	2 – 15
No. 200 [75 µm]	0

The Engineer may allow aggregate meeting the gradation requirements of 3126.2.G, "Gradation Requirements," for joints thicker than ½ in [12.5 mm].

3128.3 SAMPLING AND TESTING — (BLANK)

3135 MODIFIED AGGREGATE BASES

3135.1 SCOPE

Provide modified aggregate bases for Full Depth Reclamation (FDR) mixtures.

3135.2 REQUIREMENTS

A General

Produce aggregate materials that have uniform: appearance, texture, moisture content, and performance characteristics.

B Gradation

Provide modified aggregate bases for FDR mixtures in accordance with Table 3135-1.

Table 3135-1 Gradation Requirements	
Sieve Size, in [mm]	Percent Passing
2.0 [50]	97 – 100
Note 1: Report gradation results to the nearest whole number. Note 2: Exclude rock that is larger the 2 inches [50 mm], in the gradation calculations, when it originates from material below the reclaimed pavement.	

C Add Materials

Supply materials as required by the contract .

3135.3 SAMPLING AND TESTING

Test the FDR mixture at the rates specified in the Schedule of Materials Control.

A Sampling and Sieve AnalysisGrading and Base Manual

3136 DRAINABLE BASES

3136.1 SCOPE

Provide aggregates for use in Open Graded Aggregate Base (OGAB) or Drainable Stable Base (DSB).

3136.2 REQUIREMENTS

A Aggregate Composition

Use aggregate sources in accordance with 1601, "Source of Supply and Quality."

A.1 Virgin Aggregates

Provide virgin aggregates meeting the following requirements:

- (1) Comprised of naturally occurring mineral materials, and
- (2) Does not contain topsoil, organics, or severely weathered rock.

B Gradation

Table 3136-1		
Permeable Bases, Total Percent Passing		
Sieve Size	OGAB	DSB
1½ in [37.5 mm]	100	100
1 in [25.0 mm]	95 – 100	-
¾ in [19.0 mm]	65 – 95	75 – 100
⅝ in [9.5 mm]	30 – 65	45 - 75
No. 4 [4.75 mm]	10 – 35	30 - 60
No. 10 [2.00 mm]	3 – 20	10 - 35
No. 40 [425 µm]	0 – 8	5 - 20
No. 200 [75 µm]	0 – 3	0 – 5.0%, for class B or C material, 0 - 6.5% for class A material. Classes defined per 3137, "Coarse Aggregate for Portland Cement Concrete".
D_{60}/D_{10}^*	≥ 4	≥ 8
* D_{60} is the diameter of the soil particle of which 60 percent is smaller, by weight. D_{10} is the diameter of the soil particle of which 10 percent is smaller, by weight.		

C Crushing

Crush coarse aggregates in accordance with Table 3136-2.

Table 3136-2 Crushing Requirements		
Coarse Aggregate Angularity	OGAB	DSB
Two face	85%	50%

D Los Angeles Rattler Loss (LAR)

Provide aggregates with a Los Angeles Rattler Loss in accordance with Table 3136-3.

Table 3136-3 LAR Requirement		
	OGAB	DSB
Maximum	≤ 40%	≤ 40%

E Acid Insoluble Residue (IR)

Mixtures containing crushed carbonate quarry rock (limestone or dolostone), or natural gravel containing greater than 55 percent carbonate retained on the No. 4 sieve, must meet the requirements in Table 3136-4.

Table 3136-4 Insoluble Residue Requirement		
	OGAB	DSB
Minus No. 200 [75 μm] sieve	≤ 10%	≤ 10%

F Spall

The total of all spall materials, including shale, iron oxide, unsound chert, and similar materials, must meet the requirements of Table 3136-5.

Table 3136-5 Spall Requirements		
Spall	OGAB	DSB
Total sample	≤ 5.0%	≤ 5.0%

3136.3 SAMPLING AND TESTING

Sample the drainable bases from the roadway after placement and before compaction.

Test in accordance with the following procedures:

- A Sieve Analysis Laboratory Manual Method 1202 & 1203**
- B Coarse Aggregate Angularity Laboratory Manual Method 1214**
- C Los Angeles Rattler Loss Laboratory Manual Method 1210**
- D Insoluble Residue Laboratory Manual Method 1221**
- E Spall Laboratory Manual Method 1209**

3137 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

3137.1 SCOPE

Provide coarse aggregate for use in portland cement concrete.

3137.2 REQUIREMENTS

A General

Provide coarse aggregate consisting of clean, sound, durable particles, uniform in quality, and free from wood, bark, roots, and other deleterious material.

The Engineer, in conjunction with the Concrete Engineer, may consider the following as the basis for acceptance of coarse aggregate for portland cement concrete:

- (1) Results of laboratory tests,
- (2) Behavior under natural exposure conditions,
- (3) Behavior of other portland cement concrete with aggregate from the same or similar geological formations or deposits, and
- (4) Any other tests or criteria as deemed appropriate by the Engineer, in conjunction with the Concrete Engineer.

B Classification

Provide coarse aggregate meeting the requirements of one of the following classifications:

- (1) Class A: Crushed quarry rock including quartzite, gneiss, and granite, or mine trap rock including basalt, diabase, gabbro, and other igneous rock types. Class A aggregate may contain no greater than 4.0 percent non-Class A aggregate. The Department will not allow the intentional blending or adding of non-Class A aggregate.

- (2) Class B: All other crushed quarry or mine rock types including carbonates, rhyolite, and schist.
- (3) Class C: Natural or partly crushed gravel obtained from a natural gravel deposit.
- (4) Class D: Mixture of at least two other classes of coarse aggregate. The Engineer, in conjunction with the Concrete Engineer, will determine the suitability of the Class D aggregate for the proposed use including proportioning.
- (5) Class R: Aggregate obtained from recycling concrete. The Engineer, in conjunction with the Concrete Engineer, will determine the suitability of the Class R aggregate for the proposed use, including proportioning.

C Washing

Wash Class B, Class C, Class D, and Class R coarse aggregate. Wash Class A aggregate as needed to comply with the requirements of Table 3137-1.

D Quality

Quality requirements are based on each individual fraction unless otherwise approved by the Engineer, in conjunction with the Concrete Engineer, except for the following:

- (1) If 100 percent of the fractions from a single source pass the 1 in [25 mm] sieve, base quality requirements on the composite value of the combined aggregates.
- (2) If less than 100 percent of the fractions from a single source pass the 1 in [25 mm] sieve, base the quality requirements in accordance with the following:
 - (2.1) For fractions passing the 1 in [25 mm] sieve, base the quality requirement on the composite value of the combined aggregates;
 - (2.2) For fractions greater than or equal to 1 in [25 mm], base the quality requirement on each individual aggregate fraction.

D.1 Coarse Aggregate for General Use

Provide coarse aggregate for general use concrete in accordance with Table 3137-1. Table 3137-1 Coarse Aggregate for General Use		
Quality Test		Maximum Percent by Weight
(a)	Shale:	
	Fraction retained on the ½ in [12.5 mm] sieve	0.4
	Fraction retained on the No. 4 [4.75 mm] sieve, as a percentage of the total material	0.7
(b)	Soft iron oxide particles (paint rock and ochre)	0.3
(c)	Total spall materials*:	
	Fraction retained on the ½ in [12.5 mm] sieve	1.0
	Fraction retained on the No. 4 [4.75 mm] sieve, as a percentage of the total material	1.5
(d)	Soft particles	2.5
(e)	Clay balls and lumps	0.3
(f)	Sum of (c) total spall materials, (d) soft particles, and (e) clay balls and lumps†	3.5
(g)	Slate	3.0
(h)	Flat or elongated pieces‡	15.0
(i)	Quantity of material passing No. 200 [75 µm] sieve:	
	Class A and Class B aggregates#	1.5
	Class C and Class D aggregates§	1.0
(j)	Los Angeles Rattler, loss on total sample	40.0
(k)	Soundness of magnesium sulfate**	15.0
<p>* Includes the percentages retained by shale and soft iron oxide particles, plus other iron oxide particles, unsound cherts, pyrite, and other materials with similar characteristics.</p> <p> Exclusive of shale, soft iron oxide particles, and total spall materials.</p> <p>† Sum of the total spall materials, soft particles, and clay balls and lumps. For total spall materials, use the percent in the total sample retained on the No. 4 [4.75 mm] sieve.</p> <p>‡ Thickness less than 25 percent of the maximum width. Length greater than 3 times the maximum width.</p> <p># Each individual fraction at the point of placement consists of dust from the fracture and free of clay or shale.</p> <p>§ For each individual fraction at the point of placement.</p> <p>** Loss at 5 cycles for any fraction of the coarse aggregate. Do not blend materials from multiple sources to obtain a fraction meeting the sulfate soundness requirement.</p>		

D.2 Coarse Aggregate for Bridge Superstructure

Provide coarse aggregate in accordance with 3137.2.D.1, “Coarse Aggregate for General Use,” except as modified by Table 3137-2, for use in the following:

- (1) Bridge superstructure (deck, railing, posts, curbs, sidewalks, and median strips);
- (2) Approach panels; and
- (3) Precast concrete panel facings for Mechanically Stabilized Earth walls.

Table 3137-2		
Coarse Aggregate for Bridge Superstructure		
Quality Test		Maximum Percent by Weight
(a)	Shale:	
	Fraction retained on the ½ in [12.5 mm] sieve	0.2
	Fraction retained on the No. 4 [4.75 mm] sieve as a percentage of the total material	0.3
(b)	Soft iron oxide particles (paint rock and ochre)	0.2
(c)	Total spall materials*:	
	Fraction retained on the No. 4 [4.75 mm] sieve as a percentage of the total material	0.5
(d)	Soft particles	2.5
(e)	Clay balls and lumps	0.3
(f)	Sum of (c) total spall materials, (d) soft particles, and (e) clay balls and lumps, use the percent in the total sample retained on the No. 4 [4.75 mm] sieve	3.0
(g)	Absorption for Class B aggregate	1.75
(h)	Absorption for Class B aggregate for all concrete bridge decks	1.10
(i)	Carbonate in Class C and Class D aggregates by weight	30.0
<p>* Includes the percentages retained by shale and soft iron oxide particles, plus other iron oxide particles, unsound cherts, pyrite, and other materials with similar characteristics.</p> <p> Exclusive of shale, soft iron oxide particles, and total spall materials.</p> <p>† Sum of the total spall materials, soft particles, and clay balls and lumps. For total spall materials, use the percent in the total sample retained on the No. 4</p>		

Table 3137-2	
Coarse Aggregate for Bridge Superstructure	
Quality Test	Maximum Percent by Weight
[4.75 mm] sieve.	

D.3 Coarse Aggregate for Concrete Pavement

Provide coarse aggregate in accordance with 3137.2.D.1, “Coarse Aggregate for General Use,” except as modified by Table 3137-3, for use in the following:

- (1) Concrete pavement, and
- (2) Concrete pavement rehabilitation.

Table 3137-3		
Coarse Aggregate for Concrete Pavement		
Quality Test		Maximum Percent by Weight
(a)	Absorption for Class B aggregate	1.75
(b)	Carbonate in Class C aggregate by weight	30.0

E Gradation

Provide coarse aggregate in accordance with Table 3137-4 including all sizes within the specified limits. The Department defines coarse aggregate as the uniform product of the producing plant, unless some sizes are removed to meet the gradation requirements. Do not use broken or non-continuous gradations.

If the coarse aggregate contains less than 100 percent passing the 1 in [25 mm] sieve, use at least two fractions to proportion the coarse aggregate. Base gradation requirements on the composite value of the combined coarse aggregates.

If producing Class R aggregate, remove reinforcing steel from the concrete and any concrete material passing the No 4 [4.75 mm] sieve.

Table 3137-4
Coarse Aggregate Designation for Concrete,
percent by weight passing square opening sieves

Aggregate	2 in [50 mm]	1½ in [37.5 mm]	1¼ in [31.5 mm]	1 in [25.0 mm]	¾ in [19.0 mm]	⅝ in [16.0 mm]	½ in [12.5 mm]	⅜ in [9.5 mm]	No.4 [4.75 mm]
CA-00	—	—	—	100	95 – 100	—	—	—	0 – 10
CA-15	100	95 – 100	—	—	35 – 65	—	—	5 – 25	0 – 7
CA-25	100	95 – 100	—	—	50 – 80	—	—	20 – 40	0 – 7
CA-35	—	100	95 – 100	—	55 – 85	—	—	20 – 45	0 – 7
CA-45	—	—	100	95 – 100	65 – 95	—	—	25 – 55	0 – 7
CA-50	—	—	—	100	85 – 100	—	—	30 – 60	0 – 12
CA-60	—	—	—	—	100	85 – 100	—	40 – 70	0 – 12
CA-70	—	—	—	—	—	100	85 – 100	50 – 100	0 – 25
CA-80*	—	—	—	—	—	—	—	100	55 – 95

* Do not allow greater than 5 percent to pass the No. 50 [300 µm] sieve.

3137.3 SAMPLING AND TESTING

Sample and test coarse aggregate fractions separately in accordance with Table 3137-5.

Table 3137-5 Preliminary Coarse Aggregate Testing	
Aggregate	Notification and Testing Requirement
New source	Notify the Engineer at least 1 month before use. Perform new source concrete aggregate testing.
Previously tested aggregate	Notify the Engineer at least 2 weeks before use. Perform additional testing as directed by the Engineer, in conjunction with the Concrete Engineer.

Sample and test coarse aggregate in accordance with Table 3137-6.

Table 3137-6 Coarse Aggregate Test Methods	
Test	Testing Method
Sampling	Concrete Manual
Sieve analysis	Concrete Manual
Shale test	Laboratory Manual Method 1207
Quantity of material passing the No. 200 [75 µm] sieve	Concrete Manual
Specific gravity and absorption	Laboratory Manual Method 1204
Density	AASHTO T 19 or Laboratory Manual Method 1211
Los Angeles Rattler loss	AASHTO T 96
Void content	AASHTO T 19* or Laboratory Manual Method 1211
Deleterious materials	Laboratory Manual Method 1209
Soundness; magnesium sulfate	Laboratory Manual Method 1219
Soft particles	Laboratory Manual Method 1218
Flat or elongated pieces	ASTM D 4791
Clay balls or lumps	Concrete Manual
* Base the void content on an oven-dry and compacted-by-rod- ding condition of the aggregate and a value of 62.4 lb per cu. ft [1,000 kg per cu. m] for water.	

3138 AGGREGATE FOR BASE AND SURFACE COURSES

3138.1 SCOPE

Provide certified aggregate for base and surface courses.

3138.2 REQUIREMENTS

A General

Use aggregate sources meeting the requirements of 1601, "Source of Supply and Quality."

Provide certified aggregate materials that have uniform: appearance, texture, moisture content, and performance characteristics.

Provide binder soils from sources meeting the requirements of 3146, "Binder Soil." Add binder soils during the crushing and screening operations.

B Virgin Materials

Provide virgin aggregates meeting the following requirements:

- (1) Comprised of naturally occurring mineral materials,
- (2) Conforming to the particle size distribution in accordance with Table 3138-3,
- (3) Containing no topsoil, organics, or severely weathered rock,
- (4) Conforms to the shale content requirements of Table 3138-1.

Table 3138-1 Maximum Shale Content Requirements		
Classification	Percent Pass No. 200 (75 µm)	Maximum Allowable Shale Content
Class 3, 4, and 5	≤ 7 % by mass	≤ 10 %
	> 7 % by mass	≤ 7 %
Class 6	–	≤ 7 %

- (5) Conforms to the crushing requirements of Table 3138-2.

Table 3138-2 Crushing Requirements	
Classification	Minimum Allowable Crushing Requirements
Class 2	100% Crushed Quarry Rock
Class 5	≥ 10 % by mass
Class 6	≥ 15 % by mass

- (6) Los Angeles Rattler loss in all quarry rock by mass cannot exceed 40%.
- (7) Insoluble residue test results for the portion of quarried carbonate aggregates passing the No. 200 sieve, no greater than 10 percent, and
- (8) Class 2 aggregates, 100% crushed quarry rock.

C Recycled Materials

The Contactor may substitute recycled aggregates for virgin aggregates if meeting the following requirements:

- (1) Particle size distribution meeting the requirements of Table 3138-4 if the blend contains at least 25 percent recycled aggregates.
- (2) Particle size distribution meeting the requirements of Table 3138-3 if the blend contains less than 25 percent recycled aggregates.
- (3) Recycled aggregates contain only recycled asphaltic pavement (RAP), recycled concrete materials, recycled aggregate materials, or certified recycled glass.
- (4) Bitumen content of the material blend is no greater than 3.0 percent.
- (5) Recycled concrete material meets the following requirements:
 - (5.1) The material blend contains no more than 75 percent concrete of the material blend.
 - (5.2) The material blend contains no more than 10 percent masonry block
- (6) Certified recycled glass meets the following requirements:
 - (6.1) The material blend contains no more than 10 percent glass.
 - (6.2) Particle size no greater than $\frac{3}{4}$ in [19.0 mm].
 - (6.3) Meets certification requirements specified on the Department's website at the Grading and Base homepage.
 - (6.4) Combine recycled glass with other aggregates during the crushing operation.

D Surfacing Aggregates, Class 1 and 2

Provide surfacing aggregates in accordance with 3138.2.A, "General Requirements for Aggregate for Base and Surface Courses," 3138.2.B, "Virgin Materials," and 3138.2.C, "Recycled Materials," and meeting the following requirements:

- (1) 100 percent of the material passes the $\frac{3}{4}$ in [19.0 mm] sieve,
- (2) Do not use glass,
- (3) Use recycled concrete materials only on the roadway shoulders,
- (4) There is no restriction on the bitumen content.

Table 3138-3
Base and Surfacing Aggregate
(containing 75 percent or more virgin aggregates),
Total Percent Passing

Sieve Size	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
2 in [50 mm]	—	—	100	100	—	—
1½ in [37.5 mm]	—	—	—	—	—	—
1 in [25.0 mm]	—	—	—	—	100	100
¾ in [19 mm]	100	100	—	—	90 – 100	90 – 100
⅜ in [9.5 mm]	65 – 95	65 – 90	—	—	50 – 90	50 – 85
No. 4 [4.75 mm]	40 – 85	35 – 70	35 – 100	35 – 100	35 – 80	35 – 70
No. 10 [2.00 mm]	25 – 70	25 – 45	20 – 100	20 – 100	20 – 65	20 – 55
No. 40 [425 µm]	10 – 45	12 – 30	5 – 50	5 – 35	10 – 35	10 – 30
No. 200 [75 µm]	8.0 – 15.0	5.0 – 13.0	5.0 – 10.0	4.0 – 10.0	3.0 – 10.0	3.0 – 7.0

Table 3138-4
Base and Surfacing Aggregate
(containing 25 percent or more recycled aggregates),
Total Percent Passing*

Sieve Size	Class 1	Class 3	Class 4	Class 5	Class 6
2 in [50 mm]	—	100	100	—	—
1½ in [37.5 mm]	—	—	—	100	100
1 in [25.0 mm]	—	—	—	95 – 100	95 – 100
¾ in [19 mm]	100	—	—	90 – 100	90 – 100
⅝ in [9.5 mm]	65 – 95	—	—	50 – 90	50 – 85
No. 4 [4.75 mm]	40 – 85	35 – 100	35 – 100	35 – 80	35 – 70
No. 10 [2.00 mm]	25 – 70	20 – 100	20 – 100	20 – 65	20 – 55
No. 40 [425 µm]	10 – 45	5 – 50	5 – 35	10 – 35	10 – 30
No. 200 [75 µm]	5.0 – 15.0	0 – 10.0	0 – 10.0	0 – 10.0	0 – 7.0

* Add letters in parentheses for each aggregate blend designating the type of recycled products included in the mixture.
 (B) = Bituminous
 (C) = Concrete
 (G) = Glass
 (BC) = Bituminous and Concrete
 (BG) = Bituminous and Glass
 (CG) = Concrete and Glass
 (BCG) = Bituminous, Concrete, and Glass

3138.3 SAMPLING AND TESTING

Report the No. 200 sieve results to the nearest 0.1 percent and all other sieve results to the nearest 1 percent.

- A Sampling, Sieve Analysis, Shale, and Crushing Test Grading and Base Manual**
- B Los Angeles Rattler Loss..... Laboratory Manual Method 1210**
- C Sampling and Shale Tests..... Laboratory Manual Method 1207 & 1209**
- D Bitumen Content Laboratory Manual Method 1852 & 1853**

Use Method 1852 when the Bitumen Content is beyond specification when tested with Method 1853.

- E Insoluble Residue Laboratory Manual Method 1221**
- F Reclaimed GlassAGI Visual Method (AGI Data sheet 15.1 and 15.2)**

3139 GRADED AGGREGATE FOR BITUMINOUS MIXTURES

3139.1 SCOPE

Provide graded aggregate for use in bituminous mixtures.

3139.2 PLANT MIXED ASPHALT PAVEMENT REQUIREMENTS

A Composition

Provide graded aggregate composed of any combination of the following sound durable particles as described in 3139.2.B, "Classification."

Do not use graded aggregate containing objectionable materials, including the following:

- (1) Metal,
- (2) Glass,
- (3) Wood,
- (4) Plastic,
- (5) Brick, or
- (6) Rubber.

Provide coarse aggregate free of coatings of clay and silt.

Do not add soil materials such as clay, loam, or silt to compensate for a lack of fines in the aggregate.

Do not blend overburden soil into the aggregate.

Feed each material or size of material from an individual storage unit at a uniform rate.

Do not place blended materials from different sources, or for different classes, types, or sizes together in one stockpile, unless approved by the Engineer as a Class E aggregate.

B Classification

B.1 Class A

Provide crushed igneous bedrock consisting of basalt, gabbro, granite, gneiss, rhyolite, diorite, and andosite, and rock from the Sioux Quartzite Formation containing no greater than 4.0 percent non-Class A aggregate. Do not blend or add non-Class A aggregate to Class A aggregate.

B.2 Class B

Provide crushed rock from other bedrock sources such as carbonate and metamorphic rocks (Schist).

B.3 Class C

Provide natural or partly crushed natural gravel obtained from a natural gravel deposit.

B.4 Class D

Provide 100 percent crushed natural gravel produced from material retained on a square mesh sieve with an opening at least twice as large as Table 3139-2 allows for the maximum size of the aggregate in the composite asphalt mixture. Ensure the amount of carryover, material finer than the selected sieve, no greater than 10 percent of the Class D aggregate by weight.

B.5 Class E

Provide a mixture consisting of at least two of the following classes of approved aggregate:

- (1) Class A,
- (2) Class B, and
- (3) Class D.

B.6 Steel Slag

Steel slag cannot exceed 25 percent of the total mixture aggregate and must be free of metallic and other mill waste. The Engineer will accept stockpiles if the total expansion is no greater than 0.50 percent as determined by ASTM D 4792

B.7 Taconite Tailings

Obtain taconite tailings from ore mined westerly of a north-south line located east of Biwabik, Minnesota (R15W-R16W) or from ore mined in southwestern Wisconsin.

B.8 Recycled Asphalt Shingles (RAS)

Provide recycled asphalt shingles manufactured from waste scrap asphalt shingles (MWSS) or from tear-off scrap asphalt shingles (TOSS). Consider the percentage of RAS used as part of the maximum allowable Recycled Asphalt Pavement (RAP) percentage. See Table 3139-3.

B.8.a RAS Gradation Laboratory Manual Method 1801

Provide RAS in accordance with the following gradation requirements:

Sieve size	Percent passing
½ in [12.5 mm]	100
No. 4 [4.75 mm]	90

B.8.b Binder Content

Determine the binder content using chemical extraction meeting the requirements of Laboratory Manual Method 1851 or Method 1852.

B.8.c Bulk Specific Gravity

The Contractor may use an aggregate bulk specific gravity (Gsb) of 2.650 in lieu of determining the shingle aggregate Gsb in accordance with Laboratory Manual Method 1205.

B.8.d Waste Materials

Do not allow extraneous materials including metals, glass, rubber, nails, soil, brick, tars, paper, wood, and plastics greater than 0.5 percent by weight of the graded aggregate as determined by material retained on the No. 4 [4.75 mm] sieve as specified in Laboratory Manual Method 1801.

B.8.e Stockpile

Do not blend an RAS stockpile with other salvage material. Do not blend MWSS and TOSS. The Contractor may blend virgin sand material with RAS to minimize agglomeration if the Contractor accounts for the blended sand in the final mixture gradation.

B.8.f Certification

Ensure the processor provides RAS certification on the following Department forms: *Scrap Asphalt Shingles from Manufacture Waste* or *Tear-Off Scrap Asphalt Shingles* available on the Department's website at the Bituminous Engineering home page.

B.9 Crushed Concrete and Salvaged Aggregate

The Contractor may incorporate no greater than 50 percent of crushed concrete and salvaged aggregate in non-wear mixtures. Do not use crushed concrete in wearing courses.

B.10 Ash

The Department will allow sewage sludge ash and waste incinerator ash as an aggregate source at a maximum of 5 percent of the total weight of the mixture. Only use sewage sludge ash in the mixture that meets the requirements of the Tier II hazard evaluation criteria as approved by the Engineer, in conjunction with the Environmental Assessment Engineer. Only use waste incinerator ash sources approved by the Engineer, in conjunction with the Environmental Assessment Engineer.

B.11 Recycled Asphalt Pavement (RAP)

B.11.a Aggregate Angularity

Provide combined RAP and virgin aggregates that meet the composite coarse and fine aggregate angularity for the mixture being produced.

B.11.b Objectionable Material

Do not use RAP containing objectionable materials, including metal, glass, wood, plastic, brick, or rubber.

B.11.c Asphalt Binder Content

Determine the asphalt binder content using the Laboratory Manual Methods 1851 and 1852.

B.11.d Bulk Specific Gravity

Determine the bulk specific gravity in accordance with Laboratory Manual Method 1205 or 1815.

C Quality

C.1 Los Angeles Rattler Test Laboratory Manual Method 1210

Ensure a coarse aggregate loss no greater than 40 percent.

C.2 Soundness (Magnesium Sulfate)..... Laboratory Manual Method 1219

Maximum loss after 5 cycles on the coarse aggregate fraction (material retained on No. 4 [4.75 mm] sieve for any individual source within the mix) as follows:

- (1) Percent passing the $\frac{3}{4}$ in [19 mm] sieve to percent retained on the $\frac{1}{2}$ in [12.5 mm] sieve — $\leq 14\%$,
- (2) Percent passing the $\frac{1}{2}$ in [12.5 mm] sieve to percent retained on the $\frac{3}{8}$ in [9.5 mm] sieve — $\leq 18\%$,
- (3) Percent passing the $\frac{3}{8}$ in [9.5 mm] sieve to percent retained on the No. 4 [4.75 mm] sieve — $\leq 23\%$,
- (4) For the composite if all three size fractions are tested, the composite loss — $\leq 18\%$, and the Engineer will grant acceptance if:
 - (4.1) If the Contractor meets the composite requirement, but fails to meet at least one of the individual components, the Engineer may accept the source if each individual component is no greater than 110 percent of the requirement for that component.
 - (4.2) If the Contractor meets each individual component requirement, but fails to meet the composite, the Engineer may accept the source if the composite is no greater than 110 percent of the requirement for the composite.

Do not use coarse aggregate that exceeds the requirements in this section for material passing the No. 4 [4.75 mm] sieve.

C.3 Spall Materials and Lumps..... Laboratory Manual Method 1219

Stop asphalt production if the percent of spall or lumps measured in the stockpile or cold feed exceeds the values in Table 3139-3. Determine lump compliance by dry batching.

C.4 Insoluble Residue Test..... Laboratory Manual Method 1221

If using Class B carbonate materials ensure the portion of the insoluble residue passing the No. 200 [75 μ m] sieve is no greater than 10 percent.

D Gradation

Ensure the aggregate gradation broad bands meet the following requirements in accordance with AASHTO T-11 (passing the No. 200 [75 μ m] wash) and AASHTO T-27.

Table 3139-2				
Aggregate Gradation Broad Bands (percent passing of total washed gradation)				
Sieve size	A	B	C	D
1 in [25.0 mm]	—	—	100	—
$\frac{3}{4}$ in [19.0 mm]	—	100*	85 – 100	—
$\frac{1}{2}$ in [12.5 mm]	100*	85 – 100	45 – 90	—

Sieve size	A	B	C	D
$\frac{3}{8}$ in [9.5 mm]	85 – 100	35 – 90	—	100
No. 4 [4.75 mm]	25 – 90	30 – 80	30 – 75	65 – 95
No. 8 [2.36 mm]	20 – 70	25 – 65	25 – 60	45 – 80
No. 200 [0.075 mm]	2.0 – 7.0	2.0 – 7.0	2.0 – 7.0	3.0 – 8.0
* The Contractor may reduce the gradation broadband for the maximum aggregate size to 97 percent passing for mixtures containing RAP, if the oversize material originates from the RAP source. Ensure the virgin material meets the requirement of 100 percent passing the maximum aggregate sieve size.				

Aggregate Blend Property	Traffic Level (20 year Design ESALs in millions)			
	2 (<1)	3 (1–3)	4 (3–10)	5 (10–30)
Minimum Coarse Aggregate Angularity (ASTM D5821)				
(One face/Two face), %- Wear	30/—	55/—	85/80	95/90
(One face/Two face), %- Non-Wear	30/—	55/—	60/—	80/75
Minimum Fine Aggregate Angularity (FAA) (AASHTO T 304, Method A)				
%-Wear	40	42	44	45
%-Non-Wear	40	40	40	40
Flat and Elongated Particles, Maximum % by weight (ASTM S 4791)	—	10 (5:1 ratio)	10 (5:1 ratio)	10 (5:1 ratio)
Minimum Sand Equivalent (AASHTO T 176)	—	—	45	45
Maximum Total Spall in fraction retained on the No. 4 [4.75 mm] sieve				
Wear	5.0	2.5	1.0	1.0
Non-Wear	5.0	5.0	2.5	2.5
Maximum Spall Content in Total Sample				
Wear	5.0	5.0	1.0	1.0
Non-Wear	5.0	5.0	2.5	2.5
Maximum Percent Lumps in fraction retained on the No. 4 [4.75 mm] sieve	0.5	0.5	0.5	0.5

Table 3139-3 Mixture Aggregate Requirements				
Aggregate Blend Property	Traffic Level (20 year Design ESALs in millions)			
	2 (<1)	3 (1–3)	4 (3–10)	5 (10–30)
Class B Carbonate Restrictions				
Maximum % –No. 4 [4.75 mm] sieve, Final Lift/All other Lifts	100/100	100/100	80/80	50/80
Maximum % +No. 4 [4.75 mm] sieve, Final Lift/All other Lifts	100/100	100/100	50/100	0/100
Maximum allowable scrap shingles-MWSS* Wear/Non-Wear	5/5	5/5	5/5	5/5
Maximum allowable scrap shingles-TOSS* Final Lift/All other Lifts	5/5	5/5	0/0	0/0
* MWSS is manufactured waste scrap shingle and TOSS is tear-off scrap shingle.				

3139.3 PERMEABLE ASPHALT STABILIZED STRESS RELIEF COURSE (PASSRC) AND PERMEABLE ASPHALT STABILIZED BASE (PASB) REQUIREMENTS

A Restrictions

Do not use recycled materials including glass, concrete, bituminous, shingles, ash, and steel slag.

B Gradation

The gradation limits are also considered the Job Mix Formula (JMF) limits.

B.1 PASB

Table 3139-4 PASB Aggregate Gradation	
Sieve Size	Percent Passing
1½ in [37.5 mm]	100
1 in [25.0 mm]	95 – 100
¾ in [19.0 mm]	85 – 95
⅜ in [9.5 mm]	30 – 60
No. 4 [4.75 mm]	10 – 30
No. 8 [2.36 mm]	0 – 10
No. 30 [600 µm]	0 – 5
No. 200 [75 µm]	0 – 3

B.2 PASSRC

Table 3139-5 PASSRC Aggregate Gradation	
Sieve Size	Percent Passing
5/8 in [16.0 mm]	100
1/2 in [12.5 mm]	85 – 100
3/8 in [9.5 mm]	50 – 100
No. 4 [4.75 mm]	0 – 25
No. 8 [2.36 mm]	0 – 5

C Quality

Requirements will meet all of 3139.2.C, “Quality.”

D Mixture Quality Requirements

Table 3139-6 Mixture Aggregate Requirements for PASSRC & PASB	
Aggregate Blend Property	
Coarse Aggregate Angularity, (ASTM D5821) (one face/two face) %	
PASSRC*	95/-
PASB*	-/65
Total Spall in fraction retained on the No. 4 [4.75 mm] sieve	3.0
Maximum Spall Content in Total Sample	5.0
Maximum Percent Lumps in fraction retained on the No. 4 [4.75 mm] sieve	0.5
* Carbonate Restrictions: If Class B (as defined in 3139.2.B.2, “Class B”), crushed carbonate quarry rock (limestone or dolostone), is used in the mixture, or if carbonate particles in the material retained on the No. 4 [4.75 mm] sieve exceeds 55 percent, by weight, the minus No. 200 [0.075 mm] sieve size portion of the insoluble residue shall not exceed 10 percent.	

**3139.4 ULTRA THIN BONDED WEARING COURSE (UTBWC)
REQUIREMENTS**

A Restrictions

Do not use recycled materials including glass, concrete, bituminous, shingles, ash, and steel slag.

B Coarse Aggregate

Provide a Class A aggregate, as defined in 3139.2.B.1, "Class A," in accordance with the following requirements:

Table 3139-7 UTBWC Coarse Aggregate Requirements		
Tests	Laboratory Manual Method	Limit, %
Flat and elongated ratio at 3:1	1208	≤ 25
Bulk Specific Gravity	1204	—
Los Angeles Rattler Test (LAR)	1210	≤ 40

C Fine Aggregate

Provide fine aggregate, passing the No. 4 [4.75 mm] sieve in accordance with the following requirements:

Table 3139-8 Fine Aggregate Requirements		
Tests	Method	Limit, %
Sand equivalent	AASHTO T 176	≥ 45
Bulk Specific Gravity	Laboratory Manual Method 1204	—
Uncompacted void content	AASHTO T 304	≥ 40

3139.5 SAMPLING AND TESTING

Perform sampling, sieve analysis, lumps, crushing, and shale testing meeting the requirements of the Laboratory Manual.

3146 BINDER SOIL

3146.1 SCOPE

Provide soil material for use as a binding agent in soil stabilized aggregate mixtures for base and surface courses.

3146.2 REQUIREMENTS

A Composition

Provide binder soil with the following characteristics:

- (1) Consists of fine soil particles;

- (2) May contain particles no larger than the maximum aggregate size allowed for the specified material;
- (3) Contains no sod, roots, plants, organics, or other deleterious material; and
- (4) Contains no fly ash, incinerator ash, other manufacturing byproducts, or waste material.

B Physical Properties

The liquid limit of the portion of the binder soil passing the No. 40 [425 μ m] sieve must be no greater than 45.

3146.3 SAMPLING AND TESTING

A Sampling

The Engineer will sample binder soil in accordance with the Grading and Base Manual.

B Liquid Limit

The Engineer will test the liquid limit of binder soil as in accordance with Laboratory Manual Method 1303.

C Sieve Analysis

The Engineer will perform the sieve analysis in accordance with the Grading and Base Manual.

3149 GRANULAR MATERIAL

3149.1 SCOPE

Provide certified granular materials for use in roadway embankment.

3149.2 REQUIREMENTS

Use material sources meeting the requirements of 1601, "Source of Supply and Quality."

Provide certified granular material meeting the specified gradation.

Report the No. 200 sieve results to the nearest 0.1 percent and all other sieves to the nearest whole number.

Certify all granular materials on Form 24346-02, *Certification of Aggregate and Granular Materials*, located on the Grading and Base webpage.

Provide certified granular material that has similar appearance, texture, moisture content, and performance characteristics.

A Granular Materials

A.1 Virgin Materials

Provide virgin aggregate meeting the following requirements:

- (1) Consists of naturally occurring mineral materials,
- (2) Contains no topsoil, organics, or severely weathered rock, and
- (3) Insoluble residue test results for the portion of quarried/bedrock carbonate aggregates (limestone or dolostone), passing the No. 200 sieve is no greater than 10 percent.

A.2 Recycled Materials

The Contractor may substitute recycled aggregates for virgin aggregates if the recycled aggregates meet the following requirements:

- (1) Recycled aggregates consist only of recycled asphaltic pavement (RAP), recycled concrete materials, and recycled aggregate materials;
- (2) The bitumen content of the blended material is no greater than 3.0 percent;
- (3) The recycled concrete material is:
 - (3.1) No greater than 75 percent of the material blend,
 - (3.2) No greater than 10 percent masonry block.

Only place recycled concrete materials below subsurface drainage structures, e.g. perforated drain tile.

B Granular Material Gradations

Provide granular materials meeting the following requirements:

B.1 Granular Material

Provide granular material meeting the following requirements:

Table 3149-1 Granular Material Gradation Ratio Requirement	
Percent Passing Ratio	Requirement
No. 200/1 in [75 μ m/25 mm]	0 – 20%

B.2 Select Granular Material

Provide select granular material meeting the following requirements:

Table 3149-2	
Select Granular Material Gradation Ratio Requirement	
Percent Passing Ratio	Requirement
No. 200/1 in [75 μ m/25 mm]	0 – 12%

B.3 Select Granular Material Modified

Provide select granular material modified meeting the following requirements:

Table 3149-3	
Select Granular Material Modified Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 40/No. 10 [425 μ m/2.0 mm]	0 – 65%
No. 200/No. 10 [75 μ m/2.0 mm]	0 – 10%

B.4 Select Granular Material Modified 15 Percent

Provide select granular material modified 15 percent meeting the following requirements:

Table 3149-4	
Select Granular Material Modified 15% Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 200/1 in [75 μ m/25 mm]	0 – 15%

B.5 Select Granular Material Modified 10 Percent

Provide select granular material modified 10 percent meeting the following requirements:

Table 3149-5	
Select Granular Material Modified 10% Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 200/1 in [75 μ m/25 mm]	0 – 10%

B.6 Select Granular Material Modified 7 Percent

Provide select granular material modified 7 percent meeting the following requirements:

Table 3149-6	
Select Granular Material Modified 7% Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 200/1 in [75 μ m/25 mm]	0 – 7%

B.7 Select Granular Material Modified 5 Percent

Provide select granular material modified 5 percent meeting the following requirements:

Table 3149-7 Select Granular Material Modified 5% Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 200/1 in [75 µm/25 mm]	0 – 5%

C Stabilizing Aggregate

Provide stabilizing aggregate meeting the following requirements:

Table 3149-8 Stabilizing Aggregate Gradation Requirements	
Sieve Size	Percent Passing
1 in [25 mm]	100
¾ in [19 mm]	90 – 100
⅜ in [9.5 mm]	50 – 95
No. 4 [4.75 mm]	35 – 85
No. 10 [2.0 mm]	20 – 70
No. 40 [425 µm]	10 – 45
No. 200 [75 µm]	7 – 15

The minimum crushing requirement is 10 percent.

D Backfill Materials

D.1 Granular Backfill

Provide backfill materials meeting the following requirements:

Table 3149-9 Granular Backfill Gradation Requirement	
Sieve Size	Percent Passing
3 in [25 mm]	100

Table 3149-10 Granular Backfill Gradation Ratio Requirement	
Percent Passing Ratio	Requirement
No. 200/1 in [75 µm/25 mm]	0 – 20%

D.2 Structural Backfill

Provide structural backfill in accordance with the following requirements:

Table 3149-11	
Structural Backfill Gradation Requirement	
Sieve Size	Percent Passing
¾ in [19 mm]	100

Table 3149-12	
Structural Backfill Gradation Ratio Requirements	
Percent Passing Ratio	Requirement
No. 40/No. 10 [425 µm/2.00 mm]	0 – 65%
No. 200/No. 10 [75 µm/2.00 mm]	0 – 10%

- (1) Provide screened material meeting the requirements of 3137.2.B.3, “Classification,” i.e. Class C.
- (2) Provide material with a minimum angle of friction (Φ) of 34° in accordance with AASHTO T 236. Perform tests on the sample portion passing the No. 10 sieve and compacted to 95 percent of AASHTO T 99, Method C, at optimum moisture content.

D.3 Select Granular Backfill

Provide backfill materials meeting the following requirements:

Table 3149-13	
Select Granular Backfill Gradation Requirement	
Sieve Size	Percent Passing
3 in [25 mm]	100

Table 3149-14	
Select Granular Backfill Gradation Ratio Requirement	
Percent Passing Ratio	Requirement
No. 200 [75 µm]/ 1 in [25 mm]	0 – 12%

E Aggregate Backfill

Provide aggregate backfill materials meeting the following requirements:

Table 3149-15	
Aggregate Backfill Gradation Requirements	
Sieve Size	Percent Passing
2 in [25 mm]	100
No. 4 [4.75 mm]	35 – 100
No. 10 [2.00 mm]	20 – 70
No. 40 [425 µm]	10 – 35
No. 200 [75 µm]	3 – 10

F Granular Bedding

Provide granular bedding materials meeting the following requirements:

Table 3149-16	
Granular Bedding Gradation Requirements	
Sieve Size	Percent Passing
1 in [25 mm]	100
No. 200 [75 µm]	0 – 10

G Aggregate Bedding

Provide aggregate bedding meeting one of the following requirements:

G.1 Fine Aggregate Bedding

Provide fine aggregate bedding material meeting the gradation and crushing requirements in 3138, “Aggregate for Base and Surface Courses,” for Class 5.

G.2 Coarse Aggregate Bedding

Provide 100% virgin coarse aggregate bedding material meeting the following requirements:

Table 3149-17	
Coarse Aggregate Bedding Gradation Requirements	
Sieve Size	Percent Passing
1½ in [37.5 mm]	100
No. 4 [4.75 mm]	0 – 10

G.3 Conduit Aggregate Bedding

Provide 100% virgin coarse aggregate bedding material meeting the following requirements:

Table 3149-18 Conduit Aggregate Bedding Gradation Requirements	
Sieve Size	Percent Passing
No. 4 [4.75 mm]	100
No. 200 [75 µm]	0 – 8

H Coarse Filter Aggregate

Provide 100 percent virgin material meeting the following requirements:

Table 3149-19 Coarse Filter Aggregate Gradation Requirements	
Sieve Size	Percent Passing
1 in [25 mm]	100
¾ in [19 mm]	85 – 100
⅜ in [9.5 mm]	30 – 60
No. 4 [4.75 mm]	0 – 10

I Medium Filter Aggregate

Provide naturally rounded and 100 percent virgin aggregate meeting the following requirements:

Table 3149-20 Medium Filter Aggregate Gradation Requirements	
Sieve Size	Percent Passing
¾ in [19 mm]	100
⅜ in [9.5 mm]	50 – 95
No. 4 [4.75 mm]	20 – 60
No. 10 [2.00 mm]	0 – 15
No. 40 [425 µm]	0 – 4
No. 200 [75 µm]	0 – 2

- (1) The maximum shale and soft rock content of the material retained on the No. 4 sieve is 5 percent.
- (2) The maximum carbonate content is 55 percent.
- (3) The maximum crushing content is 15 percent.

J Fine Filter Aggregate

Provide 100 percent virgin aggregate meeting the following requirements:

Table 3149-21	
Fine Filter Aggregate Gradation Requirements	
Sieve Size	Percent Passing
$\frac{3}{8}$ in [9.5 mm]	100
No. 4 [4.75 mm]	90 – 100
No. 10 [2.00 mm]	45 – 90
No. 40 [425 μ m]	5 – 35
No. 200 [75 μ m]	0 – 3

3149.3 SAMPLING AND TESTING

Sample and test at the rates specified in the Schedule of Materials Control.

A Sampling and TestingGrading and Base Manual

B Bitumen Content Laboratory Manual Method 1852 & 1853

Use Method 1852 if the bitumen content is beyond specifications if tested with Method 1853.

C Insoluble Residue Laboratory Manual Method 1221

3151 BITUMINOUS MATERIAL

3151.1 SCOPE

Provide bituminous materials consisting of asphalt binder, cut-back asphalt, and emulsified asphalt.

3151.2 REQUIREMENTS

Provide bituminous material from a certified source listed on the Approved/Qualified Products List meeting the following requirements for the type and grade required by the contract.

A Asphalt Binder

Only use Performance Grade (PG) Asphalt Binder meeting the requirements of AASHTO M 320 and the Combined State Binder Group Method of Acceptance for Asphalt Binder, available on the Asphalt Products page of the Approved/Qualified Products List.

Use asphalt binder supplier recommendations for mixing and compaction temperatures.

B Medium Curing Liquid Asphalt

Provide medium curing liquid asphalt meeting the requirements of AASHTO M 82. Only use cutback asphalt as approved by the Engineer.

C Emulsified Asphalt

Provide emulsified asphalt meeting the requirements of AASHTO M 140 for the type and grade required by the contract.

D Cationic Emulsified Asphalt

Provide cationic emulsified asphalt meeting the requirements of AASHTO M 208.

D.1 Diluted CSS-1h

Provide diluted CSS-1h meeting the requirements of AASHTO M 208 with the following modifications:

- (1) Dilute the CSS-1h at a rate of one part emulsion to one part water at the place of manufacture, and
- (2) Meets a distillation residue of at least 29 percent.

E Polymer Modified Cationic Emulsified Asphalt

E.1 CRS-2P

Provide polymer-modified cationic emulsified asphalt meeting the requirements of AASHTO M 316 CRS-2P with the following modifications:

- (1) Distilled at 400 °F [204 °C] for 15 min,
- (2) Meets a residue penetration from 100 to 150 dmm,
- (3) Meets a residue elastic recovery of at least 55 percent when measured using the AASHTO T 301 test method at 77 °F [25 °C], and
- (3) Produced using only polymer modified base asphalt. Do not use Latex modification.

E.2 CRS-2Pd- diluted CRS-2P

Provide diluted polymer-modified cationic emulsified asphalt meeting the requirements of AASHTO M-316 CRS-2P with the following modifications:

- (1) Distilled at 400 °F [204 °C] for 15 min,
- (2) Diluted at a rate of three parts emulsion to one part water, by volume, at the place of manufacture,
- (3) Meets a distillation residue of at least 50 percent,
- (4) Meets a residue penetration from 100 to 150 dmm,

- (5) Meets a residue elastic recovery of at least 55 percent, when measured using the AASHTO T 301 test method at 77 °F [25 °C], and
- (6) Produced using polymer modified base asphalt. Do not use Latex modification.

F Polymer Modified High Float Medium Set Emulsified Asphalt HFMS-2P

Ensure that emulsified asphalt is homogenous after thorough mixing provided separation has not been caused by freezing.

Perform the polymer modification step before the emulsification process.

Provide emulsified asphalt meeting the requirements of Table 3151-1.

Table 3151-1			
HFMS-2P Emulsified Asphalt Requirements			
Test	Method	Minimum	Maximum
Tests on emulsion:			
Viscosity, Saybolt Furol at 122 °F [50 °C],	AASHTO T 59	50 s	450 s
Storage stability test*, 24 h	AASHTO T 59	—	1.0%
Sieve test	AASHTO T 59	—	0.1%
Residue by distillation	AASHTO T 59	65%	—
Oil distillate by distillation	AASHTO T 59	—	3.0%
Tests on residue from distillation:			
Penetration at 77 °F [25 °C]	AASHTO T 49	100 dmm	200 dmm
Float test, 140 °F [60 °C]	AASHTO T 50	1,200s	—
Elastic recovery, at 77 °F [25 °C]	AASHTO T 301	58%	—
* After standing undisturbed for 24 hours, ensure the surface has a smooth, homogenous color.			
AASHTO T 59 with modifications to include a 329 °F ±9 °F [200 °C ±5 °C] maximum temperature to be held for a period of 15 min.			

G Ultrathin Bonded Wearing Course (UTBWC) Polymer Modified Emulsion Membrane

Provide a polymer modified emulsion membrane meeting the requirements of Table 3151-2:

Table 3151-2			
UTBWC Polymer Modified Emulsion Membrane Requirements			
Test	Method	Minimum	Maximum
Tests on emulsion:			
Viscosity, Saybolt Furol at 77 °F [25 °C]	AASHTO T 59	20 s	100 s
Storage stability test*, 24h	AASHTO T 59	—	1.0%
Sieve test	AASHTO T 59	—	0.05%
Residue by distillation	AASHTO T 59	63%	—
Oil distillate by distillation	AASHTO T 59	—	2.0%
Demulsibility, 12 oz [35 mL], 0.8% dioctyl sodium sulfosuccinate	AASHTO T 59	60%	—
Tests on residue from distillation:			
Penetration, at 77 °F [25 °C]	AASHTO T 49	60 dmm	150 dmm
Solubility in trichloroethylene	AASHTO T 44	97.5%	—
Elastic recovery, at 77 °F [25 °C]	AASHTO T 301	60%	—
* After standing undisturbed for 24 h, ensure the surface has a smooth, homogenous color.			
AASHTO T 59, except at no greater than 392 °F ± 9 °F [200 °C ± 5 °C] for 15 min.			

H Micro Surfacing Emulsified Asphalt

Provide a polymer modified, CSS-1h bituminous material meeting the requirements of Table 3151-3:

Table 3151-3 Micro Surfacing Emulsified Asphalt Requirements		
Test	Method	Requirement
Quality on emulsion:		
Residue after distillation*	AASHTO T 59	≥ 62%
Quality on residue:		
Softening point	AASHTO T 53	≥ 135 °F [57 °C]
Penetration, at 77 °F [25 °C]	AASHTO T 49	100 – 200 dmm
Absolute Viscosity, at 140 °F [60 °C]	ASTM D 2171	≥ 8,000 P [800 Pa•s]
* AASHTO T 59, except the temperature for the distillation procedure shall be held at 350 °F ±9 °F [177 °C ±5 °C] for 20 min. Complete the entire distillation procedure within 60 min from the first application of heat.		

Use natural latex polymers or Department-approved manmade latex polymer. Performance requirements for approval of micro surfacing emulsified asphalt made with manmade polymers are located in the contract.

3151.3 SAMPLING AND TESTING

Provide Bill of Ladings with a certification statement that the bituminous material meets the requirements in 3151.2, "Requirements." Sample at rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

The Engineer, in conjunction with the Materials Engineer, will test samples submitted and certified by the manufacturer as representative of the bituminous material to be provided.

3161 ANTI-STRIPPING ADDITIVE

3161.1 SCOPE

Provide anti-stripping additives to improve the moisture sensitivity and adhesion properties between the asphalt binder and aggregate.

3161.2 REQUIREMENTS

Provide anti-stripping additives meeting the following requirements:

- (1) Composition meeting the requirements of AASHTO M 320,
- (2) Miscible with all types of bituminous materials without showing separation or settlement,

- (3) Not affecting the long term stability of the asphalt binder, and
- (4) With a concentration meeting the requirements of the Modified Lottman Test (Laboratory Manual Method 1813).

Ship and store anti-stripping additives in containers provided by the manufacturer and labeled with the following information:

- (1) Name of the manufacturer,
- (2) Trade name or trade mark,
- (3) Manufacturer's lot number,
- (4) Date of manufacture, and
- (5) Net weight of the contents.

Maintain uniform consistency from drum to drum within shipments.

3161.3 SAMPLING AND TESTING — (BLANK)

3165 ASPHALT PRIMER FOR DAMPPROOFING AND WATERPROOFING

3165.1 SCOPE

Provide asphalt primer for damp proofing and waterproofing concrete and masonry surfaces above or below ground level

3165.2 REQUIREMENTS

Provide asphalt primer meeting the requirements of ASTM D 41.

3165.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.

3166 ASPHALT FOR DAMPPROOFING AND WATERPROOFING

3166.1 SCOPE

Provide asphalt for use as a mopping coat for dampproofing or as a plying or mopping cement in the construction of a membrane system of waterproofing.

3166.2 REQUIREMENTS

Provide Type II asphalt meeting the requirements of ASTM D 449, unless otherwise required by the contract.

3166.3 SAMPLING AND TESTING

Provide samples at rates and sizes meeting the requirements of the Schedule of Materials Control or as required by the contract.