SECTION 703—AGGREGATE

703.1 FINE AGGREGATE—

(a) General. Fine aggregate is natural or manufactured sand consisting of hard, durable, and uncoated inert particles reasonably free from clay, silt, vegetation, and other deleterious substances such as reactive chert, gypsum, iron sulfide, amorphous silica, and hydrated iron oxide. Substances that are present in amounts large enough to cause inconsistent performance in the properties of bituminous concrete or plastic or hardened Portland cement concrete are considered deleterious. Spent foundry sand may be used as fine aggregate in asphalt concrete and flowable fill.

Obtain fine aggregate with physical properties conforming to Table A from a source listed in Bulletin 14 or approved by the MTD.

1. Natural Sand. Natural sand is fine aggregate resulting from glacial or water action. Fine aggregate produced simultaneously with gravel coarse aggregate may contain crushed particles.

2. Manufactured Sand. Manufactured sand is fine aggregate from the controlled mechanical breakdown of rock, air-cooled blast furnace slag, or air-cooled steel slag into sound, approximately cubical particles. The Department will accept manufactured sand only if it is the primary product of the crushing operation and sized by a sand classifier. However, for fine aggregate used in bituminous concrete mixtures, a sand classifier is not required.

Fine aggregate manufactured from limestone may not be used in concrete wearing surfaces.

Fine aggregate manufactured from steel slag may not be used in cement concrete or mortar mixtures. Steel slag fine aggregate may only be used in bituminous wearing courses with the approval of the MTD; however, do not use steel slag fine aggregate in conjunction with steel slag coarse aggregate. Provide steel slag fine aggregate that is uniform in density and quality. Cure steel slag fine aggregate according to the following procedure:

- After gradation preparation, place steel slag fine aggregate, whether reclaimed from an old stockpile or processed directly from the steel-making process, in a controlled stockpile. Completely soak the steel slag fine aggregate with water before or during stockpiling. Submit the method of constructing and controlling the stockpile to the Representative for review.

- Maintain the stockpile in a uniform moist condition for a period of not less than 6 months. After the minimum cure period, the Representative will sample and test the stockpile for expansive characteristics according to PTM No. 130. The Representative will approve the stockpile for use if the average total volumetric expansion according to PTM No. 130 is less than 0.50%.

- If the stockpile fails expansion criterion, continue curing the stockpile for a minimum of 2 additional months. The Representative will resample and retest the stockpile after the required additional cure period.

The MTD will evaluate the quality of fine aggregates by conducting petrographic analysis according to ASTM C 295 and other tests necessary to demonstrate that required construction of acceptable durability can be achieved.

(b) Production Testing.

1. Personnel and Equipment. Provide and assign to the work a PENNDOT Certified Aggregate Technician who will test fine aggregate at the source according to the requirements listed in Bulletin 14.

Provide the following equipment for acceptance testing and for developing and maintaining a QC program to ensure compliance with specification requirements during production:

No.	Equipment
1	Fine aggregate mechanical sieve shaker with timer
1	Sample splitter having an even number of equal width chutes that discharge alternately to each side of the splitter. A minimum of twelve total chutes is required. The minimum width of the individual chutes is to be at least 50% larger than the largest particles in the sample and the maximum width of the individual chutes is to be 20 mm (3/4-inch). Include two receptacles to hold the samples following splitting. Splitter design must allow samples to flow smoothly without restriction or loss of material.
2	Set of standard sieves for fine aggregate.
1	Balance conforming to the requirements of AASHTO M 231 for the class of general purpose scale required for the principal sample mass (weight) of the sample being tested, PTM No. 616.
1	Oven capable of maintaining a uniform temperature of 110 °C ± 5 °C (230F ± 9F).
1	Thermometer, ASTM E 1.

Provide a separate set of sieves for exclusive use by the Department for acceptance testing. The remaining equipment is to be shared by the producer and the Department. If time or space conflicts arise, or if the Department does not have consistent access to shared equipment when acceptance testing is to be performed, provide a separate set of equipment for the Department. Perform routine maintenance and repair all equipment whether shared or for exclusive Department use. Have balances calibrated annually by an independent agency acceptable to the Department. Verify oven temperatures every 120 days using the thermometer required above. Maintain accurate records of calibration and temperature checks. Ensure that the producer has back-up equipment available so that no acceptance tests are missed.

Provide the following office equipment for exclusive Department use:

No.	Equipment
1	Desk and chair
1	Electronic calculator with tape
1	Work table 760 mm x 2100 mm x 760 mm high (2 1/2 feet by 7 feet by 2 1/2 feet high)
1	Four-drawer, fire resistant (D-label) metal file cabinet
1	Closet or locker for storage

If testing equipment is to be shared, provide a minimum of 14 m^2 (150 square feet) of office and workspace. If a separate set of testing equipment is provided for the Department, provide a minimum of 22 m^2 (240 square feet) of office and workspace to accommodate both the office and the testing equipment. The office and workspace area provided shall be heated/air-conditioned and have on-site access to a water cooler, telephone, fire extinguisher, and sanitary toilet facilities.

2. Testing and Documentation. During production, provide the necessary incidental equipment to conduct and document the specified tests.

Perform strength ratio and soundness tests at intervals sufficient to ensure the quality of the material. The strength ratio and soundness tests may be performed by the producer, a laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL), or other inspection agency approved by the MTD.

Document the results of tests made during production and make them available to the Department upon request. The equipment and test result documentation is a condition for source acceptance, source requalification, and listing in Bulletin 14.

(c) Grading and Quality Requirements.

1. Gradation. Table A lists the extreme limits for determining the suitability of supply sources.

Control the grading of Type A Fine Aggregate so that the fineness modulus of at least nine out of ten consecutive test samples from a single source delivered to a project or plant varies less than ± 0.20 from the average fineness modulus of the consecutive test samples. Determine the fineness modulus according to PTM No. 501.

For bituminous mixtures:

- If directed, vary the gradations within the limits listed in Table A.
- A blend of fine aggregates may be used if the proposed gradation limits for blending are approved by the District Executive in writing.
- If filler is required, provide fine aggregate conforming to the gradation of Table A and use cement, cement dust, fly ash, or fines from the crushing of stone, gravel, or slag that are reasonably free of clay.

2. Material Finer than the 75 µm (No. 200) Sieve. Determine the loss by washing according to PTM No.100.

3. Minimum Strength Ratio. AASHTO T 21. If color No. 5 or darker results, determine the minimum strength ratio according to AASHTO T 71.

4. Soundness Test. Determine the percentage of mass (weight) loss after five cycles of immersion and drying using a sodium sulfate solution according to PTM No. 510.

TABLE A
Fine Aggregate
Grading and Quality Requirements

	Cement Concrete Sand	Bituminous Concrete Sand Type B				Mortar Sand
Sieve Size	Type A	#1	#2	#3	Filler	Type C
9.5 mm (3/8-inch)	100	100	—	100	—	—
4.75 mm (No. 4)	95-100	95-100	100	80-100	—	100
2.36 mm (No. 8)	70-100	70-100	95-100	65-100	—	95-100
1.18 mm (No. 16)	45-85	40-80	85-100	40-80	—	—
600 µm (No. 30)	25-65	20-65	65-90	20-65	100	—
300 µm (No. 50)	10-30	7-40	30-60	7-40	95-100	—
150 µm (No. 100)	0-10	2-20	5-25	2-20	90-100	0-25
75 µm (No. 200)	—	0-10	0-5	0-10	70-100	0-10
Material Finer Than 75 µm (No. 200) Sieve Max. Percent Passing	3	—	—	—	—	—
Strength Ratio Min. Percent	95	—	—	—	—	95
Soundness Test Max. Loss Percent	10	15	15	15	—	10
Fineness Modulus	2.30-3.15	—	—	—	—	1.6-2.5

703.2 COARSE AGGREGATE—

(a) General. Coarse aggregate consists of hard, tough, durable, and uncoated inert particles reasonably free from clay, silt, vegetation, and other deleterious substances such as reactive chert, gypsum, iron sulfide, amorphous silica, and hydrated iron oxide. Substances that are present in amounts large enough to cause inconsistent performance in the properties of bituminous concrete or plastic or hardened Portland cement concrete are considered deleterious.

The MTD will evaluate the quality of coarse aggregates by conducting petrographic analysis according to ASTM C 295 and other tests necessary to demonstrate that required construction of acceptable durability can be achieved.

Furnish coarse aggregate crushed and prepared from one of the materials described below with physical properties conforming to Tables B, C, and D. Obtain coarse aggregate from a source listed in Bulletin 14 or approved by the MTD before use.

1. Stone. Durable stone free from slate texture or cleavage planes.

2. Gravel. Durable gravel particles. For use in cement concrete, wash thoroughly during production. For use in heavy duty bituminous base courses, heavy duty binder courses, and all bituminous wearing courses, a minimum of 85% crushed particles with at least two faces resulting from fracture is required. For use as No. OGS, a minimum of 75% crushed particles with at least three faces resulting from fracture is required. For all Type A use, the maximum allowable absorption determined according to AASHTO T 85 is 3.0%; however, this restriction does not apply to dredged river gravel used in Portland cement concrete. For all Type B use, the maximum allowable absorption determined according to AASHTO T 85 is 3.5%.

3. Blast Furnace Slag. By-product of a pig-iron making process. Tough, hard, and durable pieces of air-cooled blast furnace slag. Blast furnace slag is excluded from the abrasion requirements. The density (unit weight) of blast furnace slag cannot be less than 1120 kg/m^3 (70 pounds per cubic foot).

4. Steel Slag. By-product of a steel making process. Tough, hard, and durable pieces of steel slag reasonably uniform in density and quality. After crushing, grading, and forming a stockpile, take a sample from the stockpile and submit it to the MTD for testing of expansive characteristics. The MTD will accept the stockpile for use if the total expansion determined according to PTM No. 130 is less than 0.50%. Once a stockpile is accepted, do not add to it if it is for Department use. If the stockpile fails expansion requirements, cure the aggregate stockpile as follows:

- Rework the stockpile and soak the aggregate completely with water.
- Submit the proposed method of constructing and controlling the stockpile during the cure period for review and acceptance.
- Maintain the aggregate in a uniformly moist condition in the stockpile for a period of at least 6 months. Take a sample after this curing period and submit it to the MTD for testing according to PTM No. 130.
- The Representative will accept the stockpile for use if the total expansion is less than 0.50%. If the stockpile still fails the expansion requirement, continue curing for at least 2 additional months before resampling and retesting.

Aggregate manufactured from steel slag is not acceptable for pipe or structure backfill or in cement concrete. Steel slag may be used for subbase, selected granular material, shoulders, selected material surfacing, and in bituminous surface courses.

5. Granulated Slag. By-product of an iron-making process. Granulated blast furnace slag is the granular glassy material formed when molten slag from iron-making is rapidly quenched by immersion in water and contains not more than 3% total iron reported as Fe_2O_3. Provide material containing not more than 20% by mass (weight) of substances that are not granulated slag. Use material with a dry rodded density (unit weight) determined according to AASHTO T 19 of not more than 1300 kg/m^3 (80 pounds per cubic foot). Provide uniform material having a maximum size of 50 mm (2 inches) and not more than 20% passing the 150 µm (No. 100) sieve. Granulated slag may only be used for subbase material as specified in Section 350.

6. Lightweight Aggregate. Acceptable types of lightweight aggregate are as follows:

- Aggregate prepared by expanding or sintering products such as clay, shale, or slate.
- Aggregate prepared by processing natural materials such as pumice, scoria, or tuff.

Furnish lightweight aggregate conforming to AASHTO M 195, the soundness and abrasion limits for Type A aggregate as specified in Table B, and the following durability requirements.

- Aggregate Absorption Factor (PTM No. 526) Max. % 2.5
- Freeze-Thaw Resistance of Concrete, Decrease of Dynamic Modulus at 300 Cycles (AASHTO T 161, Procedure B, except that after 14 days of moist cure, dry the beams 76 mm x 102 mm x 406 mm at 22 °C ± 2 °C (3 inches by 4 inches by 16 inches at 72F ± 3F) and approximately 50% relative humidity for 14 days. Then soak the beams in water for 3 days before starting the freezing and thawing test.) Max. % 60
- Freeze-Thaw Resistance of Aggregate (PTM No. 525) Max. % 25

TABLE B
Coarse Aggregate
Quality Requirements

	Type A	Type B	Type C
Soundness, Max. %	10	12	20
Abrasion, Max. %	45******	45******	55******
Thin and Elongated Pieces, Max. %	15	20	—
Material Finer Than 75 µm (No. 200) Sieve, Max. %	*	*	10
Crushed Fragments, Min. %	55**	55**	50
Compact Density (Unit Weight), Min. kg/m³ (lbs./cu. ft.)	1100 (70)	1100 (70)	1100 (70)
Deleterious Shale, Max. %	2	2	10
Clay Lumps, Max. %	0.25	0.25	3
Friable Particles, Max. % (excluding shale)	1.0	1.0	—
Coal or Coke, Max. %	1	1	5
Glassy Particles, Max. %	4 or 10***	4 or 10***	—
Iron, Max. %	3*****	3*****	3*****
Absorption, Max. %	3.0****	3.5****	—
Total of Deleterious Shale, Clay Lumps, Friable Particles, Coal, or Coke Allowed, Max. %	2	2	15

* See Section 703.2(c)4.
** See Section 703.2(a)2.
*** See Section 703.2(c)10.
**** Gravel only. See Section 703.2(a)2.
***** See Section 703.2(c)11.
****** Blast Furnace Slag excluded. See Section 703.2(a)3.

7. Recycled Concrete. Salvaged and crushed concrete pavements and concrete highway structures from Department, county, or municipal projects for use as aggregate in subbase only. Other recycled concrete may be used in subbase if the concrete was made using materials approved by the Department. Provide recycled concrete conforming to Table B and Table C.

(b) Production Testing.

1. Personnel and Equipment. Provide and assign to the work a PENNDOT Certified Aggregate Technician who will test coarse aggregate at the source according to the requirements listed in Bullctin 14.

Provide the following equipment for acceptance testing and for developing and maintaining a QC program to ensure compliance with specification requirements during production.

No.	Equipment
1	Coarse aggregate mechanical sieve shaker with timer
1	Sample splitter having an even number of equal width chutes that discharge alternately to each side of the splitter. A minimum of eight total chutes is required. The minimum width of the individual chutes is to be at least 50% larger than the largest particles in the sample. Include two receptacles to hold the samples following splitting. Splitter design must allow samples to flow smoothly without restriction or loss of material.
2	Set of standard sieves for coarse aggregate.
1	Cylindrical metal measure (25 L (1 cubic foot)) AASHTO T 19
1	Balance conforming to the requirements of AASHTO M 231 for the class of general purpose scale required for the principle sample mass (weight) of the sample being tested, AASHTO T 85.
1	Platform scale conforming to the requirements of AASHTO M 231 for the class of general purpose scale required for the principle sample mass (weight) of the sample being tested. PTM No. 616.
1	Oven capable of maintaining a uniform temperature of 110 °C ± 5 °C (230F ± 9F).
1	Thermometer, ASTM E 1.

Provide a separate set of sieves for exclusive use by the Department for acceptance testing. The remaining equipment is to be shared by the producer and the Department. If time or space conflicts arise, or if the Department does not have consistent access to shared equipment when acceptance testing is to be performed, provide a separate set of equipment for the Department. Perform routine maintenance and repair of all equipment whether shared or for exclusive Department use. Have balances calibrated annually by an independent agency acceptable to the Department. Verify oven temperatures every 120 days using the thermometer required above. Maintain accurate records of calibration and temperature checks. Ensure that the producer has back-up equipment available so that no acceptance tests are missed.

Provide the following office equipment for exclusive Department use:

No.	Equipment
1	Desk and chair
1	Electronic calculator with tape
1	Work table 760 mm x 2100 mm x 760 mm high (2 1/2 feet by 7 feet by 2 1/2 feet high)
1	4-drawer, fire resistant (D-label) metal file cabinet
1	Closet or locker for storage

If testing equipment is to be shared, provide a minimum of 14 m^2 (150 square feet) of office and workspace. If a separate set of testing equipment is provided for the Department, provide a minimum of 22 m^2 (240 square feet) of office and workspace to accommodate both the office and the testing equipment. The office and workspace area provided shall be heated/air-conditioned and have on-site access to a water cooler, telephone, fire extinguisher, and sanitary toilet facilities.

2. Testing and Documentation. During production, provide the necessary incidental equipment to conduct and document the specified tests.

Perform soundness and abrasion tests at intervals sufficient to ensure the quality of the material. The soundness and abrasion tests may be performed by the producer, a laboratory accredited by the AMRL, or other inspection agency approved by the MTD.

Document the results of tests made during production and make them available to the Department upon request. The equipment and test result documentation is a condition for source acceptance, source requalification, and listing in Bulletin 14.

(c) Quality Requirements. The following notes are applicable to Table B.

1. Soundness. Determine the percentage of mass (weight) loss after five cycles of immersion and drying using a sodium sulfate solution according to PTM No. 510. The MTD may accept aggregate failing the test if it can be demonstrated in writing that the aggregate has a satisfactory service record in both pavements and structures. Acceptable aggregate produced from recycled concrete need not conform to soundness requirements since cementitious material cannot be evaluated with this test.

2. Abrasion. Determine the percentage of mass (weight) loss according to AASHTO T 96.

3. Thin and Elongated Particles. When directed, determine the percentage of particles retained on the 9.5 mm (3/8-inch) sieve that have a ratio greater than 1:5 (5:1) between the maximum and minimum dimensions of an imaginary enclosing rectangular prism. If the material retained on the 9.5 mm (3/8-inch) sieve constitutes less than 5.0% of the total mass (weight) of the test sample, do not determine the percentage of thin and elongated particles.

TABLE C
Size and Grading Requirements for Coarse Aggregates
(Based on Laboratory Sieve Tests, Square Openings)

AASHTO Number	Total Percent Passing													
	100 mm (4")	90 mm (3 1/2")	63 mm (2 1/2")	50 mm (2")	37.5 mm (1 1/2")	25.0 mm (1")	19.0 mm (3/4")	12.5 mm (1/2")	9.5 mm (3/8")	4.75 mm (No. 4)	2.36 mm (No. 8)	1.18 mm (No. 16)	150 µm (No. 100)	75 µm (No. 200) ***
1	100	90-100	25-60		0-15		0-5							
3			100	90-100	35-70	0-15		0-5						
467				100	95-100		35-70		10-30	0-5				
5					100	90-100	20-55	0-10	0-5					
57					100	95-100		25-60		0-10	0-5			
67						100	90-100		20-55	0-10	0-5			
7							100	90-100	40-70	0-15	0-5			
8								100	85-100	10-30	0-10	0-5		
10									100	85-100			10-30	
2A**				100			52-100		36-70	24-50	16-38*	10-30		
OGS**				100			52-100		36-65	8-40		0-12		

* Applies only for bituminous mixtures.
** PENNDOT Number
*** For 75 µm (No. 200), see Table D.

Note A: A combination of No. 7 and No. 5 may be substituted for No. 57, provided that not more than 50% or less than 30% of the combination is No. 7 size.

Note B: Provide No. OGS material that has a minimum average coefficient of uniformity of 4.0. The average coefficient of uniformity is defined as the average of the sublots within each lot. Determine the coefficient of uniformity according to PTM No. 149 each time the gradation is determined. The required minimum coefficient of uniformity for individual samples is 3.5. If the coefficient of uniformity of any sample falls below 3.5, reject the lot. Do not use the coefficient of uniformity in the multiple deficiency formula.

4. Material Finer than the 75 µm (No. 200) Sieve. Determine the loss by washing according to PTM No. 100 and Table D.

This test is not required for aggregate processed through a mechanical dryer for use in bituminous concrete; however, the aggregate is required to be clean and free of fines that would adversely affect the coating of the aggregate with bituminous material.

TABLE D
Material Passing the 75 µm (No. 200) Sieve —
(Based on Laboratory Sieve Tests, Square Openings)

Section	Specification	% Maximum
350	Subbase (No. 2A)	10
350	Subbase (No. OGS)	5
430	Bit. Wear. Crse. FB-2	2
431	Bit. Bind. Crse. FB-2	2
439	Bit. Wear. Crse. FB-1	2
440	Bit. Bind. Crse. FB-1	2
441	Bit. Bind. Crse. CP-2	2.0
450	Bit. Bind. Crse. DP-1	2.0
470	Bit. Seal Coat	1.0
471	Bit. Seal Coat w/ Precoat. Aggr.	2.0
480	Bit. Surf. Treatment	1.0
704	Cement Concrete	1
—	All other uses	2

5. Crushed Fragments. ASTM D 5821

6. Compact Density. AASHTO T 19, for slag.

7. Deleterious Shale. Determine the percentage of mass (weight) by four cycles of wetting and drying according to PTM No. 519. The MTD will use petrographic analysis to confirm the results.

8. Friable Particles. PTM No. 620, by percentage of mass (weight).

9. Coal or Coke. Determine the percentage of mass (weight) by visual identification and hand separation. If required, the MTD will use petrographic analysis to confirm the results.

10. Glassy Particles. Determine the percentage of mass (weight) by visual identification and hand separation. Pieces of slag containing more than 50% glass are considered to be glassy particles. Waste glass is also considered to be glassy particles. For coarse aggregate used in cement concrete, the maximum percentage of glassy particles allowed is 4%. For other uses, the maximum percentage of glassy particles allowed is 10%. Coarse aggregate containing glassy particles consisting of waste glass may not be used in cement concrete or bituminous wearing courses.

11. Metallic Iron. The MTD will use petrographic analysis to determine the content of metallic iron. Pieces of slag containing metallic iron are considered to be metallic iron. This requirement is waived when aggregate with metallic iron is used in bituminous mixtures or subbase.

12. Clay Lumps. Determine the percentage of mass (weight) by visual identification and hand separation. If required, the MTD will use petrographic analysis to confirm the results.

(d) Testing and Acceptance. Section 703.5(b)

703.3 SELECT GRANULAR MATERIAL (2RC)—

(a) General. Select granular material consists of durable bank or crushed gravel, stone, or slag mixed or blended with suitable filler materials to provide a uniform mixture. Obtain select granular material from a source listed in Bulletin 14. Stockpile, sample, and test material before it is used to ensure reasonable uniformity and acceptability. Use material free from vegetable or organic matter, lumps, or an excessive quantity of clay or other objectionable or foreign substances, and not more than 10% deleterious shale by mass (weight).

(b) Gradation. Conforming to the following gradation, determined according to PTM No. 619:

- Passing 50 mm (2-inch) sieve—100%
- Passing 4.75 mm (No. 4) sieve—15% to 60%
- Passing 150 µm (No. 100) sieve—0% to 30%

703.4 ANTI-SKID MATERIAL—

(a) General. For use on ice or snow-covered pavement surfaces, furnish anti-skid material conforming to Table E from a supplier listed in Bulletin 14. Do not use material containing metal, glass, or substances that may be harmful to automotive equipment and vehicles. Use material reasonably free of deleterious substances or foreign materials including, but not limited to, dirt, shale, slate, incinerated bituminous coal mine waste, and as specified in Section 703.2(a), Table B, Type C.

(b) Description.

1. Types 1 and 1A. Cinders, coke, crushed coal boiler bottom ash, or a combination of these. Bottom ash is residue of molten ash obtained from coal-burning boilers.

1.a Furnish bottom ash having no pyritic material or mill rejects commingled, mixed, or combined with it.

1.b Furnish Type 1 or 1A anti-skid material conforming to the following requirements:

- An air-dry loose density (weight) of not less than 560 kg/m^3 (35 pounds per cubic foot), determined according to AASHTO T 19, Section 7;
- Type 1, having a density (unit weight) of 1220 kg/m^3 (76 pounds per cubic foot) or less, or Type 1A, having a density (unit weight) of more than 1220 kg/m^3 (76 pounds per cubic foot);
- Crushed brick, crushed stone, blast furnace slag, steel slag, or gravel may be present in amounts not exceeding a total of 3% by mass (weight) of total dry mass (weight) of the sample, determined by the mass (weight) of this material retained on the 12.5 mm (1/2-inch) sieve;
- Unburned or partially burned coal or coke may be present in amounts not exceeding 7% by mass (weight) of total dry mass (weight) of the sample, determined by the mass (weight) of this material retained on the 9.5 mm (3/8-inch) sieve, except unburned coal, partially burned coal, or coke may not be present in bottom ash.

2. Type 2. Crushed stone, crushed gravel, or crushed slag, conforming to the following requirements:

- Not exceeding 1680 kg/m^3 (105 pounds per cubic foot);

- Los Angeles Abrasion loss not exceeding 55% by mass (weight), determined according to AASHTO T 96, Gradation D; and
- If crushed gravel is furnished, not less than 85% of the fragments retained on the 2.36 mm (No. 8) sieve are required to be crushed, one face, determined according to ASTM D 5821.
- Total of individual anti-skid particles containing metallic iron may not exceed 1.0% by mass (weight) of material, determined by the mass (weight) of particles retained on the 4.75 mm (No. 4) sieve and by the total dry mass (weight) of the sample.

3. Types 3, 3A, and 3B. Either natural sand, with not less than 35% of the material retained on the 2.36 mm (No. 8) sieve being crushed fragments, determined according to ASTM D 5821; or manufactured sand, except limestone sand; or a combination of these.

Total of individual anti-skid particles containing metallic iron may not exceed 1.0% by mass (weight) of material, determined by the mass (weight) of particles retained on the 4.75 mm (No. 4) sieve and by the total dry mass (weight) of the sample.

4. Type 4. Burned anthracite coal mine refuse with a Los Angeles Abrasion loss not exceeding 55% by mass (weight), determined according to AASHTO T 96.

5. Type 6S. Crushed stone, crushed gravel, or crushed slag conforming to the following requirements:

- Not exceeding 1680 kg/m^3 (105 pounds per cubic foot);
- Los Angeles Abrasion loss not exceeding 55% by mass (weight), determined according to AASHTO T 96, Gradation D; and
- If crushed gravel is furnished, not less than 60% of the fragments retained on the 4.75 mm (No. 4) sieve are required to be crushed, one face, determined according to ASMT D 5821.
- Total of individual anti-skid particles containing metallic iron may not exceed 1.0% by mass (weight) of material, determined by the mass (weight) of particles retained on the 4.75 mm (No. 4) sieve and by the total dry mass (weight) of the sample.

(c) Gradations. Conforming to Table E.

TABLE E
Anti-Skid Gradation

Anti-Skid Type	Maximum Percent Passing Sieve								
	31.5 mm (1 1/4")	19.0 mm (3/4")	12.5 mm (1/2")	9.5 mm (3/8")	4.75 mm (No. 4)	2.36 mm (No. 8)	300 µm (No. 50)	150 µm (No. 100)	75 µm (No. 200)
Type 1	100					70	18		
Type 1A		100	90-100			55	18		
Type 2			100	95-100		30		8	
Type 3				100		85		8	
Type 3A				100		55		8	
Type 3B				100	85-100	55		5	4*
Type 4			100	95-100		30		8	
Type 6S				100	35-85	55		8	5*

* Determined by PTM No. 100.

(d) Testing. If shipping to Department stockpiles, test material for moisture content according to PTM No. 513. A minimum of two tests per day is required. If conditions exist that would cause a change in moisture content, conduct additional tests. A Department representative will verify the test results.

Document tests at the end of delivery quantity at the end of the day and determine the average moisture content. The Department will adjust the delivery quantity by deducting the average moisture content from the aggregate quantity shipped. Payment is based on the calculated oven dry mass (weight).

703.5 ACCEPTANCE OF CONSTRUCTION AGGREGATES—

(a) General. The following describes the certification acceptance of construction aggregates. Accept AASHTO No. 1 Coarse Aggregate as specified in Section 850.2(a)1.

(b) Testing and Acceptance. Certify each day's shipment of aggregate as specified in Section 106.03(b)3.

1. QC. Section 106.03(b)2 and as follows:

- Submit for annual review a QC Plan conforming to the minimum Department requirements for aggregate suppliers.
- Establish and positively identify aggregate stockpiles that have been tested according to the approved QC Plan and conform to Department Specifications. Material may be added to or shipped from stockpiles at the producer's discretion.

2. Source Verification Samples. Under the direction and supervision of the Representative, obtain a verification sample (n=3) from each stockpile to be tested. Obtain the sample from the stockpile according to AASHTO T 2 or from a mini-stockpile. If the mini-stockpile method is chosen, obtain the sample according to the following procedure:

- Place approximately 10 tonnes (10 tons) of aggregate into a mini-stockpile on a suitable surface. Use a loader to strike off the top of the mini-stockpile.
- Obtain sufficient material for sampling from random locations on the mini-stockpile using a square faced shovel.

Immediately deliver the sample to the Representative for testing using the equipment provided as specified in Sections 703.1(b) and 703.2(b). The Representative will test all three increments for compliance with Tables A, B, C, and D, as applicable. If the test results verify that the material conforms to the specifications, use the material under certification.

If the material does not conform to the specifications, the Representative will determine the percent within limits (PWL) according to Section 106.03(a)3. If results indicate a PWL for the material of less than 90, the Representative will reject the stockpile.

If a stockpile is rejected, increase QC testing according to the reviewed QC Plan. Construct another stockpile of the aggregate to be tested consisting of 300 tonnes to 500 tonnes (300 tons to 500 tons) of material or the remainder of the quantity identified for Department projects, whichever is less. The Representative will accept the material under certification if test results verify that the material from the new stockpile conforms to the specifications.

3. Project Verification Samples. Under the direction and supervision of the Inspector, obtain verification samples (n=3) according to Table F for each type of aggregate at the point of placement (loose aggregate sample immediately before compaction):

TABLE F
Verification Samples

Aggregate Quantities	Number of Samples (n=3)
500 tonnes (500 tons) or more, but less than 2000 tonnes (2,000 tons)	1
2000 tonnes (2,000 tons) or more, but less than 10 000 tonnes (10,000 tons)	2
10 000 tonnes (10,000 tons) or more, up to 25 000 tonnes (25,000 tons)	3
Each additional increment of 25 000 tonnes (25,000 tons)	1

The Inspector will select sample locations according to PTM No. 1.

Under the direction and supervision of the Inspector, immediately deliver the sample(s) to the test site at either the producers' location or the project site. The Inspector will test the sample(s) using the equipment provided as specified in Sections 703.1(b) and 703.2(b). The Inspector will test all three increments for compliance with Tables C and D, plus the Crushed Fragments Test of Table B when applicable. The Department will continue to accept material under certification if test results verify that the material conforms to the specifications.

If the material does not conform to the specifications, the Inspector will determine the average PWL of the material as specified in Section 106.03(a)3. If results indicate a PWL for the material of less than 90, immediately obtain an additional verification sample (n=3) at the project site from the next 150 tonnes (150 tons) of material.

Discontinue all operations using that type of aggregate until the results of the second verification sample are evaluated. If results indicate a PWL of 90 or more, resume operations using the evaluated aggregate. If the results indicate a PWL of less than 90, conduct acceptance testing at the point of placement according to the following procedure:

- Provide a separate field laboratory as specified in Section 609 at no additional expense to the Department. Do not resume operations using the material until the field laboratory is in place at the project site.

- Under the direction and supervision of the Inspector, obtain an acceptance sample (n=3) at the point of placement (loose aggregate sample immediately before compaction) for each day's placement. The Inspector will select sample locations according to PTM No. 1. Immediately transport the sample from the sampling point to the testing site. The Inspector will test all three sample increments for compliance with Section 703.2(c), Tables C and D.

- The Department will continue project acceptance testing until ten consecutive day's placements are accepted with no rejected material. The Contractor will be charged $200 per day, for each day the material is placed, for project acceptance testing performed by the Department.

- For test values not conforming to the specifications, the Department will determine the PWL according to Section 106.03(a)3. If results indicate a PWL for the material of less than 90, remove and replace the material at no additional cost to the Department.

4. QA Samples. BOCM QA samples (n=3) may be taken at the source of supply or at the point of placement on the project. Submit samples to the MTD for testing. If results for any type of material indicate a PWL of less than 90, the District will immediately obtain an additional verification sample (n=3) at the appropriate site (project or source). The Department will test all three sample increments at either the producer's location or at the project site and determine the PWL for the material. If results indicate a PWL for the material of less than 90, obtain source verification samples and project verification samples as specified in Section 703.5(b)2 and Section 703.5(b)3.

703.5(c)

(c) Weighing Responsibilities. Prepare weight slips and certifications attesting to the accuracy of the weights recorded and ensuring conformance with Section 107.23(b). Designate a licensed weigh person(s) to act as the Contractor's agent. Ensure that scales are calibrated annually by an independent agency acceptable to the Department. A Department Inspector may provide random checking.

Weigh empty trucks used to haul material measured by mass (weight) daily unless otherwise directed. If the invoice mass (weight) exceeds the net mass (net weight) determined by a Department mobile weigh team by more than 3%, the Department will consider the deviation to be excessive. Take immediate corrective action upon notification of an excessive deviation. Within 30 days of notification, provide the District Executive with a written description of corrective actions and safeguards and the time that they were implemented.

SECTION 350—SUBBASE

350.1 DESCRIPTION—This work is preparation of subgrade, as specified in Section 210, and construction of a compacted aggregate subbase.

350.2 MATERIAL—

(a) Aggregates. Type C or better, No. 2A and No. OGS, as specified in Section 703.2 and 703.5.

350.3 CONSTRUCTION—

(a) Equipment.

1. Spreaders. Section 320.3(a)3

2. Compaction Equipment. Sections 108.05(c)3.a, 3.b, 3.e

(b) General. Prepare the subgrade as specified in Section 210 before placing subbase. Do not place subbase material on soft, muddy, or frozen areas. See images of defective subgrade areas.

If directed, correct unsatisfactory subbase conditions developing ahead of the base and paving operations by scarifying, reshaping, and recompacting, or by replacing the subbase.

(c) Mixing. Use acceptable methods to mix materials and water before delivery to the project. Use a blend of materials from different sources only if allowed. Use material containing enough moisture to prevent segregation during stockpiling, hauling, and placing, and to minimize water added during compaction. Maintain No. OGS aggregate in a well-moistened condition from before placement to compaction.

(d) Placement. Before placing open-graded subbase, construct berms to confine the subbase material. Place the subbase before paving and as shown on the Standard Drawings. Control the subbase elevation and depth as specified in Section 210.3(c); except do not use templates if the subbase is trimmed using an automatic grading machine. Place the material on the subgrade using spreaders and without causing segregation. In areas where using mechanical spreaders is impractical, use an acceptable method to spread the material.

For rigid pavement and shoulders, place a course of No. 2A aggregate to a minimum compacted depth of 75 mm (3 inches) directly on the subgrade and place a course of No. OGS aggregate to a minimum compacted depth of 100 mm (4 inches) on top of the No. 2A aggregate.

For flexible pavement and shoulders, place the indicated type of aggregate courses at the position and depth indicated the pavement structure. Place each layer of No. 2A aggregate to a minimum compacted depth of 75 mm (3 inches) and place each layer of No. OGS aggregate to a minimum compacted depth of 100 mm (4 inches). Construct subbase in layers not more than 200 mm (8 inches) in compacted depth; however, when granulated slag is used, limit each layer to not more than 100 mm (4 inches) in compacted depth. If permitted and when using granulated slag, the Contractor may place a maximum compacted layer of 150 mm (6 inches) when the full layer depth is compacted as specified in this Section.

If the subbase is constructed in widths less than the full pavement width, neatly trim the edge of completed subbase before placing the abutting subbase.

For simultaneous construction of more than one pavement course, complete and maintain the subbase at least 460 m (1,500 linear feet) in advance of placing the succeeding pavement course.

In areas inaccessible to spreaders or in special areas, and if permitted, deposit the subbase material on the prepared area. Spread, in a manner not causing segregation, to a uniform full depth of the layer being placed.

(e) Compaction and Density. Compact No. 2A aggregate to at least 100% of the maximum dry-mass (dry-weight) density, determined according to PTM No. 106, Method B. At locations directed by the Representative, determine the in-place density for each 2500 m^2 (3,000 square yards), of each layer according to AASHTO T 191 or T 310.

If the retained is 20% or more for the 19.0 mm (3/4-inch) sieve or if the subbase material is No. OGS, the Representative will accept compaction when the material does not move under the compaction equipment.

Compact from the sides to the center, with each pass uniformly overlapping the previous pass.

If necessary, to obtain the minimum density of No. 2A aggregate or adequate compaction of No. OGS aggregate, remix, add water, reconstruct, or replace the subbase.

(f) Surface Tolerance. Section 210.3(c)

(g) Test for Depth. *At each density test location and after completing the density test, carefully dig one test hole to the full depth of the completed subbase.*

The Representative will measure the depth of the finished subbase.

If the subbase depth is deficient by 13 mm (1/2 inch) or more from the depth indicated, the subbase is defective. The Representative may require additional test holes to determine the limits of the defective area. Scarify the subbase to a depth of 75 mm (3 inches), blend in additional material, and recompact. After recompacting, the Representative may require test holes to verify the subbase depth is within 13 mm (1/2 inch) of the indicated depth.

Backfill the test holes with subbase material and compact.

(h) Maintenance and Traffic. Section 320.3(j) and as follows:

Do not allow traffic, including construction traffic, on a subbase constructed of No. OGS aggregate. If a subbase constructed of No. 2A aggregate is used as a haul road or if a subbase is exposed to weather in excess of 60 calendar days, retest for surface irregularities and depth and correct deficiencies as specified in Section 210.3(c) and 350.3(g).

350.4 MEASUREMENT AND PAYMENT—

(a) Subbase. For the type indicated, and as follows:

1. Area Basis. Square Meter (Square Yard)

The Department will not pay the entire quantity of subbase complete in place until the base course or pavement is constructed over the subbase. However, the Department will pay for up to 75% of the estimated quantity of subbase placed in advance of the succeeding operations, if the Contractor satisfactorily completed and is properly maintaining the subbase.

2. Volume Basis. Cubic Meter (Cubic Yard)

3. Mass (Weight) Basis. Tonne (Ton)