

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95-100
No. 16 (1.18 mm)	45-80
No. 50 (300 µm)	10-30
No. 100 (150 µm)	2-10

## SECTION 703 COARSE AGGREGATE

Coarse aggregate shall consist of crushed stone, washed gravel (crushed or uncrushed), crushed slag, or any combination thereof, conforming to the requirements of these Specifications.

### 703.1-CRUSHED STONE:

**703.1.1-General Requirements:** Crushed stone shall consist of particles of clean, hard, tough, durable rock free from adherent coatings.

**703.1.2-Deleterious Substances:** Deleterious substances shall not exceed the limits set forth below:

MATERIAL	PERCENT BY WEIGHT
Thin or elongated pieces (determined by MP 703.00.25)	5
Shale (determined by MP 703.00.27)	1
Coal and other lightweight deleterious material (determined by MP 702.01.20)	1.5
Friable particles (determined by MP 703.01.20)	0.25

### 703.1.3-Percentage of Wear (AASHTO T 96 or ASTM C 535):

Crushed stone shall have a percentage of wear not to exceed 40.

**703.1.4-Soundness (Determined by MP 703.00.22):** When subjected to five cycles of the sodium sulphate test, the weighted percentage of loss shall be

not more than twelve.

### 703.2-GRAVEL:

**703.2.1-General Requirements:** Gravel shall be composed of particles of hard, durable rock, thoroughly clean and well graded in size. Gravel shall meet the requirements of 703.1.2, 703.1.3 and 703.1.4.

**703.2.2-Crushed Particles:** The following minimum requirements for percent of crushed particles (determined by MP 703.00.21) for the type of construction indicated shall govern:

	<b>Crushed Particles Minimum Percent by Weight of the Gravel or Blends Retained on No. 4 (4.75 mm) Sieve</b>	
	<b>FRACTURE</b>	
<b>TYPE OF CONSTRUCTION</b>	<b>ONE FACE</b>	<b>TWO FACE</b>
Bituminous Concrete Base 1	80	0
Bituminous Concrete Wearing, Patching and Leveling. Base 2, Prime, Tack, Surface Treatments, Winter Grade Patching Mixtures and aggregates No. 7 and smaller in penetration macadam and Road Mix Bituminous Pavements	-----	80
Bituminous Concrete Surfaces or Wearing Courses on all projects requiring specific skid resistant qualities	-----	80

**703.2.3-Pea Gravel:** Pea gravel shall consist of clean uncrushed river gravel conforming to the requirements of 703.1.3, 703.1.4, total deleterious substances shall not be greater than five percent, and shall meet the following grading requirements for percent passing:

<u>½ in. (12.5 mm)</u>	<u>No. 16 (1.18 mm)</u>
100	0-5

### 703.3-SLAG:

Slag shall be air cooled blast-furnace slag, reasonably uniform in density and quality, and free from dirt and other objectionable matter. When tested in accordance with AASHTO T 19 and when standard sizes are combined in the

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proportions used in the job mix formula, the slag shall not weigh less than 70 lb. per cu. ft. (1 Mg per cubic meter) when used in portland cement concrete or hot-laid bituminous concrete surface courses, and not less than 60 lb. per cu. ft. (960 kg per cubic meter) when used in other applications. Blast furnace slag shall meet the requirements of 703.1.2 and 703.1.4. In addition to air cooled blast furnace slag, other slags which meet the applicable physical requirements may be used with the approval of the Engineer. All other slag shall meet the requirements of 703.1.2, 703.1.3 and 703.1.4.

**703.3.1-Steel Slag:** Steel slag, from the production of steel as differentiated from air cooled blast-furnace slag obtained in the production of iron, includes open hearth, electric furnace, and basic oxygen furnace slag.

For items where steel slag is to be used, it must be crushed to its intended item gradation, maintained in a wet condition for a period of at least 12 months, and must be rendered sufficiently insoluble to prevent the discharge of harmful effluent. The aging period shall begin at the completion of stockpiling and shall be monitored by the supplier throughout the aging period. Sampling for moisture tests will be on a stratified random basis vertically with at least three samples from each top one third, the middle one third and the bottom one third of the stockpile. The plan view location of the samples shall also be on a stratified random basis with one sample from each one third of the stockpile.

Test results of the monitoring shall be available to the Division upon request throughout the period.

At approximately three month intervals during the aging period, the supplier shall perform expansion tests in accordance with MP 703.00.28 or other test method agreeable to the Division. The selection of samples for expansion testing shall be the same as that indicated for moisture monitoring.

In addition to the requirements specified elsewhere in the Contract Documents, for the particular item, acceptance of the material will be on the basis of the Division's evaluation of the supplier's written certification that the moisture and expansion monitoring have been accomplished and that the level or degree of expansion exhibited will not be detrimental to the specified item. The certification shall include all test data.

Steel slag shall not be used in any item where horizontal expansion might be detrimental. Such items include, but are not necessarily limited to, the following: aggregate for portland cement concrete or bituminous concrete; backfill around drainage structures, piers, abutments, walls, etc.

**703.3.2-Electrometallurgical Slag:** Electrometallurgical slag is from the production of metal alloys as differentiated from the production of steel. Electrometallurgical slag may not be used as a portland cement concrete aggregate.

When electrometallurgical slag is used as an aggregate in bituminous construction and payment is on a tonnage (megagram) basis, proper allowance will be made for the difference in weight per cubic foot (meter).

**703.3.3-Power Plant Slag:** Power plant slag consists of Wet Bottom Boiler Slag (shiny, black, glassy material) formed when molten ash from the burning of coal drops into water and shatters at the bottom of the boiler, and Bottom Ash formed when ash particles from the burning of pulverized coal is allowed to air cool at the bottom of the furnace. Power plant slag may not be used as a portland cement concrete aggregate.

#### **703.4-GRADING OF COARSE AGGREGATES:**

Coarse aggregate shall be uniformly graded to conform to the requirements of Table 703.4. The gradation of coarse aggregates in the production of concrete shall be controlled by the  $\bar{A}$  value as specified in 501.3 and 601.3. In addition, coarse aggregates to be used in portland cement concrete shall have no more than one percent by weight passing the No. 200 (75  $\mu\text{m}$ ) sieve, except that this percentage may be increased to 1.5 in the case of crushed aggregate if the material finer than the No. 200 (75  $\mu\text{m}$ ) sieve consists of the dust of fracture, essentially free from clay or shale. The gradation shall be determined in accordance with AASHTO T 27 and T 11.

When the coarse aggregate is to be used in portland cement concrete, larger percentages passing the No. 200 (75  $\mu\text{m}$ ) sieve in the coarse aggregate fraction will be permitted if the percent passing the No. 200 (75  $\mu\text{m}$ ) sieve in the fine aggregate fraction (702.1) is less than the specified maximum. In no event, however, shall the percent passing the No. 200 (75  $\mu\text{m}$ ) sieve in the total concrete aggregate be greater than an amount which would exist if both aggregate fractions contained their specified maximum percentage passing the No. 200 (75  $\mu\text{m}$ ) sieve.

Table 703.4 shows the gradations for coarse aggregates required by AASHTO M 43 (Note that the specification current at the time of advertisement of bid shall govern).

#### **703.5-LIGHTWEIGHT COARSE AGGREGATE FOR STRUCTURAL CONCRETE:**

Lightweight coarse aggregate for structural concrete shall meet the requirements of ASTM C 330.

**TABLE 703.4-STANDARD SIZES OF COARSE AGGREGATES  
(AASHTO M 43)**

		Amounts finer than each laboratory sieve ( square openings), percentage by weight										
Size #	Nominal size square openings ①	4 (100)	3-½ (90)	3 (75)	2-½ (63)	2 (50)	1-½ (37.5)	1 (25)	¾ (19)	½ (12.5)	¾ (9.5)	No.4 (4.75)
1	3-½ to 1-½ (90 to 37.5)	100	90 to 100		25 to 60		0 to 15		0 to 5			
2	2-½ to 1-½ (63 to 37.5)			100	90 to 100	35 to 70	0 to 15		0 to 5			
24	2-½ to ¾ (63 to 19.0)			100	90 to 100		25 to 60		0 to 10	0 to 5		
3	2 to 1 (50 to 25.0)				100	90 to 100	35 to 70	0 to 15		0 to 5		
357	2 to No. 4 (50 to 4.75)				100	95 to 100		35 to 70		10 to 30		0 to 5
4	1-½ to ¾ (37.5 to 19.0)					100	90 to 100	20 to 55	0 to 15		0 to 5	
467	1-½ to No. 4 (37.5 to 4.75)					100	95 to 100		35 to 70		10 to 30	0 to 5
5	1 to ½ (25.0 to 12.5)						100	90 to 100	20 to 55	0 to 10	0 to 5	
56	1 to ¾ (25.0 to 9.5)						100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5
Size #	Nominal size square openings ①	1-½ (37.5)	1 (25)	¾ (19)	½ (12.5)	¾ (9.5)	No.4 (4.75)	No.8 (2.36)	No.16 (1.18)	No.50 (300 µm)	No.100 (150 µm)	
57	1 to No. 4 (25.0 to 4.75)	100	95 to 100		25 to 60		0 to 10	0 to 5				
6	¾ to ¾ (19 to 9.5)		100	90 to 100	20 to 55	0 to 15	0 to 5					
67	¾ to No. 4 (19 to 4.75)		100	90 to 100		20 to 55	0 to 10	0 to 5				
68	¾ to No. 8 (19 to 2.36)		100	90 to 100		30 to 65	5 to 25	0 to 10	0 to 5			
7	½ to No. 4 (12.5 to 4.75)			100	90 to 100	40 to 70	0 to 15	0 to 5				
78	½ to No. 8 (12.5 to 2.36)			100	90 to 100	40 to 75	5 to 25	0 to 10	0 to 5			
8	¾ to No. 8 (9.5 to 2.36)				100	85 to 100	10 to 30	0 to 10	0 to 5			
89	¾ to No. 16 (9.5 to 1.18)				100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5		
9	No. 4 to No. 16 (4.75 to 1.18)					100	85 to 100	10 to 40	0 to 10	0 to 5		
10	No. 4 to 0 ② (4.75 to 0)					100	85 to 100				10 to 30	

① In inches (millimeters), except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.

② Screenings