

PART 2

CONSTRUCTION MATERIALS

SECTION 200 – ROCK PRODUCTS

200-1 ROCK PRODUCTS

200-1.1 General. Rock products are defined as crushed rock, rock dust, gravel, sand, stone for riprap, or any combination thereof. All rock products shall be clean, hard, sound, durable, uniform in quality, and free from any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

200-1.1.1 Testing. Sieve analysis shall be performed in accordance with California Test 202. Sand equivalent tests shall be performed in accordance with California Test 217. Unless otherwise specified, all percentages referred to in this Section 200 shall be determined by weight. All testing shall use the most current test methods.

200-1.1.2 Statistical Testing. Statistical testing shall conform to the following:

Whenever both individual test results and moving average requirements are specified, materials shall meet both requirements.

Individual samples tested prior to the first use of materials from each source, or prior to the first use of materials after any changes have been made in material processing procedures, shall conform to the limits specified for moving average.

Moving average shall be computed in accordance with 211-5.

200-1.2 Crushed Rock and Rock Dust. Crushed rock and rock dust shall be the product of crushing rock or gravel. The portion of the material that is retained on a 3/8-inch (9.5mm) sieve shall contain at least 50 percent of particles having three or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of that portion which passes the 3/8-inch (9.5mm) sieve but is retained on the No. 4 (4.75mm) sieve, not more than 10 percent shall be gravel particles. Crushed rock will be designated by normal size and shall conform to the following gradations:

TABLE 200-1-2 (A)

Percentage Passing Sieves			
Sieve Size	1" (25.0mm)	¾" (19.0mm)	½" (12.2mm)
1-1/2 in(37.5 mm)	100	-	-
1" (25.0mm)	90-100	100	-
3/4" (19.0mm)	30-60	90-100	100
1/2" (12.5mm)	0-20	30-60	90-100
3/8" (9.5mm)	-	0-20	20-60
No. 4 (4.75mm)	0-5	0-5	0-15
No. 8 (2.36mm)	-	-	0-5
ASTM C 131 Test Grading	A	B	B

TABLE 200-1-2 (A) (Continued)

Sieve Size	3/8" (9.5mm)	1/4" (6.3mm)	3/16" (4.75mm)	Rock Dust
1/2 in(12.5 mm)	100	-	-	-
3/8" (9.5mm)	90-100	-	-	100
1/4" (6.3mm)	-	100	-	-
No. 4 (4.75mm)	30-60	75-100	100	90-100
No. 8 (2.36mm)	0-10	0-25	40-75	-
No. 16 (1.18mm)	-	0-5	0-10	-
No. 30 (600µm)	-	-	-	20-60
No. 200 (75µm)	-	0-2	0-2	5-20
ASTM C 131 Test Grading	C	D	B	-

Crushed rock shall meet the following requirements:

TABLE 200-1.2 (B)

Test	Test Method No.	Requirements in percent
Percentage Wear	ASTM C 131	
100 Revolutions		15 Maximum
500 Revolutions		52 Maximum

200-1.2.1 Screenings. Screenings when used as a cover aggregate for asphalt emulsion chip seals in accordance with 302-2.5, shall be composed of crushed rock and will be designated by the name of the size of screenings and shall conform to the following gradations in Table 200-1.2.1 (A):

All screenings in 200-1.2.1 and 600-2.6.1 shall meet the following requirements:

TABLE 200-1.2.1 (A)

Sieve Size	Percentage Passing Sieve			
	Coarse 1/2" x No. 4 (12.5 x 4.75mm)	Medium 3/8" x No. 6 (9.5 x 3.35mm)	Medium Fine 5/16" x No. 8 (8.0 x 2.36mm)	Fine 1/4" x No. 10 (6.3 x 2.00mm)
3/4" (19.0mm)	100	-	-	-
1/2" (12.5 mm)	90-100	100	-	-
3/8" (9.5mm)	50-80	90-100	100	100
No. 4 (4.75mm)	0-15	5-30	30-60	60-85
No. 8 (2.36mm)	0-5	0-10	0-15	0-25
No. 16 (1.18mm)	-	0-5	0-5	0-5
No. 30 (600µm)	-	-	0-3	0-3
No. 200 (75µm)	0-2	0-2	0-2	0-2

TABLE 200-1.2.1 (B)

Test	Test Method No.	Requirements in percent
Percentage Wear (100 Revolutions)	ASTM C 131	12 Maximum

Percentage Wear (500 Revolutions)	ASTM C 131	35 Maximum
Film Stripping	California 302	25 Maximum
Cleanliness Value	California 227	80 Minimum
California Durability	California 229	52 Minimum

200-1.3 Gravel. Gravel shall be composed entirely of particles that have no more than one fractured face.

200-1.4 Coarse Aggregate for Portland Cement Concrete. Concrete aggregate shall be composed of gravel, crushed rock, or a blended mixture. All concrete aggregate shall be washed before delivery to the batching plant and shall conform to the following:

TABLE 200-1.4 (A)

Tests	Tests Method No.	Requirements
Cleanliness Value <u>Moving Average</u> ²	California 227	75 Minimum <u>75 Minimum</u>
Percentage Wear 100 revolutions 500 revolutions	ASTM C131 <u>or</u> <u>California 211</u>	15 Maximum 52 Maximum
Specific Gravity (Bulk Saturated surface dry)	ASTM C 127	2.58 Minimum ¹

1. Not more than 15 percent by weight shall be particles with a bulk specific gravity below 2.50.

2. Moving Average calculated in accordance with 211-5; no individual test result used shall be less than 71.

Concrete aggregate will be designated by number and shall conform to the following gradations:

TABLE 200-1.4 (B)

Sieve Size	Percentage Passing Sieve		
	No. 2	No. 3	No. 4
50 mm (2 in)	100	-	-
37.5 mm (1-1/2 in)	90-100	100	-
25.0 mm (1 in)	5-40	90-100	-
19.0 mm (3/4 in)	0-15	55-85	100
9.5 mm (3/8 in)	0-5	8-20	85-100
4.75 mm (No. 4)	-	0-5	0-30
2.36 mm (No. 8)	-	0-5	0-10
75 μ m (No. 200)	0-2	0-2	0-2
ASTM C 131 Test Grading	A	B	C

200-1.5 Sand.

200-1.5.1 General. Sand shall consist of natural or manufactured granular material, or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances not suitable for the purpose intended.

200-1.5.2 Sand for Asphalt Concrete. The sand shall conform to the gradation specified for asphalt concrete in 200-1.5.5.

200-1.5.3 Sand for Portland Cement Concrete. Sand for portland cement concrete shall be washed and shall conform to the gradation specified for portland cement concrete in 200-1.5.5 and the following quality requirements:

TABLE 200-1.5.3 (A)

Tests	Test Method No.	Requirements in percent
Organic Impurities	ASTM C 40	Satisfactory ¹
Mortar Strength Relative to Ottawa Sand	California 515	100 Minimum
Sand Equivalent	California 217	<u>75 Minimum</u>
Individual Test Result		70 Minimum
Average of Tests on 3 Samples		75 Minimum
<u>Moving Average³</u>		<u>75 Minimum</u>
Percent Clay, Silt, Loam	California 515	3 Maximum
Soundness ²	California 214	10 Maximum

1. The resultant color of the testing solution shall not be darker than the ASTM C 40 standard.

2. The soundness requirement will be waived, provided that the durability index, Df, is 60 or greater, when determined by California Test 229.

3. Moving Average calculated in accordance with 211-5; no individual test result used shall be less than 70.

200-1.5.4 Sand For Air-Placed Concrete. Sand for air-placed concrete shall be washed and conform to the gradation for portland cement concrete in 200-1.5.5. The amount of deleterious substances shall not exceed the limits prescribed in ASTM C 33.

200-1.5.5 Sand Gradations. The sand shall conform to the following gradations:

TABLE 200-1.5.5 (A)

Sieve Size	Percentage Passing Sieve		
	Asphalt Concrete	Portland Cement Concrete	Mortar
9.5 mm (3/8 in)	100	100	-
4.75 mm (No.4)	-	95-100	100
2.36 mm (No.8)	75-100	75-90	95-100
1.18 mm (No.16)	-	55-75	70-95
600 µm (No.30)	-	30-50	35-70
300 µm (No.50)	-	10-25	5-35
150 µm (No.100)	-	2-10	0-10
75 µm (No. 200)	0-8 ¹	0-5	0-5

1. May be exceeded to permit a maximum of 12 percent, provided the sand equivalent of the asphalt concrete sand is 35 or greater.

SECTION 211 – MATERIAL TESTS

211-1 COMPACTION TESTS.

211-1.1 Laboratory Maximum Density. The following method shall be used for compaction tests unless otherwise specified:

Laboratory maximum densities will be performed in accordance with ASTM D 1557.

The Engineer may modify ASTM D 1557 at his option to calculate relative compaction based on adjusted maximum density calculated as follows:

$$Da = (100 Dm) / (100 \pm Wa)$$

Da = Adjusted laboratory maximum wet density.

Dm = Maximum wet density per ASTM D 1557.

$\pm Wa$ = Percent change in moisture content from field moisture to laboratory optimum moisture. Use minus when field moisture content is higher than laboratory optimum moisture content. Use plus when field moisture is lower than laboratory optimum moisture content.

211-1.2 Field Density. Field density of soil shall be determined by ASTM D 2922 or ASTM D 1556.

211-1.3 Relative Compaction. The words Relative Compaction shall mean the ratio of the field dry or wet density to the laboratory dry or adjusted wet density, respectively, expressed as a percentage.

211-2 CHEMICAL RESISTANCE TEST (PICKLE JAR)). This test is used to determine the physical properties of material specimens used in sewers after exposure to chemical solutions. Specimens of composite materials shall be seal coated on two adjacent edges of their four edges and not coated on the inner or outer surfaces. Specimens of non-composite materials shall not be seal coated. Test specimens shall be conditioned in a mechanical convection oven for 7 days and to a constant weight at a temperature of 110°F +/- 5°F (43°C +/- 3°C) and subsequently cooled for 3 hours in a desiccators. This conditioning shall be done before and after submersion of the test specimens in the solutions specified in Table 211-2(A) for a period of 112 days at 77°F +/- 5°F (25°C +/- 3°C). Weight change specimens per ASTM D 543 shall be 1 inch x 3 inches x 0.125 inch thick (25mm x 75mm x 3175µm thick) unless otherwise approved by the Engineer.

TABLE 211-2(A)

Chemical Solution	Concentration [†]
Sulphuric acid (H ₂ SO ₄)	20%
Soduim hydroxide (NaOH)	5%
Ammonium hydroxide (NH ₂ OH)	5%
Nitric acid (HNO ₂)	1%
Ferric chloride (FeCl ₃)	1%
Soduim hypochloride	1%
Soap	0.1%
Detergent (Linear alkyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

1. Volumetric percentages; Actual concentration of reagent must be corrected to 100%.

At 28-day intervals, specimens shall be removed from each chemical solution and tested. If any specimen fails to meet the 112-day requirement for the material being tested before completion of the 112-day exposure, the material will be rejected.

The Chemical Resistance Test is a qualification test only. Requalification is required only when the compound formulation changes.

211-3 INFILTRATION CAPACITY TEST.

211-3.1 Test Apparatus. Test apparatus shall consist of a:

- a) One gallon (4L), minimum size, water container with a spout. The spout shall be able to produce a stream with a circular cross section, the diameter of that which is large enough to discharge the entire contents of the container in 20 seconds or less;
- b) Stopwatch capable of indicating elapsed time to the nearest second;
- c) Tape measure of at least +36 inches (1000mm) that is graduated in ¼ inch (6mm) increments or smaller.

211-3.2 Water. Water shall be free of suspended solids. The volume of water shall be determined to 2 significant figures.

211-3.3 Test Procedure. The testing procedure shall be as follows:

- a) Place a pre-measured amount of water into the container.
- b) Pour the water onto the surface in one spot. Control the discharge rate by manually adjusting the angle of the spout so that the diameter of the pool of water is between 10 to 30 inches (250mm to 760mm). Empty the container holding the spout over the spot until the pool of water vanished.
- c) Start the stopwatch when the water initially touches the surface and stop it when the pool disappears from the surface.
- d) Measure the longest dimension (d_1) of the dampened area. Measure the width (d_2) of the pool perpendicular to d_1 .
- e) Repeat this procedure at a minimum of 4 separate locations.

211-3.4 Infiltration Capacity. Infiltration Capacity shall be calculated as follows:

- a) The formula for U.S. Standard Measures shall be:
 $IC = (V)(3,326,400)(\pi)(d_1)(d_2)(t)$ inches per hour.
- b) The formula for SI Units shall be: $IC = (V)(14.4 \times 10^6)(\pi)(d_1)(d_2)(t)$ cm per hour.

Where:

IC is Infiltration Capacity

V is the volume of water in gallons or liters

d_1 and d_2 are the dimensions that were determined in 211-3.3

π is approximately 3.14159

211-3.5 Test Report. The test report shall include;

- a) The time and date of testing.
- b) The name and affiliation of the person performing the test.
- c) The location of the Work site.
- d) The location of each test site tested within the Work site.
- e) The volume of water used at each test site.
- f) The length of the two measurements taken at each test site.
- g) The discharge time for the water at each test site.
- h) The Infiltration Capacity at each test site.
- i) The average Infiltration Capacity for the Work site.

211-4 HAND HELD VISCOMETER TEST

(Pursuant to Change No. 189NS)

211-5 MOVING AVERAGE COMPUTATIONS

The moving average shall be computed as follows:

The moving average shall be rounded to the same number of significant figures as are reported for individual test results. When the figure to be dropped is less than 5, round down, if greater than 5, round up, and if it is 5, round up or down to the even number.

The moving average shall be continuous for the individual material processing or batch plant. In determining a moving average for a material property, all of the individual test results that represent material actually used in the Work shall be used in the calculation. The test results shall be entered into the calculation sequence in the chronological order that the Work is performed. The first individual test result shall start the moving average and shall meet the moving average requirements. Until more than 4 test results are available, the moving average shall be the numerical average of the individual test results. When more than 4 test results are available the moving average shall be determined by multiplying the last moving average by 4, adding the new result to this product and then dividing this sum by 5.

In computing the moving average, whenever an upper calculation limit value for an individual test is stated in the Specifications, the upper calculation limit value shall be used in the calculation in lieu of any actual individual test results which exceed said upper calculation limit value.

PART 4

SECTION 400 – ALTERNATE ROCK PRODUCTS, ASPHALT CONCRETE, PORTLAND CEMENT CONCRETE AND UNTREATED BASE MATERIAL

(This subsection shall apply only when Alternate Rock Material – Type S is specified)

400-1 ROCK PRODUCTS

400-1.1 General Requirements.

400-1.1.1 General. The following specifications set forth the requirements for aggregates for asphalt concrete, portland cement concrete, and untreated base material.

All rock products shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

The weight loss, as determined by ASTM C 131, shall not exceed 15 percent during 100 revolutions nor 52 percent during 500 revolutions.

Specified gradations represent the limits which determine the suitability of aggregate for use. Actual gradations shall be uniformly graded from coarse through fine, remaining proportionately distant from these limits.

Coarse aggregate is material retained on the No. 4 (4.75 mm) sieve and fine aggregate is material passing the No. 4 (4.75 mm) sieve.

The Contractor, at its expense, shall provide safe and satisfactory facilities for obtaining representative samples.

Materials may be sampled at any time until final acceptance of the Work.

400-1.1.2 Source. Before beginning portland cement concrete and asphalt concrete work, the Contractor shall submit the name of the supplier to the Engineer as specified in 2-5.3. The supplier shall have on file with the Agency mix designs for portland cement concrete conforming to 201-1.1.1, and asphalt concrete conforming to 203-6.2, when required by the Specifications.

The Contractor or supplier shall resubmit required information when any change is made.

400-1.1.3 Statistical Testing. Statistical testing shall conform to the following:

Whenever both individual test results and moving average requirements are specified, materials shall meet both requirements.

Individual samples tested prior to the first use of aggregates from each source, or prior to the first use of aggregates after ~~appreciable~~ any changes have been made in aggregate processing procedures, shall conform to the limits specified for the moving average.

Whenever the results of an individual test for any property of a material, other than concrete compressive strength, does not comply with the limits specified for an individual test and if the moving average would not comply with the limit specified for the moving average should the next test be of the same value as that of the test being considered, the production of that material shall be suspended until corrective changes have been made by the Contractor and tests indicate that the quality of the next material to be used in the work complies with that specified for the moving average.

Moving average shall be computed ~~as follows:~~ in accordance with 211-5.

~~Moving average shall be rounded to the same number of significant figures as are reported for individual test results. When the figure to be dropped is less than five, round down, if greater than five, round up, and if it is five, round up or down to the even number.~~

~~Moving averages shall be continuous for the individual material processing or batch plant. In determining a moving average for a material property, all of the individual test results that represent material actually used in the work shall be used in the calculation. The test results shall enter the calculation sequence in the chronological order that the work is performed. The first individual test result shall start a moving average and shall meet the moving average requirements. Until more than four test results are available, the moving average shall be the numerical average of the individual test results. When more than four test results are available the moving average shall be determined by multiplying the last moving average by four, adding the new result to this product and then dividing this sum by five.~~

~~In computing moving average, whenever an upper calculation limit value for an individual test is stated in the Specifications, the upper calculation limit value shall be used in the calculation in lieu of any actual individual test results which exceed said upper calculation limit value.~~