SECTION 703 - AGGREGATES

703.01 Fine Aggregate for Concrete. Fine aggregate for portland cement concrete may be a combination of calcareous sand and lava rock crusher screenings or lava rock crusher screenings alone. Fine aggregate shall be free from sticks, dirt, organic matter, and other impurities. The Contractor shall take coral beach sand from that part of the beach that has not been in recent contact with salt water.

If the Contractor uses a combination of calcareous sand and lava rock crusher screenings, the absolute volume of calcareous sand shall be less than fifty (50) percent of the absolute volume of the combined fine aggregate.

If tested according to the designated methods, the fine aggregate shall conform to the following:

Test	Method	Requirements
Sand Equivalent	AASHTO T 176	70% Minimum
Soundness	AASHTO T 104 (5 cycles using sodium sulfate)	10% Maximum
Organic Impurities	AASHTO T 21	Not darker than the reference standard color
Clay Lumps and Friable Particles	AASHTO T 112	1% Maximum
Coal and Lignite	AASHTO T 113	1% Maximum
Grading	AASHTO T 27	Refer to Table 703-I

TABLE 703-I FINE AGGREGATE GRADING REQUIREMENTS

Sieve Sizes	Percent Passing by Weight	
	Calcareous Sand	Crusher Screenings
3/8-inch	100	100
No. 4	95 - 100	95 - 100
No. 8		50 - 85
No. 16		32 - 60
No. 50		15 - 30
No. 100	0 - 5	5 - 20

If the material had a satisfactory service record of at least five (5) years, the Contractor may waive the soundness test.

The Engineer may accept materials that fail to meet the organic impurity color test provided the relative strength at seven (7) and twenty-eight (28) days is more than ninety-five (95) percent when tested according to AASHTO T 71.

The parent material of fine aggregate manufactured by crushing shall have a loss by abrasion of less than forty (40) percent when tested according to AASHTO T 96.

The Engineer will allow fine aggregate uniformly meeting the following gradation requirements instead of the gradation requirements of Table 703-I.

Sieve Size	Percent Passing by Weight
3/8-inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 12

The Engineer may waive the sand equivalent (SE) requirement provided the material finer than No. 200 sieve does not exceed five (5) percent when tested according to AASHTO T 11.

Besides the above requirements, the Contractor shall furnish the Engineer for acceptance a Quality Control Plan (QCP). The QCP shall detail process control procedures and the type and frequency of sampling and testing to ensure that the aggregate complies with the contract.

For aggregates used for structural concrete other than concrete for incidental construction, the minimum frequency of testing for sieve analysis and SE shall be once a day. The Contractor shall provide the Engineer free access to plant production records. If requested, the Contractor shall provide the Engineer informational copies of sampling and testing reports.

If the Contractor uses a blend of calcareous sand from the Waiehu area and crushed lava rock fines, the Engineer may grant waiver of the gradation requirement for fine aggregate for concrete. The Contractor shall provide

sufficient and acceptable data to show that the concrete made with the fine aggregate will have relevant properties equal to those of concrete made with the same ingredients. The exception is that the Contractor shall use a reference fine aggregate selected from a source having an acceptable performance record in similar concrete construction.

The Contractor shall grade the fine aggregate within the following limits:

Sieve Size	Percent Passing by Weight
3/8-inch	100
No. 4	95 - 100
No. 8	65 - 95
No. 16	x $\pm$ 10
No. 30	x $\pm$ 9
No. 50	x $\pm$ 6
No.100	2 - 14

In the above gradation limits, the symbol x is the gradation that the Contractor proposes to furnish for the specific sieve size.

Before beginning concrete work, the Contractor shall submit a typical gradation of the calcareous sand and the crushed lava rock fines. The Contractor shall specify the proportion of the blend that the Contractor proposes to furnish. The resulting gradation shall have less than forty-five (45) percent retained between two (2) consecutive sieves that the Contractor specifies in the control of fineness modulus.

The Contractor shall also specify a target fineness modulus that shall be between 2.4 and 3.1. The Contractor shall compute the fineness modulus using the No. 4, 8, 16, 30, 50 and 100 sieves and shall not vary by more than 0.2 from the target.

The Contractor shall meet the other specified requirements.

703.02 Coarse Aggregate for Portland Cement Concrete. The coarse aggregate for portland cement concrete includes crushed stone or gravel made from clean, hard, tough, dense, durable, lava rock free from adherent coatings.

The Contractor shall not use coarse aggregate with absorption of six (6) percent or greater.

When tested according to AASHTO T 96, the coarse aggregate shall have a loss by abrasion of less than forty (40) percent. *|

The coarse aggregate shall not contain deleterious substances over the following limits: *|

Test	Test Method	Requirement
Clay Lumps and Friable Particles	AASHTO T 112	2.0 %
Material Passing the No. 200 sieve	AASHTO T 11	1.5 %
Flat or Elongated Pieces (Length to Width or Width to Thickness Ratio of 3)	HWY-TC 4	25 %
Coal and Lignite	AASHTO T 113 using liquid of 2.0 specific gravity. The Engineer will consider only brownish-black or black material as coal or lignite. The Contractor shall not class coke as coal or lignite.	0.5 %

If tested according to AASHTO T 104 using sodium sulfate, the weighted loss shall not exceed twelve (12) percent at the end of five (5) cycles. If the material had a satisfactory service record of at least five (5) years, the Engineer may waive this test. *|

The Contractor shall grade the coarse aggregate well between the limits specified in Table 703-II. If tested according to AASHTO T 27, the course aggregate shall conform to the grading requirements of the designated size. *|

TABLE 703-II - COARSE AGGREGATE GRADING REQUIREMENTS

Designated Size (Size No.)	Percent Passing by Weight								
	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	#4	#8
3/4"- #4 (No.67)				100	90-100		20-55	0-10	0-5
1" - #4 (No.57)			100	95-100		25-60		0-10	0-5
1-1/2"-#4 (No.467)		100	95-100		35-70		10-30	0-5	
2" to #4 (No.357)	100	95-100		35-70		10-30		0-5	

703.03 Aggregate for Plant Mix Asphalt Concrete Base Course. The aggregate shall conform to Subsection 703.09 - Aggregate for Hot Plant Mix Bituminous Pavement. The grading requirement shall be as follows: |

Sieve Size	Percent Passing by Weight
1-1/4"	100
1"	85 - 100
1/2"	60 - 85
#4	40 - 55
#8	28 - 40
#30	12 - 21
#100	7 - 14
#200	3 - 10

The contract will not establish job tolerance for the asphalt concrete base course. The Contractor shall maintain controls to meet the above grading requirements. *| |

703.04 (Unassigned)

703.05 Aggregate for Waterbound Macadam Base. The Contractor shall furnish aggregate for water-bound macadam base in the fractions specified below. *|

(A) Coarse Aggregate. The Contractor shall make coarse aggregate by crushing and screening hard, tough, durable rock of uniform quality. The coarse aggregate shall be free from soft or disintegrated pieces, clay, dirt, or other deleterious substances. *|

If the Contractor makes coarse aggregate from gravel, the Contractor may use only such gravel particles as retained on a grizzly or screen having five (5) inch openings in the manufacturing process. *|

If tested according to the designated methods, the coarse aggregate shall meet the following requirements: *|

Test	Test Method	Requirement
Los Angeles Abrasion	AASHTO T 96 (Grading A)	50% Maximum
Flat or elongated pieces (Length to width or width to thickness ratio of 3)	HWY-TC 4	15% Maximum
Grading	AASHTO T 27	Refer to Table 703-III

TABLE 703-III - GRADING REQUIREMENTS					
Screen Size	Percent Passing by Weight				
	Coarse Aggregate				Filler
	Size 2	Size 24	Size 3	Size 4	
3"	100	100			
2-1/2"	90-100	90-100	100		
2"	35-70		90-100	100	
1-1/2"	0-15	25-60	35-70	90-100	
1"			0-15	20-55	
3/4"	0-5	0-10		0-15	
1/2"		0-5	0-5		100
3/8"				0-5	90 - 100
No. 8					40 - 65
No. 100					10 - 25

(B) Filler. Filler includes portions of the material crushed from coarse rock including the dust of fracture. Filler shall pass a half (1/2) inch screen. If the Contractor does not produce sufficient filler, the Contractor may supply the deficiency by the addition of other suitable materials having similar properties and a cementaceous value equal to that of the crushed product. *|

If tested according to the designated methods, the filler shall meet the requirements below. *|

Test	Test Method	Requirement
Plasticity Index	AASHTO T 90	6 Maximum
Grading	AASHTO T 27	Refer to Table 703-III

The Contractor may furnish filler in more than one fraction provided the quantities furnished and spread meet the grading requirements when combined. The Contractor shall mix the filler placed in two (2) or more fractions together by the brooming required to set the filler into the coarse aggregate. *|

703.06 Aggregate for Untreated Base. Aggregate for untreated base includes a crushed product of stone or coral. The aggregate shall be free of vegetable matter and other deleterious substances. The aggregate shall be of such nature that the Contractor can compact the aggregate readily under watering and rolling to form a firm, stable base. |*|

If the mineral aggregate does not contain sufficient natural cementing material, the Contractor shall add to and mix a binder material including rock screenings or other accepted cementaceous material uniformly into the aggregate before compaction. *|

The Contractor shall regulate the crushing so that the Contractor crushes at least eighty (80) percent by weight of the material retained on the No. 4 sieve. A crushed particle is one having at least one mechanically fractured face. *|

If tested according to the designated methods, the aggregate base in combination with the binder material, if used, shall meet the requirements below. *|

Test	Test Method	Requirement
Los Angeles Abrasion	AASHTO T 96	50 Percent Maximum
Sand Equivalent	AASHTO T 176	35 Percent Maximum
Plasticity Index	AASHTO T 90	6 Maximum
Flat or elongated pieces (Length to width or width to thickness ratio of 3)	HWY-TC 4	25 Percent Maximum
Grading	AASHTO T 27	Refer to Table 703-IV

TABLE 703-IV - GRADING REQUIREMENTS

Screen Size	Percent Passing by Weight		
	2-1/2" Maximum	1-1/2" Maximum	3/4" Maximum
3"	100	-	-
2-1/2"	90 - 100	-	-
2"	-	100	-
1-1/2"	65 - 90	90 - 100	-
1"	-	-	100
3/4"	45 - 70	50 - 90	90 - 100
No. 4	25 - 45	25 - 50	35 - 55
No. 200	3 - 9	3 - 9	3 - 9

If the portion passing the No. 4 sieve consists entirely of crushed coralline limestone, the SE requirement shall be more than twenty (20) percent and the grading requirement on the No. 200 sieve shall be three (3) to twelve (12) percent instead of that specified in Table 703-IV.

The Contractor shall furnish one and a half (1-1/2) inch maximum size aggregate.

703.07 (Unassigned)

703.08 (Unassigned)

703.09 Aggregate for Hot Plant Mix Bituminous Pavement. The Contractor shall make mineral aggregate by crushing and screening hard, tough, durable stone of uniform quality. The crushed aggregate shall be free from soft or disintegrated pieces, clay, dirt, or other deleterious substances.

Coarse aggregate shall be that portion of the mineral aggregate retained on a No. 4 sieve. Fine aggregate shall be that portion of the mineral aggregate passing a No. 4 sieve.

At least ninety (90) percent by weight of the material retained on the No. 4 sieve shall consist of crushed particles. At least seventy (70) percent of the material passing the No. 4 sieve and retained on the No. 8 sieve shall consist of crushed particles. A crushed particle is one having at least one mechanically fractured face.

If tested according to the designated methods, the combined mineral aggregate including blending sand or filler, if any, shall meet the requirements below.

Test	Test Method	Requirement
Sand Equivalent	AASHTO T 176	50 Percent Minimum
Los Angeles Abrasion	AASHTO T 96	30 Percent Maximum
Stripping	AASHTO T 182	Above 95 Percent
K-factor	AASHTO T 270	Kc-2.0 Maximum Km-1.7 Maximum
Flat and elongated pieces (Length to width or width to thickness ratio of 3)	HWY-TC 4	25 Percent Maximum
Grading	AASHTO T 27 AASHTO T 11	Job-mix formula based on Table 703-V
Soundness	AASHTO T 104 (5 cycles using sodium sulfate)	9 Percent Maximum

The Contractor may use aggregates not meeting the requirements of the stripping test for bituminous pavement provided the Contractor uses a chemical additive to result in bituminous film retention above ninety-five (95) percent. *|

With prior acceptance by the Engineer, the Contractor may lower the sand equivalent requirement from fifty (50) percent to forty-five (45) percent minimum provided material finer than No. 200 sieve does not exceed eight (8) percent.

TABLE 703-V - GRADING COMPOSITION				
MIX NO.	II	III	IV	V
Sieve Sizes	Combined Aggregate % Passing by Weight			
1-1/4"	100	-	-	
1"	85 - 100	100	-	
3/4"	-	90 - 100	100	
1/2"	60 - 85	70 - 90	85 - 100	100
3/8"	-	-	72 - 88	80 - 100
No. 4	36 - 55	40 - 57	48 - 66	55 - 75
No. 8	26 - 41	30 - 47	32 - 48	35 - 52
No.16	17 - 32	20 - 36	21 - 37	22 - 38
No.30	12 - 25	16 - 28	15 - 27	14 - 26
No.50	8 - 18	10 - 22	9 - 21	8 - 20
No. 100	5 - 14	8 - 17	6 - 16	6 - 15
NO. 200	1 - 8	4 - 10	4 - 10	4 - 10

703.10 Aggregate for Open-Graded Plant Mix Seal. The Contractor shall make mineral aggregate by crushing and screening sound, tough, durable stone of uniform quality. The mineral aggregate shall be free from coatings of clay, silt, organic matter, and other objectionable substance. *|

Coarse aggregate shall be that portion of the mineral aggregate retained on a No. 8 sieve. If tested according to AASHTO T 85, the absorption for coarse aggregate shall not exceed three (3) percent. Fine aggregate shall be that portion of the mineral aggregate passing a No. 8 sieve. The Engineer will not allow aggregates that has shown to polish under traffic. *|

The aggregate when tested shall conform to of Subsection 703.09 - Aggregate for Hot Plant Mix Bituminous Pavement. The grading shall be: *|

Sieve Size	Percent Passing by Weight
3/8-inch	100
No. 4	30 - 50
No. 8	5 - 15
No. 200	2 - 5

Also, the absorption, if tested according to AASHTO T-85, shall not exceed three (3) percent. *|

703.11 Aggregate for Slurry Seal. The mineral aggregate shall include sound and durable crushed lava rock. The mineral aggregate shall be free of dirt, clay or other objectionable material. The aggregate shall contain no free water and shall be nonplastic according to AASHTO T 89 and AASHTO T 90. *|

If tested according to AASHTO T 176, the aggregate shall have an SE of more than forty-five (45).

If tested according to AASHTO T 96, the parent rock of the mineral aggregate shall have an abrasion loss of less than thirty-five (35) percent. *|

If tested according to AASHTO T 27, the mineral aggregate shall conform to the following gradation: *|

Sieve Size	Percent Passing by Weight		
	Type I	Type II	Type III
3/8	-	100	100
No. 4	100	85 - 100	70 -90
No. 8	90 - 100	65 - 90	45 -70
No. 16	65 - 90	45 - 70	28 -50
No. 30	40 - 60	30 - 50	19 -34
No. 50	25 - 42	18 - 30	12 -25
No. 100	15 - 30	10 - 21	7 -18
No. 200	10 - 20	5 - 15	5 -15

Type I - Crack filling and fine seal.

Type II - Medium Seal.

Type III - 1st and/or 2nd application, two-course seal.

703.12 Aggregate for Roadway Construction. The Contractor shall make aggregate by crushing and screening tough, durable stone of uniform quality. The crushing rock shall be free from soft or disintegrated pieces, clay, dirt or other deleterious substances.

If tested according to the designated methods, the aggregate shall meet the requirements below:

Test	Test Method	Requirement
Flat and elongated pieces (Length to width to width to thickness ratio of 3)	HWY-TC 4	25% Maximum
Los Angeles Abrasion	AASHTO T 96	40% Maximum
Stripping	AASHTO T 182	Above 95%
Grading	AASHTO T 27	AASHTO M 43

The Contractor may use aggregates not meeting the requirements of the stripping test for bituminous treatments provided the Contractor uses a chemical additive to result in bituminous film retention above ninety-five (95) percent.

703.13 (Unassigned)

703.14 Blotter. Aggregate for blotter material shall conform to the gradation requirements of AASHTO M 43, Size No. 10. The aggregate shall be free from vegetable matter or other deleterious substances.

703.15 Filler. Filler includes that portion of the material crushed from the coarse aggregate and passes a half (1/2) inch screen. If the Contractor does not make sufficient filler, the Contractor may supply the deficiency by the addition of other suitable materials having the same properties to that of the crushed product.

The Contractor may also make filler separately from the manufacture of the coarse aggregate. Material for separately made filler shall also be of a suitable material having the same properties as that of the filler produced from the manufacture of the coarse aggregate.

If tested according to AASHTO T 27, fillers shall conform to the following grading requirements:

Sieve Size	Percent Passing by Weight
1/2 inch	100
3/8 inch	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

703.16 Bed Course Material.

(A) Bed Course Material for Sidewalks and Curbing. Bed course material for sidewalks and curbing includes one and a half (1-1/2) inch maximum size untreated base material conforming to Subsection 703.06 - Aggregate for Untreated Base.

(B) Bed Course Material for Pipe. Bed course material for pipe foundation includes one and a half (1-1/2) inch maximum size untreated base material conforming to Subsection 703.06 - Aggregate for Untreated Base.

If used as a foundation for pipe culvert and tested according to Subsection 106.09(G) - Test for Field Resistivity and pH of Backfill, the material shall have a field resistivity and pH value resulting in a service life of fifty (50) years or more.

If used as a foundation for aluminum pipe and tested according to Hawaii Test Method HWY-TC 8, the material shall have a field resistivity of more than five hundred (500) ohm-centimeters and pH value within the range of 5.5 and 9.0.

(C) Bed Course Material for Crushed Rock Cradle. The Contractor shall make bed course material for crushed rock cradle by crushing sound durable lava rock. The bed course material shall be free from vegetable matter and other deleterious substances. The wear shall not exceed fifty (50) percent at five hundred (500) revolutions if tested under AASHTO T 96.

Bed course material shall be coarse aggregate size No. 67 and the percent composition by weight shall fall within the limits shown in Table 1 of AASHTO M 43.

703.17 Aggregate for Subbase. Aggregate subbase material includes gravel, stone, lava rock or coral. The aggregate subbase shall be free from overburden, vegetable matter, or other deleterious substances. The material may be pit run except the Contractor shall handle and process the material to produce a well graded from coarse to fine material. The material shall conform to the applicable top size requirement specified in the contract.

If the Contractor uses cohesionless material including cinders, the *| Contractor shall add sufficient fine material to bind the subbase in a *| uniform mass and to aid in compaction. If the Contractor uses fine material, *| the combined material shall meet the quality requirements specified in the *| contract. *|

For material placed in the top six (6) inches of the subbase course, one hundred (100) percent of the material shall pass a two and a half (2-1/2) inch square sieve. For material placed below the top six (6) inches of the subbase course, the material shall pass a six (6) inch square sieve.

If tested according to AASHTO T 176, the SE value shall be more than *| twenty-five (25).

If tested according to AASHTO T 27, the percentage passing the No. 4 sieve shall be more than twenty (20) percent and less than sixty (60) *| percent. The percentage passing the No. 200 sieve shall be less than fifteen *| (15) percent.

If tested according to AASHTO T 90, the plasticity index shall comply *| with the following requirements:

PERCENT PASSING NO. 200 SIEVE	PLASTICITY INDEX
0 - 9	15 Maximum
10 - 15	10 Maximum

If the portion passing the No. 4 screen is entirely of crushed coralline | limestone, the SE requirement shall be more than twenty (20). |

703.18 Filter Material. Filter material shall be of hard, tough, durable, lava-rock.

If tested according to the designated methods, the aggregate shall meet | the requirements below: |

Test	Test Method	Requirement
Los Angeles Abrasion	AASHTO T 96 (Grading A)	10% Maximum @ 100 Rev. 40% Maximum @ 500 Rev.
Sand Equivalent	AASHTO T 176	35% Minimum
Plasticity Index	AASHTO T 90	6% Maximum
Grading	AASHTO T 27	Refer to Table 703-VI

TABLE 703-VI - GRADING REQUIREMENTS	
Sieve Size	Percent Passing by Weight
2"	100
1-1/2"	90 - 100
3/4"	50 - 90
No. 4	15 - 50
No. 200	0 - 5

703.19 (Unassigned)

703.20 **Structure Backfill Material.** Structure backfill material shall be free of vegetable matter and other deleterious substance and shall conform to the grading requirements in Table 703-VII.

(A) Structure Backfill Material A. If tested according to AASHTO T 176, the SE value shall be more than twenty (20). *|

(B) Structure Backfill Material B. If tested according to AASHTO T 176, the SE value shall be more than the area the Contractor will fill and more than two (2). *|

Structure fill or backfill material placed behind bridge abutments, wingwalls and retaining walls shall be structure backfill material A. The contract shall show the other areas requiring material with a SE value of more than twenty (20). *|

TABLE 703-VII - GRADING REQUIREMENTS	
Sieve Size	Percent Passing by Weight
3"	100
#4	20 -100

703.21 **Trench Backfill Material.** Trench backfill material shall be black sand-soil mixture, finely graded coral or sandy materials. The trench backfill material shall pass a one (1) inch square mesh screen or crusher screening S4C that shall pass a half (1/2) inch square mesh screen. The material shall be free from deleterious substances. For water system trench backfill, the Contractor shall not use crusher screening S4C in areas where the invert of the pipe is at or lower than the four (4) foot elevation, USGS Datum, or in swampy area or in area where the ground is continuously wet. *|

If tested according to Hawaii Test Method HWY-TC 8, the trench backfill material placed against metal pipe shall have a field resistivity and pH value that shall result in a service life of fifty (50) years or more.

(A) Trench Backfill Material A. If tested according to AASHTO T 176, the SE value shall be more than twenty (20).

(B) Trench Backfill Material B. If tested according to AASHTO T 176, the SE value shall be more than the area the Contractor will fill and more than two (2).

If tested according to the Hawaii Test Method HWY-TC 8, the trench backfill material placed against aluminum pipe shall have a field resistivity of more than five hundred (500) ohm-centimeters and pH value within the range of 5.5 and 9.0.

703.22 Blending Sand. Blending sand shall be a natural sand that is clean, hard-grained, and of the windblown or waterworn type. The blending sand shall be free of loam, clay, organic matter, or other deleterious substances.

If tested according to AASHTO T 27, the gradation shall conform to Table 703-VIII.

TABLE 703-VIII - GRADATION

Sieve Size	Percent Passing by Weight
No. 16	100
No. 20	90 - 100
No. 100	5 - 50
No. 200	0 - 10

703.23 Aggregate for Dressing of Shoulders. Aggregate shall conform to the Subsection 703.17 - Aggregate for Subbase except that one hundred (100) percent of the material shall pass the one and a half (1-1/2) inch sieve.

703.24 Granular Material for Embankment. Granular material for embankment construction may include gravel, stone, lava rock, coral or cinders. The material shall be free from overburden vegetable matter, or other deleterious substances. The material shall be pit run except that the Contractor shall handle and process the material to produce a well graded material from coarse to fine. If tested according to AASHTO T 27, the material shall conform to the following grading requirements:

Sieve Size	Percent Passing by Weight
6 inch	100
3 inch	75 - 100
No. 4	20 - 75
No.200	0 - 15