

SECTION 1033 -- AGGREGATES

1033.01 -- Description

Mineral aggregates shall be crushed rock, broken stone, gravel, sand-gravel, coarse sand, fine sand, or a mixture of these materials composed of clean, hard, durable, and uncoated particles. Crushed rock shall be crushed limestone, dolomite, granite, quartzite, or other ledge rock approved for the intended purpose by the NDR Materials and Tests Engineer.

1033.02 -- Material Characteristics

1. Sampling and Testing Procedures:

Sampling and testing shall be performed in accordance with Table 1033.01.

Table 1033.01

Sampling and Testing Procedures	
Procedure	Method
Sampling.....	NDR T 2
Sieve Analysis	NDR T 27
Clay Lumps, Shale, and Soft Particles.....	NDR T 504
Abrasion	AASHTO T 96
Freeze and Thaw Soundness.....	NDR T 103
Specific Gravity and Absorption (course aggregate)	NDR T 85, NDR T 585
Specific Gravity and Absorption (fine aggregate)	NDR T 84, NDR T 584
Plasticity Index.....	NDR T 89, NDR T 90
Sodium Sulfate Soundness	AASHTO T 104
Calcium Carbonate	NDR T 5
Organic Impurities.....	AASHTO T 21
Mortar-Making Properties.....	AASHTO T 71
Reducing Field Samples of Aggregate to Testing Size.....	NDR T 248

2. General Aggregate Properties:

a. Aggregates shall be free from injurious quantities of dust, soft or flaky particles, loams, alkali, organic matter, paper, wood, or other deleterious matter as determined by the Engineer.

b. Dolomite as herein defined is a magnesium limestone containing calcium carbonate and magnesium carbonate in approximately a 4 to 3 ratio.

c. The calcium carbonate content of limestone shall be at least 80 percent (computed as CaCO₃ from the value determined for CaO).

d. Fine sand shall have at least 95 percent of its particles pass the No. 10 sieve and no more than 25 percent pass the No. 200 sieve. This definition applies to the sodium sulfate soundness test.

e. Once an aggregate's soundness and abrasion quality has been determined, additional quality testing for soundness and abrasion loss will be at the Engineer's discretion.

3. Portland Cement Concrete Aggregate:

a. Fine aggregate and sand-gravel aggregate:

Table 1033.02A

Fine Aggregate for Concrete Gradation Limits									
Class A Aggregate			Class B Aggregate		Sand-Gravel Aggregate for Concrete Class C Aggregate		Class D Aggregate		
Percent Passing									
Sieve Size	Target Value	Tolerance	Target Value	Tolerance	Target Value	Tolerance	Target Value	Tolerance	
1 inch	---	---	100	None	100	---	---	---	
3/8 inch	100	None	---	---	---	---	---	---	
No. 4	96	+4	87	±10	66	+22	100	0	
No. 10	77	±13	60	±10	37	±13	95	+5	
No. 30	25	±15	28	±12	12	±8	57	±18	
No. 200	1.5	±1.5	1.5	±1.5	1.5	±1.5	3	±3	

Table 1033.02B

Aggregate Classes and Uses	
<u>Aggregate Class</u>	<u>Concrete Description</u>
A	Overlay Concrete SF Overlay Concrete HD
B	47B, 47B-HE, 47B-P, 47B-PHE, 47BD, and PR 1, PR 3
C	AX and 47B-SG
D	Grout Sand

(1) Fine aggregate shall be washed and composed of clean, hard, durable, and uncoated particles.

(2) Aggregates produced from wet pits by pumping will be considered to be washed.

(3) Aggregates from a dry pit shall have the method for washing approved by the Department.

(4) Fine aggregate and sand-gravel aggregate for concrete shall have a soundness loss of not more than 10 percent by weight at the end of 5 cycles using sodium sulfate solution.

(5) The weight of the fine aggregate and sand-gravel aggregate shall not contain more than 0.5 percent clay lumps.

(6) Fine aggregate and sand-gravel aggregate subjected to the colorimetric test for organic impurities which produces a color darker than the standard shall be further tested for its mortar-making properties (in accordance with AASHTO T 71).

(7) Fine aggregate and sand-gravel aggregate, when subjected to the test for mortar-making properties, shall produce a mortar having a compressive strength at the age of 7 days equal to or greater than that developed by mortar of the same proportions and consistency made of the same cement and aggregate after the aggregate has been treated in a 3 percent solution of sodium hydroxide. Materials failing to produce equal or greater strength shall be unacceptable, except when determined to be acceptable under the provisions of Subsection 105.03.

(8) Aggregate shall be evaluated based upon its past performance in concrete pavement and in laboratory test results. Aggregate with adversely reactive constituents shall not be used.

(9) Aggregate shall meet the requirements in Tables 1033.02A and B.

b. Coarse Aggregate:

Table 1033.03A

Coarse Aggregate for Concrete Gradation Limits				
Class E Aggregate			Class F Aggregate	
Percent Passing				
Sieve Size	Target Value	Tolerance	Target Value	Tolerance
1 1/2 inch	100	---	---	---
1 inch	100	- 8	---	---
3/4 inch	78	±12	100	0
1/2 inch	---	---	98	+2
3/8 inch	30	±15	65	+25
No. 4	6	±6	17	+13
No. 10	---	---	4	+4
No. 20	2*	+2	---	---
No. 200	1.5	+1.5	1.5	+1.5

* The percent passing may be increased to 3±3 provided no more than 1.5% is passing the No. 200 sieve when washed.

Table 1033.03B

Aggregate Classes and Uses	
Aggregate Class	Concrete Description
E	47B, 47B-P, 47B-PHE, and 47B-HE 47BD, PR 1, and PR 3
F	Overlay Concrete SF Overlay Concrete HD

(1) Coarse Aggregate shall consist of limestone composed of clean, hard, durable, and uncoated particles. These materials are natural sedimentary rock composed principally of calcium carbonate.

(2) The calcium carbonate content of limestone shall be at least 80 percent (computed as CaCO₃ from the value determined for CaO).

(3) The percent of clay lumps, shale, or soft particles shall not exceed the following amounts:

Clay Lumps.....	0.5 percent
Shale	1.0 percent
Soft Particles.....	3.5 percent

(4) Any combination of clay lumps, shale, and soft particles shall not exceed 3.5 percent.

(5) Coarse aggregate for concrete shall be free of coatings that will inhibit bond and free of injurious quantities of loam, alkali, organic matter, thin or laminated pieces, chert, or other deleterious substances as determined by the Engineer.

(6) Coarse aggregate for concrete shall not have a soundness loss greater than 8.0 percent by weight at the completion of 16 cycles of alternate freezing and thawing.

(7) Limestone aggregates for concrete shall have a Los Angeles Abrasion loss percentage of not more than 40.

(8) Aggregate shall be evaluated based upon its past performance in concrete pavement and in laboratory test results. Aggregate with adversely reactive constituents shall not be used.

(9) Aggregate shall meet the requirements in Tables 1033.03A and B.

4. **Bituminous Aggregate:**

Table 1033.04A

Asphalt Combined Aggregate Grading Band Tolerance			
Band "A" Mix (1/2 inch) (To Be Used When Total Thickness Is 4 Inches Or Less)			
	<u>Percent Passing</u>		
<u>Sieve Size</u>	<u>Min.</u>		<u>Max.</u>
1 inch	100%		
3/4 inch	98%		100%
1/2 inch	94%		100%
3/8 inch	80%		98%
No. 4	52%		88%
No. 10	32%		70%
No. 30	17%		38%
No. 50	10%		24%
No. 200	3%		7%

Table 1033.04B

Asphalt Combined Aggregate Grading Band Tolerance			
Band "B" Mix (3/4 inch) (To Be Used When Total Thickness Is Greater Than 4 Inches)			
	<u>Percent Passing</u>		
<u>Sieve Size</u>	<u>Min.</u>		<u>Max.</u>
1 inch	100%		
3/4 inch	98%		100%
1/2 inch	76%		93%
3/8 inch	60%		88%
No. 4	42%		78%
No. 10	27%		60%
No. 30	14%		38%
No. 50	8%		21%
No. 200	3%		7%
* On Type 17 asphalt mixes, the maximum is 100 percent.			
** On Type 17 asphalt mixes, the maximum is 32 percent.			

a. Bituminous aggregate shall have the following characteristics:

(1) Aggregate shall meet the requirements in Tables 1033.04A and B.

(2) The combined aggregate's compliance shall be tested on an individual aggregate basis.

(3) Tests to determine compliance with the quality requirements for gravel shall be performed on the "Pre-Crushed" gradation.

(4) Crushed rock for asphaltic concrete shall not contain deleterious substances in a quantity to exceed the following percentage by weight:

Clay Lumps and Shale.....	1.5
Soft Particles.....	3.5

(5) Any combination of shale, clay, or soft particles shall not exceed 3.5 percent by weight.

(6) All fractions of a crushed rock gradation shall be produced from the same type of material. The chemical and physical characteristics of the fraction passing the No. 4 sieve shall be substantially the same as those of the material which may be produced in the laboratory from the fraction which is retained on the No. 4 sieve. Crushed rock for asphaltic concrete shall have a percentage loss of not more than 8.0 percent by mass at the end of 16 cycles of the freezing and thawing test.

(7) (i) When any fraction of a mineral aggregate, except for crushed rock for use in asphaltic concrete, is of a nature adapted for the Los Angeles Abrasion Test, it shall have a loss percentage of not more than 40.

(ii) Mineral aggregates, except for crushed rock for asphaltic concrete, shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution.

(8) Quartzite and granite used in Asphaltic Concrete Types 13 and 15 shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution. The Los Angeles Abrasion Test shall have a loss percentage of not more than 40, and the "D" Grading is void.

(9) The aggregates for use in asphaltic concrete shall be tested on an individual basis. The results for crushed aggregates with identical quality requirements will be mathematically combined in the proportions proposed for use by the Contractor for the determination of compliance of the quality provisions. This mathematical procedure will not be allowed for the aggregates used in Asphaltic Concrete, Types 13 and 15.

(10) Mineral aggregates used in combination with bituminous materials shall have a resistance to loss of cohesion which is satisfactory to the Engineer. The evaluation of these properties for compacted bituminous mixtures and armor coats shall be determined by NDR T 165 and NDR T 522, respectively.

(11) The crushed values assigned to mineral aggregates are as described below:

(i) The crushed value percentage is defined as the number of particles with at least one face fractured divided by the total number of particles in a representative sample. This quotient is then multiplied by 100 to get the percentage in whole numbers.

(ii) Crushed limestone, dolomite, granite, quartzite, and other ledge rock shall be given a crushed value of 100 percent.

(iii) Except for ledge rock, any mineral aggregate having 10 percent or less passing a designated sieve before crushing and 90 percent or more passing the same sieve after crushing shall be given a crushed value of 100 percent.

[A] Final crushed aggregate is the product of only the mineral aggregate going into the crusher.

[B] The before-crushing aggregate gradation shall be representative of all the mineral aggregate going into the crusher.

[C] Screenings (scalpings) of the crushed mineral aggregate that are to be used to alter the gradation shall be submitted to the Engineer for approval.

[D] Reclaimed Asphalt Pavement (RAP) for use in recycled mixes will be given a percent crushed value following a review of the original project records, and this value will be provided in the special provisions of the contract.

[E] [i] The Contractor may submit crushed mineral aggregates other than identified above (i.e., recycled asphalt) for a determination of its crushed value percentage.

[ii] The complete production process for crushed mineral aggregate must be written out and presented to the Engineer for review before its approval.

[iii] Samples of before-crushed and after-crushed material may also be required for testing before approval.

[iv] Prior to crushing, this aggregate shall not have more than 30 percent passing the No. 10 sieve.

(12) Maximum percentages established for limestone exclude recycled materials.

b. Soil type mineral filler, fly-ash mineral filler, or limestone dust which is produced as a by-product of sugar beet refining will not be allowed.

c. Mineral filler shall consist of pulverized crushed rock, broken stone, gravel, sand-gravel, sand, or a mixture of these materials that conforms to the following requirements:

	Min.	Max.
Total Percent Passing the No. 50 Sieve	95	100
Total Percent Passing the No. 200 Sieve	80	100
Plasticity Index (material passing the No. 200 Sieve)	0	3

d. At the start of production, one sample of mineral filler will be analyzed for its properties by the NDR Materials and Tests Laboratory. If the sample is approved, no further tests will be required for the project. If the sample fails to meet the requirements, then further tests will be required.

e. When determining the maximum percentage of limestone in the mix, the recycled materials will not be considered.

5. Bituminous Sand Aggregate:

Table 1033.05

Bituminous Sand Aggregate Gradation Limits		
<u>Sieve Size</u>	<u>Percent Passing</u>	
	<u>Min.</u>	<u>Max.</u>
3/8 inch	---	---
No. 4	---	---
No. 10	---	---
No. 50	100	60
No. 200	33	12

a. Cold-mixed bituminous mixtures shall consist of approved inert mineral matter.

b. If soil type filler is approved for use, it shall be pulverized to the extent that 100 percent will pass the 1/2 inch sieve and at least 90 percent will pass the No. 10 sieve before combining with other aggregates.

c. Aggregate shall meet the requirements in Table 1033.05.

6. Armor Coat:

a. Mineral aggregate for armor coat shall have a Los Angeles Abrasion loss percentage of not more than 40.

b. Mineral aggregate for armor coat shall have a soundness loss of not more than 12 percent by mass at the end of 5 cycles using sodium sulfate solution.

c. Aggregate shall meet the requirements in Table 1033.06.

Table 1033.06

Armor Coat Aggregate Gradation Limits		
<u>Sieve Size</u>	<u>Percent Passing</u>	
	<u>Target Value</u>	<u>Tolerance</u>
3/4 inch	100	0
3/8 inch	97	+3
No. 4	---	---
No. 10	30	*
No. 50	5	+5
No. 200	2	+2

* A deduction from the contract bid price will be made for materials which are more than 5 percentage points above the target value, as specified in Subsection 515.05, Paragraph 2.

7. Surfacing Aggregates:

- a. Gravel aggregate for surfacing shall have a Los Angeles Abrasion loss percentage of not more than 40.
- b. Gravel aggregate for surfacing shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution.
- c. Aggregate shall meet requirements in Table 1033.07 or 1033.08, as applicable.

Table 1033.07

Gravel Surfacing Gradation Limits		
<u>Sieve Size</u>	<u>Percent Passing</u>	
	<u>Target Value</u>	<u>Tolerance</u>
1 inch	100	0
No. 4	73	+17
No. 10	16	*
No. 50	---	---
No. 200	3	+3

* A deduction from contract bid price will be made as specified in Section 310, Table 310.01.

- d. The gravel aggregates for surfacing shall have a Los Angeles Abrasion loss percentage of not more than 40.
- e. Gravel aggregates for surfacing shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution.

Table 1033.08

Crushed Rock for Surfacing Gradation Limits		
<u>Sieve Size</u>	<u>Percent Passing</u>	
	<u>Target Value</u>	<u>Tolerance</u>
1 inch	100	0
No. 4	40	+20
No. 10	15	+15
No. 50	---	---
No. 200	5	+5

f. Crushed rock for surfacing shall consist of clean, hard particles of crushed limestone, quartzite, or dolomite.

g. Crushed rock for surfacing shall have a Los Angeles Abrasion loss percentage of not more than 45.

h. Crushed rock for surfacing shall have a percent loss of not more than 30 at the end of 16 cycles of the freezing and thawing test.

8. Base Course:

Table 1033.09

Crushed Rock				
Crushed Rock for Base Course			Crushed Rock Screenings for Base Course	
<u>Sieve Size</u>	<u>Percent Passing</u>		<u>Target Value</u>	<u>Tolerance</u>
	<u>Target Value</u>	<u>Tolerance</u>		
1 1/2 inch	100	0		
3/4 inch	80	+15	100	0
3/8 inch	53	+17	73	+17
No. 4	---	---	55	+15
No. 10	20	+10	---	---
No. 20	---	---	28	+12
No. 200	5	+5	13	+7

a. Base Course Aggregate shall be crushed rock or broken stone or a mixture of these materials composed of clean, hard, durable, and uncoated particles.

b. (1) Crushed rock shall be crushed limestone, dolomite, granite, quartzite, or other ledge rock approved for the intended purpose by the NDR Materials and Tests Engineer.

(2) Dolomite as herein defined is a magnesium limestone containing calcium carbonate and magnesium carbonate in approximately a 4 to 3 ratio.

(3) All sizes of crushed rock for base course shall be produced from the same type of material. The chemical and physical characteristics of the fraction passing the No. 4 sieve shall be substantially the same as those of the material which may be produced in the laboratory from the fraction which is retained on the No. 4 sieve.

(4) Crushed rock for base course shall not contain shale, clay lumps, or other deleterious substances in a quantity to exceed a total of 2.5 percent based on the dry mass of the fraction retained on the No. 4 sieve.

(5) Crushed rock for base course shall be free from injurious quantities of dust, soft or flaky particles, loams, alkali, organic matter, paper, wood, or other deleterious material.

(6) The Los Angeles Abrasion loss percentage shall not exceed 45.

(7) Crushed rock for base course shall have a percentage loss of not more than 14 at the end of 16 cycles of the freezing and thawing test.

(8) The absorption of crushed rock for a base course shall not exceed 5.0 percent by weight.

(9) The product of the plasticity index (using wet preparation AASHTO T 146) of the fraction of the crushed rock for base course passing the No. 40 sieve and the percent of the crushed rock passing the No. 200 sieve shall not exceed 48. When the fraction of the crushed rock for a base course passing the No. 200 sieve does not exceed 4 percent, the plasticity index will not be determined and the product of the plasticity index and the percent passing the No. 200 sieve will not be a requirement for such material.

(10) The plasticity index (using dry preparation NDR T 87) of the crushed rock screenings passing the No. 40 sieve shall not exceed 4.

c. Crushed rock shall meet gradation requirements in Table 1033.09.

9. Foundation Course:

Table 1033.10

Foundation Course Mixture		
Sieve Size	Percent Passing	
	Target Value	Tolerance
1 inch	100	0
No. 10	62	+12
No. 40	34	+8
No. 200	9	+3

Table 1033.11

Crushed Concrete Foundation Course Gradation Requirements		
Sieve Size	Target Value (Percent Passing)	Tolerance
1 1/4 inch	100	0
1 inch	95	± 5
3/4 inch	81	±12
No. 4	38	±12
No. 10	24	±11
No. 40	9	± 5
No. 200	3	± 3

a. Soil binder from local pits shall be pulverized to the extent that at least 90 percent will pass a 1/2 inch sieve and at least 60 percent will pass a No. 10 sieve. The binder shall be pulverized before it is mixed with the other aggregates.

b. Except for crushed rock for use in asphaltic concrete, when any fraction of a mineral aggregate is of a nature adapted for the Los Angeles Abrasion Test, the loss percentage shall not be more than 40.

c. Mineral aggregates, other than crushed rock for asphaltic concrete, shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution.

d. Foundation course material shall meet the requirements in Table 1033.10 or 1033.11, as applicable.

1033.03 -- Procedures

1. Freshly washed or pumped aggregates shall be drained for 12 hours before use.

2. a. It is the Contractor's responsibility to protect materials from harmful contamination, segregation, excessive degradation, or other changes in the physical or chemical state or degree of uniformity.

b. If any detrimental change has taken place in the materials after the acceptance samples have been taken and tested, the right is reserved to retest and reject that part of the previously accepted material which is found unsatisfactory or require the Contractor to correct the deficiencies by reprocessing or providing other material meeting specification requirements.

3. a. The use of crawler-type equipment will be allowed in the stockpiling of fine aggregate and sand gravel aggregates.

b. Aggregate shall be removed from stockpiles with cranes, loaders, conveyors, or other approved equipment.

c. The use of crawler equipped dozers or end loaders will not be allowed in the stockpiling or the removal of crushed rock aggregates if the aggregate is damaged by the equipment.

4. Care shall be exercised to avoid segregation or degradation of aggregates or the inclusion of foreign material in the aggregates while they are being removed from the stockpiles.

5. a. Each aggregate that is to be stockpiled, either at the producer's plant or at the site of the work, shall be stockpiled separately.

b. Similar materials from different sources of supply shall not be mixed or stored in the same pile or used alternately in the same class of construction or mix without permission from the Engineer.

c. Materials which become intermixed (i.e., with other sources or different gradations) or which become contaminated by foreign materials shall not be used.

d. Aggregates shall not be stockpiled against the supports of proportioning devices or scales.

6. Properly drained aggregates unloaded and handled by conveyor systems may be deposited directly into the batch hoppers provided the equipment and procedures used will furnish aggregate of uniform gradation and moisture content.

7. It shall be the obligation of the contractor or concrete producer to maintain a uniform gradation and moisture content in each aggregate used during the handling and batching operations.

8. Similar materials produced by pumping from different pits in the Platte River Valley shall be considered to be from the same source.

1033.04 -- Acceptance Requirements

Aggregates will be accepted based on the requirements of this Section and sampling and testing requirements as prescribed in the NDR *Materials Sampling Guide*.