

**1010-2 AGGREGATE FOR PLANT MIXED CEMENT TREATED BASE COURSE**

Provide aggregate meeting Article 1010-1, except as modified herein. Sources of aggregate will not be approved unless the material has a percentage of wear of not greater than 65%.

**SECTION 1012  
AGGREGATE FOR ASPHALT PAVEMENTS  
AND SURFACE TREATMENTS**

**1012-1 AGGREGATE FOR ASPHALT PLANT MIXES****(A) General**

Design the asphalt plant mix with coarse and fine aggregate that meet Section 1005, except as noted herein. Size, uniformly grade and combine the aggregate fractions in such proportions that the resulting mixture meets the grading and physical requirements of these Specifications for the specified mix type. Materials that will not produce a mixture within the design criteria required by these Specifications will be rejected, unless otherwise approved.

The consensus property criteria in Table 1012-1 apply to the design aggregate blend. Source property criteria apply to individual aggregate sources.

For all dense-graded surface course mixes, that are the top or final layer, limit the amount of coarse aggregate or fine aggregate produced from crystalline limestone, crystalline-dolomitic limestone or marble to no more than 50% of the total amount of coarse aggregate or fine aggregate in the asphalt mixture. For open-graded asphalt friction course and ultra-thin bonded wearing course, do not use aggregates produced from crystalline limestone, crystalline-dolomitic limestone or marble.

**(B) Coarse Aggregate****(1) General**

Use coarse aggregate consisting of crushed stone, crushed gravel, a mixture of uncrushed gravel with either crushed stone or crushed gravel or other inert material having similar characteristics. Provide coarse aggregate composed of clean, tough, durable fragments free from an excess of flat or elongated pieces and free of organic matter and deleterious substances.

Use coarse aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of sources participating in the Department's Aggregate QC/QA Program in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

**(2) Gradation**

Use standard size coarse aggregate meeting Table 1005-1 and these *Standard Specifications* unless otherwise approved.

**(3) Coarse Aggregate Angularity (Fractured Faces)**

Use coarse aggregate meeting Table 1012-1 for coarse aggregate angularity (fractured faces) when tested in accordance with ASTM D5821.

**(4) Flat and Elongated Pieces**

Use coarse aggregate meeting Table 1012-1 for flat and elongated pieces when tested in accordance with ASTM D4791 on the No. 4 sieve and larger with a 5:1 aspect ratio (maximum to minimum) for all pavement types, except there is no requirement for Types S4.75A, SF9.5A and S9.5B.

**Section 1012**

(5) Soundness

The maximum weighted average soundness loss of individual coarse aggregate sources when subjected to 5 cycles using sodium sulfate when tested in accordance with AASHTO T 104 is 15%.

<b>TABLE 1012-1 AGGREGATE CONSENSUS PROPERTIES<sup>A</sup></b>				
<b>Mix Type</b>	<b>Coarse Aggregate Angularity<sup>B</sup></b>	<b>Fine Aggregate Angularity % Minimum</b>	<b>Sand Equivalent % Minimum</b>	<b>Flat and Elongated 5 : 1 Ratio % Maximum</b>
<i>Test Method</i>	<i>ASTM D5821</i>	<i>AASHTO T 304</i>	<i>AASHTO T 176</i>	<i>ASTM D4791</i>
S4.75A; SF9.5A; S9.5B	75 / -	40	40	-
I19.0B; B25.0B	75 / -	40	40	10
S9.5C; S12.5C; I19.0C; B25.0C	95 / 90	45	45	10
S9.5D; S12.5D; I19.0D	100 / 100	45	50	10
OGAFC	100 / 100	45	45	10
UBWC	100 / 85	45	45	10

**A.** Requirements apply to the design aggregate blend.

**B.** 95/90 denotes that 95% of the coarse aggregate has one fractured face and 90% has 2 or more fractured faces.

(6) Toughness (Resistance to Abrasion)

The maximum allowable percentage of loss of each individual coarse aggregate source for all plant mix types except open-graded asphalt friction course, shall be 55% when tested in accordance with AASHTO T 96. The maximum percentage loss for aggregate used in OGAFC shall be 45%. The percentage loss for aggregate used in UBWC shall be no more than 35%.

(7) Deleterious Materials

The maximum allowable percentage by weight of clay lumps and friable particles in individual aggregate sources shall be 0.3% when tested in accordance with AASHTO T 112.

(8) Durability (Micro-Deval test)

The maximum allowable abrasion loss for aggregate used in UBWC shall be 18% when tested in accordance with AASHTO T 327.

**(C) Fine Aggregate**

(1) General

Use fine aggregate that is consistently graded from coarse to fine and consists of natural sand, stone screenings, or a blend of natural sand and stone screenings. Use aggregate composed of rough surfaced and angular grains of quartz or other hard durable rock.

1 Use fine aggregate from sources participating in the Department's Aggregate  
 2 QC/QA Program as described in Section 1006. A list of sources participating in the  
 3 Department's QC/QA Program in North Carolina and adjoining states is available  
 4 from the Department's Materials and Tests Unit in Raleigh. If a natural sand source  
 5 is owned by the same owner as the asphalt plant where the material is used,  
 6 participation in the Aggregate QC/QA Program is not required.

7 Furnish sand from approved sources. Do not use sources contaminated by industrial  
 8 waste. A sufficient number of samples of fine aggregate, but in no case less than  
 9 three, will be taken to indicate any variation within any stockpile or source of supply.

10 Do not use fine aggregate containing sticks, roots, trash, visible lumps of clay, or  
 11 other unsatisfactory material unless all undesirable material is removed to the  
 12 satisfaction of the Engineer before the aggregate is used in the asphalt mixture.

13 Use natural sand that is non-plastic when tested in accordance with AASHTO T 90.

14 Produce stone screenings from stone that has a maximum percentage of wear of 55%  
 15 when tested in accordance with AASHTO T 96 using test grading A.

16 (2) Gradation

17 Use stone screenings that are consistently graded with not more than 20% by weight  
 18 passing the No. 200 sieve when tested by dry sieving in accordance with  
 19 AASHTO T 27. Use natural sand that is consistently graded.

20 (3) Clay Content (Sand Equivalent)

21 Use a fine aggregate blend that has a minimum sand equivalent percentage as  
 22 indicated in Table 1012-1 when tested in accordance with AASHTO T 176.

23 (4) Soundness

24 The maximum weighted average soundness loss of individual fine aggregate sources  
 25 when subjected to 5 cycles using sodium sulfate shall be 15% when tested in  
 26 accordance with AASHTO T 104.

27 Natural sand that contains grains of questionable hardness will be subjected to  
 28 5 cycles of the soundness test. The weighted average loss shall be not more  
 29 than 15%. The soundness test will be performed before establishing the mix design.

30 (5) Deleterious Materials

31 The maximum percentage by weight of clay lumps and friable particles in individual  
 32 fine aggregate sources shall be 0.3% when tested in accordance with  
 33 AASHTO T 112.

34 (6) Fine Aggregate Angularity

35 Use a fine aggregate blend that has a minimum fine aggregate angularity as indicated  
 36 in Table 1012-1 when tested in accordance with AASHTO T 304, Method A.

37 **(D) Mineral Filler**

38 Use mineral filler consisting of limestone dust, dolomite dust, Portland cement, or other  
 39 inert mineral matter that conforms to AASHTO M 17.

40 **(E) Reclaimed Asphalt Shingles (RAS)**

41 For use in asphalt mix, Reclaimed Asphalt Shingles (RAS) can be either manufacturer-  
 42 waste shingles or post-consumer shingles that have been processed into a product that  
 43 meets the requirements of this section.

## Section 1012

1 Manufacturer-waste RAS (MRAS) are processed shingle materials discarded from the  
2 manufacturing of new asphalt shingles. It may include asphalt shingles or shingle tabs  
3 that have been rejected by the shingle manufacturer.

4 Post-consumer RAS (PRAS) are processed shingle materials recovered from mixed  
5 roofing material scrap removed from existing structures. Tear-off shingle scrap must be  
6 sorted and other roofing debris, including nails, plastic, metal, wood, coal tar epoxy,  
7 rubber materials, or other undesirable components, shall be removed. This sorting of the  
8 scrap must be done prior to grinding of the PRAS for use in asphalt production.

9 Sample and test PRAS for asbestos and provide results demonstrating that the bulk  
10 samples contain less than one percent of asbestos containing material in accordance with  
11 Federal, State of North Carolina, and Local regulations. Use NC-accredited Asbestos  
12 Inspectors or Roofing Supervisors to sample the PRAS to meet the above criteria.  
13 Maintain records on-site indicating shingle source(s), asbestos operation plan approved  
14 by Division of Public Health's Health Hazards Control Unit, and all asbestos analytical  
15 reports. All documentation will be subject to review by the Department.

16 Process RAS by ambient grinding or granulating methods such that 100% of the particles  
17 will pass the 9.50 mm (3/8 inch) sieve when tested in accordance with AASHTO T27.  
18 Perform sieve analysis on processed asphalt shingles prior to ignition or solvent  
19 extraction testing.

20 RAS shall contain no more than 0.5% by total cumulative weight of deleterious materials.  
21 These materials include, but are not limited to, excessive dirt, debris, concrete, metals,  
22 glass, paper, rubber, wood, plastic, soil, brick, tars, or other contaminating substances.

23 Blend RAS with fine aggregate or RAP, meeting the requirements of this Section, if  
24 needed to keep the processed material workable.

25 MRAS and PRAS shall not be blended together for the production of hot mix asphalt.

### 26 (1) Mix Design RAS

27 Incorporate RAS from stockpiles that have been tested for uniformity of gradation  
28 and binder content prior to use in an asphalt mix design.

### 29 (2) Mix Production RAS

30 New Source RAS is defined as acceptable material which was not included in the  
31 stockpile when samples were taken for mix design purposes. Process new source  
32 RAS so that all materials will meet the gradation requirements prior to introduction  
33 into the plant mixer unit.

34 After a stockpile of processed RAS has been sampled and mix designs made from  
35 these samples, do not add new source RAS to the original stockpile without prior  
36 field testing to insure gradation and binder uniformity. Sample and test new source  
37 RAS before blending with the existing stockpile.

38 Store new source RAS in a separate stockpile until the material can be sampled and  
39 tested for comparison with the original recycled mix design data. New source RAS  
40 may also be placed against the existing stockpile in a linear manner provided it is  
41 sampled for mix design conformity prior to its use in the recycled mix. Store RAS  
42 materials in such a manner as to prevent contamination.

43 Field approval of new source RAS will be based on the table below and volumetric  
44 mix properties on the mix with the new source RAS included. Provided these  
45 tolerances are met, volumetric properties of the new mix will then be performed. If  
46 all volumetric mix properties meet the mix design criteria for that mix type, the new  
47 source RAS may continue to be used.

1 If the gradation, binder content, or any of the volumetric mix properties are not  
 2 within the allowable tolerances of the table below, do not use the new source RAS  
 3 unless approved by the Engineer. The Contractor may elect to either not use the  
 4 stockpile, to request an adjustment to the JMF, or to redesign the mix.

<b>TABLE 1012-2</b>	
<b>NEW SOURCE RAS BINDER AND GRADATION TOLERANCES</b>	
<b>(Apply Tolerances to Mix Design Data)</b>	
<b>P<sub>b</sub> %</b>	<b>± 2.5</b>
<i>Sieve Size, mm</i>	<i>Tolerance</i>
4.75	± 5
2.36	± 4
1.18	± 4
0.300	± 4
0.150	± 4
0.075	± 2.0

5 **(F) Reclaimed Asphalt Pavement (RAP)**

6 (1) Mix Design RAP

7 Incorporate RAP from stockpiles or other sources tested for uniformity of gradation  
 8 and binder content before use in an asphalt mix design. Use RAP that meets all  
 9 requirements specified for the following classifications.

10 (a) Millings

11 Existing RAP that is removed from its original location by a milling process as  
 12 specified in Section 607. Millings should be such that it has a uniform gradation  
 13 and binder content and all materials will pass a 2 inch sieve before introduction  
 14 into the plant mixer unit.

15 (b) Processed RAP

16 RAP that is processed in some manner (possibly by crushing and/or use of  
 17 a blending method) to produce a uniform gradation and binder content in the  
 18 RAP before use in a recycled mix. Process RAP so all materials have a uniform  
 19 gradation and binder content and will pass a 1 inch sieve before introduction  
 20 into the plant mixer unit.

21 (c) Fractionated RAP

22 Fractionated RAP is defined as having 2 or more RAP stockpiles, where the  
 23 RAP is divided into coarse and fine fractions. Grade RAP so all materials will  
 24 pass a 1 inch sieve. The coarse RAP stockpile shall only contain material  
 25 retained on a 3/8 inch screen, unless otherwise approved. The fine RAP  
 26 stockpile shall only contain material passing the 3/8 inch screen, unless  
 27 otherwise approved. The Engineer may allow the Contractor to use an alternate  
 28 to the 3/8 inch screen to fractionate the RAP. The maximum percentages of  
 29 fractionated RAP may be comprised of coarse, fine, or the combination of both.  
 30 Use a separate cold feed bin for each stockpile of fractionated RAP introduced  
 31 into the mix.

32 (d) Approved Stockpiled RAP

33 Approved Stockpiled RAP is defined as fractionated RAP which has been  
 34 isolated and tested for asphalt content, gradation and asphalt binder  
 35 characteristics with the intent to be used in mix designs with higher RAP  
 36 contents as specified in Article 610-3. Fractionate the RAP in accordance with

**Section 1012**

- 1 Subsection 1012-1(F)(1)(c). Use a separate cold feed bin for each approved  
 2 stockpile of RAP used.
- 3 Perform extraction tests at a rate of one per 1,000 tons of RAP, with at least  
 4 five tests per stockpile to determine the asphalt content and gradation. Separate  
 5 stockpiles of RAP material by fine and coarse fractions. Erect and maintain  
 6 a sign satisfactory to the Engineer on each stockpile to identify the material.  
 7 Assure that no deleterious material is allowed to contaminate any stockpile. The  
 8 Engineer may reject by visual inspection any stockpiles that are not kept clean,  
 9 separated and free of foreign materials.
- 10 Submit requests for RAP stockpile approval to the Engineer with the following  
 11 information at the time of the request:
- 12 (i) Approximate tons of materials in stockpile,  
 13 (ii) Name or Identification number for the stockpile,  
 14 (iii) Asphalt binder content and gradation test results, and  
 15 (iv) Asphalt characteristics of the stockpile.
- 16 For the Stockpiled RAP to be considered for approval, the gradation and asphalt  
 17 content shall be uniform. Individual test results, when compared to the target,  
 18 will be accepted if within the tolerances listed in Table 1012-3.

<b>TABLE 1012-3 APPROVED STOCKPILED RAP GRADATION AND BINDER TOLERANCES<sup>A</sup> (Apply Tolerances to Mix Design Data)</b>	
<b>P<sub>b</sub> %</b>	<b>± 0.3%</b>
<i>Sieve Size, mm</i>	<i>Tolerance</i>
25.0	± 5%
19.0	± 5%
12.5	± 5%
9.50	± 5%
4.75	± 5%
2.36	± 4%
1.18	± 4%
0.300	± 4%
0.150	± 4%
0.075	± 1.5%

- 19 **A.** If more than 20% of the individual sieves are out of the gradation tolerances, or  
 20 if more than 20% of the asphalt binder content test results fall outside the  
 21 appropriate tolerances, the RAP shall not be used in HMA unless the RAP  
 22 representing the failing tests is removed from the stockpile.
- 23 Do not add additional material to any approved RAP stockpile, unless otherwise  
 24 approved by the Engineer.
- 25 Maintain a record system for all approved RAP stockpiles at the plant site.  
 26 Include at a minimum the following: Stockpile identification and a sketch of all  
 27 stockpile areas at the plant site; all RAP test results (including asphalt content,  
 28 gradation and asphalt binder characteristics).

## (2) Mix Production RAP

During mix production, use RAP that meets the criteria for one of the following categories:

## (a) Mix Design RAP

RAP contained in the mix design stockpiles as described above may be used in all applicable JMFs. These stockpiles have been pretested; however, they are subject to required QC/QA testing in accordance with the *HMA/QMS Manual*.

## (b) New Source RAP

Define “new source RAP” as any acceptable material that was not included in the stockpile or other source when samples were taken for mix design purposes. Process new source RAP so all materials have a uniform gradation and binder content and will pass a 2 inch sieve before introduction into the plant mixer unit.

**TABLE 1012-4  
NEW SOURCE RAP GRADATION AND BINDER TOLERANCES  
(Apply Tolerances To Mix Design Data)**

	0 - 20% RAP			20 - 30 % RAP			> 30 % RAP		
Pb, %	± 0.7%			± 0.4%			± 0.3%		
Sieve Size, mm	Mix Type			Mix Type			Mix Type		
	Base	Inter.	Surf.	Base	Inter.	Surf.	Base	Inter.	Surf.
25.0	±10	-	-	±7	-	-	±5	-	-
19.0	±10	±10	-	±7	±7	-	±5	±5	-
12.5	-	±10	±6	-	±7	±3	-	±5	±2
9.50	-	-	±8	-	-	±5	-	-	±4
4.75	±10	-	±10	±7	-	±7	±5	-	±5
2.36	±8	±8	±8	±5	±5	±5	±4	±4	±4
1.18	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.300	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.150	-	-	±8	-	-	±5	-	-	±4
0.075	±4	±4	±4	±2	±2	±2	±1.5	±1.5	±1.5

After a stockpile of millings, processed RAP or fractionated RAP has been sampled and mix designs made from these samples, do not add new source RAP to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAP before blending with the existing stockpile.

Store new source RAP in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAP may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity before its use in the recycled mix.

Unprocessed RAP is asphalt material that was not milled and/or has not been processed to obtain a uniform gradation and binder content and is not representative of the RAP used during the applicable mix design. Unprocessed RAP shall not be incorporated into any JMFs before processing. Different sources of unprocessed RAP may be stockpiled together provided it is generally free of contamination and will be processed before use in a recycled mix. RAP contamination in the form of excessive dirt, debris, clean stone, concrete, etc. will not be allowed. Incidental amounts of dirt, concrete and clean stone may be acceptable. Unprocessed RAP may be processed and then classified as a new source RAP as described above.

## Section 1012

1 Field approval of new source RAP will be based on Table 1012-4 and  
2 volumetric mix properties on the mix with the new source RAP included.  
3 Provided the Table 1012-4 tolerances are met, volumetric properties of the new  
4 mix will then be performed. If all volumetric mix properties meet the mix  
5 design criteria for that mix type, the new source RAP may continue to be used.

6 If the gradation, binder content, or any of the volumetric mix properties are not  
7 within the allowable tolerances of Table 1012-4, do not use the new source RAP  
8 unless approved by the Engineer. The Contractor may elect to either not use the  
9 stockpile, to request an adjustment to the JMF, or to redesign the mix.

### 10 1012-2 AGGREGATES FOR ASPHALT SURFACE TREATMENT

#### 11 (A) General

12 Use coarse aggregate consisting of crushed stone, crushed gravel, crushed slag, or other  
13 inert material having similar characteristics. Adequately wash coarse aggregate so it is  
14 free from clay, loam, dust and other adherent materials.

15 Adequately clean all fine aggregate so it is free from sticks, roots, visible lumps of clay or  
16 other unsatisfactory material before use.

#### 17 (B) Gradation

18 Use coarse aggregate for mat and seal coat and AST as required by Section 660, unless  
19 otherwise required by the contract. Use aggregate meeting the applicable gradation  
20 requirements of Table 1005-1.

21 Remix aggregate that has become segregated until it meets the applicable gradation  
22 requirements.

#### 23 (C) Fractured Faces

24 Use coarse aggregate that contains at least 75% by weight of crushed pieces having 2 or  
25 more fractured faces and at least 90% by weight of crushed pieces having one or more  
26 fractured faces on that portion retained on the No. 4 sieve.

#### 27 (D) Soundness

28 The maximum weighted average loss of either coarse or fine aggregate when subjected  
29 to 5 cycles using sodium sulfate when tested in accordance with AASHTO T 104 is 15%.

#### 30 (E) Toughness (Resistance to Abrasion)

31 The maximum percentage loss of coarse aggregate for asphalt surface treatment when  
32 tested in accordance with AASHTO T 96 is 55%.

#### 33 (F) Blending of Aggregates

34 Blending of two or more aggregates will not be permitted regardless of the origin of the  
35 aggregates if any one of the aggregates fails to meet the requirements for soundness or  
36 resistance to abrasion.

#### 37 (G) Weight of Slag

38 The minimum weight of crushed slag is 70 lbs/cf as determined in accordance with  
39 AASHTO T 19.

### 40 1012-3 BLOTTING SAND

41 Blotting sand is fine aggregate consisting of natural sand, commercial sand, manufactured  
42 sand, coarse screenings, or other inert material having similar characteristics.  
43 Subarticles 1012-2(D) and 1012-2(F) will be applicable to blotting sand. Adequately clean  
44 the fine aggregate so it is free from sticks, roots, visible lumps of clay or other unsatisfactory  
45 material before use.



**1012-4 LIGHTWEIGHT AGGREGATE**

Lightweight aggregates used in asphalt surface treatments shall be produced by the rotary kiln process and shall come from an approved Department source meeting applicable requirements of Section 1005 and 1006. The aggregate shall meet Table 1012-8 and AASHTO M 195 with the exception of Sections 3, 6, 8 and any other references to concrete samples or concrete strength.

<b>TABLE 1012-5 LIGHTWEIGHT AGGREGATE PHYSICAL PROPERTIES</b>		
<b>Property</b>	<b>Specification (maximum limit)</b>	<b>Test Method</b>
Sodium Sulfate Soundness	5%	AASHTO T 104
Los Angeles Abrasion	45%	AASHTO T 96 (B grading)
Percent Absorption	10%	AASHTO T 19
Micro-Deval	18%	AASHTO T 327

**SECTION 1014  
AGGREGATE FOR PORTLAND CEMENT CONCRETE**

**1014-1 FINE AGGREGATE****(A) General**

Use fine aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of sources participating in the Department's QC/QA Program in North Carolina and adjoining states is available from the Materials and Tests Unit.

Use fine aggregate consisting of natural sand or manufactured sand having clean, durable, hard, uncoated particles, or other inert materials having similar characteristics. Produce manufactured sand from fractured stone material. Use fine aggregate free from dirt, wood, paper, burlap and all other foreign material.

To permit excess water to drain and the moisture content to become uniform, stockpile the aggregates either at the producer's plant or at the batch plant site for at least 24 hours before use in the concrete. Build open stockpiles of fine aggregate at the batch plant on concrete surfaces. Do not add new material to the stockpile during the 24 hour period. When the aggregates have a low and uniform moisture content and the consistency of the concrete can be satisfactorily controlled without stockpiling the aggregates for 24 hours, the minimum stockpiling period may be reduced or waived entirely by the Engineer.

The Department's list of approved sources of fine aggregate shows the target fineness modulus of each aggregate as established by the producer. Do not use fine aggregate with a fineness modulus that varies more than 0.2 from the target value until the concrete mix proportions are adjusted.

**(B) Soundness**

When subjected to 5 cycles of the soundness test, the weighted average loss shall not be more than 15%.

**(C) Deleterious Substances**

Determine the percentage of deleterious substances (clay lumps and friable particles) in accordance with AASHTO T 112. The amount of deleterious substances shall not exceed 2.0% by weight for natural sand or 1.0% by weight for manufactured sand.