

**KANSAS DEPARTMENT OF TRANSPORTATION
 SPECIAL PROVISION TO THE
 STANDARD SPECIFICATIONS, 2007 EDITION**

Create a new SECTION in DIVISION 1100:

AGGREGATES FOR ON GRADE CONCRETE

1.0 DESCRIPTION

This specification is for coarse aggregates, intermediate aggregates, fine aggregates, and mixed aggregates for use in those types of on grade concrete construction identified in the Contract Documents. This SECTION supersedes any requirements for on-grade concrete aggregates in SECTION 1102.

For Intermediate Aggregates and Mixed Aggregates, consider any aggregate with 30% or more retained on the No. 8 sieve to be Coarse Aggregate.

2.0 REQUIREMENTS

a. Coarse Aggregates.

(1) Composition. Provide coarse aggregates that are crushed or uncrushed gravel, or crushed stone. Consider aggregate produced from the crushing of limestone, calcite cemented sandstone, granite, quartzite, basalt, diabase, rhyolite, and trap rock to be crushed stone. Mixtures utilizing siliceous aggregate not found on PQL 3.1 will require supplemental cementitious materials to prevent Alkali Silica Reactions. Provide the results of mortar expansion tests of ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting. Provide the results to the Engineer at least 15 days before placement of concrete on the project.

(2) Quality. Provide coarse aggregate that complies with the following requirements. Crushed aggregates with less than 20% material retained on the 3/8" sieve must be produced from a source complying with these requirements prior to crushing.

- Soundness by Freeze/Thaw (min.) (KTMR-21)..... 0.90
- Wear Grading B (max.)(AASHTO T96)..... 50%
- Additional Requirements:**
- Modified Soundness by Freeze/Thaw (min.) (KTMR-21)..... 0.90
- Relative Dynamic Modulus of Elasticity, minimum (KTMR-22 @ 660 F/T cycles) ... 95
- Expansion, maximum (KTMR-22 @ 660 F/T cycles)..... 0.025%

**The additional requirements do not apply for uncrushed sand-gravel aggregates having less than 5% material retained on the 1/2" sieve.

(3) Product Control.

(a) Size Requirements. Provide coarse aggregates that comply with the grading requirements in TABLE 1.

TABLE 1: GRADING REQUIREMENTS FOR COARSE AGGREGATES								
Type	Percent Retained - Square Mesh Sieves							
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 30
CPA-1 ¹	0	0-10	14-35	-	50-75	-	95-100	-
CPA-3	-	-	0	0-35	30-70	75-100	95-100	-
CPA-4	-	0	0-20	-	-	-	95-100	-

¹ Cannot be limestone or dolomite.

- (b) Deleterious Substances. Maximum allowed deleterious substances by mass are:
- Material Passing the No. 200 sieve (KT-2)..... 2.0%
 - Clay Lumps and Friable Particles (KT-7)..... 1.0%

Coal (AASHTO T 113).....	0.5%
Shale or Shale-like material (KT-8).....	0.5%
Sticks (wet) (KT-35).....	0.1%
Sum of all deleterious	3.0%

(c) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to the procedure listed in the Construction Manual Part V, Section 17 before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ± 0.20 of the average fineness modulus.

(d) Proportioning of Coarse and Fine Aggregate. Combine fine and coarse aggregates in a 50%-50% ratio by mass. Adjustments to improve workability may be made when approved by the Engineer. Use of a proven optimization method such as ACI 302.1 can provide adequate justification.

(5) Handling Coarse Aggregates.

(a) Segregation. Before acceptance testing, remix all aggregate segregated by transportation or stockpiling operations.

(b) Stockpiling.

- Stockpile accepted aggregates in layers 3 to 5 feet thick. Berm each layer so that aggregates do not "cone" down into lower layers.
- Keep aggregates from different sources, with different gradings, or with a significantly different specific gravity separated.
- Transport aggregate in a manner that maintains uniform gradation.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

b. Intermediate Aggregate for Mixed Aggregate.

(1) Composition. Provide intermediate aggregate for mixed aggregates (IMA) that is crushed stone, natural occurring sand, or manufactured sand.

(2) Quality. Provide IMA complying with **subsection 2.0.a.(2), or 2.0.c.(2)**

(3) Product Control.

(a) Size Requirement. Provide IMA grading as necessary to obtain specified MA grading and any coarseness factor and workability requirements.

(b) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to the procedure listed in the Construction Manual Part V, Section 17 before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ± 0.20 of the average fineness modulus.

(4) Handling Intermediate Aggregates.

(a) Segregation. Before acceptance testing, remix all aggregate segregated by transportation or stockpiling operations.

(b) Stockpiling.

- Keep aggregates from different sources, with different gradings, or with a significantly different specific gravity separated.
- Transport aggregate in a manner that maintains uniform gradation.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

c. Fine Aggregates.

(1) Composition.

(a) Type FA-A. Provide, either singly or in combination, naturally occurring sand resulting from the disintegration of siliceous or calcareous rock or manufactured sand produced by crushing predominantly siliceous materials.

(2) Quality.

(a) Mortar strength and Organic Impurities. If the District Materials Engineer determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide fine aggregates that comply with these requirements:

- Mortar Strength (Mortar Strength Test, KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
 - At age 24 hours, minimum.....100%*
 - At age 72 hours, minimum.....100%*
- *Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
- Organic Impurities (Organic Impurities in Fine Aggregate for Concrete Test, AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(3) Product Control.

(a) Size Requirements. Provide fine aggregates that comply with the grading requirements in **TABLE 2.**

TABLE 2: GRADING REQUIREMENTS FOR FINE AGGREGATES FOR ON GRADE CONCRETE							
Type	Percent Retained-Square Mesh Sieves						
	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100
FA-A	0	0-10	0-27	15-55	40-77	70-93	90-100

(b) Deleterious Substances.

- Type FA-A: Maximum allowed deleterious substances by mass are:
 - Material passing the No. 200 sieve (KT-2).....2.0%
 - Coal (AASHTO T113)0.5%
 - Sticks (wet) (KT-35).....0.1%
 - Sum of all deleterious2.0%

(c) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to the procedure listed in the Construction Manual Part V, Section 17 before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ± 0.20 of the average fineness modulus.

(4) Proportioning of Coarse and Fine Aggregate. Combine Fine and Coarse aggregates in a 50%-50% ratio by mass. Adjustments to improve workability may be made when approved by the Engineer. Use of a proven optimization method such as ACI 302.1 can provide adequate justification.

(5) Handling and Stockpiling Fine Aggregates.

- Keep aggregates from different sources, with different gradings or with a significantly different specific gravity separated.
- Transport aggregate in a manner that maintains uniform grading.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

d. Mixed Aggregates.

(1) Composition.

(a) Total Mixed Aggregate (TMA). A natural occurring, siliceous aggregate from a single source that meets the Wetting & Drying Test and grading requirements.

(b) Mixed Aggregate.

- Basic Aggregate (BA). Singly or in combination, a natural occurring, siliceous aggregate that does not meet either the Wetting & Drying Test or grading requirements of the Total Mixed Aggregate. For MA-2 mixes, sweetened basic aggregate must contain at least 50 percent basic aggregate. For Contractor optimized mixes (MA-3 or MA-4), sweetened basic aggregate must contain at least 30 percent basic aggregate.
- Coarse Aggregate Sweetener. Provide a minimum of 30 percent coarse aggregate sweetener that complies with the requirements of **subsection 2.0.a**. Types and proportions of aggregate sweeteners to be used with BA are listed in **TABLE 3**.

TABLE 3: COARSE AGGREGATE SWEETENER FOR BASIC AGGREGATE	
Type of Coarse Aggregate Sweetener	Proportion Required by Percent Weight
Crushed Sandstone*	30 (minimum)
Crushed Limestone or Dolomite*	30 (minimum)
Siliceous Aggregate Approved under 2.0.d.(2) *	30 (minimum)
Siliceous Aggregate not Approved under 2.0.d.(2) **	30 (maximum)

*Waive the minimum portion of Coarse Aggregate Sweetener for all BA that comply with the wetting and drying requirements for TMA. In this case, combine the BA and coarse aggregate sweetener in proportions required complying with the grading listed in **TABLE 4**.

**To be used only with BA that complies with the wetting and drying requirements of TMA.

(2) Quality. Provide Mixed Aggregates complying with **subsection 2.0.a.(2), or 2.0.c.(2)**.

(a) Total Mixed Aggregate.

- Wetting and Drying Test for Total Mixed Aggregate (KTMR-29)
 Concrete Modulus of Rupture:
 - At 60 days, minimum 550 psi
 - At 365 days, minimum 550 psi
 Expansion:
 - At 180 days, maximum.....0.050%
 - At 365 days, maximum.....0.070%
 Aggregates produced from the following general areas are exempt from the Wetting and Drying Test:
 - Blue River Drainage Area.
 - The Arkansas River from Sterling, west to the Colorado state line.
 - The Neosho River from Emporia to the Oklahoma state line.

(b) Basic Aggregate.

- Retain 10% or more of the BA on the No. 8 sieve before adding the Coarse Aggregate Sweetener. Aggregate with less than 10% retained on the No. 8 sieve is to be considered a Fine Aggregate described in **SECTION 2.0.c**. Provide material with less than 5% calcareous material retained on the 3/8" sieve.
- Soundness, minimum (KTMR-21) 0.90
- Wear, maximum (AASHTO T96) 50%
- Mortar strength and Organic Impurities. If the District Materials Engineer determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide mixed aggregates that comply with these requirements:
 - Mortar Strength (Mortar Strength Test, KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
 - At age 24 hours, minimum 100%*
 - At age 72 hours, minimum 100%*
 *Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
 - Organic Impurities (Organic Impurities in Fine Aggregate for Concrete Test, AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(3) Product Control.

(a) Size Requirement. Provide mixed aggregates that comply with the grading requirements in TABLE 4.

TABLE 4 GRADING REQUIREMENTS FOR MIXED AGGREGATES											
Type	Percent Retained - Square Mesh Sieves										
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100
MA-2		-	0	3-15	15-30	33-50	45-66	64-80	78-90	87-96	95-100
MA-3		0	2-12	note ¹	note ¹	note ¹	note ¹	note ²	note ²	note ²	95-100
MA-4	0	2-12 ³	note ¹	note ²	note ²	note ²	95-100				
MA-5		0	2-12	8 min	22-34		55-65		75 min		95-100

¹Retain a maximum of 22 percent and a minimum of 6 percent of the material on each individual sieve.

²Retain a maximum of 15 percent and a minimum of 6 percent of the material on each individual sieve.

³Top size of limestone aggregate is limited to 3/4".

(b) Additional Requirements for MA-3 and MA-4.

- Actual Workability must be within ± 5 of Target Workability.

Where: W_A = Actual Workability
 W_T = Target Workability
 CF = Coarseness Factor

1. Determine the MA-3 or MA-4 Grading according to KT-2
2. Calculate the Coarseness Factor (CF) to the nearest whole number.

$$CF = \frac{+3/8" \text{ Material \% Retained}}{+ \text{ No. 8 Material \% Retained}} \times 100$$

3. Calculate the Actual Workability (W_A) to the nearest whole number as the percent material passing the No. 8 sieve.

$$W_A = 100 - \% \text{ retained on No. 8 sieve}$$

4. Calculate the Target Workability (W_T) to the nearest whole number where

For 521 lbs. cement per cubic yard of concrete

$$W_T = 46.14 - (CF/6)$$

For each additional 1 lb of cement per cubic yard, subtract 2.5/94 lbs from the Target Workability.

(c) Deleterious Substances. Maximum allowed deleterious substances by mass are:

- Material passing the No. 200 sieve (KT-2).....2.0%
- Clay lumps and friable particles (KT-7).....1.0%
- Coal (AASHTO T 113).....0.5%
- Shale or Shale-like material (KT-8).....0.5%
- Sticks (wet) (KT-35).....0.1%
- Sum of all deleterious3.0%

(d) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to the procedure listed in the Construction Manual Part V, Section 17 before delivery, or

from the first 10 samples tested and accepted. Provide aggregate that is within ± 0.20 of the average fineness modulus.

(4) Handling Mixed Aggregates.

(a) Segregation. Before acceptance testing, remix all aggregate segregated by transit or stockpiling.

(b) Stockpiling.

- Keep aggregates from different sources, with different gradings or with a significantly different specific gravity separated.
- Transport aggregate in a manner that maintains uniform grading.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

3.0 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

4.0 PREQUALIFICATION

Aggregates for on-grade concrete must meet applicable requirements of this specification, demonstrate acceptable field performance and be prequalified according to the requirements of **subsection 1101.4**. The Bureau of Construction and Materials will maintain a list of Coarse Aggregate sources approved under this specification.

5.0 BASIS OF ACCEPTANCE

The Engineer will accept aggregates for on-grade concrete based on the prequalification required by this specification, and the requirements of **subsection 1101.5**.

03-03-14 C&M (JW)

May-14 Letting