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AGGREGATES**

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1101 - GENERAL REQUIREMENTS FOR AGGREGATES

SECTION 1101

GENERAL REQUIREMENTS FOR AGGREGATES

1101.1 DESCRIPTION

This specification covers the basis of approval, certification and acceptance of aggregates specified in **DIVISION 1100**.

1101.2 REQUIREMENTS

a. General. Provide aggregates that comply with all composition, quality, product control, and handling (stockpile) requirements of the applicable specifications.

b. Process Control.

(1) Perform or cause to be performed all inspections and tests necessary to provide and maintain an adequate process control system that will provide reasonable assurance that all aggregates or aggregate combinations submitted for acceptance will comply to Contract Document.

Before beginning aggregate production for quality control/quality assurance (QC/QA) projects, submit a proposed Process Control Plan in writing for review by the Engineer or the QC/QA Contractor. Include the sampling and testing frequencies, the sampling locations, the sampling and testing methods and other inspections expected to establish and maintain process control in the plan. If requested, KDOT will make a chart of recommended sampling and testing frequencies for process control available to the Producer.

A process control plan should include procedures for all aggregates produced to determine grading, plasticity index, deleterious substance content, and other properties that may be required by the specification, and to inspect stockpiles for separation, contamination and segregation. These guidelines are considered normal activities necessary to control the production of aggregates or aggregate combinations at an acceptable quality level. It is recognized that, depending on the type of process or materials, some of the activities listed may not be necessary, or other activities may be required. The frequency of these activities is not listed in these guidelines, as they will vary with the process and the materials.

(2) Sampling and Testing. Use the same sampling and testing methods and procedures in process control as those used by KDOT. These Kansas Test (KT) Methods are included in Part V, which is made available to the producer. Part V also includes a Sampling and Testing Frequency Chart for acceptance of materials that producers may wish to use as a guide to develop their process control plan. Producers supplying material for quality control/quality assurance projects have required minimum sampling and testing frequencies that can also be found in Part V.

(3) Test Reports. Maintain a file of all process control tests. Provide copies to the Engineer upon request.

(4) Acceptance Inspection. Acceptance of aggregate will be based on KDOT and/or Contractor tests at the point of usage unless designated otherwise by the Engineer. Aggregate production will also be inspected to determine if aggregates are being produced from deposits, ledges, and beds which meet the specific quality requirements. Aggregates produced from deposits, ledges, or beds that have not been previously approved for quality will be rejected. Remove rejected material from the project stockpile area immediately. Any work incorporating aggregates from sources not approved for quality for that work must be removed and replaced, or otherwise corrected, by and at the expense of the Contractor.

KDOT reserves the right to run any test at any time to determine specification compliance. When test results on aggregates or mineral filler supplements indicate non-compliance with specifications, the Engineer may cause those materials to be rejected and removed from the work site at the expense of the Contractor.

c. Certification of Aggregates. Provide the Engineer a certification for each classification of aggregate utilized in a project.

(1) Aggregates Delivered to the Site: Certify each classification of aggregate delivered to a project or product preparation site. Prepare these certifications under the signature of the aggregate producer or their designated representative.

(a) Certify aggregates that are tested at their destination to determine final disposition as to the locations of the deposits from which they were produced.

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(b) Certify aggregates that are tested at their production site to determine final disposition. These certifications state that the aggregates were removed from a KDOT tested and approved stockpile at the production site, or that they were removed from a plant while it was producing aggregate that was in compliance with the applicable specifications.

(2) Aggregates Incorporated into the Project: At locations where aggregates and products that incorporate aggregates are produced for KDOT and non-KDOT use, provide certifications stating that only KDOT tested and approved aggregate were provided for KDOT projects.

(3) Frequency of Certification:

(a) Before the initial delivery of aggregates to a project or product preparation site, provide the Engineer a certification. This certification is to be under the signature of the aggregate producer or their designated representative and states that all aggregates to be provided for the project are in compliance with all the applicable KDOT specifications.

(b) Upon completion of the project, provide certifications as specified in **1101.2c.(1),(2)** to the Engineer. These certifications apply to all aggregates that were delivered to the project or product preparation site and ultimately used in the project.

These certifications are to indicate the approximate quantities in tons or cubic yards of each aggregate delivered to the project and the approximate quantities in tons or cubic yards of each aggregate delivered to the product preparation site and incorporated into a product that was utilized in the project.

(4) Certification Requirement for Chat: Sellers of chat must complete and submit the Chat User's Certificate within 30 days of the date of acquisition. The certification will contain the following information: location of origin of the chat, amount of chat acquired, and a certification that the chat will be used in accordance with the criteria of Chat Rule, 40 Code of Federal Regulations (CFR) Part 278. The certification should be submitted to both the Kansas Department of Health and Environment (KDHE) and to the Bureau of Construction and Materials. If the chat is sold or otherwise transferred to another party, the seller shall provide a copy of the certification to the new owner of the chat. The initial or any subsequent acquirer of chat will maintain copies of the following for a minimum of 3 years: a) a copy of the certification following transmittal to KDHE, and, as appropriate, b) any Synthetic Precipitation Leaching Procedure testing results, or c) any site specific risk assessments.

1101.3 TEST METHODS

Test all aggregates in accordance with the applicable methods cited in **SECTION 1115**.

1101.4 PREQUALIFICATION

With the exception of Lightweight (expanded shale) Aggregate, aggregates from each source require "Official Quality" testing on samples obtained by an authorized representative of KDOT before use on KDOT projects. These samples are taken from actual production, which may be "pit-run", "crusher-run" or may involve some processing. Approved sources remain approved only if there are no major changes in the production methods or deposit characteristics.

Lightweight (expanded shale) Aggregate must be prequalified. In-state producers wishing to get their product prequalified must submit a written request to the District Materials Engineer for the District in which the production facility is located. Out-of-state producers must submit their written request to the Engineer of Tests. In the request, the producer must specify whether they want the material to be used for Modified Lightweight Aggregate [**subsection 1102.2.e.(2)**] or for Cover Material (**subsection 1109**). Samples will be collected by KDOT and tested for compliance with applicable specifications. Lightweight aggregates that comply with all applicable requirements will be added to a list of prequalified lightweight aggregates maintained by the Bureau of Construction & Materials. Any change in material source, equipment, or process voids the prequalification and a new prequalification will be required.

1101.5 BASIS OF ACCEPTANCE

Aggregates from sources approved for the intended use are accepted based on the following:

a. Current official quality test results complying with the requirements of the applicable subsection are on file with KDOT or the aggregate source is named on an applicable Prequalified List (PQL).

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b. Results of tests conducted on samples taken at a point or points designated by the Engineer. KDOT reserves the right to re-sample, test and reject any previously accepted aggregate if the Engineer has reason to believe it no longer complies with the Contract Documents.

c. Certifications as specified in **subsection 1101.2 c.**

1102 - AGGREGATES FOR CONCRETE NOT PLACED ON GRADE

SECTION 1102

AGGREGATES FOR CONCRETE NOT PLACED ON GRADE

1102.1 DESCRIPTION

This specification is for coarse aggregates, intermediate aggregates, fine aggregates, mixed aggregates (coarse, intermediate and fine material) and miscellaneous aggregates for use in construction of concrete not placed on grade.

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

1102.2 REQUIREMENTS

a. Quality of Individual Aggregates.

(1) Provide Aggregates for Concrete that comply with **TABLE 1102-1**. Fine Aggregates for Concrete have additional Quality Requirements stated in **subsection 1102.2e.(2)**.

TABLE 1102-1: QUALITY REQUIREMENTS FOR CONCRETE AGGREGATES				
Concrete Classification	Soundness (min.)	Wear (max.)	Absorption (max.)	Acid Insoluble⁵ (min.)
Grade xx (AE)(SW) ¹	0.90	40	-	-
Grade xx (AE)(SA) ²	0.90	40	2.0	-
Grade xx (AE)(AI) ³	0.90	40	-	85
Grade xx (AE)(PB) ⁴	0.90	40	3.0	-
Bridge Overlays	0.95	40	-	85
All Other Concrete	0.90	50	-	-

¹Grade xx (AE)(SW) - Structural concrete with select coarse aggregate for wear.

²Grade xx (AE)(SA) - Structural concrete with select coarse aggregate for wear and absorption.

³Grade xx (AE)(AI) - Structural concrete with select coarse aggregate for wear and acid insolubility.

⁴Grade xx (AE)(PB) - Structural concrete with select aggregate for use in prestressed concrete beams.

⁵Acid Insoluble requirement does not apply to calcite cemented sandstone.

- Soundness (KTMR-21) requirements do not apply to aggregates having less than 10% material retained on the No. 4 sieve.
- Wear (AASHTO T 96) requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.
- Absorption KT-6 Procedure I for material retained on the No. 4 sieve. Apply the maximum absorption to the portion retained on the No. 4 sieve.

(2) All predominately siliceous aggregate must comply with the Wetting & Drying Test requirements, or be used with a Coarse Aggregate Sweetener, or will require Supplemental Cementitious Materials (SCM) to prevent Alkali Silica Reactions (ASR). When an SCM is utilized, 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.

Wetting & Drying Test of Siliceous Aggregate for Concrete (KTMR-23)

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%

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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.

(3) Coarse Aggregate Sweetener. Types and proportions of aggregate sweeteners to be used with Mixed Aggregates are listed in **TABLE 1102-2**.

TABLE 1102-2: COARSE AGGREGATE SWEETENER	
Type of Coarse Aggregate Sweetener	Proportion Required by Percent Weight
Crushed Sandstone*	40 (minimum)
Crushed Limestone or Dolomite*	40 (minimum)
Siliceous Aggregates meeting subsection 1102.2a.(2)	40 (minimum)
Siliceous Aggregates not meeting subsection 1102.2a.(2) **	30 (maximum)

*Waive the minimum portion of Coarse Aggregate Sweetener for all intermediate and fine aggregates that comply with the wetting and drying requirements for Siliceous Aggregates. In this case, combine the intermediate, fine and coarse aggregate sweetener in proportions required to comply with the requirements of **subsection 1102.2a.(3)**

**To be used only with intermediate and fine aggregates that comply with the wetting and drying requirements of Siliceous Aggregates unless a Supplemental Cementitious Material is utilized.

b. Mixed Aggregates.

(1) Composition. Provide coarse, intermediate, and fine aggregates in a combination necessary to meet **subsection 1102.2b.(2)**. Use a proven optimization method such as ACI 302.1 or other method approved by the Engineer. Aggregates may be from a single source or combination of sources.

(2) Product Control.

(a) Gradations such as those shown in **TABLE 1102-3** have proven satisfactory in reducing water demand while providing good workability. Adjust mixture proportions whenever individual aggregate grading varies during the course of the work. Use the gradations shown in **TABLE 1102-3**, or other gradation approved by the Engineer.

Optimization is not required for concrete for patching pavements more than 10 years old, or Commercial Grade Concrete. The Engineer may waive the optimization requirements if the concrete meets all the requirements of **DIVISION 400**.

Follow these guidelines:

1. Do not permit the percent retained on two adjacent sieve sizes to fall below 4%;
2. Do not allow the percent retained on three adjacent sieve sizes to fall below 8%; and
3. When the percent retained on each of two adjacent sieve sizes is less than 8%, the total percent retained on either of these sieves and the adjacent outside sieve should be at least 13%.
(for example, if both the No. 4 and No. 8 sieves have 6% retained on each, then:
 - 1) the total retained on the 3/8 in. and No. 4 sieves should be at least 13%, and
 - 2) the total retained on the No. 8 and No. 16 sieves should be at least 13%.)

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TABLE 1102-3: ALLOWABLE GRADING FOR MIXED AGGREGATES FOR CONCRETE													
Type	Usage	Percent Retained - Square Mesh Sieves											
		1 ½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
MA-3	Optimized All Concrete		0	2-12	Note ¹	Note ¹	Note ¹	Note ¹	Note ²	Note ²	Note ²	95-100	98-100
MA-4	Optimized All Concrete	0	2-12	Note ¹	Note ¹	Note ¹	Note ¹	Note ¹	Note ²	Note ²	Note ²	95-100	98-100
MA-5	Optimized Drilled Shafts		0	2-12	8 min	22-34		55-65		75 min		95-100	98-100
MA-6	Optimized for Bridge Overlays		0	0	2-12	Note ¹	Note ¹	Note ¹	Note ²	Note ²	Note ²	95-100	98-100
MA-7	Contractor Design KDOT Approved	Proposed Grading that does not correspond to other limits in this table but meet the requirements for concrete in DIVISION 400 .											98-100

¹Retain a maximum of 22% (24% for MA-6) and a minimum of 6% of the material on each individual sieve.

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

- (b) Optimization Requirements for all Gradations.
- Actual Workability must be within ± 5 of Target Workability.

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

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

$$CF = \frac{+3/8'' \text{ Material \% Retained}}{+ \# 8 \text{ Material \% Retained}} \times 100$$

3. Calculate the Actual Workability (W_A) to the nearest whole number as the percent material passing the #8 sieve.

$$W_A = 100 - \% \text{ retained on \#8 sieve}$$

4. Calculate the Target Workability (W_T) to the nearest whole number where
 For 517 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 weight are:

- 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 1.5%

- (d) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) for each aggregate according to the procedure listed Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

Provide a single point grading for the combined aggregates along with a plus/minus tolerance for each sieve. Use plus/minus tolerances to perform quality control checks and by the Engineer to

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perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

Maintain an Actual Workability within ± 5 of the Target Workability for the combined aggregate.

(3) Handling of All Aggregates.

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

(b) Stockpiling.

- Maintain separation between aggregates from different sources, with different gradings or with a significantly different specific gravity.
- Transport aggregate in a manner that promotes 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.

c. Coarse Aggregates for Concrete.

(1) Composition. Provide coarse aggregate that is crushed or uncrushed gravel or crushed stone meeting the quality requirements of **subsection 1102.2a**. Consider limestone, calcite cemented sandstone, rhyolite, quartzite, basalt and granite as crushed stone.

Mixtures utilizing siliceous aggregate not meeting **subsection 1102.2a.(2)** 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) Product Control. Use gradations such as those in **TABLE 1102-4** which have been shown to work in Optimized Mixed Aggregates, or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1102.2b**.

TABLE 1102-4: ALLOWABLE GRADING FOR COARSE AGGREGATES									
Type	Composition	Percent Retained - Square Mesh Sieves							
		1½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 30
SCA-1	Siliceous Gravel or Crushed Stone	0	0-10	14-35	-	50-75	-	95-100	-
SCA-2	Siliceous Gravel or Crushed Stone			0	0-35	30-70	75-100	95-100	
SCA-4	Siliceous Gravel or Crushed Stone		0	0-20				95-100	

d. Intermediate Aggregate for Concrete.

(1) Composition. Provide intermediate aggregate for mixed aggregates (IMA) that is crushed stone, natural occurring sand, or manufactured sand meeting the quality requirements of **subsection 1102.2a**.

(2) Product Control. Provide IMA grading when necessary to provide a combined aggregate gradation meeting **subsection 1102.2b**.

e. Fine Aggregates for Concrete.

(1) Composition.

(a) Type FA-A. Provide either singly or in combination natural occurring sand resulting from the disintegration of siliceous or calcareous rock, or manufactured sand produced by crushing predominately siliceous materials meeting the quality requirements of **subsection 1102.2a**. and **1102.2e.(2)**.

(b) Type FA-C. Provide crushed siliceous aggregate, steel slag, or chat that is free of dirt, clay, and foreign or organic material.

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(2) Additional Quality Requirements for FA-A.

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

- Mortar Strength (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 (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(b) Provide FA-C for Multi/Single-Layer Polymer Concrete Overlay complying with **TABLE 1102-5**.

TABLE 1102-5: QUALITY REQUIREMENTS FOR MULTI/SINGLE-LAYER POLYMER CONCRETE OVERLAY		
Property	Requirement	Test Method
Soundness, minimum	0.92	KTMR-21
Wear, maximum	30%	AASHTO T 96
Acid Insoluble Residue, minimum	55%	KTMR-28
Uncompacted Voids Fine Aggregate, minimum	45	KT-50
Moisture Content, maximum	0.2%	KT-11

(3) Product Control.

(a) Size Requirements. Provide FA-C for Multi/Single-Layer Polymer Concrete Overlay complying with **TABLE 1102-6**. Provide FA-A that comply with **TABLE 1102-6** or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1102.2.b**.

TABLE 1102-6: GRADING REQUIREMENTS FOR FINE AGGREGATES FOR CONCRETE								
Type	Percent Retained-Square Mesh Sieves							
	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
FA-A	0	0-10	0-27	15-55	40-77	70-93	90-100	98-100
FA-C	0	0	25-70	95-100	99-100	99-100	99-100	98-100

(b) Deleterious Substances.

- Type FA-A: Maximum allowed deleterious substances by weight are:
 - Coal (AASHTO T 113)..... 0.5%
 - Sticks (wet) (KT-35)..... 0.1%
 - Sum of all deleterious 0.5%

f. Miscellaneous Aggregates for Concrete.

(1) Aggregates for Mortar Sand, Type FA-M.

(a) Composition. Provide aggregates for mortar sand, Type FA-M that is natural occurring sand.

(b) Quality.

- Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide aggregates for mortar sand, Type FA-M that comply with the following:
 - Mortar Strength (KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
 - At age 24 hours, minimum 100%*

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- 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 (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(c) Product Control.

- Size Requirements. Provide aggregates for mortar sand, Type FA-M that comply with **TABLE 1102-7**.

TABLE 1102-7: GRADING REQUIREMENTS FOR MORTAR SAND								
Type	Percent Retained - Square Mesh Sieves							Gradation Factor
	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	
FA-M	0	0-2	0-30	20-50	50-75	90-100	98-100	1.70-2.50

- Deleterious Substances. Maximum allowed deleterious substances by weight are:
 - Clay lumps and friable material (KT-7)..... 1.0%
 - Coal (AASHTO T 113)..... 0.5%
 - Sticks (wet) (KT-35)..... 0.1%
 - Sum of all deleterious 1.5%

(2) Modified Lightweight Aggregates.

(a) Composition. Provide a modified lightweight aggregate produced from a uniform deposit of raw material combined with FA-A **subsection 1102.2c**.

(b) Quality.

- Soundness, minimum (KTMR-21) 0.90
- Loss on Ignition 5%

(c) Product Control.

- Size Requirements. Provide modified lightweight aggregates that comply with **TABLE 1102-8**.

TABLE 1102-8: GRADING REQUIREMENTS FOR MODIFIED LIGHTWEIGHT AGGREGATES						
Type	Percent Retained - Square Mesh Sieves					
	¾"	½"	⅜"	No. 4	No. 8	No. 16
Grade 1	0	0-10	30-60	85-100	95-100	
Grade 2		0-2	0-30	20-50	50-75	90-100

- Deleterious Substances.
 - Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.
- Unit Weight (dry, loose weight) (max.) 1890 lbs/cu yd

(d) Concrete Making Properties. Drying shrinkage of concrete specimens prepared with modified lightweight aggregate and FA-A proportioned as shown in the Contract Documents can not exceed 0.07%.

(e) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to procedure listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

(f) Proportioning Materials. Submit mix designs for concrete using modified lightweight aggregate to Construction and Materials for approval prior to use.

(g) Stockpiling.

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- 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 promotes 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.

1102.3 TEST METHODS

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

1102.4 PREQUALIFICATION

Aggregates for concrete must be prequalified according to **subsection 1101.4**.

1102.5 BASIS OF ACCEPTANCE

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

1103- AGGREGATES FOR HOT MIX ASPHALT (HMA)

SECTION 1103

AGGREGATES FOR HOT MIX ASPHALT (HMA)

1103.1 DESCRIPTION

This specification covers the quality, composition and gradation requirements of aggregates for hot mix asphalt (HMA) on QC/QA projects.

1103.2 REQUIREMENTS

a. Composition Individual Aggregates. Use aggregate from each source that complies with the gradation requirements listed in **TABLE 1103-1**.

(1) Crushed Aggregates. Limit crushed aggregates to the following materials.

(a) Produce Crushed Stone (CS-1) and Crushed Stone Screenings (CS-2) by crushing limestone, sandstone, porphyry, (rhyolite, basalt, granite, and Iron Mountain Trap Rock are examples of porphyry) or other types of stone.

(b) Produce Crushed Gravel (CG) by crushing siliceous gravel containing not more than 15% non-siliceous material. If 95% or more of crushed gravel is retained on the #8 (2.65 mm) sieve, then the material must have a minimum Uncompacted Void Content of Coarse Aggregate (UVA) value of 45 when tested in accordance with KT-80. Testing will be the same frequency as KT-50. Do not use material with a UVA value less than 45.

(c) Provide Chat (CH-1) obtained during the mining of lead and zinc ores in the tri-state mining district.

(d) Consider materials complying with Mineral Filler Supplements MFS-1, MFS-2, MFS-4, and MFS-7 as crushed aggregate.

(e) Produce Crushed Steel Slag (CSSL) by crushing electric furnace steel slag. Some sources of steel slag are angular when produced and may be treated the same as crushed gravel and manufactured sand. Use steel slag with an Uncompacted Void Content of the Fine Aggregate "U" Value, determined by test method KT-50, of more than 42.00 and the Coarse Aggregate Angularity greater than the minimum specified value. The maximum allowable quantity of crushed steel slag is 50% of the total aggregate weight.

(f) Manufactured sand shall have an Uncompacted Void Content of the Fine Aggregate "U" Value, determined by test method KT-50, greater than or equal to 42.00. Produce manufactured sand by crushing siliceous sand and gravel (designate as crushed gravel (CG-2, CG-3, etc) in the mix design), or by washing or screening crushed stone (designate as crushed stone (CS-2, CS-3, etc) in the mix design), or by washing or screening chat (designate as chat (CH-2, CH-3, etc) in the mix design).

(2) Uncrushed Aggregates. Limit uncrushed aggregates to the following materials.

(a) Produce Sand-Gravel (SSG) by mixing natural sand and gravel formed by the disintegration of siliceous and/or calcareous materials.

(b) Provide Natural Sand consisting of particles formed by the natural disintegration of siliceous and/or calcareous materials. Use natural sand with an Uncompacted Void Content "U" value of less than 42.

(c) Provide Grizzly (Grizzly Waste) consisting of the matrix or bedding material occurring in conjunction with calcitic or dolomitic cemented sandstone "Quartzite", generally separated from the sandstone prior to crushing.

(d) Provide Wet Bottom Boiler Slag (WBBS) consisting of a hard angular by-product of the combustion of coal in wet-bottom boilers. Quality requirements do not exist for this material. Obtain written approval by the Chief of Construction and Materials for use in HMA. The use of WBBS does not modify the requirements for minimum contents of either crushed stone or natural sand.

(3) Mineral Filler Supplement. Provide a mineral filler supplement that is easily pulverized and free of cemented lumps, mudballs, and organic materials that complies with the following and the general requirements in **subsection 1103.2c**. Do not blend 2 or more materials to produce mineral filler supplement. Provide only 1 mineral filler supplement in each HMA design.

1103- AGGREGATES FOR HOT MIX ASPHALT (HMA)

- (a) Mineral Filler Supplement designation MFS-1 is Portland cement, blended hydraulic cements, or crushed stone.
- (b) Mineral Filler Supplement designation MFS-2 is crushed limestone.
- (c) Mineral Filler Supplement designation MFS-3 is water or wind deposited silty soil material.
- (d) Mineral Filler Supplement designation MFS-4 is Hydrated lime. The minimum allowable quantity of MFS-4 or Hydrated Lime is 1% of the total aggregate weight when required as a supplement on the Contract Documents.
- (e) Mineral Filler Supplement designation MFS-5 is volcanic ash containing a minimum of 70% glass shard. The maximum allowable quantity of MFS-5 is 5% of the total aggregate weight when specified as acceptable mineral filler supplement.
- (f) Mineral Filler Supplement designation MFS-6 is fly ash. Fly ash is the finely divided residue resulting from the combustion of ground or powdered coal and is transported from the boiler by flue gasses. The maximum allowable quantity of MFS-6 is 3% of the total aggregate weight when specified as acceptable mineral filler supplement.
- (g) Mineral Filler Supplement designation MFS-7 is processed chat sludge that has been dewatered at the source of supply, and does not exceed 15% moisture content by weight at the time of shipping.

(4) Reclaimed Asphaltic Pavement (RAP). Use RAP in HMA only when such an option is permitted by Contract Special Provision. Subject the RAP to the limitations (i.e. source, max. percent allowed in mix, etc.) shown on the Contract Documents and contained in the appropriate Contract Special Provisions. Screen the RAP through a 2 ¼ inch screen or grizzly before it enters the HMA plant.

Fractionated Reclaimed Asphaltic Pavement (FRAP) is defined as having two or more RAP stockpiles, where the RAP is divided into a minimum of two fractions consisting of coarse and fine fractions. Subject the FRAP to the same limitations shown on the Contract Documents and contained in the appropriate Contract Special Provisions for RAP. Comprise the maximum percentage of FRAP of coarse or fine FRAP or a combination of coarse and fine FRAP, unless otherwise stated in the Contract Documents. Utilize a separate cold feed bin for each stockpile of FRAP used. Add FRAP to the mix through the RAP collar. Include the processing requirements for each FRAP stockpile within the Quality Control Plan.

(5) Recycled Asphalt Shingles. Recycled Asphalt Shingles (RAS) are allowed in any mixture specified to use RAP. The Contractor may use the %RAP as shown in the Contract Special Provision or a maximum of 5% RAS and 10% RAP.

Follow the guidelines in AASHTO PP 53 except as modified in this Special Provision. Drop the grade of the virgin binder one grade from both the top and the bottom grade specified for 0% RAP. For example, if a PG 64-22 is specified for 0% RAP, then the virgin grade of the binder for up to 5% RAS and 10% RAP is PG 58-28.

Comply with the Kansas Department of Health and Environment’s Bureau of waste Management Policy 2011-P3 or current version and other regulations pertaining to the recycling of shingles.

Grind the shingles to a minus 3/8-inch size. Remove deleterious materials from waste, manufacturer, or new shingles. Use post-consumer RAS that contains less than 0.5% wood by weight or less than 1.0% total deleterious by weight. Determine the gradation of the aggregate by extraction of the binder or by using TABLE 2 as a standard gradation:

TABLE 1103-1: SHINGLE AGGREGATE GRADATION	
Sieve Size	Percent Retained
3/8 in.	0
No. 4	5
No. 8	15
No. 16	30
No. 30	50
No. 50	55
No. 100	65
No. 200	75

b. Quality of Individual Aggregates.

- Soundness, minimum (KTMR-21) 0.90

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Soundness requirements do not apply to aggregates having less than 10% material retained on the No. 4 mesh sieve.

- Wear, maximum (AASHTO T 96).....40%
Wear requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.
- Absorption, maximum (KT-6)4.0%
Test aggregates for absorption as follows:
 - Crushed Stone (CS-1)Test Method KT-6, Procedure I
 - Screenings (CS-2)Test Method KT-6, Procedure II
 - Sand Gravel (SSG)/Crushed Gravel (CG)Test Method KT-6, Procedures I & IIApply the specified maximum absorption to both the fraction retained on the No. 4 sieve and the fraction passing the No. 4. Screenings produced concurrently with CS-1 will be accepted without tests for absorption.
Crushed aggregates with less than 10% materials retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.
- Plasticity Index, the maximum P.I. for MFS-1, MFS-2, MFS-3, MFS-5, and MFS-7 is 6.

c. Product Control of Individual Aggregates

(1) Size Requirements. Produce each individual aggregate that complies with **TABLE 1103-2 and 1103-3**

(2) Deleterious Substances. Provide combined aggregates free from alkali, acids, organic matter, or injurious quantities of other foreign substances that does not exceed the following maximum percentages by weight.

- Shale or Shale-like (KT-8) 1.0%
- Clay lumps and friable particles (KT-7) 1.0%
- Sticks (wet) (KT-35) 0.1%
- Coal (AASHTO T-113) 0.5%

1103- AGGREGATES FOR HOT MIX ASPHALT (HMA)

TABLE 1103-2: REQUIREMENTS FOR INDIVIDUAL AGGREGATES								
Designation	Material	Percent Retained – Square Mesh Sieves						
		1”	½”	3/8”	No. 4	No. 8	No. 30	No. 200
CS-1	Crushed Stone	0						95.5-100.0
CS-2	Crushed Stone Screenings		0	0 - 5				60-100
CG	Crushed Gravel	Blend gradation with other aggregates in the mix.						
CH-1	Chat	Blend gradation with other aggregates in the mix						
SSG	Sand & Sand Gravel	0						80-100
WBBS	Wet Bottom Boiler Slag		0	Blend gradation with other aggregates in the mix.				
CSSL	Crushed Steel Slag	Blend gradation with other aggregate in the mix.						

TABLE 1103-3: REQUIREMENTS FOR MINERAL FILLER SUPPLEMENTS								
Designation	Material	Percent Retained – Square Mesh Sieves						
		1”	½”	3/8”	No. 4	No. 8	No. 30	No. 200
MFS-1	Cement or Crushed Stone			0		0-5	0-8	0-40
MFS-2	Crushed Limestone			0		1-10		60-80
MFS-3	Silt			0	0-5			0-40
MFS-4	Hydrated Lime	Blend gradation with other aggregate in the mix						
MFS-5	Volcanic Ash			0		0-5	0-8	0-40
MFS-6	Fly Ash	Blend gradation with other aggregate in the mix						
MFS-7	Processed Chat Sludge			0		0-5	0-8	0-40

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

e. Special Requirements for aggregates used in ultrathin bonded asphalt surface (UBAS).

TABLE 1103-4: INDIVIDUAL COARSE AGGREGATE PROPERTIES		
Property	Test Method	Limits
Coarse Aggregate Angularity (% min.)	KT-31	95/90 ^a
Los Angeles Abrasion (% max.) ^b	AASHTO T 96	35 ^c
Micro-Deval, (% max.) ^b	AASHTO T 327	18 ^d
Soundness (% min.)	KTMR-21	0.90 ^d
Absorption (% max.)	KT-6	4.0 ^d
Methylene Blue (% max.)	AASHTO T 330	10 ^e
An individual aggregate will be considered a coarse aggregate source if it contributes more than 5% of the total plus No. 4 sieve material of the combined aggregate (individual aggregate contribution No. 4 / total JMF retained No. 4 > 5%).		
a – 95% of the coarse aggregate has one fractured face & 90% has two or more fractured faces.		
b – Sample from stockpiled material with top size aggregate not larger than the maximum aggregate size for the mix designation type from TABLE 613-1 .		
c - For calcitic or dolomitic cemented sandstone “quartzite”, the maximum percent is 40.		
d - May use KDOT’s Official Quality results		
e – Perform this test on all individual aggregates that contribute more than 1.0% to the JMF for the material passing the No. 200 sieve.		

1103- AGGREGATES FOR HOT MIX ASPHALT (HMA)

Property	Test Method	Limits
Methylene Blue (% max.)	AASHTO T 330	10
Soundness (% min.)	KTMR-21	0.90 ^a
Los Angeles Abrasion (% max.)	AASHTO T 96	40 ^a
Absorption (% max.)	KT-6	4.0 ^a

a –May use KDOT’s Official Quality results.

- The above requirements for wear do not apply for aggregates having less than 10% material retained on the No. 8 sieve.
- The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

1103.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTIONS 1115 and 2501**.

1103.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1103.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedure described in **subsection 1101.5**.

1104 - AGGREGATES FOR AGGREGATE BASE CONSTRUCTION

SECTION 1104

AGGREGATES FOR AGGREGATE BASE CONSTRUCTION

1104.1 DESCRIPTION

This specification covers aggregates for use in aggregate base construction.

1104.2 REQUIREMENTS

a. Composition.

(1) Type AB-1 or AB-2 may be singularly or any combination of crushed stone, crushed or uncrushed gravel, sand, sand-gravel, or limestone gravel mixed with soil or other qualified binder material.

(2) Type AB-3 is at least 85% limestone or dolomite produced by mechanical crushing.

b. Quality¹.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 50%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Gradation and Plasticity. Provide a uniformly mixed final product that complies with **TABLE 1104-1**.

(2) Deleterious Substances. Provide aggregates that are free from weeds, sticks, grass, roots and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1104.3 TEST METHODS

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

TABLE 1104-1: GRADATION AND PLASTICITY OF AGGREGATES FOR AGGREGATE BASE CONSTRUCTION											
Type	Percent Retained-Square Mesh Sieves									P.I.	Liquid Limit (Max.)
	2"	1 1/2"	1"	3/4"	3/8"	No. 4	No. 8	No. 40	No. 200		
AB-1	0	0-10		5-40		35-75	54-85	78-95	90-98	0-6	25
AB-2*			0		1-35		25-50	60-75	78-90	1-6	25
AB-3**	0	0-5		5-30		35-60	45-70	60-84	80-92	1-8	30

*The fraction passing the No. 200 sieve shall not exceed 2/3 of the fraction passing the No. 40 sieve.

**The fraction passing the No. 200 sieve shall not exceed 3/4 of the fraction passing the No. 40 sieve.

1104.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1104.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1105 - AGGREGATES FOR CEMENT TREATED BASES

SECTION 1105

AGGREGATES FOR CEMENT TREATED BASES

1105.1 DESCRIPTION

This specification covers aggregate for the construction of fly ash and portland cement treated base.

1105.2 REQUIREMENTS

a. Composition. Provide singly or in combination, crushed limestone, crushed dolomite, crushed portland cement concrete pavement (PCCP) reclaimed from the project site and sand or sand-gravel produced from a naturally occurring alluvial deposit.

b. Quality¹. Provide individual aggregates that comply with the following:
Crushed Limestone and Dolomite.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 50%

Reclaimed crushed PCCP.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 60%

Sand or Sand Gravel.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96)..... 50%

¹ Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

² The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³ The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Develop a single point aggregate gradation and establish a plus and minus tolerance for each sieve specified in **TABLE 1105-1**. The established tolerances will be applied to the designated single point gradation for the purposes of establishing a gradation band for field acceptance testing. Perform sieve analyses of the aggregates and chart the results. Suspend production of materials when any test result on any sieve falls outside the gradation band.

TABLE 1105-1: GRADATION OF AGGREGATES FOR CEMENT TREATED BASES (PERCENT RETAINED)						
Sieve size	1 ½"	¾"	No. 4	No. 8	No. 40	No. 200
Single point	*	*	*	*	*	*
Tolerance	*	+/-*	+/-*	+/-*	+/-*	+/-*

* These values to be established by the Contractor

(2) Deleterious Substances. Provide aggregates that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1105 - AGGREGATES FOR CEMENT TREATED BASES

1105.3 TEST METHODS

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

1105.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1105.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1106 - AGGREGATES FOR GRANULAR BASE

SECTION 1106

AGGREGATES FOR GRANULAR BASE

1106.1 DESCRIPTION

This specification covers aggregate for granular base for concrete pavements.

1106.2 REQUIREMENTS

a. Composition. Mix sand, gravel, crushed stone, and/or a suitable binder soil, singly or in combination, to produce uniformity of grading and plasticity, and comply with the following.

b. Quality¹.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 50%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

Apply the specified maximum absorption to both the fraction retained on the No. 4 sieve and the fraction passing the No. 4 sieve. Screenings produced concurrently with products approved under KT-6, Procedure I, will be accepted without tests for absorption.

c. Product Control.

(1) Size and Plasticity Requirements:

TABLE 1106-1: GRADATION OF AGGREGATES FOR GRANULAR BASE					
Percent Retained – Square Mesh Sieves					
1 ½”	¾”	No. 4	No. 8	No. 40	No. 200
0	0-15	10-65	25-70	50-90	85-95

Plasticity Index.

- Mixes containing more than 50% Crushed Limestone 1-8
- Other Aggregate Combinations 3-8
- Liquid Limit, maximum 25

(2) Pulverization.

(a) Binder Soil. Pulverize binder soil that occurs in natural deposits and not naturally combined with coarse material that complies with **TABLE 1106-2**:

TABLE 1106-2: GRADATION OF BINDER SOIL		
Percent Retained – Square Mesh Sieves		
¾”	No. 4	No. 8
0	0-25	0-50

Determine pulverization of binder soil in moist or natural conditions at the latest possible point before incorporation into the total combined material.

(b) Natural Mixtures. When binder and coarse material occur naturally combined, pulverize the combination so that at least 25% of the total passing the No 40 sieve by washing passes the No. 40 sieve by dry screening.

1106 - AGGREGATES FOR GRANULAR BASE

(3) Deleterious Substances. Provide aggregates that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1106.3 TEST METHODS

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

1106.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1106.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1107 - AGGREGATES FOR BACKFILL

SECTION 1107

AGGREGATES FOR BACKFILL

1107.1 DESCRIPTION

This specification covers aggregate for backfill. Use this when structures, pipe, mechanically stabilized earth (MSE) walls (panel or modular), underdrain, permeable or crushed stone backfill requirements are specified in the Contract Documents.

1107.2 REQUIREMENTS

a. Structures or Pipe.

(1) Composition. Provide singly or in combination sand, gravel, or crushed stone. Consider limestone, calcite-cemented sandstone, rhyolite, basalt, and granite as crushed stone.

(2) Quality¹.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 45%

For Structures Backfill Only:

- Coarse Aggregate Angularity⁴, minimum (KT-31) 75%
- Fine Aggregate Angularity⁴, minimum (KT-50) 40%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

⁴Required testing for sand and gravel.

(3) Product Control.

(a) Gradation and Plasticity.

TABLE 1107-1: AGGREGATES FOR STRUCTURES OR PIPE BACKFILL										
Type	Percent Retained-Square Mesh Sieves									Plasticity Index (Max.)
	2"	1 1/2"	1"	3/4"	3/8"	No. 4	No. 8	No. 40	No. 200	
SB-1	0	0-10		15-40	50-75		95-100			
SB-2			0	0-20	40-70	75-100	95-100			
SB-3	0	0-5		5-30		35-60	45-70	60-84	80-92	8
PB-1 ¹	0	0-10		15-40	50-75		95-100			
PB-2 ¹			0	0-20	40-70	75-100	95-100			
PB-3 ¹			0	0-30		35-60	50-75	70-90	90-100	8

¹Use of PB is required for PE and PVC pipe backfill.

(b) Deleterious Substances.

- Shale or shale-like material, maximum (KT-8) 3.0%
- Clay Lumps and friable particles, maximum (KT-7) 3.0%
- Sticks (wet), maximum (KT-35) 1.0%

(4) Foundation Stabilization. Use SB aggregates at those locations where the use of SB aggregates for foundation stabilization is specified elsewhere in the Contract Documents. When the preceding sentence applies, use SB-3 when the expected depth of foundation stabilization is less than 6 inches.

Except at the locations described above, the use of alternate granular materials (except chat) may be permitted, but only with the approval of the District Materials Engineer.

1107 - AGGREGATES FOR BACKFILL

b. MSE Walls: Precast Panel and Modular Block with Steel Soil Reinforcing Mesh or Steel Reinforcing Strips and Tie Strips.

(1) Composition. Use granular backfill material in the structure volume of sand, sand-gravel, or crushed stone, reasonably free from organics or other deleterious materials, and complies with the following:

(2) Quality. Submit representative material samples for the following tests to the Materials and Research Center, 2300 Van Buren, Topeka, KS 66611 (ATTENTION: Geotechnical Engineer) for acceptance prior to utilizing this material on the project.

- (a) The Plasticity Index (P.I.) is 6 maximum, determined by KT-10.
- (b) An angle of internal friction of 34 degrees or greater, as determined by the standard direct shear test – AASHTO T 236, utilizing a sample of the material compacted to 95 percent of AASHTO T 99 Methods C or D (with oversize correction, as outlined in Note 9 in AASHTO T 99) at optimum moisture content.
- (c) Soundness. Use material substantially free of shale or other soft, poor durability particles as determined in accordance with **SECTION 1115**. “Freeze and Thaw”, minimum 0.90 as determined in **DIVISION 1100**.
- (d) Wear. Los Angeles Wear Abrasion, maximum 40%.
- (e) Provide material that complies with **TABLE 1107-2**.

TABLE 1107-2: ELECTROCHEMICAL REQUIREMENTS (PANEL)	
Requirements	Test Method
Resistivity > 5000 ohm-cm	AASHTO T 288
pH: 5.0 to 10.0	AASHTO T 289
Organic Content < 1%	AASHTO T 267

If the resistivity is less than 5000 ohm-cm, but greater than 3000 ohm-cm, the backfill material can be accepted if it complies with **TABLE 1107-3**.

TABLE 1107-3: ADDITIONAL ELECTROCHEMICAL REQUIREMENTS		
Property	Requirements	Test Method
Chlorides	< 100 parts per million	ASTM D 4327
Sulfates	< 200 parts per million	ASTM D 4327

- (3) Product Control.
 - (a) Gradation.

TABLE 1107-4: AGGREGATES FOR PANEL MSE WALLS BACKFILL		
Percent Retained – Square Mesh Sieves		
4”	No. 40	No. 200
0	40 - 100	95 - 100

(b) Coefficient of Uniformity. Provide material with a minimum coefficient of uniformity of 4.0 as defined by ASTM D 2487 for systems that utilize steel reinforcing strips and tie strips (Reinforced Earth). Material with a coefficient of uniformity less than 4.0 may be accepted based on the results of pullout tests conducted by the University of Kansas, Civil Engineering Department, Geotechnical Section. (Contact: Dr. Jie Han @ 785-864-3714 or Dr. Bob Parsons @ 785-864-2946.)

- (4) Use only crushed stone in District 1.

For select granular backfill material composed of crushed stone, submit a proposed project gradation with single-point gradations and tolerances for approval. For sand and sand-gravel combinations, a project gradation will be issued that will specify gradation tolerances after the proposed material is approved. Any quality assurance samples which fall outside the tolerances will necessitate re-approval to be in compliance with **subsection 1108.2 b.(2)**.

1107 - AGGREGATES FOR BACKFILL

c. MSE Walls: Modular Block with Soil Reinforcing Geogrid.

(1) Composition. Use granular backfill material in the structure volume of sand, sand-gravel, or crushed stone, reasonably free from organics or otherwise deleterious materials, and complies with the following:

(2) Quality. Submit representative material samples for the following tests to the Materials and Research Center, 2300 Van Buren, Topeka, KS 66611 (ATTENTION: Geotechnical Engineer) for acceptance prior to utilizing this material on the project.

(a) The Plasticity Index (P.I.) is 6 maximum, determined by KT-10.

(b) An angle of internal friction of 34 degrees or greater, as determined by the standard direct shear test – AASHTO T 236, utilizing a sample of the material compacted to 95% of AASHTO T 99 Methods C or D (with oversize correction, as outlined in Note 9 in AASHTO T 99) at optimum moisture content.

(c) Soundness. “Freeze and Thaw”, minimum 0.90 as determined in **DIVISION 1100**.

(d) Wear. Los Angeles Wear Abrasion, maximum 40%.

(e) Provide material that complies with **TABLE 1107-5**.

TABLE 1107-5: ELECTROCHEMICAL REQUIREMENTS (Block)		
	Requirements	Test Method
(Mesa)	pH > 3.0	AASHTO T 289
(Anchor Landmark)	pH: 3.0 to 9.0	AASHTO T 289
	Organic Content < 1%	AASHTO T 267

(3) Product Control.

(a) Gradation.

TABLE 1107-6: AGGREGATES FOR MODULAR BLOCK MSE WALLS BACKFILL			
Type of Material	% Retained – Square Mesh Sieves		
	1”	No. 40	No. 200
Sand	0	40-100	95-100
Crushed Stone	0	40-100	95-100

Limit the maximum particle size to ¾ inch for geosynthetic reinforced structures and for epoxy or PVC coated reinforcements. Use only crushed stone in District 1.

For select granular backfill material composed of crushed stone, submit a proposed project gradation with single-point gradations and tolerances for approval. For sand and sand-gravel combinations, a project gradation will be issued that will specify gradation tolerances after the proposed material is approved. Any quality assurance samples which fall outside the tolerances will necessitate re-approval to be in compliance with **subsection 1108.2 c.(2)**.

d. Underdrain, Permeable or Granular Backfill.

(1) Composition. Provide washed aggregate Type BD-1 and Type UD-1 composed of crushed or uncrushed gravel, or crushed stone.

(2) Quality.

- Soundness, minimum (KTMR-21) 0.90
- Wear, maximum (KTMR-24) 40%

(3) Product Control. Provide aggregate that complies with **TABLE 1107-7**

TABLE-1107-7: AGGREGATES FOR UNDERDRAIN AND OTHER PERMEABLE BACKFILL										
Type	Percent Retained-Square Mesh Sieves									
	1 ½”	1”	¾”	3/8”	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100
BD-1*	0	0-10	10-40		80-100		90-100		93-100	98-100
UD-1			0	0-15		40-60		70-95		98-100

*BD-1 is intended for use with a filter fabric.

1107 - AGGREGATES FOR BACKFILL

(4) Deleterious substances.

- Shale or shale-like material, maximum (KT-8) 3.0%
- Clay Lumps and friable particles, maximum (KT-7) 3.0%
- Sticks (wet), maximum (KT-35) 1.0%

e. Crushed Stone.

(1) Composition. Provide material produced by the crushing of any type of stone complying with the following.

(2) Quality.

- Soundness, minimum (KTMR-21) 0.70
- Wear, maximum (AASHTO T 96) 50%

(3) Product Control.

(a) Size Requirements. Provide uniformly graded crushed stone, from coarse to fine, for backfill that complies with **TABLE 1107-8:**

TABLE 1107-8: CRUSHED STONE BACKFILL		
Percent Retained-Square Mesh Sieves		
2"	3/8"	No. 16
0	20 - 50	50 - 100

(b) Deleterious Substances.

- Clay lumps and friable particles, maximum (KT-7) 5.0%

1107.3 TEST METHODS

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

1107.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4.**

1107.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

1108 - AGGREGATES FOR COVER MATERIAL

SECTION 1108

AGGREGATES FOR COVER MATERIAL

1108.1 DESCRIPTION

This specification covers aggregates for cover material to be used for asphalt sealing of the type shown in the Contract Documents for each project.

1108.2 REQUIREMENTS

a. Composition. Provide sand-gravel, lightweight aggregate, crushed limestone, crushed sandstone, crushed or uncrushed gravel for cover material. Use expanded shale as lightweight aggregate.

b. Quality Requirements.

- Soundness, minimum (KTMR-21) 0.90
- Wear, Maximum (AASHTO T 96)
 - Sand-gravel, Gravel or Limestone 40%
 - Sandstone 45%
 - Lightweight aggregate 30%
- Absorption, maximum (KT-6, Procedure I) 4.0%
(All types except CM-L)

c. Product Control.

(1) Size Requirements. Use various size cover material that comply with **TABLE 1108-1**. Determine the gradation factor according to Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

(2) Deleterious Substances. Do not exceed the following deleterious substances by weight:

- Shale or Shale like material (KT-8) 1.5%
- Clay lumps and friable particles (KT-7) 1.5%
- Coal (AASHTO T-113) 0.5%
- Sticks (wet) (KT-35) 0.1%
- Sum of all deleterious..... 2.0%

TABLE 1108-1: GRADATION REQUIREMENTS FOR AGGREGATES FOR COVER MATERIAL

Type	Composition	Percent Retained-Square Mesh Sieves*							Minimum Gradation Factor
		¾"	½"	3/8"	No. 4	No. 8	No. 50	No. 200	
CM-A	Sand-Gravel		0	0-20	30-100	85-100		98-100	
CM-B	Sand-Gravel		0	0-25		35-100	90-100	98-100	4.00
CM-C	Crushed Stone	0	0-12	40-100	95-100			98-100	
CM-D	Crushed Sandstone	0	0-5	15-35	70-100	95-100		98-100	
CM-G	Sand-Gravel, or Crushed Sandstone		0	0-15	45-100	95-100		99-100	
CM-H**	Crushed Stone	0	0-5		40-100	90-100		98-100	
CM-J**	Sand-Gravel	0	1-20			30-100	90-100	96-100	
CM-K	Crushed Limestone	0	0-5	15-35	70-100	95-100		98-100	
CM-L-1	Lightweight Aggregate	0	0	0-10	10-40	85-100		98-100	
CM-L-2	Lightweight Aggregate	0	0-5	0-15	70-100	90-100		98-100	
CM-L-3	Lightweight Aggregate	0-15	0-60	65-100	95-100			98-100	

*After removal of all deleterious substances.

**Do not specify Types CM-H and CM-J for Federal Aid projects.

1108 - AGGREGATES FOR COVER MATERIAL

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1108.3 TEST METHODS

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

1108.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1108.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1109 - AGGREGATE FOR MICROSURFACING

SECTION 1109

AGGREGATE FOR MICROSURFACING

1109.1 DESCRIPTION

This specification covers aggregates for use in microsurfacing operations.

1109.2 REQUIREMENTS

a. Composition. Provide aggregate for microsurfacing that is crushed gravel, crushed calcite cemented sandstone, or chat which is a material obtained from the mining of lead and zinc ores.

Produce crushed gravel by mechanical crushing of siliceous gravel and not containing more than 15% non-siliceous material.

b. Quality.

- Soundness, minimum (KTMR-21)0.90
- Wear, maximum (AASHTO T 96)40%

c. Product Control.

Provide material that complies with **TABLE 1109-1**:

TABLE 1109-1: GRADING REQUIREMENTS							
Percent Retained - Square Mesh Sieves							
½"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 200
0	0-1	6-14	35-55	54-75	65-85	75-90	85-95

Additional Requirements for Crushed Gravel.

- Percent Crushed Particles (KT-31) (minimum)98%*
- Uncompacted Void Content of Fine Aggregates (KT-50) (minimum)46%
- Sand Equivalent (KT-55) (minimum)65%

*Provide 98% of the crushed gravel with 2 or more fractured faces.

Deleterious Substances. Provide materials that are free from weeds, sticks, grass, roots and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1109.3 TEST METHODS

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

1109.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1109.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1110 - AGGREGATES FOR SUBGRADE MODIFICATION OR RECONSTRUCTION

SECTION 1110

AGGREGATES FOR SUBGRADE MODIFICATION OR RECONSTRUCTION

1110.1 DESCRIPTION

This specification covers the required types of aggregates for use in subgrade modification or reconstruction operations as shown in the Contract Documents.

1110.2 REQUIREMENTS

a. Composition. Provide one of the types of aggregate for subgrade modification or reconstruction as shown in **TABLE 1110-1**.

b. Quality¹.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 50%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size and Plasticity. Provide aggregate that complies with **TABLE 1110-1**. Determine the grading factor in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1110-1: GRADING AND PLASTICITY REQUIREMENTS										
Type	Material	Percent Retained-Square Mesh Sieves ¹								Plasticity Index ²
		1 ½"	1"	¾"	3/8"	No. 4	No. 16	No. 50	No. 200	
SR-1	Crushed Stone	0	0-15			35-100		85-100	85-100	0-6
SR-3	Crushed Stone Screenings ³	0			0-5				85-100	0-5
SR-4	Sand-Gravel ⁴		0	0-5	0-20				85-100	0-6
SR-7	Sand-Gravel	0					5-50	85-100	85-100	0-6

¹After removal of all deleterious substances.

²This requirement does not apply if there is more than 70% retained on the No. 30 sieve.

³Do not exceed 7% of moisture contained in the aggregate when delivered to the road.

⁴Gradation Factor is between 4.00-5.00.

(2) Deleterious Substances. Do not exceed the following percentages of deleterious substances by weight:
For crushed stone and sand-gravel:

- Shale or shale-like material (KT-8) 3.0
- Clay lumps & friable material (KT-7) 3.0
- Sticks (wet) (KT-35) 1.0

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1110.3 TEST METHODS

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

1110 - AGGREGATES FOR SUBGRADE MODIFICATION OR RECONSTRUCTION

1110.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1110.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1111 - AGGREGATES FOR SURFACING OR RESURFACING

SECTION 1111

AGGREGATES FOR SURFACING OR RESURFACING

1111.1 DESCRIPTION

This specification covers the type of aggregate used for surfacing or resurfacing operations as shown in the Contract Documents.

1111.2 REQUIREMENTS

a. Composition. Provide one of the following types of aggregates for surfacing or resurfacing as shown in **TABLE 1111-1**.

b. Quality¹.

- Soundness², minimum (KTMR-21)0.85
- Wear³, maximum (AASHTO T 96)45%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Provide aggregate that complies with **TABLE 1111-1**. Determine the fineness modulus in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1111-1: GRADING REQUIREMENTS FOR AGGREGATES FOR SURFACING OR RESURFACING									
Type	Material	Percent retained-square mesh sieve (Gradings after removal of deleterious substances)							Fineness Modulus
		1 1/2"	1"	3/4"	3/8"	No. 8	No. 30	No. 200	
SA-1	Sand-gravel		0	0-5	0-20			97-100	4.00 min.*
SA-2	Sand-gravel	0	1-15					97-100	5.00 min.
SA-6	Crushed Stone	0	0-5	5-25	45-100		95-100	97-100	
SA-7	Crushed Stone	0		25-50		85-100		97-100	
SA-X	Crushed Stone		0	0-5	35-65		95-100	97-100	

*For fineness modulus less than 4.00 but greater than 3.75, provide additional materials as a penalty at a rate of 1.5% for each 0.05 less than 4.00 fineness modulus. Use a maximum lot size of 500 cubic yards or tons to determine penalty. Average all tests within the lot to determine penalty.

(2) Deleterious Substances. Do not exceed the following percentages of deleterious substances by weight:

- Clay lumps and friable particles (KT-7) 2.0
- Sticks (wet) (KT-38) 2.0

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1111.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1111**.

1111 - AGGREGATES FOR SURFACING OR RESURFACING

1111.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1111.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

**1112 - AGGREGATES FOR SURFACING OR SUBGRADE MODIFICATION
FOR COUNTY SECONDARY ROADS**

SECTION 1112

**AGGREGATES FOR SURFACING OR SUBGRADE MODIFICATION
FOR COUNTY SECONDARY ROADS**

1112.1 DESCRIPTION

This specification covers types of aggregates used for surfacing or subgrade modification for county secondary roads as shown in the Contract Documents.

1112.2 REQUIREMENTS

a. Composition. Provide one of the types of aggregate for surfacing or subgrade modification for secondary roads as shown in **TABLE 1112-1 and 1112-2.**

b. Quality¹.

- Soundness², minimum (KTMR-21) 0.85
- Wear³, maximum (AASHTO T 96) 55%

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Provide aggregate that complies with **TABLE 1112-1.** Determine the gradation factor in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1112-1: GRADATION REQUIREMENTS											
Type	Material	Percent retained On standard square mesh sieves*								Gradation Factor	
		2"	1 ½"	1"	¾"	3/8"	No. 4	No. 8	No. 30		No. 200
SS-3	Crushed Stone		0	0-15		45-85			90-100	92-100	
SS-5	Crushed Stone	0	0-5	0-30		45-90			90-100	92-100	
SS-7	Sand-gravel			0	0-5	0-20				97-100	4.00 - 5.00**
SS-8	Sand-gravel			0	0-5	0-30				92-100	3.75+
SS-9	Sand-gravel			0		0-20				90-100	3.50+
SS-10	Sand-gravel	0	0-5			0-30				90-100	3.25+
SS-14	Limestone gravel		0							93-100	

*After removal of all deleterious substances

**For grading factors less than 4.00 but greater than 3.75, provide additional materials as a penalty at a rate of 1.5% for each 0.05 less than 4.00 grading factors. Use a maximum lot size of 500 cubic yards or tons to determine penalty. Average all tests within the lot to determine penalty.

**1112 - AGGREGATES FOR SURFACING OR SUBGRADE MODIFICATION
FOR COUNTY SECONDARY ROADS**

2. (2) Deleterious Substances. Do not exceed the values for each respective type as shown in **TABLE 1112-**

TABLE 1112-2: DELETERIOUS SUBSTANCES				
Type	Material	Sticks (wet)	Clay Lumps & Friable Particles	Combination¹
SS-3	Crushed Stone	2.0	5.0	5.0
SS-5	Crushed Stone	2.0	5.0	5.0
SS-7	Sand-gravel	2.0	5.0	5.0
SS-8	Sand-gravel	2.0	4.0	
SS-9	Sand-gravel	2.0	3.0	
SS-10	Sand-gravel	2.0	3.0	
SS-14	Limestone gravel			

¹Of any deleterious substances.

d. Stockpiling.

Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1112.3 TEST METHODS

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

1112.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4.**

1112.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

1113 - AGGREGATES FOR SHOULDER CONSTRUCTION

SECTION 1113

AGGREGATES FOR SHOULDER CONSTRUCTION

1113.1 DESCRIPTION

This specification covers types of aggregates for shoulder construction.

1113.2 REQUIREMENTS

a. Composition.

(1) Type AS-1 is a mixture of aggregate and binder with at least 85% the material produced by the mechanical crushing of limestone, dolomite or sandstone.

b. Quality¹.

- Soundness², minimum (KTMR-21)0.85
- Wear³, maximum (AASHTO T 96)50%
- Specific Gravity⁴ (dry), minimum (KT-6 Procedure I)2.20

¹Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

²The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

³The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

⁴Apply the specific gravity requirement to individual materials and to any combination of materials required to meet the grading and plasticity requirements.

c. Product Control.

(1) Gradation and Plasticity. Provide aggregate that complies with **TABLE 1113-1**.

TABLE 1113-1: GRADING AND PLASTICITY REQUIREMENTS FOR AGGREGATES FOR SHOULDER CONSTRUCTION											
Type	Percent Retained - Square Mesh Sieves								P.I.	L.L. ³ (Max)	Ratio ⁴ (Max)
	2"	1½"	¾"	3/8"	No. 4	No. 8	No. 40	No. 200			
AS-1	0	0-5	5-30		35-60	45-70	60-84	80-92	1-8 ¹ 4-8 ²	30	3/4

¹Crushed Limestone or Dolomite

²Crushed Sandstone

³Liquid Limit

⁴Ratio of percent passing the No. 200 sieve to the percent passing the No. 40 sieve.

(2) Deleterious Substances. Provide aggregates for shoulder construction that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1113.3 TEST METHODS

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

1113.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1113.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1114 - STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

SECTION 1114

STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

1114.1 DESCRIPTION

This specification covers stone for the following uses:

- Riprap
- Aggregate Ditch Lining (D₅₀)
- Filter Course
- Flumes, Flume Drains and Slope Drains
- Tree Wells or Cribs
- Shot Rock
- Granular Drainage Blanket
- Sediment Basin Risers

Where referred to, quarried stone is defined as limestone, dolomite, calcite cemented sandstone, rhyolite, quartzite, basalt and granite, removed from naturally occurring formation by standard extraction and sizing methods.

Recycled PCCP may be used for Riprap, Ditch Lining, and Shot Rock, provided the respective Soundness and Wear requirements are met.

1114.2 REQUIREMENTS

a. Stone for Riprap.

(1) Composition. Provide quarried stone for riprap that meets the installation class specified in the Contract Documents.

(2) Quality.

- Soundness, minimum (KTMR-21)..... 0.85
- Wear, maximum (AASHTO T 96) 45%
- Inspection of the quarry ledge, stock piles, and available sites where comparable stone from the same bed(s) is in service to verify the Product Control requirements have been met.

(3) Product Control.

- Provide stone for riprap that is free of soil, shale or shale-like material and cracks, seams or other defects that will decrease the durability of the material after placement.
- Provide riprap from sources that have been inspected and approved by the KDOT Geologist.
- A riprap source may be rejected if more than 15% of the product from the source deteriorates within 5 years of exposure, either in service or in a natural weathering test plot (such as a boulder pile at the quarry). Deterioration is defined as any one piece losing more than 25% of its original volume either due to damage during handling and placement or due to cracking or splitting as a result of weak seams in the rock. Determination is made by visual inspection.
- Size. The class requirements are given in **TABLE 1114-1**.

1114 - STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

TABLE 1114-1: STONE FOR RIPRAP*											
Class	Percent Heavier Than										
	8 ton	4 ton	2 ton	1 ton	½ ton	¼ ton	250 lbs	200 lbs	100 lbs	75 lbs	5 lbs
Heavy Series											
8 Ton	50+	95+									
4 Ton	0	50+	95+								
2 Ton		0	50+	95+							
1 Ton			0	50+	95+						
½ Ton				0	50+	95+					
¼ Ton					0	50+				90+	
Light Series											
Facing								0		50+	90+
Light 24"				0				50+			90+
Light 18"					0				50+		90+

*Percent of total sample weight composed of pieces heavier than the indicated weight

b. Stone for Aggregate Ditch Lining (D₅₀).

(1) Composition. Provide crushed or uncrushed gravel or quarried stone meeting the size of ditch lining aggregate specified in the Contract Documents.

(2) Quality

- Soundness, minimum (KTMR-21)..... 0.85
- Wear, maximum (AASHTO T 96)..... 45%
- Inspection of the quarry ledge, stock piles, and available sites where comparable stone from the same beds is in service to verify the Product Control requirements have been met.

(3) Production Control.

- Provide stone for ditch lining that is free of soil, chert, shale or shale-like material and cracks, seams, or other defects that will decrease the durability of the material after placement. No more than 10% of individual rocks shall have their least dimension less than 1/3 of their greatest dimension.
- Provide ditch lining from sources that have been inspected and approved by the KDOT Geologist.
- A ditch lining source may be rejected if more than 15% of the product from the source deteriorates within 5 years of exposure, either in service or in a natural weathering test plot (such as a boulder pile at the quarry). Deterioration is defined as any one piece losing more than 25% of its original volume either due to damage during handling and placement or due to cracking or splitting as a result of weak seams in the rock. Determination is made by visual inspection.
- Size. Provide stone for ditch lining that complies with **TABLE 1114-2**.

TABLE 1114-2: STONE FOR AGGREGATE DITCH LINING (D₅₀)												
Size D₅₀	Max. Size	Percent Retained on Sieve Size (Minimum)										
		8"	6 ½"	6"	5"	4"	3"	2 ½"	2"	1 ½"	1"	½"
1	2										50	85
2	4							15*	50		85	
3	6					15*	50			85		
4	8				15*	50			85			
5	10		15*		50			85				
6	12	15*		50			85					

*Suggested

c. Stone for Filter Course.

(1) Composition. Provide crushed or uncrushed gravel or quarried stone for filter course that meets the installation type specified in the Contract Documents.

1114 - STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

(2) Quality.

- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.

- Size. Provide stone for filter course material that complies with **TABLE 1114-3**.

TABLE 1114-3: STONE FOR FILTER COURSE									
Material	Percent Retained on Sieve Size								
	6"	5"	4"	3"	2"	1"	½"	3/8"	No. 4
Type I		0	0-5		10-40	25-60		55-85	70-95
Type II			0	0-5			50-90		
Type III	0	5-25			40-60			75-95	

d. Stone for Flumes, Flume Drains and Slope Drains.

(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality.

- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.

- Deleterious Substances. Provide stone that is free from soapstone, shale, shale-like or other easily disintegrated material.
- Size. Provide stone for flumes, flume drains and slope drains as shown in the Contract Documents or as required by the Engineer.

e. Stone for Tree Wells or Cribs. Stone may be set aside during excavation on the project or obtained from nearby deposits. If stone is not available, use salvaged, durable concrete blocks from old structures or other materials approved by the Engineer.

f. Stone for Shot Rock.

(1) Composition. Provide stone resulting from drilling and blasting or other various methods of excavation. Shot rock may be subsequently sized using heavy equipment or other suitable methods.

(2) Quality.

- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.

- Deleterious Substances. Provide stone for shot rock that is free from injurious quantities of clay and soapstone.
- Size. Shot rock shall be quarry run with no more than 10 percent larger than 10 feet in circumference measured in any direction and not more than 10 percent passing the 1 inch sieve as determined by visual inspection. The maximum size of the shot rock will be limited by the thickness of the rock to be placed, as shown on the Contract Documents.

g. Granular Drainage Blanket

(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality

- Soundness, minimum (KTMR-21)..... 0.85
- Wear, maximum (AASHTO T 96)..... 45%

1114 - STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

(3) Product Control.

- Deleterious Substances. Stone for these types of construction shall be free from soapstone, shale, shale-like or other easily disintegrated material.
- Size Requirements. Provide aggregate for granular drainage blankets that complies with **TABLE 1114-4**.

TABLE 1114-4: AGGREGATE FOR GRANULAR DRAINAGE BLANKETS	
Percent Retained – Square Mesh Sieves	
4 in	No. 8
0	95-100

h. Sediment Basin Risers

(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality

- Soundness, minimum (KTMR-21)..... 0.85
- Wear, maximum (AASHTO T 96)..... 45%

(3) Product Control.

- Deleterious Substances. Stone for these types of construction shall be free from soapstone, shale, shale-like or other easily disintegrated material.
- Size Requirements. Provide stone for sediment basin risers that complies with **TABLE 1114-5**:

TABLE 1114-5: SEDIMENT BASIN RISERS	
Percent Retained	
5 in	2 in
0	90

1114.3 TEST METHODS

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

1114.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1114.5 BASIS OF ACCEPTANCE

a. Aggregates covered by this subsection, except stone for tree wells and cribs, are accepted based on the procedures described in **subsection 1101.5**.

b. Stone for tree wells or cribs are acceptable based on visual inspection by the Engineer.

1115 - TEST METHODS FOR DIVISION 1100, AGGREGATES

SECTION 1115

TEST METHODS FOR DIVISION 1100, AGGREGATES

1115.1 GENERAL TEST METHODS

KT tests are general procedures performed in the field and the central laboratory. They are included in Part V. Copies can be obtained by contacting the Plans and Proposals Section in the Bureau of Construction and Materials, the local DME, or the Quality Assurance Section at the Materials and Research Center. Check the special provision regarding test methods to ascertain the date of the latest revision.

TITLE	TEST METHOD
Sampling Aggregates	KT-1
Sieve Analysis of Aggregates	KT-2
Material Passing No. 200 Sieve by the Wash Method	KT-3
Percent Retained on the No. 200 Sieve by Dry Screening	KT-4
Unit Weight of Aggregate	KT-5
Specific Gravity and Absorption of Aggregate	KT-6
Clay Lumps and Friable Particles in Aggregate	KT-7
Shale or "Shalelike" Materials in Aggregate	KT-8
Plasticity Test	KT-10
Moisture Test	KT-11
Determination of Free Moisture or Absorption of Aggregate For Use in Concrete	KT-24
Determination of Percentage of Crushed Particles in Crushed Gravel	KT-31
Sieve Analysis of Extracted Aggregate	KT-34
Sticks in Aggregate	KT-35
Making, Curing and Testing Cement Treated and Unbound Bases In the Laboratory	KT-37
Moisture Contents of Asphalt Mixtures of Mineral Aggregates -Microwave Oven Method	KT-43
Uncompacted Void Content of Fine Aggregate	KT-50
Plastic Fines in Combined Aggregates by Use of the Sand Equivalent Test	KT-55
Flat and Elongated Particles in Coarse Material Test	KT-59

1115 - TEST METHODS FOR DIVISION 1100, AGGREGATES

1115.2 MATERIALS AND RESEARCH CENTER TEST METHODS

KTMR tests are procedures found at the Materials and Research Center and are not expected to be performed in the field. Copies can be obtained by contacting the Quality Assurance Section in the Materials and Research Center.

TITLE	MR TEST METHOD
Permeability for Base Course Material	KTMR-5
Soundness and Modified Soundness of Aggregates by Freezing and Thawing	KTMR-21
Durable Aggregate Test	KTMR-22
Wetting and Drying Test of Sand-Gravel Aggregate for Concrete	KTMR-23
Procedures for Testing Lightweight Aggregates	KTMR-24
Test Method for Compressive Strength of Hydraulic Cement Mortars Using 2 inch Cube Specimens	KTMR-26
Modified Specific Gravity and Absorption of Aggregate	KTMR-27
Determination of Total Acid Insoluble Residue	KTMR-28

1115.3 AASHTO TEST METHODS

In addition to the test methods referenced above, the following American Association of State Highway and Transportation Officials (AASHTO) test methods are used as written in the current edition of the AASHTO Materials Manual, Part II. Copies can be obtained from AASHTO, or can be viewed at the offices of the local DME, Construction and Materials Headquarters, or the Quality Assurance Section in the Materials and Research Center.

TITLE	AASHTO TEST METHOD
Organic Impurities in Fine Aggregates for Concrete	AASHTO T 21
Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	AASHTO T 96
Lightweight Pieces in Aggregate	AASHTO T 113

1116 – AGGREGATES FOR ON GRADE CONCRETE

SECTION 1116

AGGREGATES FOR ON GRADE CONCRETE

1116.1 DESCRIPTION

This specification is for coarse aggregates, intermediate aggregates, fine aggregates, mixed aggregates (coarse, intermediate and fine material) and miscellaneous aggregates for use in construction of concrete placed on grade.

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

1116.2 REQUIREMENTS

a. Quality of Individual Aggregates.

(1) Provide aggregate for concrete that complies with the following requirements. Crushed aggregates with less than 20% material retained on the 3/8" sieve from a source complying with these requirements prior to crushing. Fine Aggregates for Concrete have additional Quality Requirements stated in subsection 1116.2e.(2).

Soundness by Freeze/Thaw (min.) (KTMR-21)*	0.90
Wear Grading B (max.)(AASHTO T 96)**	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%
* Soundness (KTMR-21) requirements do not apply to aggregates having less than 10% material retained on the No. 4 sieve.	
** Wear (AASHTO T 96) requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.	
***The additional requirements do not apply for uncrushed sand-gravel aggregates having less than 5% material retained on the 1/2" sieve.	

(2) All predominately siliceous aggregate must comply with the Wetting & Drying Test requirements, or be used with a Coarse Aggregate Sweetener, or will require Supplemental Cementitious Materials (SCM) to prevent Alkali Silica Reactions (ASR). When an SCM is utilized, 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.

Wetting & Drying Test of Siliceous Aggregate for Concrete (KTMR-23)	
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.

(3) Coarse Aggregate Sweetener. Types and proportions of aggregate sweeteners to be used with Mixed Aggregates are listed in TABLE 1116-1.

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TABLE 1116-1: COARSE AGGREGATE SWEETENER	
Type of Coarse Aggregate Sweetener	Proportion Required by Percent Weight
Crushed Sandstone*	40 (minimum)
Crushed Limestone or Dolomite*	40 (minimum)
Siliceous Aggregates meeting subsection 1116.2a.(2)	40 (minimum)
Siliceous Aggregates not meeting subsection 1116.2a.(2) **	30 (maximum)

*Waive the minimum portion of Coarse Aggregate Sweetener for all intermediate and fine aggregates that comply with the wetting and drying requirements for Siliceous Aggregates. In this case, combine the intermediate, fine and coarse aggregate sweetener in proportions required to comply with **subsection 1116.2a.(2)**

**To be used only with intermediate and fine aggregates that comply with the wetting and drying requirements of Siliceous Aggregates unless a Supplemental Cementitious Material is utilized.

b. Mixed Aggregates

(1) Composition. Provide coarse, intermediate, and fine aggregates in a combination necessary to meet **subsection 1116.2b.(2)**. Use a proven optimization method such as ACI 302.1 or other method approved by the Engineer. Aggregates may be from a single source or combination of sources.

(2) Product Control.

(c) Gradations such as those shown in **TABLE 1116-2** have proven satisfactory in reducing water demand while providing good workability. Adjust mixture proportions whenever individual aggregate grading varies during the course of the work. Use the gradations shown in **TABLE 1116-2**, or other gradation approved by the Engineer.

Optimization is not required for concrete for patching pavements more than 10 years old, or Commercial Grade Concrete. The Engineer may waive the optimization requirements if the concrete meets all the requirements of **DIVISION 400** and/or **DIVISION 500**.

Follow these guidelines:

1. Do not permit the percent retained on two adjacent sieve sizes to fall below 4%;
2. Do not allow the percent retained on three adjacent sieve sizes to fall below 8%; and
3. When the percent retained on each of two adjacent sieve sizes is less than 8%, the total percent retained on either of these sieves and the adjacent outside sieve should be at least 13%.
(for example, if both the No. 4 and No. 8 sieves have 6% retained on each, then:
 - 1) the total retained on the 3/8 in. and No. 4 sieves should be at least 13%, and
 - 2) the total retained on the No. 8 and No. 16 sieves should be at least 13%.)

TABLE 1116-2: ALLOWABLE GRADING FOR MIXED AGGREGATES FOR CONCRETE													
Type	Usage	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	No. 200
MA-3	Optimized All Concrete		0	2-12	Note ¹	Note ¹	Note ¹	Note ¹	Note ²	Note ²	Note ²	95-100	98-100
MA-4	Optimized All Concrete ³	0	2-12	Note ¹	Note ¹	Note ¹	Note ¹	Note ¹	Note ²	Note ²	Note ²	95-100	98-100
MA-5	Optimized All Concrete		0	2-12	8 min	22-34		55-65		75 min		95-100	98-100
MA-7	Contractor Design KDOT Approved	Proposed Grading that does not correspond to other limits in this table but meet the requirements for concrete in DIVISION 400 and/or DIVISION 500 .											98-100

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

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

³ Maximum top size of Limestone is 3/4".

(d) Optimization Requirements for all Gradations.

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

Where: W_A = Actual Workability

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W_T = Target Workability

CF = Coarseness Factor

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

$$CF = \frac{+3/8'' \text{ Material \% Retained}}{+ \#8 \text{ Material \% Retained}} \times 100$$

3. Calculate the Actual Workability (W_A) to the nearest whole number as the percent material passing the #8 sieve.

$$W_A = 100 - \% \text{ retained on \#8 sieve}$$

4. Calculate the Target Workability (W_T) to the nearest whole number where
For 517 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 weight are:

- 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 1.5%

- (d) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) for each aggregate according to the procedure listed in Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) of Part V before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ± 0.20 of the average fineness modulus.

Provide a single point grading for the combined aggregates along with a plus/minus tolerance for each sieve. Use plus/minus tolerances to perform quality control checks and by the Engineer to perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

Maintain an Actual Workability within ± 5 of the Target Workability for combined aggregates.

- (3) Handling of All Aggregates.

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

(b) Stockpiling.

- Maintain separation between aggregates from different sources, with different gradings or with a significantly different specific gravity.
- Transport aggregate in a manner that promotes 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.

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c. Coarse Aggregates for Concrete.

(1) Composition. Provide coarse aggregate that is crushed gravel or crushed stone meeting the quality requirements of **subsection 1116.2a**. Consider limestone, calcite cemented sandstone, rhyolite, quartzite, basalt and granite as crushed stone.

Mixtures utilizing siliceous aggregate not meeting **subsection 1116.2a.(2)** 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) Product Control. Use gradations such as those in **TABLE 1116-3** which have been shown to work in Optimized Mixed Aggregates, or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1116.2b**.

TABLE 1116-3: GRADING REQUIREMENTS FOR COARSE AGGREGATES									
Type	Composition	Percent Retained - Square Mesh Sieves							
		1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 30
CPA-1	Crushed Gravel or Crushed Stone	0	0-10	14-35	-	50-75	-	95-100	-
CPA-3	Crushed Gravel or Crushed Stone	-	-	0	0-35	30-70	75-100	95-100	-
CPA-4	Crushed Gravel or Crushed Stone	-	0	0-20	-	-	-	95-100	-

d. Intermediate Aggregate for Concrete.

(1) Composition. Provide intermediate aggregate for mixed aggregates (IMA) that is crushed stone, natural occurring sand, or manufactured sand meeting the quality requirements of **subsection 1116.2a**.

(2) Product Control. Provide IMA grading when necessary to provide a combined aggregate gradation meeting **subsection 1116.2b**.

e. Fine Aggregates for Concrete.

(1) Composition.

(a) Type FA-A. Provide either singly or in combination natural occurring sand resulting from the disintegration of siliceous or calcareous rock, or manufactured sand produced by crushing predominately siliceous materials meeting the quality requirements of **subsection 1116.2a**. and **subsection 1116.2e.(2)**.

(2) Additional Quality Requirements.

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

- Mortar Strength (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 (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 FA-A that comply with **TABLE 1116-5** or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1116.2b**.

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TABLE 1116-4: GRADING REQUIREMENTS FOR FINE AGGREGATES FOR CONCRETE								
Type	Percent Retained-Square Mesh Sieves							
	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
FA-A	0	0-10	0-27	15-55	40-77	70-93	90-100	98-100

(b) Deleterious Substances.

- Type FA-A: Maximum allowed deleterious substances by weight are:
 - Coal (AASHTO T113).....0.5%
 - Sticks (wet) (KT-35).....0.1%
 - Sum of all deleterious0.5%

f. Miscellaneous Aggregates for Concrete.

(1) Aggregates for Mortar Sand, Type FA-M.

(a) Composition. Provide aggregates for mortar sand, Type FA-M that is natural occurring sand.

(b) Quality.

- Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide aggregates for mortar sand, Type FA-M that comply with the following:
 - Mortar Strength (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 (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(c) Product Control.

- Size Requirements. Provide aggregates for mortar sand, Type FA-M that comply with **TABLE 1116-5**.

TABLE 1116-5: GRADING REQUIREMENTS FOR MORTAR SAND								
Type	Percent Retained - Square Mesh Sieves							Gradation Factor
	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	
FA-M	0	0-2	0-30	20-50	50-75	90-100	98-100	1.70-2.50

- Deleterious Substances. Maximum allowed deleterious substances by weight are:
 - Clay lumps and friable material (KT-7)..... 1.0%
 - Coal (AASHTO T 113).....0.5%
 - Sticks (wet) (KT-35).....0.1%
 - Sum of all deleterious 1.5%

(2) Modified Lightweight Aggregates.

(a) Composition. Provide a modified lightweight aggregate produced from a uniform deposit of raw material combined with FA-A that meets **subsection 1102.2c**.

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(b) Quality.

- Soundness, minimum (KTMR-21)0.90
- Loss on Ignition5%

(c) Product Control.

- Size Requirements. Provide modified lightweight aggregates that comply with **TABLE 1116-6**.

TABLE 1116-6: GRADING REQUIREMENTS FOR MODIFIED LIGHTWEIGHT AGGREGATES						
Type	Percent Retained - Square Mesh Sieves					
	¾"	½"	⅜"	No. 4	No. 8	No. 16
Grade 1	0	0-10	30-60	85-100	95-100	
Grade 2		0-2	0-30	20-50	50-75	90-100

- Deleterious Substances.
 - Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.
- Unit Weight (dry, loose weight) (max.) 1890 lbs/cu yd

(d) Concrete Making Properties. Drying shrinkage of concrete specimens prepared with modified lightweight aggregate and FA-A proportioned as shown in the Contract Documents can not exceed 0.07%.

(e) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to procedure listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

(f) Proportioning Materials. Submit mix designs for concrete using modified lightweight aggregate to Construction and Materials for approval prior to use.

(g) 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 promotes 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.

1116.3 TEST METHODS

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

1116.4 PREQUALIFICATION

Aggregates for concrete must be prequalified according to **subsection 1101.4**.

1116.5 BASIS OF ACCEPTANCE

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

