

Qualified Aggregate Technician

Kentucky Specifications



Aggregate Specifications

- State, FHWA, FAA, Contractor
- Kentucky Transportation Cabinet

Aggregate Size Designations

- **Nominal Maximum Size**
 - The largest sieve on the gradation table for an aggregate size on which any material may be retained
- **Maximum Size**
 - The largest sieve size through which all material must pass

Aggregate Source Approval

- Provide fine aggregates from the Aggregate Source List
- For approval provide:
 - 1) A Quality Control Plan
 - 2) A satisfactory laboratory facility
 - 3) A Qualified Aggregate Technician
- To supply sand **only** for asphalt mixtures--1,2 and 3 will be waived.

Non-Approved Sources

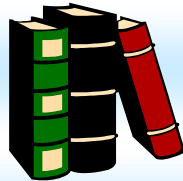
- Coarse aggregates are subject to preliminary source approval
 - Obtain the Department's approval before furnishing aggregates from sources not on the Aggregate Source List
 - The Department will sample during stockpiling, and test according to KY Manual of Field Testing and Sampling Practices
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Material May Be Rejected By Department When:

- Excessive gradation variations exist
 - Aggregate physical properties cause:
 - unworkable mixtures
 - mixture control problems
 - nonconformance to finished product or mixture requirements
 - Contaminated
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Kentucky Standard Specifications

- Section 804--Fine Aggregates
- Section 805--Coarse Aggregates



Fine Aggregates Section 804

- Conglomerate sand– Natural material, processed without crushing. May include some crushed natural material
- Mortar Sand– Natural, crushed, or conglomerate sand—cement mortar
- Natural Sand--natural disintegration
- Crushed Sand--Fine granular material--from crushing stone or gravel. Includes slag where permitted
- Mineral filler– crusher fines, cement, fly ash

Fine Aggregate Definition ASTM C-125

- FINE AGGREGATE - passing the 3/8-in. sieve, almost entirely passing the No. 4 sieve, and predominately retained on the No. 200 sieve

 - COARSE AGGREGATE - The portion of aggregate predominately retained on the No. 4 sieve
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Coarse Aggregate Section 805

- Crushed stone and crushed or uncrushed gravel

 - Includes lightweight aggregates or slag where permitted

 - Department's List of Approved Materials

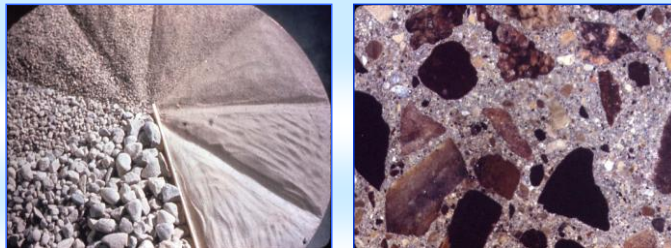
 - Aggregate Source List

 - Class A and Class B Polish Resistant Aggregate Sources
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Coarse Aggregate Definition ASTM C-125

- AGGREGATE - predominately retained on the No. 4 sieve
- ASPHALT - The portion of aggregate retained on the No. 4 sieve

Aggregate Applications in Concrete



Aggregate Applications in Concrete

Section 804.03 - Fine Aggregate
Concrete Applications

Section 805.04 - Coarse Aggregate
Concrete Applications

Fine Aggregate for Concrete 804.03

- Department will allow any combination of natural, crushed, or conglomerate sand when the combination is achieved in the concrete plant weigh hopper
 - Combined sand must meet the minimum requirements for use in concrete
- Wearing surfaces for vehicular traffic:
 - Use natural or conglomerate sand
- Engineer may allow other sands

**Fine Aggregate for Concrete
804.03**

• Conform to:

- 1) Sand Equivalent – 80 (min)
- 2) Soundness --10% loss (max)
- 3) Friable Particles --3.0% (max)
- 4) Coal plus Lignite -- 0.50% (max)
- 5) Uncompacted Voids (FAA) -- 47% (max)
- 6) Organic Impurities -- Not darker than standard

**Fine Aggregate for Concrete
804.03**

• Conform to (cont.):

- 7) Mortar Strength--95% at 7 days (min)
- 8) Gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
No. 4	90-100
No. 16	45-85
No. 50	5-25
No. 100	0-8

WHY?

- **Coal plus Lignite**
 - Air Entraining Agent
 - Surface Staining and Popouts
- **Mortar Strength**
 - Verifies fine aggregate and cement combination
- **Organic Impurities**
 - Strength gain
 - Air Entraining agent
- **Gradation**
 - Workability of concrete mixture
 - #16, #30, and #50 screens affect air entraining agents effectiveness

Acceptable Coarse Aggregates for Concrete Applications

- Crushed Stone
- Crushed or Uncrushed Gravel
- Includes Lightweight Aggregates and Slag (where permitted)

**Coarse Aggregate
Requirements for Concrete
805.04**

- General (section 805.03)
 - Physical properties (Section 805.03.02)
 - Specifications (Section 805.04)
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**General Requirements
Section 805.03**

- Provide coarse aggregates that are free of objectionable amounts of clay lumps, dirt coatings, and foreign material
- Soundness and Shale
 - Portland Cement Concrete Mixtures
 - Asphalt Mixtures
 - Other Uses



Physical Properties Section 805.03.02

- Wear (except slag and sandstone) 40% max
- Wear (sandstone) 50% max
- Wear (slag) 60% max
 - Note "Wear" refers to L.A. Abrasion
- Friable particles 1.0% max
- Unit weight (slag) 70 lbs/ft³ min

Blending Section 805.03.03

- Must be done with precise procedures, e.g. cold feeds, belts, weigh hopper or equivalent

Coarse Aggregate for Concrete
Section 805.04

- Provide aggregates from the Aggregate Source List
- Sources not on the Aggregate Source List must be sampled and tested by the Department prior to use
- Must use material from approved ledges and benches as listed on the Concrete Restriction List maintained by the Department.

Minus #200 is Critical

- Indicates workability
- High -#200 more water demand
- High -#200 more air entrainment required

Coarse Aggregate for Concrete Section 805.04

<u>Conform:</u>	<u>Max % By Wt.</u>
– Friable Particles	1.0
– Finer than No. 200	2.0
– Coal and Lignite	0.5
– Lightweight particles (Gravel)	4.0
• (Sp. Gr. Less than 2.40)	
– Lightweight particles (Limestone)	1.0
• (Sp. Gr. Less than 2.40)	

General Concrete Use Section 805.04

- Must pass the Carbonate Alkali Expansion Test (KM 64-629) - Test takes a minimum of 6 months to complete
- OK if less than 20% of total lift footage (bench) is potentially alkali-carbonate reactive as determined from Petrographic Investigation

**JPC Base, JPC Pavement, JPC Shoulders
and Concrete for Bridge Decks**
Section 805.04

- Must pass the Carbonate Alkali Expansion Test -(KM 64-629)
 - 20% maximum of lift footage as determined by Petrographic examination (see previous slide)
- Must pass Freeze Thaw Testing - (KM 64-626).
 - Up to 3 months to complete test
 - Contractor to provide Certification of Compliance-
 - * See page 221 of this manual with Section 805.04.01

**JPC Base, JPC Pavement, JPC Shoulders,
and Concrete for Bridge Decks**
Section 805.04

- Must pass Petrographic Examination
- OR
- Must pass Carbonate-Alkali Beam test (KM 64-629)
 - Must pass Freeze/Thaw testing (KM64-626)
 - Expansion **0.06%** max.

Potential Alkali Reactivity

- ASTM C-33 Appendix indicates some methods for evaluating potentially reactive coarse and fine aggregates
- A petrographic examination of hand samples is very helpful in determining if materials are present which are known to be reactive with cements

Alkali Reactivity Example

- The problem with a reactive aggregate is that sometimes it may take several years for the problem to become visible.



Concrete Mix Design

- Aggregate Grading
- Aggregate Specific Gravity
- Water content
- Cementitious content
- Curing
- Admixtures
- Aggregate shape
- Air content



Mix Design Data: Specific Gravity (SSD) and Absorption

- While all testing is important, these two tests have the most dramatic impact on the manufacturing, placement and acceptance of concrete products
- As such, the testing methods **must** be strictly adhered to for uniformity and consistency of results

Absorption

- Free moisture = Total Moisture - Absorption
- Critical for accurate water / cement ratio which will affect various concrete properties, including strength and durability

Summary Concrete Aggregate

- Section 804.03 - Fine Aggregate Concrete Applications
- Section 805.04 - Coarse Aggregate Concrete Applications

Aggregate Applications in Asphalt Mixtures



Aggregate Applications in Asphalt

Division 400 - Asphalt Pavements

Section 804.04 - Fine Aggregate for
Asphalt Mixtures

Section 805.05 - Coarse Aggregate for
Asphalt Mixtures

Mixture Designations 403.03.03

- Polish-Resistant Aggregate Requirements

Type A

- 100% Class A Coarse / 20% Class A Fine (total combined)

Type B

- 100% Class B Coarse or 50% Class A Coarse / 20 % Class A Fine or 30% Class B Fine or 30% Class A & B Fine (total combined)

Type D

- No Restrictions – but must be on the List of Approved Materials

Note: Type C has been eliminated

Polish-Resistant Fine Aggregate 804.04.03

- Provide fine aggregate from a Class A Polish-Resistant Aggregate Source
- Natural sand, conglomerate sand, and crushed gravel sand are always considered Polish-Resistant
- Contractor to provide Certificate of Compliance- see page 212 of this manual with 804.04.03

**Polish Resistant
Coarse Aggregate
805.05.05**

- Provide coarse aggregate from a Class A or Class B Polish-Resistant Aggregate Source
- Requirements are based on the mixture designation of aggregate type
- Contractor to provide Certificate of Compliance- see page 222 of this manual with 805.05.05

Aggregates

- Five mixture types--nominal max. size
 - 9.5 mm (3/8")
 - 12.5 mm(1/2")
 - 19 mm (3/4")
 - 25 mm (1")
 - 37.5 mm (1.5")

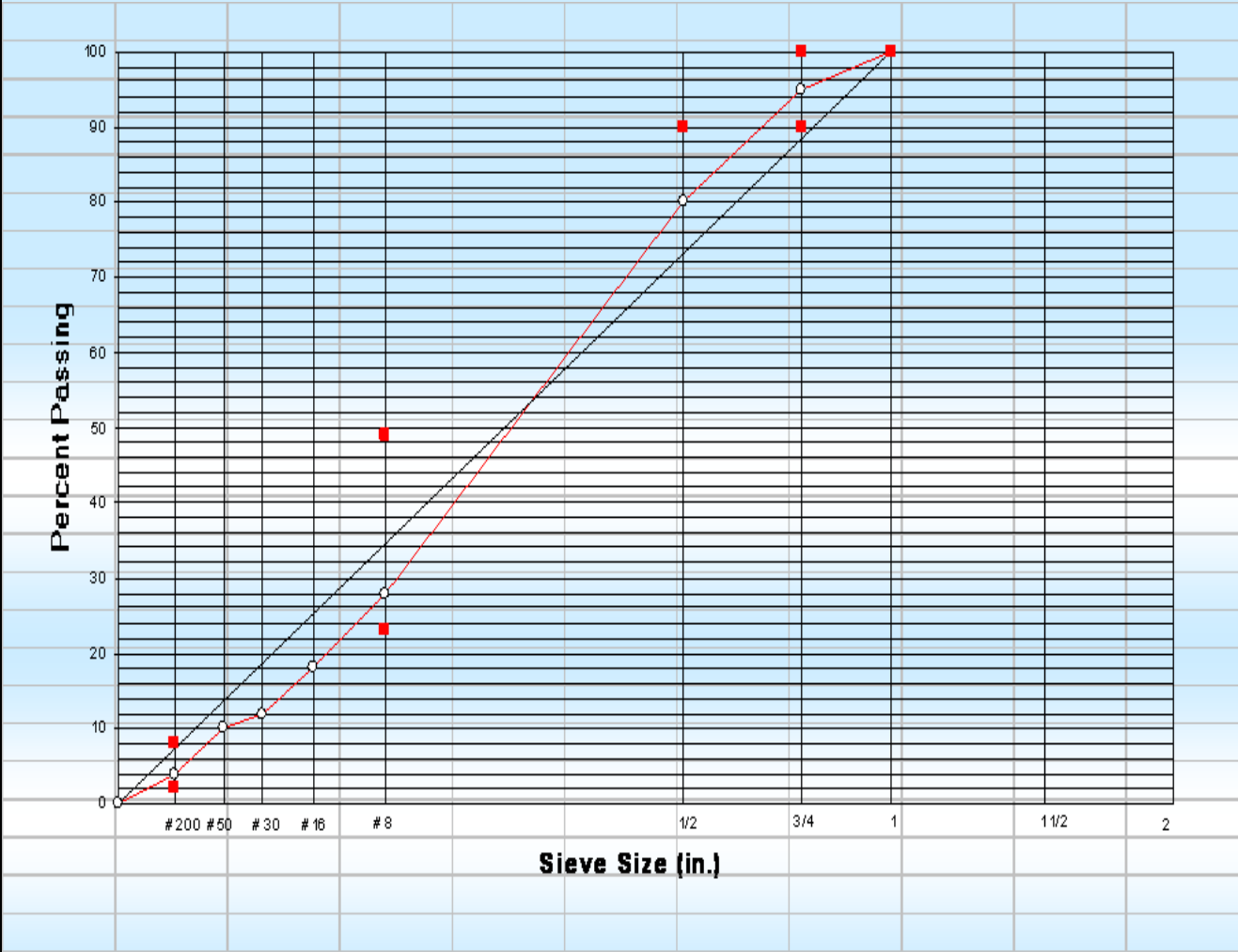
Aggregate Size Designations

- **Nominal Maximum Size**
 - The largest sieve on the gradation table for an aggregate size on which any material may be retained
- **Maximum Size**
 - The largest sieve size through which all material must pass

Superpave Size Designations

Superpave Mix mm (inches)	Nom Max Size mm (inches)	Max Size mm (inches)
37.5 (1.5")	37.5 (1.5")	50 (2")
25 (1")	25 (1")	37.5 (1.5")
19 (3/4")	19 (3/4")	25 (1")
12.5 (1/2")	12.5 (1/2")	19 (3/4")
9.5 (3/8")	9.5 (3/8")	12.5 (1/2")

Superpave Gradations



Material Requirements

- Absorption (805.05.01)
 - ≤ 3.0 % for each aggregate type
 - ≤ 4.0 % for slag
- Crushed Particles (805.05.02)
 - Superpave – see table next slide
 - OGFC – 95/75
 - Seal Coats – 90/-
 - Other Mixtures – 75/-
- Friable Particles (804.04.04)
 - Maximum 1.0 % of combined aggregates
 - Excludes sandstone
- Flat & Elongated (805.05.03)
 - See table next slide
- Uncompacted Voids (804.04.04)
 - See table (2 slides forward)
 - Indication of particle shape
- Sand Equivalent
 - Indication of clay-size particles in fine aggregate
 - See table (2 slides forward)

Coarse Aggregate Requirements for Hot Mix Asphalt 805.05.02

SUPERPAVE COARSE AGGREGATE CONSENSUS PROPERTY REQUIREMENTS						
ESAL Class	Design ESALS (millions)	Coarse Aggregate Angularity (Percent)				Flat and Elongated ⁽¹⁾ (Percent), maximum
		Minimum Depth From Surface				
		≤ 100 mm		> 100 mm		
		Crushed Faces		Crushed Faces		
		≥ 1	≥ 2	≥ 1	≥ 2	
1	< 0.3	75	-	75	-	10
2	0.3 to < 3	75	-	75	-	10
3	3 to < 30	95	90	80	75	10
4	≥ 30	100	100	100	100	10

⁽¹⁾ Criterion based on a 5:1 maximum-to-minimum ratio.

**Requirements for Superpave Fine Aggregates
804.04.04**

ESAL Class	Design ESALs (millions)	Uncompacted Voids Minimum (Method A) (Depth from Surface)		Sand Equivalent Minimum
		≤ 100mm	> 100mm	
1	< 0.3	40	40	45
2	0.3 to < 3	40	40	45
3	3 to < 30	45	40	45
4	≥ 30	45	45	50

**Asphalt Mixtures
804.04**

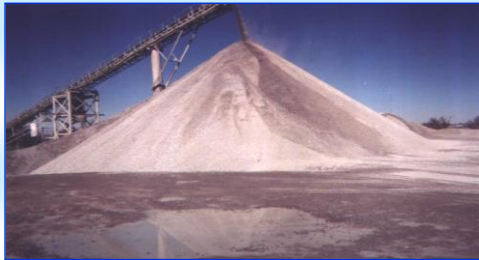
- Provide natural, crushed, conglomerate, and slag sand to meet gradation requirements
- Department will allow any combination of these sands to achieve cold feeds at the plant

Seal Coats Section 805.05.04

- No more than 3.0% passing No. 200 sieve



Other Specifications...



**Dense Graded Aggregate
and Crushed Stone Base
Section 805.06**

- Sand Equivalent 30 or greater
- Plasticity Index (PI) of 4 or less



**Bedding, Backfill, Underdrains,
Drainage, Granular Embankment, and Fill
Material**

- Listed in Section 805
- Gradations
- Shale
- Friable Particles
- Minus 200 content

Other Specifications
Section 805.13

- Slope Protection
- Cyclopean Stone Riprap
- Channel Lining
 - Class IV - excavated material

**Aggregate Surfacing, Traffic-Bound
Base, and Maintenance**
Section 805.14

- Use #57's, #610's, #710's or DGA
- Meet Gradation requirements in table
- Minus 200 content -- 12% maximum,
except for DGA

Size and Use Tables

- **Aggregate size chart** Spec book pg. 805-15
Manual pg 218
- **Aggregate size use table** S book pg. 805-16
Manual pg 234
- **Test Methods used** Spec book pg. 805-16
Manual pg 234

Summary

- Specifications
- Kentucky Standard Specifications
- Section 804, Fine Aggregate
- Section 805, Coarse Aggregates
- Aggregates for Asphalt and Concrete

