

Product Classifications Guide for Aggregates

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What is an Aggregate?

For INDOT, aggregates consist of Crushed Stone,
Sand, Gravel, and Slag



Aggregate Categories

- Coarse Aggregate
 - Coarse graded (2's through 12's, 91's, and 93PG)
 - Dense graded (53's and 73's)
- Fine Aggregate – various sand sizes
- Seal Coat Aggregate – SC 11, SC 12, and SC 16
 - Coarse aggregates with additional special physical requirements
- RipRap – various size ranges/gradations
- Structure Backfill – various gradations

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Fine and Coarse Aggregate

- Fine aggregate
 - 80 % passing number 4 sieve
 - 100% Passing the 3/8" sieve
- Coarse aggregate
 - Minimum 20 % retained on number 4 sieve



Number 4 sieve

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What are the Quality Classifications?
Standard Classes are A through F
Special Classes are AP, AS, Dolomite, and PRA
(Polish Resistant Aggregate).

What are the Classifications?
Standard Classes are A through F
Special Classes are AP, AS, Dolomite, and PRA
(Polish Resistant Aggregate).
Class G – Definition in ITM 203, Section 3.9

Initial Classification is by:

Standard Quality testing:

Coarse Agg - F/T Loss, LA Abrasion, deleterious content,
and absorption



Initial Classification is by:

Standard Quality testing:

Coarse Agg - F/T Loss, LA Abrasion, deleterious content,
and absorption

or

Fine Agg - F/T Loss, organic impurities, and absorption

Natural sand, ACBF slag sand, and GBF slag sand subject to acid-insoluble test.



Further classification is:

Characteristic to the product:

Assuming passing standard quality results,

2's, 53's and 73's are always assigned Class D;

#93 Pea Gravel and RipRap are always assigned Class F

Often not tested directly; assigned off equal or better results from either other aggregates or the Ledge Letter.

Class G Ledge rock mixed with other Ledge rock



Special classification is by:
 Special test or field trial: Dolomite test, AP test,
 placement of a PRA test strip, etc.

Table 904.03 (a)

| Characteristic Classes | AP | AS | A | B | C | D | E | F |
|---|------|------|------|------|--------------|------|------|------|
| Quality Requirements: | | | | | | | | |
| Freeze and Thaw Beam Expansion, % max. (Note 1) .. | .060 | | | | | | | |
| Los Angeles Abrasion, % max. (Note 2) | 40.0 | 30.0 | 40.0 | 40.0 | 45.0 | 45.0 | 50.0 | |
| Freeze and Thaw, AASHTO T 103, Procedure A, % max. (Note 3) | 12.0 | 12.0 | 12.0 | 12.0 | 16.0 | 16.0 | 20.0 | 25.0 |
| Sodium Sulfate Soundness, % max. (Note 3) | 12.0 | 12.0 | 12.0 | 12.0 | 16.0 | 16.0 | 20.0 | 25.0 |
| Brine Freeze and Thaw Soundness, % max. (Note 3) .. | 30 | 30 | 30 | 30 | 40 | 40 | 50 | 60 |
| Absorption, % max. (Note 4) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | | | |
| Additional Requirements: | | | | | | | | |
| Deleterious, % max. | | | | | | | | |
| Clay Lumps and Friable Particles | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 4.0 | | |
| Non-Durable (Note 5) | 4.0 | 2.0 | 4.0 | 4.0 | 6.0 | 8.0 | | |
| Coke | | | | | (See Note 6) | | | |
| Iron | | | | | (See Note 6) | | | |
| Chert (Note 7) | 3.0 | 3.0 | 3.0 | 5.0 | 8.0 | 10.0 | | |
| Weight per Cubic Foot for Slag, lb. min. | 75.0 | | 75.0 | 75.0 | 70.0 | 70.0 | 70.0 | |
| Crushed Particles, % min. (Note 8) | | | | | | | | |
| Compacted Aggregates | | | 20.0 | 20.0 | 20.0 | 20.0 | | |
| Notes: | | | | | | | | |
| 1. Freeze and thaw beam expansion shall be tested and re-tested in accordance with ITM 210. | | | | | | | | |
| 2. Los Angeles abrasion requirements shall not apply to BF. | | | | | | | | |

Class AP

Determined by testing coarse aggregate according to ITM 210

Typically #8 or QA equivalent (AASHTO #57?)

Mix 3 or 5 standardized concrete beams, typically 3

Subject beams to 350 cycles of F/T

Measure the horizontal beam expansion periodically

Class AP

Maximum particle size of 1-1/2 inch.

| Sieve Size | Percent Passing |
|------------|-----------------|
| 1-1/2 in. | 100 |
| 1 in. | 95 |
| 3/4 in. | 70 |
| 1/2 in. | 45 |
| 3/8 in. | 20 |
| No. 4 | 0 |

Maximum particle size of 1 inch.

| Sieve Size | Percent Passing |
|------------|-----------------|
| 1 in. | 100 |
| 3/4 in. | 95 |
| 1/2 in. | 55 |
| 3/8 in. | 35 |
| No. 4 | 0 |

Class AP Aggregate Use

Permitted in all INDOT concrete, but especially:
Concrete pavement
Slab-on-grade concrete



501 QC/QA Portland Cement Concrete Pavement

MATERIALS

501.03 Materials

Materials shall be in accordance with the following:

| | |
|---|-----------------|
| Admixtures | 912.03 |
| Concrete Coarse Aggregate, Class AP | 904.03, ITM 226 |
| Fine Aggregate, Size No. 23 | 904.02 |
| Fly Ash | 901.02 |
| Liquid Membrane Forming Compound | 912.01(e) |
| Portland Cement | 901.01(b)* |
| Rapid Setting Patch Materials | 901.07 |
| Silica Fume | 901.04 |



702 Structural Concrete

MATERIALS

702.03 Materials

Materials shall be in accordance with the following:

| | |
|--|--------------|
| Admixtures for Use in Concrete..... | 912.03 |
| Castings | 910.05 |
| Concrete Coarse Aggregate: | |
| for exposed concrete, Class A or Higher | 904, ITM 226 |
| for non-exposed concrete, Class B or Higher..... | 904, ITM 226 |
| Curing Materials..... | 912.01 |
| Elastomeric Bearings | 915.04 |

#91 coarse aggregate

Class A or higher, used in a variety of precast concrete items:

Section 615 – monuments, markers, and parking barriers (#8 or #91)

Section 707 – concrete structural members (#91 only)

Section 714 – reinforced concrete box structures (#91 only)

Section 723 – reinforced concrete 3-sided structures (#91 only)

Section 731 – concrete MSE wall elements (#8 and #91)

Section 732 – modular concrete block retaining wall (blocks, #91 only)

Section 735 – temporary wire-faced MSE wall (lower panels, #8 or #91)

Class AS

Steel Furnace slag, sandstone, crushed dolomite, or PRA

LA Abrasion less than 30.0%

Non-durable deleterious less than 2.0%

Limited to Sizes 9, 11, 12 and QA equivalents

Does the material otherwise meet Class A specs?

If yes, proceed with Micro-Deval Abrasion testing following ITM 220



Class AS Use

Micro-Deval Abrasion testing should yield a loss of 18.0% or less.

Official results on Class AS Aggregates QPL and CAPP source Sum Qual Letter.

Use the aggregate in Stone Matrix Asphalt (SMA) with a suitable design and submit the design on the asphalt DMF form.

Mix designs are approved or disapproved by the District Materials Engineer (DME).



410 QC/QA HMA – SMA Pavement

MATERIALS

410.03 Materials

Materials shall be in accordance with the following:

Asphalt Materials

| | |
|--|--------------|
| PG Binder, PG 76-22, PG 70-22 | 902.01(a) |
| Coarse Aggregates, Class AS | 904.03 |
| Fine Aggregates (sand, mineral filler) | 904.02 |
| Stabilizing Additives | AASHTO M 325 |



HMA mixes require different quality
classifications for different applications

401 QC/QA HMA Pavement

MATERIALS

401.03 Materials

Materials shall be in accordance with the following:

Asphalt Materials

| | |
|---|--------------|
| PG Binder | 902.01(a) |
| Coarse Aggregates | 904.03 |
| Base Mixtures – Class D or Higher | |
| Intermediate Mixtures – Class C or Higher | |
| Surface Mixtures* – Class B or Higher | |
| Fine Aggregates | 904.02 |
| Stabilizing Additives | AASHTO M 325 |

* Surface aggregate requirements are listed in 904.03(d).



What is Dolomite?

- For INDOT purposes it is a crushed stone that is tested in accordance with ITM 205 and contains at least 10.3% elemental magnesium.
- Chemically it is calcium magnesium carbonate vs limestone which is simply calcium carbonate.
- Why is this important?
- Characteristically polish resistant.
- INDOT maintains Dolomite Aggregates QPL which lists all CAPP-approved sources and their relevant ledge combinations.



What is Polish Resistant Aggregate (PRA)?

An aggregate used in surface mix HMA and specified for use under certain traffic ESAL loading conditions.

Two test methods - ITM 214 and ITM 221

ITM 214 is a two part test



What is Polish Resistant Aggregate (PRA)?

Aggregates that pass ITM 214 are classed as PRA and can be used in ESAL Cat 2 or Cat 3 traffic conditions.

PRA can be further tested under ITM 221.

ITM 221 is a two part test.

Aggregates that pass ITM 221 are still classed as PRA, but can be used in ESAL Cat 4 traffic conditions.



What is Polish Resistant Aggregate (PRA)?

What aggregates can be tested?

- Dolomite less than 10.3% elemental Mg,
- crushed limestone, or
- gravel.

Generally assigned to sizes 9, 11, 12 and QA equivalents, plus manufactured sand.

INDOT maintains PRA Aggregates QPL which lists all CAPP-approved sources, the relevant ledge combinations (if applicable), and the ESAL Category of HMA that the aggregate can be used in.



#93 PG (#93 Pea Gravel)

Use: Impact attenuator barrels (Section 601) and MSE wall pile sleeves.

Special Requirements:

Meet the specified decant and gradation range

Crush count LESS than 20% in accordance with ASTM D5821.



Dense Grade Coarse Aggregate

53's and 73's

Characteristically capped at Class D

Used as Base or Subbase for HMA and Concrete;

As the entire pavement structure (i.e. gravel roads);

For roadway shoulders and berms



Seal Coat Aggregates

SC 11, SC 12, and SC 16

May be Class A or Class B

Decant capped at 1.5%

Flakiness Index maximum of 25% in accordance with ITM 224

For crushed gravel, must be 85% single-face crushed and 80% two-faced crushed minimum.



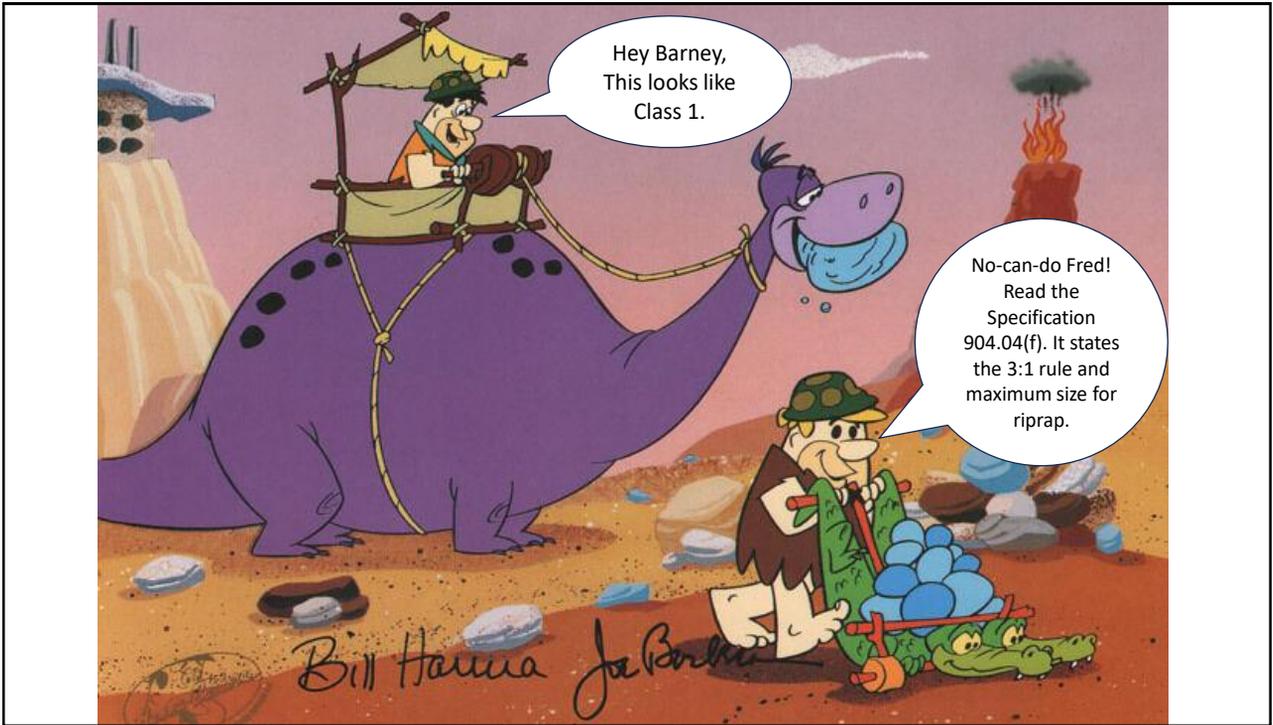
RipRap

Characteristically restricted to Class F; not directly quality tested.

Visual Inspection Requirements:

- Maximum size
- 3:1 rule (dimensional ratio)
- general gradation and consistency





904.04 (f)

RipRap

(f) Sizes of Riprap

| GRADATION REQUIREMENTS | | | | | |
|------------------------|-----------|----------|----------|-----------|-----------|
| Percent Smaller | | | | | |
| Size, in. | Revetment | Class 1 | Class 2 | Uniform A | Uniform B |
| 30 | | | 100 | | |
| 24 | | 100 | 85 - 100 | | |
| 18 | 100 | 85 - 100 | 60 - 80 | | |
| 12 | 90 - 100 | 35 - 50 | 20 - 40 | | |
| 8 | | | | 100 | |
| 6 | 20 - 40 | 10 - 30 | 0 - 20 | 35 - 80 | 95 - 100 |
| 3 | 0 - 10 | 0 - 10 | 0 - 10 | | 35 - 80 |
| 1 | | | | 0 - 20 | 0 - 20 |
| Depth of Riprap, min. | 18 in. | 24 in. | 30 in. | | |

The maximum dimension of individual pieces shall not be greater than three times the minimum dimension and no dimension shall exceed the maximum size listed for the respective size of riprap. The riprap will be visually inspected for size, shape, and consistency.

904.05 and 211.03.1

Structure Backfill

Five Types total, three allow aggregates to be used (Type 1, 2, and 3).

Type 1 – in accordance with 904.05

Type 2 – crushed stone or ACBF slag in accordance with 904.05
– specifically prohibits No. 30, No. 4, and 2-inch SB sizes

Type 3 – 1-inch or ½-inch SB

- Coarse Agg. #5, 8, 9, 11, 12, or AASHTO #57, plus (904.05)
- If ACBF slag, only #5, 8, or AASHTO #57 allowed
- Type A certification required

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904.05

904.05 Structure Backfill

The material shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter. It shall consist of suitable sand, gravel, crushed stone, ACBF, or GBF. Structure backfill shall be in accordance with one of the gradations shown in the table below, or coarse aggregate No. 5, No. 8, No. 9, No. 11, No. 12, No. 53, or No. 73 in accordance with the gradation requirements of 904.03(e). Coarse aggregate No. 5, No. 8, No. 9, No. 11, No. 12, No. 53, No. 73, or AASHTO No. 57 shall be crushed stone or ACBF, class D or higher.

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904.05

Structure Backfill Gradations:

| Sieve Sizes | Nominal Sizes and % Passing | | | | | |
|---------------------|-----------------------------|-----------|----------|----------|----------|----------|
| | 2 in. | 1 1/2 in. | 1 in. | 1/2 in. | No. 4 | No. 30 |
| 2 1/2 in. (63 mm) | 100 | | | | | |
| 2 in. (50 mm) | 90 - 100 | 100 | | | | |
| 1 1/2 in. (37.5 mm) | 70 - 100 | 90 - 100 | 100 | 100 | | |
| 1 in. (25.0 mm) | 55 - 95 | 70 - 100 | 85 - 100 | | | |
| 3/4 in. (19.0 mm) | 45 - 90 | 55 - 95 | 70 - 100 | | | |
| 1/2 in. (12.5 mm) | 35 - 85 | 40 - 90 | 55 - 95 | 85 - 100 | 100 | 100 |
| No. 4 (4.75 mm) | 20 - 65 | 20 - 70 | 25 - 75 | 45 - 85 | 90 - 100 | |
| No. 8 (2.36 mm) | 10 - 50 | 10 - 55 | 15 - 60 | 25 - 75 | 75 - 100 | |
| No. 30 (600 µm) | 3 - 35 | 3 - 35 | 3 - 35 | 5 - 45 | 15 - 70 | 70 - 100 |
| No. 200 (75 µm) | 0 - 8 | 0 - 8 | 0 - 8 | 0 - 8 | 0 - 8 | 0 - 8 |



904.05 and 211.03.1

Structure Backfill

Type 1:

If following Structure Backfill gradations:

Sizes: Any of the six listed Structure Backfill gradations

Materials: sand, gravel, crushed stone, ACBF, or GBF

If following Coarse Agg. gradations:

Sizes: #5, 8, 9, 11, 12, 53, 73, or AASHTO #57

Materials: crushed stone or ACBF, Class D or higher



904.05 and 211.03.1

Structure Backfill

Type 2:

If following Structure Backfill gradations:

Sizes: 1 ½-inch, 1-inch, or ½-inch Structure Backfill gradations

Materials: crushed stone or ACBF slag

If following Coarse Agg. gradations:

Sizes: #5, 8, 9, 11, 12, 53, 73, or AASHTO #57

Materials: crushed stone or ACBF, Class D or higher



904.05 and 211.03.1

Structure Backfill

Type 3:

If following Structure Backfill gradations:

Sizes: 1-inch or ½-inch Structure Backfill gradations only

Materials: sand, gravel, crushed stone, ACBF, or GBF

If following Coarse Agg. gradations:

Crushed stone, Class D or higher, #5, 8, 9, 11, 12, or AASHTO #57

ACBF, Class D or higher, #5, 8, or AASHTO #57



211.03.1

Structure Backfill

Type A certification for Type 3 Structure Backfill:

- Testing performed by 3rd party lab
- results should be documented on the Type A certification form and submitted to INDOT



211.03.1

Type A tests:

The results of the following shall be shown on the certification.

| Property | Criteria | Test Method |
|---|----------------------|--------------|
| pH (Note 1) | $5 < \text{pH} < 10$ | AASHTO T 289 |
| Organic Content (Note 2) | 1% max. | AASHTO T 267 |
| Permeability, min. (Note 3) | 30 ft/day | AASHTO T 215 |
| <u>Notes:</u> | | |
| 1. One pH test is required for each bench of stone, each source of air-cooled blast furnace slag, and each source of gravel. | | |
| 2. One organic content test is required for each source of gravel. | | |
| 3. One permeability test is required for the smallest aggregate size from each source. Sizes No. 5, No. 8, No. 9, and AASHTO No. 57 do not require a permeability test. | | |

The gradation shall be performed on the material used in the permeability test. Testing for permeability shall be performed on the sample of the material compacted to 95% in accordance with AASHTO T 99, Method C or D. All of the tests listed above shall be performed a minimum of once every 12 months per source.



211.03.1

Further Type A tests:

In addition to the criteria above, structure backfill for retaining wall systems containing metal components in contact with structure backfill shall also be in accordance with the following criteria:

| Property | Criteria | Test Method |
|--|--------------------|-------------------------|
| Chlorides | < 100 ppm | AASHTO T 291 |
| Sulfates | < 200 ppm | AASHTO T 290 |
| Resistivity, min. | 3,000 Ω -cm | AASHTO T 288 |
| Internal friction angle, ϕ , min. | 34° | AASHTO T 236* or T 297* |

* under consolidated drained conditions

If the minimum resistivity exceeds 5,000 Ω -cm, the requirement for the testing of chlorides and sulfates will be waived. The resistivity shall be tested at 100% saturation. All of the tests listed above shall be run a minimum of once every 12 months per




ENDINGS

Not everything can end well.