

SS-A-281b

JULY 8, 1954

SUPERSEDING

Fed. Spec. SS-A-281a

12 November 1941

FEDERAL SPECIFICATION**AGGREGATE; (FOR) PORTLAND-CEMENT-CONCRETE**

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope.—This specification covers aggregate for use in concrete (other than light-weight concrete). (See 6.1.)

1.2 Classification.

1.2.1 Classes.—Aggregates shall be of the following classes, as specified:

Class 1.—Fine aggregate.

Class 2.—Coarse aggregate.

1.2.2 Sizes.—Fine aggregate shall be of the size-grading indicated in 3.1.2.1. Coarse aggregate shall be of the sizes shown in table I, as specified (see 3.2.2).

2. APPLICABLE SPECIFICATIONS

2.1 The following Federal Specification, of the issue in effect on date of invitation for bids, forms a part of this specification:

SS-R-406—Road and Paving Materials;
Methods of Sampling and Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications and Standards as outlined under "General Information" in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the GSA Regional Offices in Boston, New York, Atlanta, Chicago,

Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.

(Federal Government activities may obtain copies of Federal Specifications and Standards and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

2.2 Specifications and publications applicable only to individual departments are listed in section 7.

3. REQUIREMENTS**3.1 Fine aggregate.**

3.1.1 General characteristics.—Fine aggregate shall consist of natural sand, manufactured sand, or a combination thereof. (See 6.4.)

3.1.2 Sieve analysis.

3.1.2.1 Fine aggregate, except as provided in 3.1.2.2, shall be graded within the following limits:

Total passing	Percent by weight
¾-inch sieve.....	100
No. 4 sieve.....	95-100
No. 8 sieve.....	80-100
No. 16 sieve.....	50- 85
No. 30 sieve.....	25- 60
No. 50 sieve.....	10- 30
No. 100 sieve.....	2- 10

3.1.2.2 As applied to natural sands, the minimum percentages shown above for material passing the No. 50 and No. 100 sieves may be reduced to 5 and 0, respec-

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tively, if the aggregate is to be used in air-entrained concrete containing more than 4.5 bags of cement per cubic yard, or in non-air-entrained concrete containing more than 5.5 bags of cement per cubic yard, or if an approved mineral admixture is used to supply the deficiency in the material passing these sieves. (Air-entrained concrete is here considered to be concrete containing air-entraining cement or an air-entraining agent and having an air content of more than 3.0 percent.)

3.1.2.3 The fine aggregate shall not have more than 45 percent retained between any two consecutive sieves of those shown in 3.1.2.1, and its fineness modulus shall be not less than 2.3 nor more than 3.1.

3.1.2.4 If the fineness modulus varies by more than 0.20 from the value assumed in selecting proportions for the concrete, the fine aggregate shall be rejected unless suitable adjustments are made in the proportions of the concrete to compensate for the difference in grading.

3.1.3 *Deleterious substances.*—The amount of deleterious substances in fine aggregate, each determined independently on samples complying with the grading requirements given in 3.1.2.1, shall not exceed the limits given below:

Item	Maximum percent by weight
Clay lumps -----	1.0
Material finer than No. 200 sieve:	
(a) Concrete subject to surface abrasion -----	3.0 ¹
(b) Other concrete -----	5.0 ¹
Saturated surface-dry material, coarser than No. 50 sieve, floating on liquid having a specific gravity of 2.0 -----	0.5 ²

¹ If the material finer than the No. 200 sieve in manufactured sand consists of the dust of fracture and is essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

² Does not apply to manufactured sand prepared from blast-furnace slag.

3.1.4 *Organic impurities.*

3.1.4.1 Fine aggregate shall be free from injurious amounts of organic impurities. Except as herein provided, aggregates subjected to the test for organic impurities and producing a color darker than the standard shall be rejected.

3.1.4.2 Fine aggregate failing in the test may be used provided that the discoloration is due principally to the presence of coal, lignite, or similar discrete particles.

3.1.4.3 Fine aggregate failing in the test may be used provided that, when tested for mortar-making properties, the mortar develops a compressive strength at 7 and 28 days of not less than 90 percent of that developed by a similar mortar made from another portion of the same fine aggregate which has been washed in a 3 percent solution of sodium hydroxide followed by thorough rinsing in water. The treatment with sodium hydroxide shall reduce the organic-matter content of the fine aggregate to such an extent that the washed sand when tested for organic-matter content shall show a color lighter than standard.

3.1.5 *Reaction with alkali in cement.* Fine aggregate for use in concrete which will be subjected to adverse conditions with respect to moisture content (see 6.2) shall be free from material which could react harmfully with alkalis in the cement. If such materials are present in injurious amounts, the fine aggregate shall be rejected unless used with such a cement that mortar or concrete is prepared which will not develop undue expansion caused by the alkali-aggregate reaction, or be used with the addition of a material which has been shown to inhibit the expansion caused by this reaction. (See 6.3.)

3.1.6 *Soundness.*

3.1.6.1 Except as provided herein, fine aggregate subjected to 5 cycles of the sound-

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ness test, shall show a loss, weighed in accordance with the grading of a sample complying with the limitations given in 3.1.2.1, not greater than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

3.1.6.2 *Fine aggregate failing to meet the requirements given in 3.1.6.1 may be accepted provided that concrete of a composition comparable to that proposed, and made with similar aggregate from the same source, can be shown to have given satisfactory service when exposed to weathering similar to that to be encountered.*

3.1.6.3 *Fine aggregate not having a demonstrable service record and failing to meet the requirements of 3.1.6.1 may be accepted provided concrete prepared with*

this aggregate, and tested by freezing and thawing shows results satisfactory to the Engineer in contrast with comparable concrete prepared with fine aggregate of satisfactory quality, and tested at the same time under the same conditions.

3.2 Coarse aggregate.

3.2.1 *General characteristics.* — Coarse aggregate shall consist of crushed stone, crushed or uncrushed gravel, or air-cooled iron-blast-furnace slag, or combinations thereof, conforming to the requirements of these specifications.

3.2.2 *Size-grading.* — Coarse aggregate shall be graded between the limits shown in table I for sizes, as specified.

TABLE I.—Size-grading requirements for coarse aggregate

Size number	Nominal size ¹	Amounts passing each laboratory sieve (square openings ¹), percentage by weight											
		4	3½	3	2½	2	1½	1	¾	½	⅜	No. 4	No. 8
1	3½ to 1½	100	90-100	----	25- 60	-----	0- 15	-----	0- 5	-----	-----	-----	-----
2	2½ to 1½	----	-----	100	90-100	35- 70	0- 15	-----	0- 5	-----	-----	-----	-----
3	2 to 1	----	-----	----	100	95-100	35- 70	0- 15	-----	0- 5	-----	-----	-----
357	2 to No. 4	----	-----	----	100	95-100	-----	35- 70	-----	10- 30	-----	0-5	-----
4	1½ to ¾	----	-----	----	-----	100	90-100	20- 55	0- 15	-----	0- 5	-----	-----
467	1½ to No. 4	----	-----	----	-----	100	95-100	-----	35- 70	-----	10-30	0-5	-----
57	1 to No. 4	----	-----	----	-----	-----	100	95-100	-----	25- 60	-----	0-10	0-5
67	¾ to No. 4	----	-----	----	-----	-----	-----	100	90-100	-----	20-55	0-10	0-5
7	½ to No. 4	----	-----	----	-----	-----	-----	-----	100	90-100	40-70	0-15	0-5

¹ In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.

3.2.3 Deleterious substances.—The amount of deleterious substances in coarse aggregate, each determined on independent samples complying with the designated grading requirements of 3.2.2, shall not exceed the limits given below:

Item	Maximum percent by weight
Clay lumps -----	0.25
Soft particles -----	5.0
Material finer than No. 200 sieve -----	1.0 ¹
Saturated surface-dry material floating on liquid having specific gravity of 2.0.	1.0 ²

¹ If the material finer than the No. 200 sieve in crushed aggregate consists of the dust of fracture and is essentially free from clay or shale, this limit may be increased to 1.5 percent.

² This requirement does not apply to blast-furnace slag.

3.2.4 Reaction with alkali in cement.—Coarse aggregate for use in concrete which will be subjected to adverse conditions with respect to moisture content (see 6.2) shall be free from material which could react harmfully with alkalis in the cement. If such materials are present in injurious amounts, the coarse aggregate shall be rejected unless used with such a cement that mortar or concrete is prepared which will not develop undue expansion caused by the alkali-aggregate reaction, or be used with the addition of a material which has been shown to inhibit the expansion caused by this reaction (see 6.3).

3.2.5 Weight of slag.—Blast-furnace slag conforming to the several size-gradings to be used in concrete shall have a compact weight of not less than 70 pounds per cubic foot.

3.2.6 Soundness.

3.2.6.1 Except as provided herein, coarse aggregate subjected to 5 cycles of the sound-

ness test, shall show a loss, weighed in accordance with the grading of a sample complying with designated limitations given in 3.2.2, not greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

3.2.6.2 Coarse aggregate failing to meet the requirements given in 3.2.6.1 may be accepted provided that concrete of a composition comparable to that proposed, and made with similar aggregate from the same source can be shown to have given satisfactory service when exposed to weathering similar to that to be encountered.

3.2.6.3 Coarse aggregate not having a demonstrable service record and failing to meet the requirements of 3.2.6.1 may be accepted provided concrete prepared with this aggregate, and tested by freezing and thawing, shows strength satisfactory to the Engineer in contrast with comparable concrete prepared with coarse aggregate of satisfactory quality, and tested at the same time under the same conditions.

3.2.7 Resistance to abrasion.

3.2.7.1 Except as provided in 3.2.7.2, coarse aggregate tested for abrasion by the applicable method in 4.1 shall have a loss of not more than 40 percent.

3.2.7.2 Coarse aggregate having an abrasive loss greater than 40 percent when tested as in 3.2.7.1 may be used, provided concrete prepared with the aggregate and having the same proportions as will be used in the proposed work develops a satisfactory strength.

4. SAMPLING AND TEST PROCEDURES

4.1 Sampling and testing shall be done in accordance with the following methods described in Federal Specification SS-R-406:

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Sampling and tests	Method No.
Sampling -----	101.0
Unit weight -----	201.0
Sieve analysis -----	202.0
Material finer than No. 200 sieve -----	202.1
Soundness -----	203.0
Fineness modulus -----	204.0
Clay lumps -----	205.0
Mortar-making properties -----	206.0
Abrasion (Los Angeles) -----	208.1
Soft pieces -----	228.0
Organic impurities -----	235.0
Compressive strength of concrete -----	229.0
Flexural strength of concrete -----	230.0
Lightweight constituents -----	236.0
Reactive aggregates -----	206.1
Rapid freezing and thawing in water -----	234.1
Rapid freezing in air and thawing in water -----	234.2
Slow freezing in air and thawing in water or brine -----	234.3
Slow freezing in air and thawing in water -----	234.0

5. PREPARATION FOR DELIVERY

5.1 Packing and marking. — These materials are usually shipped in bulk. Any special requirements will be included in the contract or order.

6. NOTES

6.1 Intended use. — This specification is regarded as adequate to insure satisfactory materials for most concrete. It is recognized that, for certain work or in certain regions, it may be less restrictive than needed.

6.2 Adverse moisture conditions. — Expansion due to the alkali-aggregate reaction appears to develop to the most marked extent only when the concrete is wetted frequently but intermittently as by rain- or

snow-fall, or is subjected to extended exposure to moist air, or is in contact with moist ground. Concrete which is continually saturated with water does not seem to be subject to the effects of this reaction.

6.3 Determination of alkali-reactive aggregates.—Aggregate producing excessive expansion when tested for potential alkali reactivity in accordance with method 206.1 of Federal Specification SS-R-406 contains injurious amounts of reactive materials. Aggregates which have shown harmful reactions in concrete generally have produced expansions of more than 0.05 percent at an age of six months or 0.10 percent at one year when tested with a cement containing alkalis in excess of 0.8 expressed as sodium oxide. However, aggregates which produce an expansion of more than 0.05 percent at six months but 0.10 percent or less at one year should not be expected to be harmful for general uses.

6.4 Slippery concrete. — Sand manufactured by the crushing of certain limestones produces slippery pavement surfaces. Sand of this type should be investigated for this characteristic prior to acceptance for any such susceptible use. (See 3.1.1.)

6.5 Bid samples.—If samples are required with bid, this requirement should be stated in the inquiry or invitation for bids, giving information as to the size or quantity of sample.

7. DEPARTMENTAL REQUIREMENTS

Interested Activities:

ARMY: CE
NAVY: MC CG Y
AIR FORCE

Copies of this specification may be purchased for 5 cents.