



Designation: **D 693 – 03a**

## Standard Specification for Crushed Aggregate for Macadam Pavements<sup>1</sup>

This standard is issued under the fixed designation D 693; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope

1.1 This specification covers crushed aggregate suitable for use in the construction of dry- or water-bound macadam base courses and bituminous penetration macadam base and surface courses of pavements.

1.2 The values stated in SI units are to be regarded as standard. The inch-pound units, shown in parentheses, are for information only.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

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<sup>1</sup> This method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.50 on Aggregate Specifications.

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## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C 29/C 29M Test Method for Bulk Density (Unit Weight) and Voids in Aggregate
- C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C 535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- D 75 Practice for Sampling Aggregates
- D 448 Classification for Sizes of Aggregate for Road and Bridge Construction
- D 3665 Practice for Random Sampling of Construction Materials
- D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D 4791 Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- D 5821 Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

## 3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

- 3.1.1 Name of material (Crushed Aggregate for Macadam Construction),
- 3.1.2 ASTM designation (D 693 and year of issue),
- 3.1.3 Grading (Size Number) to be furnished (see 5.7 and Note 2),<sup>3</sup>
- 3.1.4 Whether to be used in base course or surface course (see 5.1),
- 3.1.5 Whether for dry- or water-bound construction, or bituminous construction (see 5.4),
- 3.1.6 Quantity required, and
- 3.1.7 Special requirements.

## 4. General Characteristics

4.1 *Crushed Stone or Crushed Gravel*—The crushed stone or crushed gravel shall consist of reasonably clean, tough, durable fragments.

4.2 *Crushed Slag*—The crushed slag shall be air-cooled blast-furnace slag and shall consist of fragments reasonably clean, tough, durable, and consistent in density and quality.

4.3 *Choking Material for Dry- or Water-bound Macadam Base Courses*—The choking material shall consist of natural sand or the fine product resulting from crushing coarse aggregate.

## 5. Physical Requirements

5.1 *Degradation*—The aggregates (with the exception of ~~C~~ crushed-S blast-furnace slag), when subjected to degradation testing, shall have a loss not greater than 40 % when used for surface courses or 50 % when used for base courses.

NOTE 1—For some materials the LA Abrasion loss may not be indicative of the performance of the aggregate. In these instances the purchaser, prior to determining the following requirements:

	Base courses	Surface courses
Loss, Los Angeles Machine, max., %	50	40

suitability of the aggregate use, may consider the results of other tests, previous experience, and/or past performance of that aggregate in similar applications.

5.2 *Bulk Density of Slag*—Air-cooled blast-furnace slag coarse aggregate, when tested in size No. 57 or No. 8, shall have a rodded bulk density not less than 1120 kg/m<sup>3</sup> (70 lb/ft<sup>3</sup>).

5.3 *Crushed Pieces in Gravel*—For crushed gravel, the portion of particles retained on the 4.75 mm (No. 4) sieve; shall have no less than 75 % two fractured faces; by mass of that portion.

NOTE 2—Some sources of gravel contain angular particles which will perform similarly to a mechanically crushed particle. Where laboratory tests or service records indicate this to be true, such angular particles may be considered as crushed.

5.4 *Soundness*—Coarse aggregate, for dry- or water-bound base courses, when subjected to five cycles of the soundness test, shall have a weighted loss of not more than 20 % when sodium sulfate is used or not more than 30 % when magnesium sulfate is used.

5.5 *Liquid Limit and Plasticity Index*—The fraction of the size No. 10 choking material (for dry- and water-bound courses) passing the 425 μm- (No. 40-) sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards*, Vol 04.02, volume information, refer to the standard's Document Summary page on the ASTM website.

5.6 *Flat and Elongated Particles*—The portion retained on the 9.5-mm (3/8-in.) sieve shall not contain more than 15 %, by mass, of particles so flat and elongated that the ratio between the maximum (length) and the minimum (thickness) dimensions exceeds 5:1.

5.7 *Gradation*—The aggregate gradation shall be within the limits specified for the appropriate size in accordance with Specification D 448.

NOTE 23—See Appendix X1 for guidance in selecting aggregate sizes.

## 6. Methods of Sampling and Testing

6.1 Sample the aggregates and determine the properties in accordance with the following:

6.1.1 *Sampling*—Practice D 75.

6.1.2 *Degradation*— Test Method C 131 or Test Method C 535.

6.1.3 *Bulk Density*— Test Method C 29/C 29M.

6.1.4 *Sieve Analysis*— Method C 136.

6.1.5 *Soundness*—Test Method C 88.

6.1.6 *Liquid Limit and Plasticity Index*—Test Method D 4318.

6.1.7 *Flat and Elongated Particles* —Test Method D 4791.

6.1.8 *Random Sampling*— Practice D 3665.

6.1.9 *Fractured Particles*—Test Method D 5821.

## 7. Inspection

7.1 Inspection of materials shall be agreed upon between the purchaser and the seller as part of the purchase contract.

7.2 This agreement shall provide clear definition of the size of a lot, place of sampling, and the number of samples to be obtained to determine the acceptability of this lot.

## 8. Keywords

8.1 aggregate; choke aggregate; coarse aggregate; crushed aggregate; macadam

# APPENDIX

## (Nonmandatory Information)

### X1. Guide for Selecting Aggregate Sizes

X1.1 Aggregate size numbers are selected from Specification D 448. An appropriate size should be selected for each use, depending on thickness of the base or the surface course, and on other local construction and service conditions.

X1.2 For dry- or water-bound macadam base course, the following combinations of size numbers are suggested:

Size No. of Coarse Aggregate	Size No. of Choke Aggregate
1, 2, or 3	10

X1.3 For penetration macadam courses, the size number of choke aggregate best suited for the work depends upon the size of surface voids in the penetration course and on the fluidity of the bituminous binder. The following combinations of size numbers are suggested:

Size No. of Penetration Course Aggregate	Viscous Binders	Size No. of Choke Aggregate	Fluid Binders
4	5, 56, or 57	67 or 68	67 or 68
2	5, 56, 57 or 6	67, 68 or 78	67, 68 or 78
3	57, 6 or 7	68, 78 or 8	68, 78 or 8
1	5, 56, or 57	67 or 68	67 or 68
2	5, 56, 57, or 6	67, 68, or 78	67, 68, or 78
3	57, 6, or 7	68, 78, or 8	68, 78, or 8

X1.4 The size of surface course aggregate depends upon the type of surface desired. The following sizes have been commonly used: 7, 78, 8<sub>2</sub> and 9.

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