



Designation: D 2940 – 98

## Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports<sup>1</sup>

This standard is issued under the fixed designation D 2940; 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 quality-controlled graded aggregates that, when hauled to and properly spread and compacted on a prepared grade to appropriate density standards, may be expected to provide adequate stability and load support for use as highway or airport bases or subbases.

NOTE 1—The engineer is cautioned to provide appropriate construction specifications to ensure compaction to an extent that further densification from traffic loadings on the completed pavement will be insignificant. The method suggested is to require compaction on a firm foundation of a short control strip of the material at a suitable moisture content, by means of vibratory or other proven effective rollers or tampers, until no further increase in density results. Compaction requirements should ensure that an average density of certain appropriate percentages of the control strip maximum density be achieved on the balance of the job; for base courses, 98% is suggested as the minimum average requirement.

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

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates<sup>2</sup>
- C 702 Practice for Reducing Field Samples of Aggregate to Testing Size<sup>2</sup>
- D 75 Practice for Sampling Aggregates<sup>3</sup>
- D 422 Test Method for Particle-Size Analysis of Soils<sup>4</sup>
- D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate<sup>3</sup>
- D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils<sup>4</sup>
- D 4792 Test Method for Potential Expansion of Aggregates from Hydration Reactions<sup>3</sup>

E 11 Specification for Wire-Cloth Sieves for Testing Purposes<sup>5</sup>

E 105 Practice for Probability Sampling of Materials<sup>5</sup>

E 122 Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process<sup>5</sup>

### 3. General Requirements

3.1 Coarse aggregate retained on the 4.75-mm (No. 4) sieve shall consist of durable particles of crushed stone, gravel, or slag capable of withstanding the effects of handling, spreading, and compacting without degradation productive of deleterious fines. Of the particles which are retained on a 9.5-mm ( $\frac{3}{8}$ -in.) sieve, at least 75% shall have two or more fractured faces.

NOTE 2—No standard ASTM method is recognized to be capable of measuring the quality, or tendency of coarse aggregate to degrade to the extent that deleterious fines may be produced. Some local jurisdictions have developed tests believed to be of value in this respect. The purchaser of material under this specification is advised to investigate the availability and reliability of such tests in order to specify quality requirements appropriate to his local area.

3.1.1 The fractured particle requirement of 3.1 is modified when specified in the contract documents, providing for the use of another method for measuring interparticle friction which has been correlated with good field performance.

3.2 Fine aggregate passing the 4.75-mm (No. 4) sieve shall normally consist of fines from the operation of crushing the coarse aggregate. Where available and suitable, addition of natural sand or finer mineral matter, or both, is not prohibited. The fraction of the final mixture that passes the 75- $\mu$ m (No. 200) sieve shall not exceed 60 % of the fraction passing the 600- $\mu$ m (No. 30) sieve. The fraction passing the 425- $\mu$ m (No. 40) sieve shall have a liquid limit no greater than 25 and shall have a plasticity index no greater than 4. The sand equivalent value of the fine aggregate shall be no lower than 35.

3.2.1 For material to be used as a subbase at a greater depth than probable frost penetration, the plasticity index and sand equivalent requirements are modified to a maximum of 6 and a minimum of 30, respectively.

3.3 The gradation of the final composite mixture shall conform to an approved job mix formula, within the design

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<sup>2</sup> Annual Book of ASTM Standards, Vol 04.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.03.

<sup>4</sup> Annual Book of ASTM Standards, Vol 04.08.

<sup>5</sup> Annual Book of ASTM Standards, Vol 14.02.

range prescribed by Table 1, subject to the appropriate tolerances, and to the acceptance criteria described in Section 4. The job mix formula shall be established prior to the beginning of the work and shall not be changed without the approval of the engineer or his authorized representative.

NOTE 3—The job mix formula should be selected with due consideration to the footnotes appended to Table 1. In general a plotted graph of the fine aggregate portion should be reasonably parallel to a plot of the nearest grading limit of the design range.

3.4 Aggregates that contain components subject to hydration, such as steel slags, shall be obtained from sources approved by the engineer on the basis of either a satisfactory performance record, or of aging or other treatment known to reduce potential expansion to a satisfactory level, or of expansion values not greater than 0.50 % at seven days when tested in accordance with Test Method D 4792.

#### 4. Sampling

4.1 Sample each unit, or batch selected, to be tested for compliance with the above requirements in accordance with

Practice D 75. A batch shall be defined as the amount of material required to fill at least one normal sized haul truck.

4.2 Base acceptance decisions upon average results obtained on samples from at least three units or batches picked at random from each lot. A lot shall be defined as not more than 3000 metric tons (approximately 3300 tons) or a full day's production for delivery to a given project.

4.3 In the case of grading, test each sample separately. Average values of all sieve size determinations for a given lot shall comply with the job mix formula within the permissible tolerances shown. Results of individual batch determinations shall conform to the job mix formula with the tolerances of Table 1, and an additional tolerance of 2 percentage points for all sizes other than 75- $\mu$ m (No. 200) sieve; noncompliance shall necessitate that the entire lot be resampled or rejected.

4.4 In case of requirements other than grading, the sampling frequency and lot size shall be designated by the specifying agency. Make at least three determinations to represent a lot. Base acceptance or rejection on the average of all determinations for a lot.

#### 5. Test Methods

5.1 Sample the material and determine the properties enumerated in this specification in accordance with the following methods:

5.1.1 *Sampling*—Practice D 75.

NOTE 4—Attention is also called to Practices E 105 and E 122.

5.1.2 *Grain-Size Analysis (Dry Sieving)*—Method C 136.

5.1.3 *Grain-Size Analysis (Wet Sieving and Determination of Subsieve Size Fractions, by Hydrometer Analysis)*—Test Method D 422.

5.1.4 *Liquid Limit*—Test Method D 4318.

5.1.5 *Plastic Limit and Plasticity Index*—Test Method D 4318.

5.1.6 *Sand Equivalent Value*—Test Method D 2419.

5.1.7 *Expansion*—Test Method D 4792 when required for source approval.

#### 6. Keywords

6.1 aggregate; base course; subbase; coarse aggregate; fine aggregate

**TABLE 1 Grading Requirements for Final Mixtures**

Sieve Size (Square Openings)	Design Range <sup>A</sup> (Mass Percentages Passing)		Job Mix Tolerances (Mass Percentages Passing)	
	Bases	Sub-bases	Bases	Sub-bases
50 mm (2 in.)	100	100	-2	-3
37.5 mm (1½ in.)	95 to 100	90 to 100	±5	+ 5
19.0 mm (¾ in.)	70 to 92	...	±8	...
9.5 mm (¾ in.)	50 to 70	...	±8	...
4.75 mm (No. 4)	35 to 55	30 to 60	±8	±10
600 $\mu$ m (No. 30)	12 to 25	...	±5	...
75 $\mu$ m (No. 200)	0 to 8 <sup>B</sup>	0 to 12 <sup>B</sup>	±3	±5

<sup>A</sup> Select the Job Mix Formula with due regard to availability of materials and service requirements of project. Test results outside the design range are not prohibited, provided they are within the job mix tolerances.

<sup>B</sup> Determine by wet sieving. Where local environmental conditions (temperature and availability of free moisture) indicate that in order to prevent damage by frost action it is necessary to have lower percentages passing the 75- $\mu$ m (No. 200) sieve than permitted in Table 1, appropriate lower percentages shall be specified. When specified, the material having a diameter smaller than  $\mu$ m shall not exceed 3 mass %.

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