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# Standard Practice for Quantities of Materials for Bituminous Surface Treatments[1]

This standard is issued under the fixed designation D1369; 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 (ε) 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 practice covers the rates of application of bituminous materials and aggregates and types and grades of bituminous materials for single and multiple bituminous surface treatments as applied to suitably prepared pavements or bases.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

C29/C29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
D448 Classification for Sizes of Aggregate for Road and Bridge Construction
D490 Specification for Road Tar
D633 Volume Correction Table for Road Tar
D946 Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
D977 Specification for Emulsified Asphalt
D1139 Specification for Aggregate for Single or Multiple Bituminous Surface Treatments
D1250 Guide for Use of the Petroleum Measurement Tables
D2027 Specification for Cutback Asphalt (Medium-Curing Type)
D2028 Specification for Cutback Asphalt (Rapid-Curing Type)
D2397 Specification for Cationic Emulsified Asphalt

## 3. Terminology

3.1 *Definitions:*

3.1.1 The types of surface treatments covered by this practice are as follows:

3.1.2 *multiple-surface treatment*—a wearing surface composed of bituminous material and aggregate, in which coarser aggregate is placed uniformly over an initial application of bituminous material and followed by one or more subsequent applications of bituminous material and smaller aggregate.

3.1.2.1 *Discussion*—Generally, the designated maximum size of the smaller aggregate is one half that of the aggregate used in the preceding application. Each application of aggregate is placed uniformly in a single layer, the thickness of which approximates the nominal maximum size of the aggregate.

3.1.3 *single-surface treatment*—a wearing surface of bituminous material and aggregate in which the aggregate is placed uniformly over the applied bituminous material in a single layer, the thickness of which approximates the nominal maximum size of the aggregate used.

## 4. Significance and Use

4.1 This practice is intended to be used as a guide by those involved in the design of bituminous surface treatments. It covers typical application rates for the various types of surface treatments and covers aggregate sizes and covers recommended grades of asphaltic material for both hot and cool weather conditions.

4.2 The typical bituminous material application rates given are for normal surfaces and non-porous aggregates. Provision is made for rate adjustment when other than normal surfaces or porous aggregates, or both, are involved.

## 5. Rates of Application

5.1 Typical quantities of materials for the several types of surface treatments are listed in Table 1 and Table 2.

5.2 The quantities of the various gradations are normally sufficient to provide a uniform cover over the area specified. The quantities of aggregate are shown by volume measurement in order to minimize the effect of variations due to specific gravity, particle shape, surface texture, and porosity. For job control, the quantity of aggregate by volume may be converted to a weight figure by determining the loose unit weight of the

[1] This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.24 on Bituminous Surface Treatments.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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**TABLE 1 Quantities of Materials for Bituminous Surface Treatments (U.S. Customary Units)**

NOTE 1—The values are typical design or target values and are not necessarily obtainable to the precision indicated.

| Surface Treatment | | Aggregate | | | Bituminous Material[A] |
|---|---|---|---|---|---|
| Type | Application | Size No.[B] | Nominal Size (Square Openings) | Typical Rate of Application, $ft^3/yd^2$ | Typical Rate of Application, $gal/yd^2$ |
| Single | initial | 5 | 1 in. to ½ in. | 0.50 | 0.42 |
| | | 6 | ¾ in. to ⅜ in. | 0.36 | 0.37 |
| | | 7 | ½ in. to No. 4 | 0.23 | 0.23 |
| | | 8 | ⅜ in. to No. 8 | 0.17 | 0.19 |
| | | 9 | No. 4 to No. 16 | 0.11 | 0.13 |
| Double | initial | 5 | 1 in. to ½ in. | 0.50 | 0.42 |
| | second | 7 | ½ in. to No. 4 | 0.25 | 0.26 |
| Double | initial | 6 | ¾ in. to ⅜ in. | 0.36 | 0.37 |
| | second | 8 | ⅜ in. to No. 8 | 0.18 | 0.20 |
| Triple | initial | 5 | 1 in. to ½ in. | 0.50 | 0.42 |
| | second | 7 | ½ in. to No. 4 | 0.25 | 0.26 |
| | third | 9 | No. 4 to No. 16 | 0.13 | 0.14 |
| Triple | initial | 6 | ¾ in. to ⅜ in. | 0.36 | 0.37 |
| | second | 8 | ⅜ in. to No. 8 | 0.18 | 0.20 |
| | third | 9 | No. 4 to No. 16 | 0.13 | 0.14 |

[A]Experience has shown that these quantities should be increased slightly (5 to 10 %) when the bituminous material to be used was manufactured for application with little or no heating.
[B]According to Classification D448.

**TABLE 2 Quantities of Materials for Bituminous Surface Treatments (Metric Units)**

NOTE 1—The values are typical design or target values and are not necessarily obtainable to the precision indicated.

| Surface Treatment | | Aggregate | | | Bituminous Material[A] |
|---|---|---|---|---|---|
| Type | Application | Size No.[B] | Nominal Size (Square Openings, mm) | Typical Rate of Application, $m^3/m^2$ | Typical Rate of Application, $litre/m^2$ |
| Single | initial | 5 | 25.0 to 12.5 | 0.017 | 1.90 |
| | | 6 | 19.0 to 9.5 | 0.012 | 1.68 |
| | | 7 | 12.5 to 4.75 | 0.008 | 1.04 |
| | | 8 | 9.5 to 2.36 | 0.006 | 0.86 |
| | | 9 | 4.8 to 1.2 | 0.004 | 0.59 |
| Double | initial | 5 | 25.0 to 12.5 | 0.017 | 1.90 |
| | second | 7 | 2.5 to 4.75 | 0.008 | 1.18 |
| Double | initial | 6 | 19.0 to 9.5 | 0.012 | 1.68 |
| | second | 8 | 9.5 to 2.36 | 0.006 | 0.91 |
| Triple | initial | 5 | 25.0 to 12.5 | 0.017 | 1.90 |
| | second | 7 | 12.5 to 4.75 | 0.008 | 1.18 |
| | third | 9 | 4.75 to 1.18 | 0.004 | 0.63 |
| Triple | initial | 6 | 19.0 to 9.5 | 0.012 | 1.68 |
| | second | 8 | 9.5 to 2.36 | 0.006 | 0.91 |
| | third | 9 | 4.75 to 1.18 | 0.004 | 0.63 |

[A]Experience has shown that these quantities should be increased slightly (5 to 10 %) when the bituminous material to be used was manufactured for application with little or no heating.
[B]According to Classification D448.

aggregate and calculating or using Table 3 and Table 4 to determine the pounds per square yard or kilograms per square metre.

5.3 The quantities of bituminous materials for the various aggregate gradations are typical rates of application considered adequate to retain aggregate of the specified size on a normal surface. The quantity of bituminous material should be increased when highly absorptive or porous aggregate is used and when treating an old surface that is dry, in order to allow for bituminous material absorbed. The quantity of bituminous material should be decreased when treating an existing surface that is rich in bitumen, in order to compensate for such excess. Quantities of bituminous materials shown are for volumes of the material at 60°F (15.6°C). For application at elevated temperatures these quantities should be adjusted to provide the desired volume at 60°F.

5.4 The typical rates of application shown in Table 1 and Table 2 may be adjusted for variations in the gradation of the

**TABLE 3 Approximate Conversion Table—Loose Unit Weight To Pounds per Square Yard**

| Loose Unit Weight | | Approximate lb/yd² at various application rates (ft³/yd²) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| lb/yd³ | lb/ft³ (approximately) | 0.10 ft³ | 0.15 ft³ | 0.20 ft³ | 0.25 ft³ | 0.30 ft³ | 0.35 ft³ | 0.40 ft³ | 0.45 ft³ | 0.50 ft³ |
| 1800 | 66.5 | 6.5 | 10 | 13.5 | 17 | 20 | 23.5 | 26.5 | 30 | 33.5 |
| 1900 | 70.5 | 7.0 | 10.5 | 14 | 17.5 | 21 | 24.5 | 28 | 31.5 | 35 |
| 2000 | 74 | 7.5 | 11 | 15 | 18.5 | 22 | 26 | 29.5 | 33.5 | 37 |
| 2100 | 78 | 8 | 11.5 | 15.5 | 19.5 | 23 | 27 | 31 | 35 | 39 |
| 2200 | 81.5 | 8 | 12 | 16.5 | 20.5 | 24.5 | 28.5 | 32.5 | 36.5 | 41 |
| 2300 | 85 | 8.5 | 13 | 17 | 21.5 | 25.5 | 30 | 34 | 38.5 | 42.5 |
| 2400 | 89 | 9 | 13.5 | 18 | 22 | 26.5 | 31 | 35.5 | 40 | 44.5 |
| 2500 | 92.5 | 9.5 | 14 | 18.5 | 23 | 28 | 32.5 | 37 | 41.5 | 46.5 |
| 2600 | 96.5 | 9.5 | 14.5 | 19.5 | 24 | 29 | 33.5 | 38.5 | 43.5 | 48 |
| 2700 | 100 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 2800 | 103.5 | 10.5 | 15.5 | 20.5 | 26 | 31 | 36.5 | 41.5 | 46.5 | 52 |
| 2900 | 107.5 | 10.5 | 16 | 21.5 | 27 | 32 | 37.5 | 43 | 48.5 | 53.5 |
| 3000 | 111 | 11 | 16.5 | 22 | 28 | 33 | 39 | 44.5 | 50 | 55 |

**TABLE 4 Approximate Conversion Table—Loose Unit Weight to Kilograms per Square Metre**

| Loose Unit Weight, kg/m³ | Approximate kg/m² at various application rates (m³/m²) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0028 m³ | 0.0042 m³ | 0.0057 m³ | 0.0071 m³ | 0.0085 m³ | 0.0099 m³ | 0.0113 m³ | 0.0127 m³ | 0.0142 m³ |
| 1067.9 | 3.53 | 5.42 | 7.32 | 9.22 | 10.85 | 12.75 | 14.38 | 16.27 | 18.17 |
| 1127.2 | 3.80 | 5.70 | 7.59 | 9.49 | 11.39 | 13.29 | 15.19 | 17.09 | 18.99 |
| 1186.5 | 4.07 | 5.97 | 8.14 | 10.04 | 11.93 | 14.10 | 16.00 | 18.17 | 20.07 |
| 1245.9 | 4.34 | 6.24 | 8.41 | 10.58 | 12.48 | 14.65 | 16.82 | 18.99 | 21.16 |
| 1305.2 | 4.34 | 6.51 | 8.95 | 11.12 | 13.29 | 15.46 | 17.63 | 19.80 | 22.24 |
| 1364.5 | 4.61 | 7.05 | 9.22 | 11.66 | 13.83 | 16.27 | 18.44 | 20.89 | 23.06 |
| 1423.9 | 4.88 | 7.32 | 9.76 | 11.93 | 14.38 | 16.82 | 19.26 | 21.70 | 24.14 |
| 1483.2 | 5.15 | 7.59 | 10.04 | 12.48 | 15.19 | 17.63 | 20.07 | 22.51 | 25.23 |
| 1542.5 | 5.15 | 7.87 | 10.58 | 13.02 | 15.73 | 18.17 | 20.89 | 23.60 | 26.04 |
| 1601.8 | 5.42 | 8.14 | 10.85 | 13.56 | 16.27 | 18.99 | 21.70 | 24.41 | 27.12 |
| 1661.2 | 5.70 | 8.41 | 11.12 | 14.10 | 16.82 | 19.80 | 22.51 | 25.23 | 28.21 |
| 1720.5 | 5.70 | 8.68 | 11.66 | 14.65 | 17.36 | 20.34 | 23.33 | 26.31 | 29.02 |
| 1779.8 | 5.97 | 8.95 | 11.93 | 15.19 | 17.90 | 21.16 | 24.14 | 27.12 | 29.84 |

aggregate from the coarse to the fine limit of the specification. The quantities of bituminous material and aggregate should be increased when the gradation of the aggregate approaches the coarse limit of the specification. Likewise, the quantities should be decreased when the aggregate approaches the fine limit of the specification. The amount of such increase or decrease should not be more than 20 % of the quantity given.

5.5 The types and grades of bituminous materials recommended for use with the various aggregate sizes are listed in Table 5 and Table 6.

## 6. Reference Specifications

6.1 The specifications for aggregates are covered in Specification D1139.

6.2 The specifications for bituminous materials are covered by the following ASTM specifications: Specification D946, Specification D2027, Specification D2028, Specification D977, Specification D2397, and Specification D490.

## 7. Measurement of Materials

7.1 The following method and tables are applicable for measuring the quantities of bituminous materials and aggregates:

7.1.1 *Volume of Bituminous Material:*
Guide D1250 and Table D633.

7.1.2 *Unit Weight of Aggregate-Loose Weight*—To be made in accordance with Test Method C29/C29M.

**TABLE 5 Recommended Grades of Asphaltic Materials for Bituminous Surface Treatments[A]**

| Nominal Size (Square Openings), in. (mm) | Size No. | Hot Weather (80°F + ) (26.7°C + ) | | Cool Weather[B] (50 to 80°F) (10 to 26.7°C) | |
|---|---|---|---|---|---|
| 1 to ½ (25.0 to 12.5) | 5 | MC | 3000 | MC | 3000 |
| | | RC | 3000 | RC | 3000 |
| | | RS | 2 | RS | 2 |
| | | CRS | 2 | CRS | 1, 2 |
| | | 120 to 150 | | 120 to 150 | |
| ¾ to ⅜ (19.0 to 9.5) | 6 | MC | 3000 | MC | 800 |
| | | RC | 3000 | RC | 800 |
| | | RS | 2 | RS | 2 |
| | | CRS | 1, 2 | CRS | 1, 2 |
| | | 120 to 150 | | | |
| ½ to No. 4 (12.5 to 4.75) | 7 | MC | 3000 | MC | 800 |
| | | RC | 800, 3000 | RC | 250, 800 |
| | | RS | 2 | RS | 2 |
| | | CRS | 1, 2 | CRS | 1, 2 |
| | | 200 to 300[C] | | | |
| ⅜ to No. 8 (9.5 to 2.36) | 8 | RC | 250, 800 | RC | 250, 800 |
| | | RS | 1, 2 | RS | 1, 2 |
| | | CRS | 1, 2 | CRS | 1, 2 |
| No. 4 to No. 16 (4.75 to 1.18) | 9 | RC | 250, 800 | RC | 250, 800 |
| | | RS | 1, 2 | RS | 1, 2 |
| | | CRS | 1, 2 | CRS | 1, 2 |

[A]Grades of asphaltic materials are according to Specifications D946, D977, D2027, D2028, and D2397.
[B]Under certain conditions, the heavier grades of MC liquid asphalts may be used in cool weather.
[C]In some areas persistent difficulty in retaining aggregate has been experienced with 200 to 300 penetration asphalt cements. Where this has occurred, its use is not recommended.

**TABLE 6 Recommended Grades of Tar for Bituminous Surface Treatments[A]**

| Nominal Size (Square Openings), in. (mm) | Size No. | Hot Weather (80°F + ) (26.7°C + ) | | Cool Weather (up to 80°F) (Up to 26.7°C) | |
|---|---|---|---|---|---|
| 1 to ½ (25.0 to 12.5) | 5 | ... | | ... | |
| ¾ to ⅜ (19.0 to 9.5) | 6 | RT | 10, 11 | RT | 9, 10 |
| ½ to No. 4 (12.5 to 4.75) | 7 | RT | 9, 10, 11 | RT | 8, 9, 10 |
| ⅜ to No. 8 (9.5 to 2.36) | 8 | RT | 9, 10, 11 | RT | 8, 9, 10 |
| No. 4 to No. 16 (4.75 to 1.18) | 9 | RT | 8, 9, 10 | RT | 7, 8, 9 |

[A]According to Specification D490.

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