



Designation: ~~D4552/D4552M – 10 (Reapproved 2016)~~^{ε1} D4552/D4552M – 20

Standard Practice Classification for Classifying Hot-Mix Recycling Agents¹

This standard is issued under the fixed designation D4552/D4552M; 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.

~~^{ε1} NOTE—The words ‘asphalt’ and ‘asphalt cement’ were changed editorially to ‘asphalt binder’ in December 2016.~~

1. Scope

1.1 This practice covers a standardized method whereby petroleum product additives to be used in hot recycling of asphalt concrete can be identified. The products are classified by viscosity in mm^2/s measured at 60 °C [140 °F]. This practice does not apply to emulsified materials.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.3 *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

~~D70 Test Method for Density of Semi-Solid Asphalt Binder (Pycnometer Method)~~

~~D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester~~

~~D140 Practice for Sampling Asphalt Materials~~

~~D946 Specification for Penetration-Graded Asphalt Binder for Use in Pavement Construction~~

~~D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method~~

~~D1754 Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)~~

~~D2007 Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method~~

~~D2170 Test Method for Kinematic Viscosity of Asphalts~~

~~D2171 Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer~~

~~D2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)~~

~~D3381 Specification for Viscosity-Graded Asphalt Binder for Use in Pavement Construction~~

3. Significance and Use

3.1 Recycling of deteriorated asphalt pavements is being used with increasing frequency for its economy and benefit of conserving raw materials. The objective of recycling is to reuse the two ingredients of asphalt concrete—aggregate and asphalt binder—and to restore the desired properties to the mixture. Recycling is carried out hot or cold, depending on the condition of the deteriorated pavement, construction procedure, availability of equipment, and cost. This practice is for classifying recycling agents to be used in hot recycling.

4. Classification

4.1 This practice describes recycling agents (RA) as belonging to one of the following six groups: RA 1, RA 5, RA 25, RA 75, RA 250, or RA 500, as shown in [Table 1](#). The viscosity ranges are designed to avoid overlap and to provide sufficient flexibility

¹ This practice classification is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.40 on Asphalt Specifications.

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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.

TABLE 1 Physical Properties of Hot-Mix Recycling Agents

NOTE 1—Compliance requires the asphalt binder be extracted from the pavement to be recycled and combined with the recycling agent being tested. This combination should be in accordance with ratio of recycling agent to recovered asphalt binder used in the mix. The resulting mixture must meet all specifications for the appropriate grade within Specification D946 or Table 1, 2 or 3 of Specification D3381.

Test	ASTM Test Method	RA 1		RA 5		RA 25		RA 75		RA 250		RA 500	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity • 60 °C [140 °F], — mm ² /s	D2170 or D2171	50	175	176	900	901	4500	4501	12500	12501	37500	37501	60000
Flash Point, COC, °C [°F]	D92	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞
Saturates, wt, %	D2007	∞	30	∞	30	∞	30	∞	30	∞	30	∞	30
Tests on Residue — from RTFO or — TFO oven — 163 °C [325 °F]	D2872 or D1754	∞	3	∞	3	∞	3	∞	3	∞	3	∞	3
— Viscosity Ratio ^A	"	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4
— Wt Change, ±, %	"	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4
Specific Gravity	D70 or D1298	Report		Report		Report		Report		Report		Report	

TABLE 1 Physical Properties of Hot-Mix Recycling Agents

Test	ASTM Test Method	RA 0		RA 1		RA 5		RA 25		RA 75		RA 250		RA 500	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity • 60 °C [140 °F], mm ² /s	D2170/D2170M	10	49	50	175	176	900	901	4500	4501	12 500	12 501	37 500	37 501	60 000
Flash Point, COC, °C [°F]	D92	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞	219 [425]	∞
Saturates, wt, % ^A	D2007	∞	30	∞	30	∞	30	∞	30	∞	30	∞	30	∞	30
Tests on Residue from RTFO 163 °C [325 °F]	D2872	∞	3	∞	3	∞	3	∞	3	∞	3	∞	3	∞	3
Viscosity Ratio ^B	D2872	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4
Wt Change, ±, %	D2872	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4	∞	4
Specific Gravity at 25 °C [77 °F]	D70 or D1298	0.900	1.100	0.900	1.100	0.900	1.100	0.900	1.100	0.900	1.100	0.900	1.100	0.900	1.100

^A The suitability of Test Method D2007 for measurement of saturates content and determination of compatibility of non-petroleum-based recycling agents has not been established. Additional testing may be required for assessment of the compatibility of non-petroleum-based recycling agents.

^B Viscosity Ratio = $\frac{\text{Viscosity of Residue from RTFO or TFO Oven Test } 60\text{ }^{\circ}\text{C [140 }^{\circ}\text{F)], cSt}}{\text{Original Viscosity } 60\text{ }^{\circ}\text{C [140 }^{\circ}\text{F)], cSt}}$ Viscosity Ratio = $\frac{\text{Viscosity of residue from RTFO test at } 60\text{ }^{\circ}\text{C [140 }^{\circ}\text{F]}}{\text{Original viscosity at } 60\text{ }^{\circ}\text{C [140 }^{\circ}\text{F]}}$



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to satisfy a wide range of mix proportions. Other properties specified include flash point (handling), weight percent of saturates (compatibility), selected properties of the RTF or TF oven residue (durability), and specific gravity.

4.2 The choice of RA grade will depend on the amount and hardness of the asphalt binder in the aged pavement. In general, the lower viscosity RA types can be used to restore aged asphalt binder of high viscosity and vice versa. Additionally, grades RA 1, RA 5, RA 25, and RA 75 will generally be most appropriate for hot-mix recycling of salvaged asphalt concrete when no more than 30 % virgin aggregate is added, while grades RA 250 and RA 500 will generally be most appropriate when more than 30 % virgin aggregate is incorporated into the mix.

5. Physical Properties

5.1 All recycling agents must be homogeneous, free-flowing at pumping temperature, and must conform to the requirements shown in [Table 1](#).

5.2 The final acceptance of recycling agents meeting the requirements shown in [Table 1](#) is subject to the compliance of the reconstituted asphalt blends with current asphalt specifications.

6. Sampling

6.1 All sampling shall be carried out in accordance with Practice [D140](#).

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1. Scope

1.1 This standard covers a standardized method whereby recycling agents to be used in hot recycling of asphalt concrete can be classified. The recycling agents are classified by viscosity in mm^2/s measured at 60 °C [140 °F]. This classification does not apply to emulsified recycling agents.

1.2 This standard does not address the performance of asphalt binder blends with recycling agents, or that of hot-mix asphalt mixture containing recycling agents. Adherence of a recycling agent to this specification does not necessarily relate to the performance of asphalt binders and mixtures containing the recycling agents.

NOTE 1—The impact of recycling agents has been evaluated by extracting the asphalt binder from the pavement to be recycled, and combining with the recycling agent to meet the appropriate grade within Specification [D946/D946M](#) or Table 1, 2, or 3 of Specification [D3381/D3381M](#). More recently, some specifications have referred to performance grading as described in Specification [D6373](#) or [D8239](#).

NOTE 2—Efforts are underway to utilize performance-based testing of the asphalt mixture containing recycling agents as a measure of compliance.

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1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D70 Test Method for Density of Semi-Solid Asphalt Binder \(Pycnometer Method\)](#)

[D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester](#)

[D140/D140M Practice for Sampling Asphalt Materials](#)

[D946/D946M Specification for Penetration-Graded Asphalt Binder for Use in Pavement Construction](#)