Designation: D 4924 – 89 (Reapproved 1999)

Standard Classification for Petroleum Waxes for Use in Rubber Compounding[1]

This standard is issued under the fixed designation D 4924; 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.

1. Scope

1.1 This standard is intended to establish a classification system and test methods for petroleum waxes used in rubber compounding primarily as a static protective agent or material for unsaturated rubbers such as styrene-butadiene rubber, polyisoprene rubber, natural rubber, chloroprene rubber, acrylonitrile-butadiene rubber, and polybutadiene rubber. These unsaturated rubbers are subject to ozone cracking. Under certain exposure conditions, waxes retard this cracking.

1.2 This classification is applicable to petroleum waxes used as process aids in rubber compounding. It is not applicable to nonpetroleum waxes such as carnuba wax, candelille wax, or ceresin wax, nor to synthetic hydrocarbon waxes such as polyethylene wax. These non-petroleum waxes display a different behavior on gas chromatographic analysis than do petroleum waxes.

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:*

D 87 Test Method for Melting Point of Petroleum Wax (Cooling Curve)[2]

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)[2]

D 721 Test Method for Oil Content of Petroleum Waxes[2]

D 938 Test Method for Congealing Point of Petroleum Waxes, Including Petrolatum[2]

D 1321 Test Method for Needle Penetration of Petroleum Waxes[2]

D 1500 Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)[2]

D 1747 Test Method for Refractive Index of Viscous Materials[2]

D 1833 Test Method for Odor of Petroleum Wax[2]

D 2887 Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography[3]

D 3944 Test Method for Solidification Point of Petroleum Wax[3]

D 4419 Test Method for Measurement of Transition Temperatures of Petroleum Waxes by Differential Scanning Calorimetry[3]

2.2 *ASTM Committee Proposal:*

D-2 Proposal P167 Test Method for Boiling Range Distribution of Crude Petroleum[4]

NOTE 1—A procedure using similar gas chromatographic methodology but designed specifically for waxes is currently being developed by ASTM Committee D02.04.C.

3. Summary of Classification

3.1 The boiling point range of the petroleum wax is determined by simulated distillation by gas chromatography (Test Method D 2887). If necessary, an internal standard is used to determine the amount of material not volatile under the conditions of the chromatograph.

3.2 Classification is made on the basis of the amount of the sample with normal boiling point above 538°C (1000°F).

3.3 Further characterization is then done using other test methods on the wax. In particular, the melting point behavior, color, odor, and viscosity when melted and refractive index when melted have been found useful.

4. Significance and Use

4.1 Petroleum waxes in rubber compounds are commonly used to provide protection from degradation by ozone under static conditions, that is, when there is little or no flexing of the rubber products. The mode of action for this protection is (*1*) migration of the wax through the rubber to the surface of the product and (*2*) the formation of an ozone impervious film on the surface.

4.2 This standard classifies the petroleum waxes on the basis of molecular weight. In general, waxes of lower molecular weight (“paraffinic’’ or “crystalline’’) migrate through the rubber more rapidly and form more brittle film than the higher molecular weight waxes (“microcrystalline’’). Wax mixtures and blends are commonly used.

4.3 No direct inference of suitability for use in a particular rubber compound is made or implied by the classifications herein.

[1] This classification is under the jurisdiction of ASTM Committee D-11 on Rubber and is the direct responsibility of Subcommittee D11.20 on Compounding Materials and Procedures.

Current edition approved March 31, 1989. Published May 1989.

[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 05.02.

[4] Discontinued—See 1985 *Annual Book of ASTM Standards*, Vol 05.03.

5. Basis of Classification

5.1 Determine the boiling point curve by gas chromatographic distillation, using Test Method D 2887. The presence of high boiling wax (carbon number >42) is indicated in Test Method D 2887 by a baseline that does not return to zero at an equivalent temperature of 538°C. Internal standard methods are used to determine the amount of high boiling material. It is often useful to use cyclohexane or toluene both for a solvent to inject the wax into the gas chromatograph and for an internal standard.

5.2 Divide the boiling point distribution curve into two parts at a boiling point of 538°C (1000°F).

5.3 Classify the wax according to Table 1.

TABLE 1 Classification of Wax

Type	Wax Designation	Mass Wax of Boiling Point >538°C, %
A	paraffin	<1
B	modified paraffin	1–10
C	intermediate microwax content	10–30
D	high microwax content	>30

5.4 If desired, the wax can be further characterized as follows:

5.4.1 By determination of melting point behavior by any one of the methods D87, D938, D3944, or D4419; by certain chemical characteristics such as oil content (Test Method D 721) or odor (Test Method D 1833); physical properties of the solid wax such as hardness by needle penetration (Test Method D 1321), or properties of the molten wax such as viscosity (Test Method D 445), color (Test Method D 1500), clarity, and freedom from foreign solids (inspection only) and Refractive Index (Test Method D 1747). These properties are of limited importance for wax used as a protective agent but may affect other properties of the rubber compounds. They are also used to control lot to lot variation.