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Standard Specification for Aramid Fiber for Asphalt Mixtures¹

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1. Scope

1.1 This standard specification covers a standardized method whereby an aromatic polyamide fiber can be evaluated prior to modification where the finished product (formulation of aramid fiber plus some form of treatment) is to be used in asphalt mixtures. The aromatic, polyamide fiber (shortened to “aramid” in non-treated form) can be specified by physical and mechanical properties whereby the aramid fiber is treated and the final product form is used in asphalt mixtures. The purpose of adding aramid fiber is to improve the asphalt mixture’s mechanical performance. Aramid fiber may provide structural properties to the mixture and thus is different than fibers such as cellulose fibers that are used to prevent drain down. The aramid fiber may be coated (that is, “treated”) with a binder such as wax, emulsion, or similar. The fiber can also be blended with a polyolefin fiber or other additive to reduce loss of fibers into the airstream during mixing due to the lightweight nature of aramid fiber. The mechanical properties listed in the standard specification are for the non-treated aramid fiber since it is difficult to test shortened fibers for properties such as linear density, tensile strength, and Young’s modulus.

1.2 This standard specification does not address the performance of asphalt binder blends with aramid fiber or that of the asphalt mixture containing aramid fiber, but rather specifies the aramid fiber properties for use in formulating the finished product which is then used in asphalt mixtures.

1.3 *Units*—The values stated in International System of Units (SI) are to be regarded as standard. No other units of measurement are included in this standard.

1.4 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.

1.5 *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 appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.6 *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

D8 Terminology Relating to Materials for Roads and Pavements

D1907/D1907M Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

D2256/D2256M Test Method for Tensile Properties of Yarns by the Single-Strand Method

D2258/D2258M Practice for Sampling Yarn for Testing

D7269/D7269M Test Methods for Tensile Testing of Aramid Yarns

E1131 Test Method for Compositional Analysis by Thermogravimetry

3. Terminology

3.1 *Definitions*—Definitions for many terms common to asphalt binder and asphalt mixtures are found in Terminology D8.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *non-treated aramid fiber, n*—a class of heat-resistant, lightweight, high-strength synthetic fibers with molecules that are relatively rigid polymer chains formed from monomers linked via covalent bonding.

3.2.1.1 *Discussion*—The term “aramid” is short for aromatic polyamide or para-aramid. Aramid fibers derive their properties from crystalline domains of poly (p-phenylene terephthalamide) (PPTA). The microstructure of aramid fibers reveals elongated highly crystalline fibrils in which the PPTA chains are aligned along the fibril length forming stacked PPTA sheets. PPTA crystal structure is highly anisotropic along the

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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.

low index crystallographic directions. Polymer sheets are formed by in-plane hydrogen bonding and stacked via weaker Van der Waals interactions. The manufacturing process of commercial aramid fibers takes advantage of the unique PPTA crystal structure and yields material with polymer chains that are highly aligned along the fiber axis. Because of their structure, aramid fibers have outstanding strength with the capability to transfer mechanical stress while withstanding shock loading.

3.2.2 *treated aramid fiber*, *n*—aramid fibers that may be coated or blended as defined in 1.1.

3.2.2.1 *Discussion*—The treatment allows for dosing at the asphalt mix production plant to reduce loss of fibers into the airstream during mixing of the extremely lightweight aramid fiber.

4. Ordering Information

4.1 When ordering under this specification, include physical and mechanical properties of the aramid fiber that are in **Tables 1 and 2**.

TABLE 1 Physical Properties of Aramid Fiber (Non-Treated)

Property	Value	Test Method
Linear density	>3200 dtex	ASTM D1907/D1907M , Option 6
Decomposition ^A	>425 °C	n/a
Length	19 or 38 mm ± 10 %	n/a

^A Decomposition by heat can be performed by conducting a thermogravimetric analysis (TGA) in nitrogen such as Test Method **E1131**.

TABLE 2 Mechanical Properties of Aramid Fiber (Non-Treated)

Property	Value	Test Method
Tensile strength	>2700 MPa	ASTM D2256/D2256M , D7269/D7269M
Young's modulus	>80 GPa	ASTM D2256/D2256M , D7269/D7269M

5. Materials and Manufacture

5.1 The production of aramid fiber is a multi-stage process that includes polymerization, continuous filament yarn spinning, and cutting of the fibers.

5.2 The aramid fiber shall be homogeneous and free from deleterious materials.

5.3 The aramid fiber may be coated or blended as defined in 1.1.

5.4 The fiber shall conform to the requirements given in **Tables 1 and 2**.

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NOTE 1—See manufacturer for a typical dosage rate. A typical minimum dosage rate of 0.0066 % aramid fiber (non-treated) by weight of asphalt mix has historically been used. Manufacturer's modification will result in different total dosage weights while the "non-treated" dosage typically remains at 0.0066 % by weight of asphalt mix.

NOTE 2—Typical aramid fiber length that has been used ranges from 19 to 38 mm in length.

NOTE 3—See manufacturer recommendations for addition of fibers to mix. Addition of fibers into the asphalt mix depends on the mix plant type. Example: Aramid fibers are usually added at the recycled asphalt pavement (RAP) collar/RAP belt at a drum mix plant while fibers are added in the pug mill at a batch plant.

5.5 Aramid fiber for asphalt mixtures is not crimped.

6. Sampling

6.1 The material shall be sampled in accordance with Practice **D2258/D2258M**.

7. Physical Properties

7.1 Aramid fiber shall meet the physical property requirements as shown in **Table 1**. Density refers to density of aramid polymer that makes up the aramid fiber.

8. Mechanical Properties

8.1 The aramid fiber shall meet the mechanical property requirements as shown in **Table 2**.

9. Inspection and Certification

9.1 A certificate of analysis (COA) on the non-treated aramid fiber should be supplied to the purchaser upon request. The COA should be inspected to ensure that the physical and mechanical properties follow **Tables 1 and 2**.

9.2 Inspection and certification of the non-treated material shall be agreed upon between the purchaser and seller. Specific requirements shall be made part of the purchase contract. The seller shall provide material handling and storage procedures for the aramid fiber.

10. Rejection and Rehearing

10.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformity is performed as indicated in the purchase order or as otherwise agreed upon between the purchaser and seller.

11. Keywords

11.1 aramid fiber; modified aramid fiber reinforced asphalt mixture; para-aramid fiber