



Designation: D6754/D6754M – 10

## Standard Specification for Ketone Ethylene Ester Based Sheet Roofing<sup>1</sup>

This standard is issued under the fixed designation D6754/D6754M; 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.

### 1. Scope

1.1 This specification covers flexible sheet made from ketone ethylene ester (KEE) as the primary polymer intended for use in single ply roofing membrane exposed to the weather. The sheet shall be reinforced with fabric.

1.2 In-place roof system design criteria, such as fire resistance, field-seaming strength, material compatibility, uplift resistance, in-situ shrinkage, among others, are factors that must be considered, but are beyond the scope of this specification.

1.3 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 non-conformance with the standard.

1.4 The following precautionary caveat pertains to the test methods portion only, Section 8, of this specification: *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 requirements prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

- D471 Test Method for Rubber Property—Effect of Liquids
- D751 Test Methods for Coated Fabrics
- D1079 Terminology Relating to Roofing and Waterproofing
- D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature
- D2136 Test Method for Coated Fabrics—Low-Temperature Bend Test

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.18 on Nonbituminous Organic Roof Coverings.

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<sup>2</sup> 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.

- D3045 Practice for Heat Aging of Plastics Without Load
- D3389 Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)
- D5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens
- D5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens
- G21 Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
- G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

### 3. Terminology

3.1 *Definitions*—Terminology D1079 shall apply to this specification.

3.2 *ketone ethylene ester (KEE), n*—a high molecular weight thermoplastic copolymer of ethylene, containing carbon monoxide and either vinyl acetate or acrylate monomer which are incorporated to provide softness and polarity.

3.2.1 *Discussion*—Ester groups of the vinyl acetate or acrylate are pendant from the ethylene backbone and reduce crystallinity, which provides flexibility. Carbon monoxide groups within the polymer backbone provide polarity. The KEE polymer is therefore a flexible polymer, which is miscible with other polymers of similar polarity.

3.3 *polymer content, n*—in this specification, polymer content shall be defined as polymeric materials which are in the solid state at room temperature, and are high (greater than 50 000 Mw) in molecular weight. Other ingredients, known to the art of polymer compounding, such as certain waxes, stabilizers, and other additives, while polymeric in nature are not considered to be part of the base polymer system.

### 4. Materials and Manufacture

4.1 The sheet shall be formulated from the appropriate polymers and other compounding ingredients. The KEE polymer shall be a minimum of 50 % by weight of the polymer content of the sheet.

4.2 The sheet shall be reinforced internally with a fabric.

4.3 To make seam and repairs, the sheet shall be capable of being bonded watertight to itself during the design service life of the sheets. The manufacturer shall recommend a suitable method. Design service life is defined as the designated time period of intended system performance.

## 5. Physical Properties

5.1 The sheet shall conform to the physical requirements prescribed in **Table 1**.

5.2 The tolerance for time conditions (aging, weathering, and so forth) is  $\pm 15$  min or  $\pm 1$  % of the period, whichever is greater, unless specified.

5.3 The tolerance for temperature conditions (aging, weathering, and so forth) is  $\pm 2^\circ\text{C}$  [ $4^\circ\text{F}$ ] of the specified temperature, unless otherwise specified.

## 6. Dimensions and Permissible Variations

6.1 The width and length of the sheet shall be agreed upon between the purchaser and the supplier as part of the purchase contract. The width and length tolerance shall be  $+3$  %  $-0$  % after permitting the sheet to relax 1 h at  $23 \pm 1^\circ\text{C}$  [ $73 \pm 2^\circ\text{F}$ ].

6.2 The thickness and thickness tolerance shall be agreed upon between the purchaser and supplier as part of the purchase contract, subject to the minimum requirement in **Table 1**.

## 7. Workmanship, Finish, and Appearance

7.1 The sheet, including factory seams if present, shall be watertight and be visually free of pinholes, particles of foreign

matter, undispersed raw materials, protruding reinforcement, and other manufacturing defects that might affect serviceability.

7.2 The sheet shall be visually free of nicks and cuts, voids, thin areas, delaminations, moisture-bound fabric, or other defects.

7.3 Edges of the sheet shall be straight and flat so that they may be seamed to one another.

## 8. Test Methods

8.1 *Thickness, Overall*—Test Method **D751**.

8.2 *Thickness, Coating Over Reinforcement Optical Method*—see **Annex A1**, Optical Method for Measurement of Thickness of Coating.

8.3 *Breaking Strength*—Test Method **D751**, Procedure B Strip Method.

8.4 *Elongation at Break*—Test Method **D751**.

8.5 *Tearing Strength*—Test Method **D751**, Procedure B Tongue Tear Method, 200-mm [8-in.] by 250-mm [10-in.] specimen size. Test at 5.0 mm/s [12 in./min].

8.6 *Linear Dimensional Change*—Test Method **D1204**, 1 h at  $100 \pm 2^\circ\text{C}$  [ $212 \pm 5^\circ\text{F}$ ].

8.7 *Fabric Adhesion*—Test Method **D751**, 5.0-mm/s [12-in./min] jaw speed.

8.8 *Heat Aging*—Practice **D3045**, at  $80 \pm 2^\circ\text{C}$  [ $176 \pm 4^\circ\text{F}$ ] for 56 days  $\pm 2$  h.

8.8.1 *After Heat Aging Low Temperature Bend*—Test Method **D2136**, at  $-35 \pm 1^\circ\text{C}$  [ $-30 \pm 2^\circ\text{F}$ ].

8.9 *Low Temperature Bend*—Test Method **D2136** at  $-35 \pm 1^\circ\text{C}$  [ $-30 \pm 2^\circ\text{F}$ ].

8.10 *Water Absorption*—Test Method **D471**, Procedure for exposure to one side only in water, at  $70 \pm 2^\circ\text{C}$  [ $158 \pm 4^\circ\text{F}$ ] for 166 h.

8.11 *Factory Seam Strength*—Test Method **D751**, Grab Method.

8.12 *Hydrostatic Resistance*—Test Method **D751**, Method A, Procedure 1.

8.13 *Static Puncture Test*—Test Method **D5602**, at a load of 45 kg [99 lbf] min. at  $23 \pm 1^\circ\text{C}$  [ $73 \pm 2^\circ\text{F}$ ].

8.14 *Dynamic Puncture Test*—Test Method **D5635**, at energy of 10 J min.  $23 \pm 1^\circ\text{C}$  [ $73 \pm 2^\circ\text{F}$ ].

8.15 *Accelerated Weathering Test*—The two different types of exposures may produce different test results. Therefore, they cannot be used interchangeably without supporting data that demonstrates equivalency of the procedures for the material tested.

8.15.1 *Xenon Arc Exposure Test*—Practices **G155** and **G151**, 5000 hours exposure. Irradiance: 0.35 W/(m<sup>2</sup>·nm) at 340 nm. The maximum allowable operational fluctuation is  $\pm 0.02$  W/(m<sup>2</sup>·nm). Cycle: 102-min light followed by 18-min light plus water spray on the front surface. Spray Water: Refer to Practice **G155**, Section 6.6.1 (Water Spray). Typical spray water temperature is  $21 \pm 5^\circ\text{C}$  [ $70 \pm 9^\circ\text{F}$ ], but if ambient

**TABLE 1 Physical Requirements of the KEE-Reinforced Membrane**

| Property  |              |
|---|--------------|
| Thickness, min., mm [in.]   | 0.81 [0.032] |
| Thickness over fiber, min., mm [in.]                                | 0.18 [0.007] |
| Breaking strength, strip, N [lbf]                                   | 1550 [348]   |
| Elongation at break, strip, min., %                                 | 18           |
| Tearing strength, min., N [lbf]                                     | 480 [108]    |
| Lineal dimension change, max., %                                    | 1.3          |
| Fabric adhesion, min., N/m [lbf/in.]                                | 3330 [19]    |
| Retention of properties after heat aging:                           |              |
| Breaking strength, strip, min., % of original                       | 90           |
| Elongation at break, strip, min., % of original                     | 90           |
| Low-temperature bend after heat aging                               | pass         |
| Low-temperature bend  | pass         |
| Change in weight after exposure in water, max., %                   | 0.0, +6.0    |
| Factory seam strength, min., N [lbf]                                | 1955 [440]   |
| Hydrostatic resistance, min., MPa [psi]                             | 4.1 [590]    |
| Static puncture resistance  | pass         |
| Dynamic puncture resistance   | pass         |
| Accelerated weathering test after 5000-h xenon arc light exposure   |              |
| Cracking (7× magnification)   | none         |
| Crazing (7× magnification)  | none         |
| Accelerated weathering test after 5000-h fluorescent light exposure |              |
| Cracking (7× magnification)   | none         |
| Crazing (7× magnification)  | none         |
| Fungi resistance  |              |
| Sustained growth  | no growth    |
| Discoloration   | none         |
| Abrasion test, min., cycles   | 1500         |