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Standard Test Method for Evaluating Wind Safety and Durability of Market Umbrellas[1]

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INTRODUCTION

Market umbrellas (MUs) are commonly used as protection against rain, sun, or other potential weather in home, recreation, and commercial business settings. Buyers involved in the selection, use, and maintenance of market umbrellas, as well as customers of businesses who desire protection of weather, can be exposed to numerous hazards capable of causing harm when an improperly designed, installed, or maintained market umbrella has contact with the human body. The deleterious effects of a market umbrella being blown over or broken by wind forces can range from acute injury, such as cuts or bruises, to blunt force trauma, such as concussions or broken bones.

MUs range from 4 ft to over 40 ft in diameter of multiple materials of construction, designs, shapes and base or stanchions. MUs are often selected based on these factors, but equally important is the safety, overall structural integrity of the MU, and durability, how long the market umbrellas will last in service, allowing the end user to safely carry out his or her assigned work tasks or enjoy the weather protection and comfort of the MU.

No known standards apply to the design and manufacture of market umbrellas. Additionally, MU designs vary depending on different end use applications and settings of use. Consequently, purchasers are faced with a variety of MU products and generally depend on manufacturer sales information to decide which MU is appropriate for their specific application. Base stanchion weights and methods must also be selected and integrated with the MU to provide an accurate assessment.

This standard is intended to provide standardized methods for evaluating the wind safety and durability of MU using a wind tunnel and rating the performance of the MU on a standardized scale. This standard may also be used by MU manufacturers to assess current or proposed designs.

1. Scope

1.1 These test methods are intended for evaluating market umbrellas (MUs) to determine the suitability of the MU in a use environment on the basis of wind safety and durability.

1.1.1 Procedure A is a safety scenario intended to test the structural strength of the MU to a uniform wind force generated by a wind tunnel.

1.1.2 Procedure B is a wind durability scenario intended to determine the ability of the MU to perform in a high wind weather environment for a sustained period.

1.1.3 The performance of the MU is then rated using the Beaufort Scale, as shown in Annex A1, to communicate the safety and durability performance of the MU.

1.2 These test methods apply to most MUs designed for use in-home setting, such as pool or patio areas; recreation areas, such as the beach, pool, or tennis courts; and business settings, such as theme parks, water parks, resort pools, hotels, restaurants, cafés, and other business settings.

1.3 The values as stated in inch-pound units are to be regarded as the standard. The values in parentheses are given for information only.

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] This test method is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.79 on Market Umbrellas.

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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 *Other Documents:*

Beaufort Scale Beaufort Wind Force Scale[2]

ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures—Chapter 31, Wind Tunnel Procedure[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *care, n*—procedures for cleaning and storage of market umbrella.

3.1.2 *contamination, n*—the addition of an undesired soil or stain-causing substance to the market umbrella.

3.1.3 *degradation, n*—a deleterious change in one or more properties of a material.

3.1.4 *end user, n*—the entity or organization whose employees or customers ultimately use the market umbrella.

3.1.5 *installation, n*—procedures for placing, fitting, and adjusting market umbrellas and preparing market umbrellas for use.

3.1.6 *maintenance, n*—procedures for inspection, repair, and removal from service of market umbrella.

3.1.7 *market umbrella, n*—a removable device consisting of a canopy of cloth or other material on a folding frame supported by a central or cantilever rod, used as protection against rain, sun, or other potential weather.

4. Summary of Test Method

4.1 In Procedure A, the safety of the MUs and base components are evaluated by subjecting the MU to a uniform wind generated by a wind tunnel. The MU is inspected prior to and after the series of escalating wind speeds to assess any changes in the MU's structural integrity.

4.2 In Procedure B, the wind durability of the MU and base components are evaluated by observing the ability of the MU to perform in a high wind weather environment for a sustained period of time. As in Procedure A, the MU is inspected prior to and after a fixed wind speed for a set period of time to assess changes in the MU's structural integrity.

4.3 For each option, the MU safety and durability and base components are assessed by examining the test subject's structural parts and performance. These data are used to evaluate and rate the wind safety and durability following each test using the Beaufort Scale to correlate the wind speed safety and durability determined in the testing to visual and subjective observation of the area of uses of the MU.

5. Significance and Use

5.1 These test methods establish standard procedures designed for evaluating the performance wind safety and durability characteristics of MUs.

5.2 These test methods are suitable for both end users and manufacturers to evaluate performance characteristics of MUs and base mounting components.

5.2.1 End users may use these test methods to determine how well MUs and base components meet their particular application and conditions of use.

5.2.2 Manufacturers of MUs and base mounting components may use these test methods to determine the wind performance characteristics in existing or proposed designs.

5.3 Procedure A is an evaluation of MU structural integrity (pole, frame, canopy, and base components) by subjecting the MU to a uniform wind generated by a wind tunnel. Procedure B is an evaluation of MU and base component durability by subjecting the MU to a uniform wind generated by a wind tunnel for a fixed period of time. Each procedure is used to rate MU and base stanchion performance using the Beaufort Scale for users to be able to correlate the wind speed safety and durability determined in the testing to visual and subjective observation of the area of uses of the MU.

5.4 Results from use of these test methods on one type of MU and base components are not comparable to other test results on a different MU due to differences in MU materials and designs used for poles, frames, canopies, vents, and hubs as well as base weights, shapes, and holding mechanisms.

5.5 These test methods are not intended to assess cleaning or other weather stress resulting from wear and tear in an actual use environment.

5.6 End users and manufacturers of MU and base components should consider these test methods to be minimum procedures for evaluating MU and base component wind safety and durability characteristics as a wind tunnel procedure is considered to produce the most accurate wind pressures of any method according to ASCE/SEI 7-10 Wind Tunnel Procedure. Users of these test methods may wish to consider additional tests and procedures that relate directly to their application such as finite element analysis software.

5.7 Each buyer of a MU should establish its own criteria for assessing acceptable safety and durability performance.

6. Apparatus

6.1 *Wind Tunnel*—A wind tunnel is a facility used to simulate the flow conditions around either a stationary object or a moving object through air. For this test method, a wind tunnel of sufficient size is required so that the MU under study fit reasonably within the test section or diffuser of the wind tunnel. The wind speed in the wind tunnel should be determined by measurements collected upstream of the MU under study.

[2] Available from National Weather Service, https://www.weather.gov/mfl/beaufort.

[3] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

6.2 *Base or Stanchion*—The base or stanchion the MU is mounted in that is under study should rest on a horizontal surface near the floor of the wind tunnel test section or diffuser. The base or stanchion can be free-standing, bolted to the horizontal surface, or otherwise secured according to the manufacturer's instructions.

6.3 *Safety Tether*—A metal cable should be used between the MU being tested and a grounded point within the wind tunnel; this prevents excessive travel of the MU after a toppling event.

6.4 *Handtruck*—A standard, industrial-grade hand truck that is typically employed for the transportation of base anchor.

6.5 *Video*—Video is used to document tests and correlate with wind speed measurements.

6.6 *Tools*—The following may be required during the test: crescent wrenches, screwdrivers, hammers, fasteners.

7. Safety Precautions

7.1 A safety monitor shall be present during all testing specified in this test method. The safety monitor shall continuously observe the condition of the test MU.

7.2 Testing shall be stopped, and the MU removed from the wind tunnel, for any of the following reasons: observable structural damage to the MU pole, frame, or canopy; observable instability of the base such as tipping, sliding, hovering, or swaying; the MU falling over or being pulled out of the base stanchion.

7.3 MU shall be in good structural condition and inspected before performing any tests.

7.4 Emergency equipment, such as a cable, shall be connected to the MU and base and anchored to an immovable object.

7.5 The selection of MU, base, and stanchion components shall take into account the estimated wind rating and durability of the test subject prior to testing or any other analysis that has been performed on the MU.

8. Procedure

8.1 Select the MU and base components to be tested. Record applicable data for each item including, but not limited to the following:

8.1.1 Type of MU (center pole, cantilever, etc.);

8.1.2 Manufacturer;

8.1.3 Model number, serial number of MU and base or stanchion;

8.1.4 Size of canopy diameter;

8.1.5 General description of base shape and weight;

8.1.6 Special component features;

8.1.7 Any other relevant MU and base or stanchion dimensions (that is, height, pitch, weight, material, thickness etc.); and

8.1.8 Method of MU attachment or security to the base or stanchion.

8.2 Before starting each test:

8.2.1 Visually inspect each MU component for flaws or defects in the pole, frame, and canopy. An illustration, such as that given in Fig. 1, may be used to mark and record the location of imperfections.

8.2.2 Disregard any MU that may fail prematurely due to manufacturing quality.

8.3 Using tape measure and weighing scales, measure the MU test subject dimensions and base weight without the MU installed in the base or stanchion. Critical MU dimensions include, but are not limited to, the following:

8.3.1 Standing height,

8.3.2 Canopy diameter,

8.3.3 Pole diameter,

8.3.4 Ensure that the test MU and base or stanchion components are the correct size for the MU test subject.

8.4 Install the MU as per manufactures directions into the base or stanchion.

8.5 Measure ambient temperature and relative humidity of wind tunnel.

8.6 Video the test MU during testing.

8.7 The mean and fluctuating wind forces and pressures shall meet the following conditions consistent with the ASCE/SEI 7-10 Wind Tunnel Procedure.

8.7.1 The longitudinal pressure gradient in the wind tunnel test section is accounted for and measured.

8.8 *Procedure A—Wind Safety:*

FIG. 1 Market Umbrella

8.8.1 Accelerate the wind tunnel to in increments as per Beaufort Scale maximum speed of each Beaufort number, holding each wind velocity for 1 min.

8.8.2 Observe and note the MU and base stability.

8.8.3 If the MU tips, hovers, or falls over or the MU is pulled out of the base, discontinue testing, noting wind speed and any MU parts or components that were damaged and or separated from the MU; and change or add weight to the base or a fixed stanchion or base that is anchored so as not to tip, hover, or fall over. Anchor the MU to the base to prevent the MU from getting pulled out of the base and restart testing as per 8.8.1 until one of the following occurs:

8.8.3.1 If any component of the MU canopy rips, tears, is punctured, or otherwise fails during evaluation, discontinue testing, noting wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.8.3.2 If any component of the MU frame cracks, breaks, or otherwise fails during evaluation, discontinue testing, noting wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.8.3.3 If any component of the MU pole cracks, breaks, bends, or otherwise fails during evaluation, discontinue testing, noting wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.8.4 Take photos of the MU, clearly identifying the reason for discontinuing the testing.

8.8.5 Repeat Procedure A three times on identical MU and base.

8.8.5.1 If the test MU is repairable and damaged parts can be replaced, the MU can be retested. If the damage to the MU is not repairable, repeat the testing with an identical MU.

8.9 *Procedure B—Wind Durability:*

8.9.1 Accelerate the wind tunnel to the Beaufort Scale number that is one rating lower than the rating determined in Procedure A; maintain that wind velocity for 30 min, the average length of a thunderstorm.

8.9.2 Observe and note the MU and base stability.

8.9.3 If the MU tips, hovers, or falls over, or the MU is pulled out of the base, discontinue testing, noting wind speed, and change the base to a higher weight or a fixed base that is anchored so as not to tip, hover, or fall over. Anchor the MU to the base to prevent the MU from getting pulled out of the base and restart testing as per 8.9.1.

8.9.4 If the MU and base is stable, maintain the wind tunnel velocity as per 8.9.1 until one of the following occurs:

8.9.4.1 If any component of the MU canopy rips, tears, is punctured, or otherwise fails during evaluation, discontinue testing, noting wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.9.4.2 If any component of the MU frame cracks, breaks, or otherwise fails during evaluation, discontinue testing, noting wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.9.4.3 If any component of the MU pole cracks, breaks, bends, or otherwise fails during evaluation, discontinue testing noting, wind speed and any MU parts or components that were damaged and/or separated from the MU.

8.9.5 Take photos of the MU clearly identifying the reason for discontinuing the testing.

8.9.6 Repeat Procedure B three times on same MU and base.

8.9.6.1 If the test MU is repairable and damaged parts can be replaced, the MU can be retested. If the damage to the MU is not repairable, the testing is concluded.

9. Report

9.1 For each MU tested, prepare a report which includes, but is not limited to, the following:

9.1.1 All descriptions and dimensions of the MU and base components tested, including the method by which the base is secured if the manufacturer provides several alternatives, and the position of any settings, such as height adjustments;

9.1.2 Environmental conditions in which the testing was conducted: wind speed, pressure, humidity, etc.

9.1.3 The wind velocity and time at each Beaufort Number with the following:

9.1.3.1 Results of visual inspection before and after test procedures.

9.1.3.2 The wind velocity at which testing the MU or base became unstable and testing was discontinued and reason for discontinuance.

9.1.3.3 The observations on the performance of the MU and base to perform at each Beaufort Number or changes at specific time points during the testing; and any other observations or relevant measurements made during the tests after the MU and base were adjusted or modified as per 8.8.3.

9.1.3.4 The reason the testing was discontinued.

9.1.3.5 Attach to the report test MU video and any photographs or diagrams illustrating visual inspection results before and after MU testing.

9.1.4 For Procedure A, Wind Safety is set at the Beaufort Scale number that corresponds to 50 % of the lowest wind velocity of the three tests that the testing was discontinued using the base weight or method used in testing.

9.1.5 For Procedure B Wind Durability, report as Pass if the MU maintains structural integrity for all three tests for the full 30 min of each test. If the test was discontinued for any of the three tests, report a Fail and retest as per Procedure B at the next lowest Beaufort Number from the one tested.

10. Keywords

10.1 durability; market umbrellas; safety; wind tunnels