



Designation: E 1038 – 98

Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls¹

This standard is issued under the fixed designation E 1038; 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 test method provides a procedure for determining the ability of photovoltaic modules to withstand impact forces of falling hail. Propelled ice balls are used to simulate falling hailstones.

1.2 This test method defines test specimens and methods for mounting specimens, specifies impact locations on each test specimen, provides an equation for determining the velocity of any size ice ball, provides a method for impacting the test specimens with ice balls, provides a method for determining changes in electrical performance, and specifies parameters that must be recorded and reported.

1.3 This test method does not establish pass or fail levels. The determination of acceptable or unacceptable levels of ice ball impact resistance is beyond the scope of this test method.

1.4 The size of the ice ball to be used in conducting this test is not specified. This test method can be used with various sizes of ice balls.

1.5 This test method may be applied to concentrator and nonconcentrator modules.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.7 *This standard does not purport to address all of the safety problems, 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.* For specific precautionary statements, refer to 5.1, Section 6, Note 8, and Note 9.

2. Referenced Documents

2.1 ASTM Standards:

E 772 Terminology Relating to Solar Energy Conversion²

¹ This test method is under the jurisdiction of ASTM Committee E-44 on Solar, Geothermal, and Other Alternative Energy Sources and is the direct responsibility of Subcommittee E44.09 on Photovoltaic Electric Power Systems.

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² Annual Book of ASTM Standards, Vol 12.02.

E 822 Practice for Determining Resistance of Solar Collector Covers to Hail by Impact with Propelled Ice Balls²

E 1036 Test Methods for Electrical Performance of Non-concentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells²

E 1328 Terminology Relating to Photovoltaic Solar Energy Conversion²

E 1462 Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules²

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology E 772 and Terminology E 1328.

3.2 *Symbols*—The following symbols are used in this test method.

m = ice ball mass, g,

d = ice ball diameter, mm, and

r = ice ball radius, mm.

3.2.1 Velocity:

V_t = ice ball terminal, m s^{-1} ,

V_w = wind, m s^{-1} , and

V_r = ice ball resultant, m s^{-1} .

4. Significance and Use

4.1 In many geographic areas, there is concern about the effect of falling hail upon photovoltaic modules. This test method may be used to determine the ability of photovoltaic modules to withstand the impact forces of hailstones. In this test method, the ability of a photovoltaic module to withstand hail impact is related to its tested ability to withstand impact from ice balls. The effects of impact may be either physical or electrical degradation of the module.

4.2 This test method describes a standard procedure for mounting the test specimen, conducting the impact test, and reporting the effects.

4.2.1 The procedures for mounting the test specimen are provided to assure that modules are tested in a configuration that relates to their use in a photovoltaic array.