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An American National Standard

# Standard Test Method for Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method[1]

This standard is issued under the fixed designation F2898; 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 may be used to determine the permeability rate of synthetic turf playing field systems, playing field systems with pad or premolded drainage boards, or both, playing field systems with premolded panel base systems, porous and non porous pavement systems, or base stone systems in the field, or a combination thereof, by non-confined area flood test method. This system is suitable for use on the finish synthetic turf playing surface and on the stone base system below the playing system.

1.2 This test method is applicable for synthetic turf playing field systems and stone bases where system is designed for permeability through the synthetic turf surface and or through a base stone surface. It is also suitable for synthetic turf playing systems that are directly underlined with resilient and nonresilient pre-molded drainage boards systems and porous pavement base systems. The method tests a larger surface area than confined ring test methods and decreases the effect lateral flow within the surface and or stone base system due to the large increase in the ratio of test surface area to the synthetic turf playing system and stone base system thickness. The method is intended to more accurately mimic natural storm flow conditions by eliminating the effect of head pressure created by the water column height which creates a pressure flow condition at the surface of the test area that does not exist naturally.

1.3 This test method is intended for finish-graded and compacted stone or finished surfaces that are installed with cross-slope gradients of less than 2.0 % or under conditions where the effect of cross-slope is mitigated by high system permeability. High sloping systems tend to have high sloping base systems which may impact results due to increases in the lateral flow within the section caused increased hydraulic energy caused by larger slopes.

1.4 This test method is not applicable for conditions or locations in-which surface flow, due to high surface cross-slope or proximity, carries water flow from the test site to surface and subsurface drainage trenches or structures.

1.5 Further, this test method may be impacted if preformed directly after a significant rainfall event in cases where the downstream capacity of the receiving drainage system is taxed to the extent that water backs up in the downstream system.

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.7 *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:*[2]

F1551 Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials

## 3. Terminology

3.1 *Definitions:*

3.1.1 *area of test site, n*—the area of test site is the surface area in square feet of the test site area.

3.1.1.1 *Discussion*—This surface area represents an approximated and simplified shape of equal area such as a rectangle that includes the full wetted area. Small fingers of non-wetted surface within the wetted area shall be ignored in the surface approximation. It is assumed that these small fingers of non-wetted area are wetted below the surface within the test site.

3.1.2 *dry surface, n*—a dry surface after testing or saturation is defined as follows:

3.1.2.1 *dry stone base surface, n*—a surface where water is no longer visible as ponded water on or above the surface of the stone.



[1] This test method is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.65 on Artificial Turf Surfaces and Systems.

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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.

3.1.2.2 *Discussion*—After saturation or testing the surface will be moist and water may be visible within the surface voids.

3.1.2.3 *dry synthetic turf surface, n*—a surface where water is no longer visible on the surface, and water will no longer pump to the surface when walked upon.

3.1.2.4 *Discussion*—After saturation or testing the surface will be moist and water maybe visible within the fiber and or infill matrix.

3.1.3 *flow rate control valve, n*—located between the on-off valve at the outlet hose and the water supply source valve, it is intended to allow the flow rate to be throttled back to a lower flow rate if needed.

3.1.3.1 *Discussion*—This secondary valve is needed in cases where the unmodified source flow rate exceeds 10 gal per minute. A flow rate of 10 gal per minute will fill the 5-gal container in 30 s which makes the procedure subject to flow rate errors due to the time necessary to open flow and record times. The secondary valve is necessary to mitigate such errors.

3.1.4 *hydrophobicity, n*—the physical property of a molecule that is repelled from a mass of water.

3.1.4.1 *hydrophobic, n*—materials that repel water and may prevent water molecules from passing through a field cross-section.

3.1.5 *on-off valve, n*—located on the discharge end of the hose nearest to the water discharge point, it will allow the tester to turn the water from the fully off position to the fully open position with minimal variation in flow during the period that the valve is turned from the open to closed positions or vice a versa.

3.1.5.1 *Discussion*—A quarter turn ball valve or similar quick on-off valve must be used at this location.

3.1.6 *permeability, n*—a measure of the ability of a porous material to transmit fluids.

3.1.6.1 *Discussion*—For the purpose of this standard, permeability applies to transmission of water both vertically and horizontally through a system.

3.1.7 *surface system, n*—the finish grade top surface of the synthetic turf playing field and any resilient padding and or pre-molded drainage boards and or pre-molded panel base systems located directly below the synthetic turf carpet.

3.1.8 *surfactant, n*—wetting agents that lower the surface tension of a liquid, allowing easier spreading, and lower the interfacial tension between water molecules and other materials. Surfactants can be used to reduce hydrophobicity.

3.1.9 *test flow rate, n*—the water flow rate of the water supply at the hose outlet for the water source used during the test period.

3.1.10 *test site area, n*—the area observed during the test to be wetted as a result of the 25-gal test procedure.

3.1.11 *water supply source valve, n*—the shutoff valve or hose bib at the source.

## 4. Summary of Test Method

4.1 A plastic or other waterproof lightweight material container of 5 US gal (18.95 L), full volume, is filled using a water source with a relatively constant flow to determine test flow rate, and which is then allowed to overflow the container at the calculated flow rate onto the test site area in an unconfined manner. The amount of time, in seconds, required to fill the container to the point of overtopping (overflowing) is set as the 5-gal flow rate of the test.

4.2 The container shall be leveled using the water level across the top of the container as the gauge. Leveling the container is accomplished using wood wedges, shims or similar devices. This leveling is intended to allow a somewhat uniform flow overtopping the full circumference of the top edge of the container.

4.3 A splash board made of plywood or other material can be placed below the container to control the erosive forces associated with the falling water on the test surface. This is not required however may be helpful during the procedure.

4.4 The test site area is pre-saturated by a volume of approximately 50 US gal (189.5 L) of water which has overflowed the container onto the surface and allowed to spread in an unconfined manner. This volume of water is then allowed to dissipate into the surface system or stone base until the surface is considered to be a dry surface. The 50 US gal (189.5 L) volume is metered based on the multiplying the time to fill the 5 gal container by a factor of 10.0. The 50 US gal (189.5 L) volume represents a volume equivalent to 1.0 in. (25.4 mm) of rain, applied without the effect of a hydraulic head, over an 80 $ft^2$ (7.43 $m^2$) area. At the point when the pre-wetted area on the surface is considered a dry surface the site is considered pre-saturated and ready for the 25 gal test volume.

4.5 The site is then flooded by the unconfined container overflow of 25 US gal (94.75 L) of water which has overflowed the container onto the surface and allowed to spread in an unconfined manner. This volume of water is then allowed to dissipate into the surface system or stone base until the surface is considered to be a dry surface. The 25 US gal (94.75 L) volume is metered based on the multiplying the time to fill 5 gal container by a factor of 5.0. The 25 US gal (94.75 L) volume represents an approximate volume equivalent to 0.5 in. (12.7 mm) of rain, applied without the effect of a hydraulic head, over an 80 $ft^2$ (7.43 $m^2$) area. The inclusive time period in seconds, from the start of container overflow to the point when the wetted surface of the test area is considered to be a dry surface, is recorded. This time period is identified as the time to dry. The wetted surface area of the test site is measured to determine the area of test site. Using the measured area of the test site and the actual volume of the 25 US gal test, a permeability rate is calculated.

## 5. Significance and Use

5.1 This test method can be used to determine in-place permeability of synthetic turf playing field systems, playing field systems with pad and or premolded drainage boards, playing field systems with premolded panel base systems, porous and non porous pavement systems in order to confirm compliance with design specifications and or evaluate existing as-built conditions. The simplicity of the test method, the quickness of the procedure, and the limited requirement for special tools and apparatus' makes this ideal for performing a large quantity of tests over a large area such as a sports field.

5.2 Synthetic turf field systems tend to drain under several flow regimes. The first flow regime is surface flow where water travels across the surface from typically higher elevations to lower elevations. The second flow regime is flow through the turf surface and base system. The third flow regime is lateral flow, which has two parts. Lateral flow within the section of the turf surface and lateral flow within the pre-molded drainage board, porous pavement and or base stone system below the turf. These are depicted diagrammatically in Fig. 1.

5.3 This test method can provide owners, designers and turf system builders with a clear indication of actual in-field permeability flow rates with limited effect of lateral flow through base systems and no effect from head pressure.

5.4 This test method can be used to determine the effectiveness of treatments intended to reduce the effect of hydrophobicity which has been known to decrease the permeability of some synthetic turf infill materials and components.

5.5 The observable performance of the test method enables one to determine permeability by both a quantitative and qualitative measure.

## 6. Interferences

6.1 The test site should be free from surface drains or other conditions that would result in nonrepresentative permeability rates. Other conditions such as open graded clean stone directly exposed at the surface would be expected to impact the test results.

6.2 In fields where collector piping backfill is open-graded and brought to the stone surface, care should be taken to located test sites such that impact from these areas is avoided or clearly noted in the test report.

## 7. Apparatus

7.1 *Plastic Container,* with a measured and confirmed volume of approximately 5 US gal (18.95 L). See Fig. 2.

7.1.1 The container shall be container clean of any debris or chemicals that may act as a surfactant.

NOTE 1—Soap residue can act as a surfactant which may reduce hydrophobicity and impact the results of the test method.

7.1.2 The container volume must be measured and confirmed prior to the test and the actual measured volume recorded in the test report. Volume shall be measured to the nearest 0.1 US gal (0.4 L).

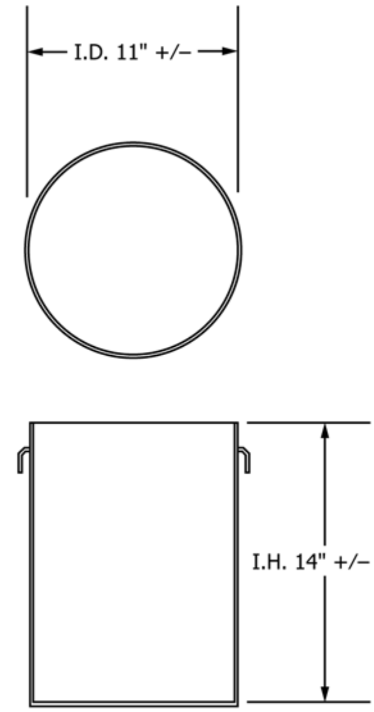


FIG. 2 Test Container Diagram

NOTE 2—For ease of calculation, the container volume can be measured and a base fill line near the container bottom representing the excess volume over the 5.0 gal quantity can be added to allow the testing volume to be consistently 5.0 gal. In this case, the base fill line represents the point at which 5.0 gal of volume is above the line.

7.1.3 The container should be equipped with a suitable handle for moving the full bucket into and out of the test site.

NOTE 3—It is recommended that water from the container not be poured onto the test site until the procedure is completed and that care should be taken to avoid damaging fine graded surfaces by aggressively pouring excess water from the container onto the test area.

7.2 *Constant Water Source:*

7.2.1 A source of water capable of supplying a constant flow rate throughout the test period must be used. Water supplies, whether public, private well or construction tank tend to vary over time and must be measured and reconfirmed for each test and test location. This method requires that for each test a new time to fill the container must be obtained. Should a test be



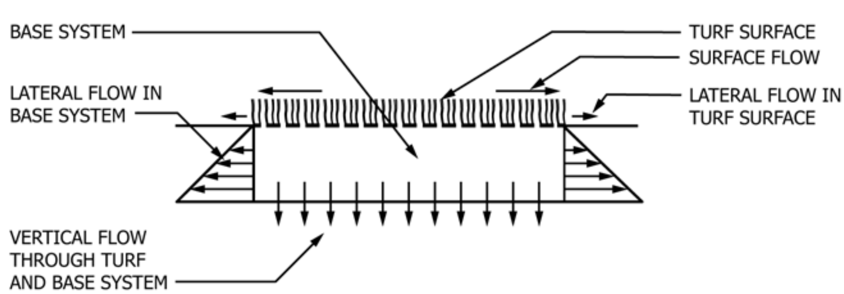


FIG. 1 Basic Flow Regime Diagram