Designation: C1814/C1814M – 16

Standard Test Method for Measurement of Hydraulic Characteristics of Stormwater Filtration Elements[1]

This standard is issued under the fixed designation C1814/C1814M; 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 standard shall be used to determine the hydraulic characteristics of stormwater filtration elements.

1.2 Elements tested shall be of a size commonly manufactured, not a scale model.

1.3 The position and orientation of all filter elements during testing shall be identical to the position and orientation used during normal operation.

1.4 The direction of flow during testing shall be identical to the direction of flow during normal operation.

1.5 As each stormwater treatment device is unique in design and hydraulic capacity, a sufficient number of accurately measured data points are needed to properly define the hydraulic characteristics of each test element. Therefore, it is imperative that the element setup and subsequent testing methodologies be well defined and executed to assure accurate flow and elevation data.

1.6 This test determines the hydraulic capacity of stormwater filtration systems. Test results are not an indicator of the filtration performance with respect to the capture of solids or other materials.

1.7 *Units*—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 nonconformance with the standard.

1.8 *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]

D3858 Test Method for Open-Channel Flow Measurement of Water by Velocity-Area Method

D4409 Test Method for Velocity Measurements of Water in Open Channels with Rotating Element Current Meters

D5089 Test Method for Velocity Measurements of Water in Open Channels with Electromagnetic Current Meters

D5242 Test Method for Open-Channel Flow Measurement of Water with Thin-Plate Weirs

D5389 Test Method for Open-Channel Flow Measurement by Acoustic Velocity Meter Systems

D5413 Test Methods for Measurement of Water Levels in Open-Water Bodies

D5460 Test Method for Rubber Compounding Materials—Water in Rubber Additives

2.2 *ASME Standard:*

MFC-3M Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *element*—the smallest filter unit that is commercially available or a combination thereof, or a full commercially available filter system comprised of one or more internal filter units.

4. Summary of Test Method

4.1 This test method describes procedures and equipment required to measure the hydraulic characteristics of filtration elements (as defined in 3.1).

4.2 Other standards that may be useful to reference include: Test Methods D3858, D4409, D5089, D5242, D5389, D5413, Guide D5460, and ASME MFC-3M (see Section 2).

[1] This test method is under the jurisdiction of ASTM Committee C27 on Precast Concrete Products and is the direct responsibility of Subcommittee C27.70 on Precast Concrete Products for Stormwater Management.

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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] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

5. Significance and Use

5.1 Each element has unique flow patterns and each element has unique hydraulic characteristics (that is, flow and head loss). In addition, each element may exhibit variable hydraulic capacity as the element filters become occluded, the filter media swells or shrinks, and water viscosity (that is, water temperature) changes. In some cases filters experience hysteresis with respect to filling and emptying. The testing procedure in Section 7 will help develop the parameters necessary to determine the hydraulic capacity of an element at one instance in time. The test can be repeated at desired time increments to determine how the hydraulic capacity varies over time.

6. Apparatus

6.1 The test element shall be set up in the same configuration as a commercially available element. Pipe type, diameter, and orientation shall be configured such that they represent approach angles and velocities found in the field.[4] The selection of the approach or inlet velocity shall be such that the resulting flow capacity is the lowest for the range of possible velocities. The inlet and outlet pipe elevations also need to be hydraulically representative of that found in the field.

6.2 All components of the experimental setup shall be inspected immediately before all testing to confirm that no damage or obstruction is present and that there are no sediments or other deleterious materials therein. Leakage from the system piping or from the element shall not exceed 0.5 % of the measured flow rate.

7. Test Parameters and Methodologies

7.1 Several parameters shall be measured, recorded, and reported for use in establishing hydraulic capacity: the type and gradation of filter media, flow rate and direction through the filter, the surface area of the filter in a plane perpendicular to the flow, surface loading rate (flow per area), piezometric head upstream and downstream of the filter, the length of the filter in the direction of flow, and water temperature. When a test element consists of more than one filter units, the filter surface area and length of filter in the direction of flow shall be reported for both the individual filter units and for the element as a whole.

7.1.1 *Flow Rate Measurement*—The methodology for flow measurement includes the gravimetric method and open-channel and closed-conduit (full-pipe) flow meters. Suitable methods include, but are not restricted to, velocity area sensors, appropriate weirs and flumes, and pressure drop measurement methods using orifices, nozzles, or Venturi tubes.

7.1.2 *Piezometric Head*—Piezometric head shall be recorded for each flow rate The head measurement is taken from the static water surface elevation on the upstream side of the filter element, and at the invert of the discharge side of the filter element or appropriate piezometic head measurement at the outlet. Data collected shall record the depth of the upstream water surface elevation (WSE) relative to the dimensions of the filter such that it is clear when the filter element is partially exposed, submerged, and surcharged. The outlet measurement locations shall remain fixed for all flow conditions and serve as an elevation datum for all the various changes in the upstream WSE.

7.1.3 *Filter Length*—The length of the filter in the direction of flow shall be measured and reported. Filter lengths as provided by the device manufacturer are acceptable as long as they are validated prior to testing.

7.1.4 *Filter Surface Area*—The filter surface area in a plane perpendicular to the direction of flow at the point of first contact with the filter media shall be measured to the nearest 2 %. Surface areas of common geometric shapes (for example, rectangles, squares, circles, ovals, etc.) may be determined from measuring characteristic lengths (for example, length of sides, diameters, etc.) and calculating, by geometry, the corresponding surface area. When the filter area varies in the direction of flow, the reported filter area shall be that of the outermost media/water interface.

7.1.5 *Temperature*—Tests shall be run at a water temperature of 17 to 27°C [62-80°F].[5] At a minimum, water temperatures shall be recorded three times: at the beginning, the middle, and the end of each test. The average temperature shall be used in data reduction and reporting.

8. Filter Conditioning

8.1 Initial runs may exhibit different filter properties[6] as compared to subsequent runs. Thus, in order to more accurately represent filter characteristics, all filters must be conditioned prior to testing. Conditioning seeks to have these changes occur before testing begins. Actual conditioning procedures shall be reported.

8.2 Water levels upstream and downstream of the filter element shall be established such that the filter is completely submerged and the flow rate achieved is at least 90 % of the maximum flow rate to be tested. The flow rate shall be maintained at this level for at least two hours with flow rate measurements being made every 10 minutes at a minimum. After a minimum of two hours of continuous flow, the flow into the filter element shall be stopped and the filter allowed to drain to its natural static level. The filter element shall rest in this state with no additional inflow for 24 to 48 hours before testing begins.

9. Procedure

9.1 All associated instrumentation shall be calibrated according to the manufacturer's specifications and verified before testing. Flow conditions shall be stabilized prior to commencement of testing. Flow conditions shall be considered stabilized when the upstream and downstream piezometric heads remain

[4] If the test cannot be run using the specified set up an alternative test set up may be used. In this case documentation shall be provided that states why the specified set up could not be used. The documentation shall also list all the ways that the test set up varies from the specified set up.

[5] The effect of temperature on viscosity is well known and can be significant over the given temperature range. Viscosity variations can potentially impact hydraulic characteristics.

[6] Filter properties may vary due to media compaction, the washing out of media fines, and media ripening, among others.