Designation: ~~C1745/C1745M – 18~~ C1745/C1745M – 24

Standard Test Method for Measurement of Hydraulic Characteristics of Hydrodynamic Stormwater Separators and Underground Settling Devices[1]

This standard is issued under the fixed designation C1745/C1745M; 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 concerns measurement of selected hydraulic characteristics of hydrodynamic separators and underground settling devices critical to their function as stormwater treatment devices.

1.2 Units tested shall be of a size commonly ~~manufactured, not a scale model.~~manufactured and available for purchase. In order to facilitate testing it is permissible to substitute alternate materials for the housing and structural components of the test units if operational components are at full size, with identical dimensions, configurations and materials specified for commercial use. Scale models are not permissible.

1.3 As each stormwater treatment device is unique in design, so are its hydraulic characteristics (flow versus head and loss coefficients). A sufficient number of accurately measured data points are needed to ~~define~~ properly define the hydraulic characteristics of each test unit. Therefore, it is imperative that the unit setup and subsequent testing methodologies be well defined and executed to ensure accurate flow and elevation data.

~~1.4 This test method addresses gravity flow operation only. It does not address performance of units operating under pressurized conditions.~~

1.4 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.~~as standard, except for methods to establish and report sediment concentration and particle size. It is convention to exclusively describe sediment concentration in mg/L and particle size in mm or µm, both of which are SI units. The SI units given in parentheses are mathematical conversions, which are provided for information purposes only and are not considered standard. Reporting of test results in units other than inch-pound units shall not be regarded as non-conformance with this test method.

1.5 *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.*

1.6 *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.*

[1] This test method is under the jurisdiction of ASTM Committee E64 on Stormwater Control Measures and is the direct responsibility of Subcommittee E64.01 on Lab Evaluation.

Current edition approved ~~May 1, 2018~~Jan. 1, 2024. Published ~~May 2018~~February 2024. Originally approved in 2011. Last previous edition approved in ~~2011~~2018 as ~~C1745/C1745M - 11~~.C1745/C1745M - 18. DOI: ~~10.1520/C1745_C1745M-18~~.10.1520/C1745-24.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3858E3318 Test Method for Open-Channel Flow Measurement of Water by Velocity-Area MethodTerminology for Standards Relating to Stormwater Control Measures (Withdrawn 2023)

D4409 Test Method for Velocity Measurements of Water in Open Channels with Rotating Element Current Meters (Withdrawn 2023)[3]

D5089 Test Method for Velocity Measurements of Water in Open Channels with Electromagnetic Current Meters (Withdrawn 2023)[3]

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

D5640 Guide for Selection of Weirs and Flumes for Open-Channel Flow Measurement of Water (Withdrawn 2023)[3]

2.2 *ASME Standard:*[4]

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *inlet (or outlet) rounding, n*—radius of fillet at inside pipe junction with separator structure.

3.1 *Definitions:*

3.1.1 For definitions of common technical terms used in this standard, refer to Terminology E3318.

3.2 *Definitions of Terms Specific to This Standard:*

NOTE 1—The terms and definitions related to this standard also relate to other standards currently being balloted. As such they are being balloted separately in a single terminology document, Terminology E3318.

4. Summary of Test Method

4.1 This test method describes procedures and equipment required to measure the hydraulic characteristics of hydrodynamic separators and underground settling devices used for treating stormwater runoff.

4.2 Other standards that may be useful to reference include: Test Methods D3858, D4409, D5089, D5242, D5389, D5413, Guide D5640, and ASME MFC-3M (see Section 2).

5. Significance and Use

5.1 Each device has unique flow patterns and turbulence characteristics. In addition, each device exhibits a wide range of efficiencies as discharge, particle size, particle density, and flow viscosity (that is, water temperature) change. The testing procedure in Section 7 will help develop the parameters necessary to input into a function that describes the performance of a device under a wide range of application conditions. Specifically, this test standard produces a characteristic curve that describes the hydraulic head-discharge relationship in a hydrodynamic separator over a range of flow rates typical in system operation.

6. Apparatus

6.1 The test unit shall be set up to reflect actual field installation parameters to the greatest degree possible. Influent and effluent pipes shall have a Manning's roughness coefficient not greater than 0.013 be the same diameter and shall be the minimum diameter recommended by the device manufacturer. Pipe type, diameter, slope (2 to 3 %), orientation, and inlet/outlet roundings shall be recorded and reported for each test. The influent pipe shall be a minimum of ten pipe diameters in length, or 6 m [20 ft] whichever

[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.

~~is less, to ensure a uniform approach flow to the test unit, and an effluent pipe of length equivalent to three pipe diameters with a free-fall condition at its downstream end.~~ equal or less than 25 % of the test unit inside diameter or inside width of the unit, being the smallest measured dimension.

6.2 The experimental setup includes an influent straight pipe (without bends) of minimum length equivalent to ten pipe diameters to ensure stable flow conditions upstream from the test unit. The effluent pipe length is to be from 3 ft to 5 ft long aswith a free-fall condition at its end. No fittings are allowed in the straight pipe with the exception of:

(1) Sediment injection port
(2) Water sampling port(s)
(3) Fitting connecting the inlet pipe and outlet pipe to the test unit
(4) Pressure transducer taps and temperature sensors

6.3 ~~All components of the experimental setup shall be inspected immediately before any testing to confirm that no damage or obstruction is present and that there are no sediments or other deleterious materials therein. Leakage in system piping or from the unit during the test is allowable as long as the leakage rate is less than 0.1 % of the measured flow rate.~~Pipe slopes for the influent and effluent pipes shall be 1-2 %.

6.4 Both influent and effluent pipes shall have smooth, non-corrugated interior walls with an accepted Manning's n value of <0.022 or a roughness of <5 mm.

7. Test Parameters and Methodologies

7.1 Three major parameters shall be measured and recorded for use in establishing a unit's hydraulic characteristics: flow, surface water elevations, and water temperature.

7.1.1 *Water Surface Elevation*—Pressure heads or water elevations shall be recorded to a minimum accuracy of 0.25 in. for each condition tested to determine the head elevations. The locations of elevation measurements shall be fixed for all flow conditions. Elevation measurements shall be recorded in the influent and effluent pipes at locations ~~2 ± 0.1~~1-2 ± 0.1 pipe diameters upstream and downstream of the unit using piezometer taps in the pipe inverts. Internal measurements shall be recorded at a location that allows determination of bypass flow. Measurements are to be recorded using a data acquisition (DA) system and pressure transducers, differential pressure (DP) cell or point-gage system adjusted to a known reference. Manual measurements using an engineer's ~~ruler~~scale are acceptable for estimated elevations and shall be recorded as such.

NOTE 2—When supercritical flow occurs in the outlet pipe, the energy head at the outlet may appear to exceed the energy head at the inlet leading to erroneous determination of a loss coefficient. Under this condition, the critical depth at the outlet shall be determined and used for calculation of the unit loss coefficient.

7.1.1.1 *Flow Measurement*—A flow meter or equivalent device must be located upstream of the device. If a constant head or equalization tank is used the head level in the tank must also be reported. All flow meters must be located a sufficient distance away from any velocity or turbulence increasing devices (valves, pumps, elbows, flanges, etc.) and mounted as required by the instrument manufacturer.

7.1.1.2 Flow measurements shall be made to a precision of 1 % of measured flow. The accuracy of the flow measurement shall be within ±10 % of the target value for controlled laboratory testing. The acceptable coefficient of variation of measurements should not exceed 0.03.

7.1.1.3 All flow meters used in this protocol must be calibrated as required by the instrument manufacturer. Copies of flow meter calibrations shall be included in the final report. The flow meter data logger must record flows at a minimum of once per minute so that samples can be compared to corresponding flow rate values. The average flow rate shall be reported.

~~NOTE 1—When supercritical flow occurs in the outlet pipe, the energy head at the outlet may appear to exceed the energy head at the inlet leading to erroneous determination of a loss coefficient. Under this condition, the critical depth at the outlet shall be determined and used for calculation of the unit loss coefficient.~~

~~7.1.2 *Flow Measurement*—The accuracy of the flow measurement shall be within ±5 % for controlled laboratory testing. The acceptable coefficient of variation of measurements is 0.03. The methodology for flow measurement includes the gravimetric~~