Designation: E3373 – 23

Standard Test Method for Scour of Hydrodynamic Separators and Settling Devices[1]

This standard is issued under the fixed designation E3373; 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 covers the testing of hydrodynamic stormwater separators and underground settling devices as it relates to the measurement of the resuspension and washout (scour) of previously captured sediment.

1.2 Units tested shall be of a size commonly 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 The test method provides a means of evaluating retention of suspended solids previously captured in with a manufactured treatment device (MTD) that is placed as an offline or online treatment device along storm drain pipe lines. It provides criteria in which to evaluate whether the MTD is appropriate for installation in offline or online conditions.

1.4 This test method provides the means for evaluating the scour potential for both offline and online conditions.

1.5 *Units*—The values stated in inch-pound units are to be regarded 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 nonconformance with this test method.

1.6 This test method may be subject to specific requirements set by a Quality Assurance Project Plan, a specific verification protocol, or Authority Having Jurisdiction (AHJ). It is advised to review one or all of the above to ensure compliance

1.7 Acceptance of test results attained according to this specification may be subject to specific requirements set by a Quality Assurance Project Plan, a specific verification protocol, or Authority Having Jurisdiction (AHJ). It is advised to review one or all of the above to ensure compliance.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *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 *ASTM Standards:*[2]

C1745/C1745M Test Method for Measurement of Hydraulic Characteristics of Hydrodynamic Stormwater Separators and Underground Settling Devices

C1746/C1746M Test Method for Measurement of Suspended Sediment Removal Efficiency of Hydrodynamic Stormwater Separators and Underground Settling Devices

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D3977 Test Methods for Determining Sediment Concentration in Water Samples

D4959 Test Method for Determination of Water Content of Soil By Direct Heating

D5241 Practice for Micro-Extraction of Water for Analysis of Volatile and Semi-Volatile Organic Compounds in Water

D6889 Practice for Fast Screening for Volatile Organic Compounds in Water Using Solid Phase Microextraction (SPME)

D6913/D6913M Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

D7928 Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation

[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.

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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.

(Hydrometer) Analysis
E3317 Specification for Silica-Based Sediments for the Evaluation of Stormwater Treatment Devices
E3318 Terminology for Standards Relating to Stormwater Control Measures

3. Terminology

3.1 *Definitions:*

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

4. Summary of Test Method

4.1 This test method describes procedures and equipment required to measure the susceptibility to scouring and re-suspension of settled sediments in hydrodynamic separators and underground settling devices used for treating stormwater runoff.

5. Significance and Use

5.1 This test method provides test results for evaluating the potential for scour of sediment captured within a MTD in online and offline configurations.

5.2 This test method will determine if an MTD can meet the scour performance requirements prescribed by an associated verification protocol or local AHJ requirements.

6. Apparatus and Setup

6.1 The experimental setup includes a water supply, piping, fittings, background sampling port, sediment delivery system, flow meter, temperature instrumentation, scales/balances and sample containers. Set up may also include a false floor.

6.1.1 *Water Supply:*

6.1.1.1 Water upstream of the sediment delivery system shall be "clear." Clear water is defined as having a background SSC no more than 20 mg/L.

6.1.1.2 "Recirculated" water that passes through the test unit shall not be redirected into the test unit until it has been filtered such that it is indistinguishable from "clear" water. If background SSC of the recirculated water is below 20 mg/L filtration is not required

6.1.1.3 The use of flocculants, surfactants, etc. is not an acceptable means to reduce background SSC levels.

6.1.1.4 If a non-potable water source is used, VOC testing in accordance with Practice D5241 or Practice D6889 shall be conducted and the values shall be reported.

6.1.2 *Piping:*

6.1.2.1 The test unit shall be set up to reflect actual field installation parameters to the greatest degree possible. Influent and effluent pipe shall be the same diameter and shall be equal to or less than 25 % of the test unit inside diameter or inside width of the unit, being the smallest measured dimension.

6.1.2.2 The experimental setup includes an influent straight pipe (without bends) of minimum length equivalent to five pipe diameters or 20 ft (6.10 m), whichever is less, to ensure stable flow conditions upstream from the test unit. The effluent pipe length is to be from 3 to 5 feet (0.91-1.5 m) long with a free-fall condition at its end. No fittings are allowed with the exception of:

(1) Sediment injection port

(2) Water sampling port(s)

(3) Fittings connecting the influent pipe and effluent pipe to the test unit

(4) Pressure transducer taps and temperature sensors

6.1.2.3 Pipe slopes for the influent and effluent pipes shall be 1-2 %.

6.1.2.4 Both influent and effluent pipes shall have smooth interior walls with an accepted manning's *n* value of <0.02 or a roughness of <5mm.

6.1.3 *Background Sampling Port:*

6.1.3.1 The background sampling port shall be at a fixed, pre-determined location on the influent pipe upstream from the MTD.

6.1.3.2 The background sampling port shall be placed at the invert, and along the centerline, of the influent pipe.

6.1.3.3 The background sampling port shall utilize a tee with a maximum diameter of 2 in. (50 mm) and a ball valve.

6.1.3.4 The background sampling port shall not extend higher than the invert of the influent pipe.

6.2 *Flow Measurements:*

6.2.1 A flow meter of sufficient accuracy, precision, and stability to meet the requirements of this standard must be located upstream of the tested unit at a location in or on the influent pipe where full pipe flow is attained to accurately measure the flow through the unit tested.

6.2.2 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.

6.2.3 All flow meters shall have a valid certificate of calibration or verification in force at the time of testing. A copy of the certificate or validation shall be included in the final report.

6.2.4 The flow meter data logger must record flows at a minimum of once per minute so that effluent sediment concentration samples can be matched to specific flow rate values. The flow meter data logger must record flows to the nearest 1 gpm (0.063 L/s). The average flow rate shall be reported. The Coefficient of Variation (COV) shall be ≤0.03.

6.2.5 During testing, the allowable variation shall be ±10 % of the target flow rate.

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.

7. Sampling and Sample Testing

7.1 *Background Sampling:*

7.1.1 A minimum of eight (8) Background SSC samples must be obtained at a pre-determined location upstream of the MTD inlet;

7.1.2 During background sampling, the valve to the background sampling port shall be opened for a minimum of three seconds prior to sampling to flush the sampling port of any sediment that may have accumulated within the port.

7.1.3 Each sample shall be collected in a clean 1 L container or larger with a wide mouth and shall be a minimum volume of 500 mL.

7.1.4 Influent background samples shall be taken in correspondence with the odd number effluent samples (first, third, fifth, etc.).

7.1.5 The time each background and effluent sample is collected shall be recorded. The background data will be used in adjusting the effluent samples for background concentration.

7.1.6 All samples shall be analyzed for SSC in accordance with Test Methods D3977.

7.1.6.1 If a sample sediment concentration is lower than the detection limit, 50% of the detection limit shall be the reported value.

7.1.7 Background concentration shall not exceed 20 mg/L for any samples collected.

7.2 *Sampling of Effluent:*

7.2.1 Sampling shall be performed using either the Isokinetic Sampling Method or the Grab Sampling Method.

7.2.2 Grab Sampling Method allows for conducting manual sample collection. The effluent sample location shall be at the end of the outlet pipe. The end of pipe sample shall be collected by moving the container through the free discharge from the effluent pipe in a single sweeping motion.

7.2.3 Each sample shall be collected in a clean 33 oz (1 L) container or larger with a wide mouth and shall be a minimum volume of 16.9 oz (500 mL).

7.2.4 Samples shall be taken downstream of the device such that any internally bypassed water is also sampled

7.2.5 Fifteen (15) samples shall be taken over the duration of the test.

7.2.6 Flow rates shall be recorded at least once every minute so that samples can be matched to corresponding flow rate values.

7.2.7 All samples shall be analyzed for SSC by a certified third party laboratory in accordance with Test Methods D3977.

8. Test Procedure

8.1 The sedimentation storage sump(s) shall be pre-loaded with sediment to 50 % of the manufacturer's recommended maximum sediment storage volume. If a manufactured treatment device has more than one sediment storage sump, all sumps must be preloaded with sediment to the 50 % of the manufacturer's recommended maximum sediment volume.

8.2 A false floor may be placed in the sedimentation chamber at a level equal to or below the 50 % maximum sediment storage volume minus 4 inches. The false floor is then covered with sufficient sediment to achieve 50 % of the maximum storage volume.

8.3 The test sediment layer shall either be leveled or placed in a condition documented to be similar to actual laboratory sediment removal testing observations (for example, cone or favored to the influent side).

8.4 The scour testing pre-load sediment particle size distribution shall be in accordance with Table 1 in Specification E3317.

NOTE 1—Mandated PSD is subject to change by AHJ or associated verification protocol.

8.5 The MTD shall be filled with clear water to its stipulated normal dry weather operating depth.

8.6 Scour test shall start within 96 hours of preloading/prefilling the unit.

8.7 Testing shall commence by conveying clear water through the MTD at increasing flow rates up to values prescribed by an associated verification protocol or local AHJ requirements.

NOTE 2—Acceptable testing flowrates for NJ protocol compliance are 125 % of the MTFR for offline units or 200 % of MTFR for online units.

8.8 Testing begins when the flow of water into the unit starts. The flow rate shall be increased to the target flow rate within 3 minutes of commencing the test.

8.9 The flow rate shall remain constant (±10 %) at the targeted flow rate for the remainder of the test duration.

8.10 Tests shall be run at water temperatures not to exceed 80°F (26.7°C). At a minimum, water temperatures in the supply line of the test unit shall be recorded three times, at the beginning, the middle, and the end of each test. The maximum temperature shall be used in data reduction and reporting.

8.11 Effluent samples are to be taken at 1, 3, and 5 minutes and then every two minutes thereafter for an additional 12 samples. The timing used for sample collection shall start when the water flow to the unit starts.

8.12 Background samples shall be taken at the same time as every odd numbered effluent sample.

9. Calculation or Interpretation of Results

9.1 All effluent sample results from a scour test must be adjusted for background concentration [effluent concentration = recorded effluent concentration – background concentration (maximum allowable background is 20 mg/L)].

9.2 The time each background and effluent sample is collected shall be recorded. The even numbered background sample values shall be determined by interpolating between the nearest odd numbered values.

9.3 Background concentrations shall not exceed 20 mg/L at any time during testing.

9.4 The 15 adjusted effluent sample results used to determine the average effluent SSC concentration.

NOTE 3—The acceptable effluent value for scour testing is subject to change by the AJH.

NOTE 4—Acceptable effluent concentration for NJ protocol compliance is <20 mg/L.

10. Report

10.1 Measurements for each datum shall be recorded for the following parameters regardless which effluent sampling method is utilized:

10.1.1 A labelled diagram including:

10.1.1.1 Location and capacity of water source,

10.1.1.2 Pump type and location,