Canadian Procedure for Laboratory Testing of Oil-Grit Separators

A Publicly Available Specification

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Publication Information

This Publicly Available Specification (PAS) was prepared by the Toronto and Region Conservation Authority (TRCA) with support from the Standards Council of Canada. As a Vocabulary this PAS takes the form of guidance and recommendations on policies, practices and approaches. The user should be aware that the process used to develop this document does not include the full consensus process normally associated with standards. It is the responsibility of the user of this document to judge the suitability of the document for the user's purpose. A PAS can be considered for further development as a Canadian Standard.

The *Procedure* presented in this document builds on existing laboratory testing procedures for hydrodynamic separator manufactured treatment devices in the United States. The most notable of these is the New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device, finalized on January 25, 2013, and updated on January 1, 2021.

Citation: Toronto and Region Conservation Authority, 2023. *Canadian Procedure for Laboratory Testing of Oil-Grit Separators,* Toronto, Ontario.

The TRCA retains ownership and copyright of this PAS, which will be reviewed at intervals not exceeding 2 years. Any amendments arising from the review will be published as an amended PAS.

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Use of the Document

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Developing a Publicly Available Specification

In collaboration with the SCC, the TRCA leveraged Canada's standardization system to bring together experts and organizations to define key terms and develop a PAS on how to apply these definitions.

This PAS builds on preliminary research and a series of public consultations with key experts, as well as those representing provincial agencies, municipalities, small and medium enterprises, large businesses, non-profit organizations, post-secondary institutions and others. Their comments on initial base documents, as well as written feedback and consultation transcripts, were analyzed. Suggestions were reviewed by the Steering Group and representatives from the SCC.

This PAS provides definitions and procedures for performance testing, reporting and verification of oil-grit separator manufactured treatment devices

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Industry organizations (i.e., technology companies, vendors, manufacturers, intellectual property owners, licensees)

This laboratory testing *Procedure* was originally prepared by TRCA in 2013 for the Canadian Environmental Technology Verification (ETV) Program (which ended in 2016), with assistance from a Technical Advisory Committee made up of 32 representatives from government and industry.

Preface

In Canada and other jurisdictions, different regulatory agencies and permitting authorities may have different requirements and performance criteria for approval and acceptance of various stormwater treatment devices for specific applications and operating conditions. To support their decisions, these agencies and authorities can benefit from scientifically defensible, verifiable performance data applicable to a range of possible end use requirements and operating conditions.

The "*Procedure for Laboratory Testing of Oil-Grit Separators*" was initially prepared in 2013 by TRCA for the Canadian Environmental Technology Verification (ETV) Program. When the Canadian ETV Program ended in 2016, the *Procedure* was subsequently used by various parties as the basis for Oil-Grit-Separator (OGS) technology performance testing and subsequent verification following the requirements of the International Organization for Standardization ISO 14034:2016 ETV standard, published in November 2016.

This Publicly Available Specification (PAS) was developed under the Canadian Stormwater Environmental Technology Verification (SETV) project, which was established to develop publicly available specifications for testing and verification of stormwater manufactured treatment devices. It consists of a review and update of the original 2013 *Procedure* for testing and verifying the performance of OGS Manufactured Treatment Devices (MTDs). Independent verification of the performance data using the *Procedure* as the basis for testing has and will continue to assist Canadian regulatory agencies, permitting authorities and other affected stakeholders in evaluating treatment technology options.

Although this *Procedure* is not intended to be a compulsory standard, it does represent an effective approach for conducting testing to produce verifiable performance data on specific technologies under defined operating conditions. When applied in accordance with the requirements of the ISO 14034 ETV standard, the *Procedure* reduces uncertainties and improves the likelihood of market acceptance of the independently generated performance data, contributing to more informed technology decisions. As such, it responds to a recognized market need, representing a consensus among stakeholders and experts for a standardization approach that serves an important public policy interest in an evolving technology and services market.

It is understood that the ultimate decision to approve, select and implement a particular technology is the responsibility of the technology buyer, guided by the requirements of the respective permitting authorities within the affected jurisdiction(s). Application of this *Procedure* will assist in the calibration and parameterization of OGS Manufactured Treatment Device (MTD) sizing models and calculators applied by regulators and the regulated community to select device types and sizes that are required to meet regulatory goals and other storm water management criteria.

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1.0 Scope

This Canadian Publicly Available Specification (PAS) was developed under the Canadian Stormwater Environmental Technology Verification (SETV) project, which was established to develop publicly available specifications for testing and verification of stormwater manufactured treatment devices. It responds to a recognized market need, representing a consensus among stakeholders and experts for a standardization approach that serves an important public policy interest in an evolving technology and services market.

This PAS specifies the technology performance test procedures required for OGS MTDs seeking verification under the ISO 14034 ETV standard. OGS MTDs (also referred to in this document as MTDs) are devices consisting of one or more chambers with internal components that remove high specific gravity particulates by sedimentation and low specific gravity liquids and debris by floatation. The devices are distinguished from Filtration MTDs in that they do not include filter(s) that would be expected to significantly restrict or impede flow either initially or within the normal maintenance cycle.

This standardized laboratory testing *Procedure* is to be used as the basis for determining the capacity of MTDs to capture and retain sediment and light liquids under the specified test conditions. Application of this *Procedure* will inform MTD sizing methods applied by regulators and the regulated community to predict the effectiveness of these devices in meeting regulatory goals and other stormwater management requirements. A separate PAS provides guidance on the use and application of verified testing data of stormwater treatment technologies for regulatory review.

The specific objectives of the *Procedure* are to:

- quantify the sediment removal performance, by particle size fraction, of a device under different SRLs (flow rate per unit sedimentation area);
- propose a methodology for scaling the performance results obtained from this testing *Procedure* to larger or smaller untested devices in the same device classification;
- quantify the mass, by particle size fraction, of sediment particles that may be re-suspended and washed out of a MTD at high flow rates;
- assess the quantity of light liquid that may be captured, re-entrained and washed out from a MTD at high flow rates, and
- measure hydraulic performance of the MTD to quantify head loss and bypass rates.

2.0 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ISO 14034:2016, Environmental management — Environmental technology verification (ETV)
- ISO/IEC 17020, Conformity assessment - Requirements for the operation of various types of bodies performing inspection
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

3.0 Terms and Definitions

Bypass: An MTD design feature or upstream diversion structure that allows flow rates or flow volumes higher than a predetermined flow rate to be routed past the stormwater treatment technology without receiving treatment.

Commercially available: A MTD that is engineered, sold and deployed in the field for use as a stormwater control measure.

Effective Treatment Area: The area within the MTD where sedimentation occurs.

False Floor: For the purpose of sediment removal and scour testing, a temporary construct in an MTD test device used to simulate performance of a device that is partially filled with sediment.

Head Loss: The difference in static water pressure upstream and downstream of a structure. Head loss is influenced by material roughness, flow velocity, system eddies, direction of flow and flow path length.

International Organization for Standardization (ISO) Environmental Technology Verification (ETV) Standard: ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the International Organization for Standardization (ISO). The ISO ETV standard specifies that technology operating conditions shall be clearly stated, and the performance parameters shall be measurable using quality-assured test procedures and analytical techniques. The objective of ETV is to provide credible, reliable, and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact.

Light Liquid: Liquid with a density no greater than 0.95 g/cm3, which is completely, or nearly insoluble and unsaponifiable.

Modified Mass Balance Test Method: The method to determine sediment removal rates by comparing a known influent mass of test sediment to the mass of test sediment retained by the MTD.

Maintenance Sediment Storage Depth and Volume: The maintenance sediment storage depth and volume of a MTD represents the amount of sediment that can accumulate in the MTD prior to maintenance, as recommended by the manufacturer or approval agency.

New Jersey Department of Environmental Protection: The New Jersey Department of Environmental Protection (NJDEP) is a government agency in the U.S. state of New Jersey that is responsible for managing the state's natural resources and addressing issues related to pollution.

Oil-Grit Separator: Treatment devices consisting of one or more chambers with internal components that remove high specific gravity particulates by sedimentation and low specific gravity liquids and debris by floatation. These devices are also referred to as hydrodynamic separators.

Particle Size Distribution: The particle-size distribution (PSD) of a material, or particles dispersed in fluid, is a list of values that defines the relative amount, typically by mass, of particles present according to size.

Retention Chamber: The chamber in which sediment is retained through settling. The chamber may include ledges, pre-treatment areas or other horizontal surfaces that may be subject to scour if sediment settles in these areas.

Scour: The resuspension and washout of previously captured sediment, resulting in loss of previously captured pollutants from a treatment device.

Surface Loading Rate: Surface Loading Rate (SLR) - The SLR is a hydraulic loading factor expressed in terms of flow per surface area. This factor is also referred to as the surface settling rate, surface overflow rate or hydraulic loading rate. The SLR is computed as follows:

$$Surface\ Loading\ Rate = \frac{Flow(\mathrm{L}\,min^{-1})}{Effective\ Treatment\ Area\ of\ the\ Device\ (m^2)}$$

where the Effective Treatment Area is the area in the MTD where sedimentation occurs.

Sump: The primary sediment capture and storage location in the MTD.

Test Body: The Test Body is an organization providing the means for test implementation, including performing and reporting on the testing of an environmental technology for the purposes of verification as specified in ISO 14034.

Test Plan: Prepared by the third-party testing body and submitted to the VB for review by the VE prior to the initiation of monitoring or technology performance testing. The term “Technology Specific Test Plan” (TSTP) is also used. The Test Plan outlines quality-assured test procedures and analytical techniques used to ensure results are scientifically defensible and meet the objectives outlined in the verification plan.

Verification Body: The Verification Body (VB) is a third-party organization that administers the testing and verification process and acts as the point of contact for all questions relating to the verification. The VB and Verification Expert must meet the conformity requirements of ISO 17020 or equivalent.

Verification Expert: The Verification Expert (VE) is the third-party, impartial technical reviewer sub-contracted by the ISO 14034 VB to supply assessment and validation expertise and services. The VE may not both generate the required data and then assess/validate that same data for any one performance claim, as this would present a conflict of interest with respect to that verification. The VB and VE must meet the conformity requirements of ISO 17020 or equivalent.

Verification Plan: Prepared by the Verification Body to guide the verification process, specifying accountabilities and related quality requirements in accordance with the ISO 14034 ETV standard.

Verifier: The verifier is the organization that performs environmental technology verification (as defined in ISO 14034:2016). The term can apply to a Verification Body, a Verification Expert, or a combination of the two.

4.0 Performance Test Body and Verification Requirements

4.1 Test Body

The testing shall be conducted by an independent third-party Test Body that meets the requirements of ISO 17025, or equivalent. The Test Body shall have experience with the test and laboratory methods specified in this *Procedure* and have the infrastructure and staff expertise needed to perform the full range of testing in a manner that generates reliable and repeatable results. In addition, Test Body staff shall have a thorough understanding of the operation of MTDs, acquired by laboratory or field work hydraulics (including particle settling) and stormwater sampling, including expertise in the statistical analysis of the data being collected. The Test Body prepares the Technology Specific Test Plan and Test Report.

4.2 Verification Body and Expert

The Verification Body (VB) is a third-party organization that administers the verification process and acts as the point of contact for all questions relating to the verification. The VB contracts an independent, impartial Verification Expert (VE) that is responsible for reviewing the reporting and analysis prepared by the Technology Performance Test Body and delivering a verification report and verification statement. The VB and VE must meet the conformity requirements of ISO 17020 or equivalent.

The ISO 14034 ETV standard guides the verification process, specifying accountabilities and related quality requirements in the form of a verification plan. The publicly available verification statement for the class of technologies referred to as MTDs shall conform to the minimum content requirements listed in Appendix E.

5.0 Sediment Removal Performance Test

The tested MTD shall be a full scale, commercially available device with the same configuration and components as would be typical for an actual installation. Allowances may be made for the substitution of the housing, or other structural components that do not affect performance, which may be used to facilitate laboratory testing. The sediment removal test requires the MTD be set-up to simulate a realistic in-situ operating state. The test is then run on a clean system, with clean water that has a background total suspended solids concentration (SSC) below 20 mg/L. A false floor shall be installed to simulate having the sediment retention chamber filled to 50% of the manufacturer's recommended Maximum Sediment Storage Depth.

5.1 Test Sediment

The test sediment used for sediment removal performance testing shall be comprised of inorganic ground silica with a specific gravity of 2.65, uniformly mixed to meet the PSD shown in Table 5.1. The PSD includes a broad range of particle sizes from clay to coarse sand.

Table 5.1: PSD of Test Sediment

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Nominal Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

The test sediment batch shall be separated into individual batches for use in testing at each of the required SLRs (minimum 7) and for preloading (minimum 1) during the sediment resuspension and scour test (see section 6.0 below). Samples of sediment from each individual test run batch shall be collected and analyzed for PSD in accordance with ASTM D6913-17 and ASTM D7928. The average PSD of the samples shall be allowed to vary from the specified percent less than value in Table 5.1 by three percentage points, as long as the median particle size (d_{50}) does not exceed 75 µm. For each of the individual eight samples, the PSD shall be allowed to vary from the specified percent less than value in Table 5.1 by five percentage points, as long as the median particle size does not exceed 75 µm. The individual test run PSD samples will be used to calculate removal efficiencies by particle size fraction, in conjunction with a single PSD sample from the retained sediment mass (see section 5.4).

5.2 Test Conditions

The system shall be clean with no pre-loaded sediment. A false floor shall be set to 50% of the manufacturers recommended Maximum Sediment Storage Depth to mimic a partially filled device. The set-up of the test system needs to reflect realistic operation of a gravity flow device in the storm sewer. The inlet and outlet pipes shall have a minimum slope of 1% and a diameter not exceeding 25% of the diameter or width of the unit. Temperature of the water used in the test shall not exceed 25°C.

5.3 Test Parameters and Requirements

In order to obtain an accurate accounting of performance for sediment removal, tests shall be conducted at each of the different test SLRs specified in section 5.3.1. To achieve stabilized flows and sediment fluxes through the MTD, the tests shall be run for a minimum duration. A minimum mass of sediment shall also be injected to limit analytical errors associated with mass balance testing (see section 5.3.2 below).

5.3.1 Flow rates and hydraulic characteristics

The flow rates tested should be sufficient to characterize the performance curve across different SLRs. A minimum of seven steady state SLRs shall be tested: 40, 80, 200, 400, 600, 1000 and 1400 Liters per minute (L min^{-1}) per square metre (m^2) of Effective Treatment Area, where the Effective Treatment Area is defined as the horizontal area in the MTD over which sedimentation occurs. Testing at additional SLRs may be conducted at the manufacturer's discretion. These shall be reported in the Test Report and considered for inclusion in the publicly available verification statement. The flow rates associated with each SLR shall be determined based on the specified SLRs and the Effective Treatment Area of the tested MTD. It should be noted that some Canadian jurisdictions (*e.g.* Quebec) may require sediment removal performance testing at SLRs exceeding the highest SLR noted above. Therefore, the maximum SLR to be tested should be confirmed after reviewing approval criteria in the jurisdiction(s) where manufacturers are seeking approval for installation.

Flow rates from calibrated flow instruments shall be recorded at intervals no longer than 30 seconds for test run flow durations less than 2 hours, and no longer than 1 minute for longer test run flow durations. Instrument calibration reports shall be submitted with the final Test Report. Flow rates shall not vary from the target flow rate by more than ±10% and have a Coefficient of Variation (COV) of less than 0.04.

Head loss across the MTD shall be measured on a clean unit without sediment over the full range of operational flow rates using calibrated instruments installed at appropriate locations. Tests shall be run with a false floor at 50% of the manufacturer's recommended sediment storage depth. The methodology for measuring head losses shall be determined by the independent Test Body based on the unit design and described in detail within the Test Report. If available at the time of testing, the methodology shall follow the latest revision to *ASTM C1745/C1745M-18: Standard Test Method for Measuring Hydraulic Characteristics of Hydrodynamic Separators and Underground Settling Devices*. Loss coefficients shall be reported over the full range of test flow rates and include measurements before and after correction for velocity head. The maximum treatment SLR prior to the onset of bypass shall also be measured.

5.3.2 Test duration

The test duration shall be the greater of 25 minutes total or the length of time required to complete 8 volume exchanges of the primary sedimentation chamber. The test shall also ensure that a minimum of 11.3 kg of sediment is fed into the MTD during the test, even if the duration and volume exchange criteria have been satisfied.

5.3.3 Influent sediment concentration

The test requires use of a calibrated sediment feed system that delivers a constant concentration of 200 mg/L (within ±25 mg/L) over the duration of the test. The maximum length of pipe from the point where sediment is injected to the test unit shall not exceed 0.91 m (3 feet) upstream of the inlet. Injection of test sediment shall be initiated only after a constant flow rate has been achieved. Six calibration samples shall be collected from the injection point at evenly spaced intervals over the duration of the test to verify that the test sediment is being injected at a constant rate. Calibration samples shall be a minimum 0.1 L, or the collection interval shall not exceed one minute, whichever comes first. The collection time may be extended to ensure that a minimum sample size of 20 g is collected. The samples shall be weighed to the nearest 10 milligrams and the concentration COV shall not exceed 0.10.

The average influent concentration during the test shall be determined based on the mass injected divided by the volume of water flowing through the unit during the period of sediment injection. The moisture content of the test sediment used for each flow rate test should be measured in accordance with ASTM D2216 (2019). The test sediment used in each test shall be sampled and analyzed for PSD in accordance with ASTM D6913/7928, as described in section 5.1.

5.3.4 Modified mass balance

The influent sediment mass load and retained sediment mass shall be measured. The influent mass is equal to the mass of test sediment injected over the duration of the test. Sediment retained within the unit is to be collected at the end of the test for mass balance analysis. Sediment collected from the inlet pipe and sump(s) and other significant settling areas outside of the sump(s) (if applicable) shall be measured and reported separately. Significant settling areas are a single area or a collection of areas outside of the main sump(s) where more than 5% of the total retained mass settled during the 40 L min^{-1} m^{-2} sediment removal test. The water remaining in the unit after the test shall be decanted over a period not exceeding 30 hours after the end of the test. The decanted water shall be discarded. The remaining mixture of sediment and water in the MTD retention chamber shall be transferred to pre-weighed nonferrous trays for drying.

After drying and weighing following ASTM D2216 (2019), the sediment collected from each source - the inlet pipe, sump(s) and other settling areas (if applicable) - is to be separately mixed, and a sample of the well-mixed sediment collected from each source area shall be analyzed for PSD in accordance with ASTM 6913/7928, as described in section 5.1. If the mass of sediment in small areas outside of the main sump(s) where sediment was observed to settle does not meet the minimum sample mass for PSD analysis (e.g. 300 g), the Verification Expert and Test Body will provide direction on how sample masses may be combined to meet the requirement.

5.3.5 Background samples

Aqueous background suspended solids samples shall be taken over the entire testing period at minimum one hour increments and a minimum of 5 samples shall be taken at equally spaced intervals for test run durations less than 5 hours. These samples are to be analyzed by the SSC method ASTM D3977-97. SSCs of background samples shall be less than 20 mg/L.

5.4 Sediment removal calculation

The sediment removal efficiency shall be calculated and reported based on the influent mass load and retained mass load, as follows:

$$Removal\ Efficiency\ (\%) = \left(\frac{Total\ Mass\ Retained}{Inlet\ Mass\ Injected}\right) * 100$$

where the mass retained is the mass collected from the MTD after completion of the test, including any residual sediment accumulated in the inlet pipe. Removal efficiency calculations shall be provided both for the combined mass accumulated in the inlet pipe and MTD retention chamber as well as for the mass captured in the MTD retention chamber alone. The vendor may claim the higher of the two values only if the median particle size of the sediment sample collected in the inlet pipe is greater than 150 µm. Otherwise claimed removal efficiencies shall be based on the sediment mass accumulated in the MTD retention chamber alone.

Sediment removal results shall be reported as a percentage of influent mass retained, both for the total mass and by individual particle size fractions. The PSD of the samples taken from each of the influent and retained mass, as described previously, shall be used as the basis for reporting removal efficiencies by particle size fraction. The size fractions used for reporting of removal efficiencies shall include, at a minimum, the following:

< 8 µm
8 µm - 50 µm
50 µm - 100 µm
100 µm - 250 µm
> 250 µm

Laboratory results may be graphically or statistically interpolated for the purposes of reporting sediment removal results in the size fractions shown above. However, to minimize errors, interpolations of analytical laboratory data should be based on as many discrete size fractions as is practically feasible.

6.0 Sediment Scour and Re-suspension Test

Sediment scour and re-suspension testing is done on the same unit tested for sediment removal to determine the mass and range of particle sizes that are re-suspended and washed out during high flows. The test sediment is the same as that used in the sediment removal test, and effluent results are reported by total mass load and particle size fraction. The re-suspension test requires the MTD to be set up in an operating condition that mimics a MTD filled to half of the maximum recommended sediment storage depth. A false floor can be used, with a specified quantity of test sediment on top of the false floor. For the purposes of assessing the potential for sediment re-suspension, test results are to be interpreted in relation to the particle size fractions retained by the MTD during the sediment removal performance tests (see section 6.4 below).

6.1 Preloaded Test Sediment

The test sediment preloaded in the sedimentation chamber shall be the same batch prepared for the sediment scour and re-suspension test and tested for PSD, as described in section 5.1 above. Ledges or surfaces other than the main sump(s) shall also be preloaded with sediment if: (i) the total mass is greater than 5% of the total sediment captured in the retention chamber during the 40 L min^{-1} m^{-2} sediment removal test, and (ii) the median particle size of the sediment captured during the same sediment removal test is equal to or less than 150 µm. Where there are multiple areas with varying amounts of sediment, the total of which exceeds the 5% threshold, the Test Body and VE shall provide direction on the sediment preloading locations and patterns based on observations and measurements during the 40 L min^{-1} m^{-2} sediment removal test. Likewise, if the PSD of the sediment deposited in one or more locations outside of the main sump(s) is appreciably coarser than the test PSD (*e.g.* pre-treatment area), the Test Body and VE shall provide direction on the PSD of the sediment that is preloaded in these locations.

6.2 Test Conditions

This test is run with clean water at temperatures not exceeding 25°C. The false floor, if used, is set to a minimum of 10.2 cm below 50% of the maximum recommended sediment storage depth and covered with the required quantity of test sediment to achieve the 50% capacity level. The sediment shall be evenly distributed and leveled.

The MTD shall be filled with clear water to a normal operating depth prior to initiating flows. Background SSCs of the clear water used to fill the MTD shall be less than 20 mg/L. The test shall be initiated within 96 hours of pre-loading of the unit.

6.3 Test Parameters and Requirements

6.3.1 Flow Rates

Re- suspension and washout of sediments is determined at five SLRs that shall be increased in 5-minute intervals from 200 to 800 to 1400 to 2000 to 2600 L min^{-1} m^{-2}. Higher SLRs may be tested at the manufacturer's discretion. If the manufacturer wishes to test additional SLRs less than 2600 L min^{-1} m^{-2}, these shall be conducted as a separate test. The results of these additional tests shall be reported in the test report and considered for inclusion in the publicly available verification statement. Flows shall be measured with calibrated instruments. It should be noted that some Canadian jurisdictions (*e.g.,* Quebec) may require sediment resuspension and scour testing at SLRs exceeding the highest SLR noted above. Therefore, the maximum SLR to be tested for sediment resuspension and scour should be confirmed after reviewing approval criteria in the jurisdiction(s) where manufacturers are seeking approval for installation.

6.3.2 Flow Durations

Flow rates shall be recorded at no longer than 30 second intervals over the duration of the test and be maintained within ±10% of the target flow rate with a COV less than 0.04. The time for flows to increase initially, and from one rate to the next, shall not exceed 1 minute. If the flow rate needs to be stopped in the middle of the testing to change flow meters, the transition period to the next flow rate should not exceed 1 minute from the end of the previous 5-minute interval. Thus, the maximum duration of the test for the 5 SLRs shall not exceed 30 minutes.

6.3.3 Sampling and analysis

Duplicate effluent samples shall be collected throughout the test each at 1 minute sampling intervals starting no longer than 1 minute from the initiation of flow and no longer than 1 minute after the start of flow increase from one target flow rate to the next (*i.e.,* sampling should start as soon as the target flow rate is achieved). The effluent SSC will be determined based on the grab sample method (see Appendix A). Alternative effluent sampling methods, or variants of the NJDEP methods, may be employed, pending approval by the VE prior to testing. Samples shall be a minimum of 500 mL.

The samples are to be analyzed for SSCs using the SSC analytical method ASTM D3977-97. The PSD of the samples shall be determined in accordance with ISO 13320 (2020). Discrete samples collected for PSD analysis may be combined to form two composite samples at each SLR.

The scour test results for suspended solids and PSD shall be reported for each of the SLRs tested. In addition to effluent samples, a minimum of 5 aqueous background suspended solids samples of the influent water shall be taken over the testing period at regular increments. SSCs of background samples shall be less than 20 mg/L, and effluent sample SSCs shall be adjusted according to the measured background concentration.

6.4 Sediment Scour Test Analysis

In addition to correcting for background SSCs, the smallest 5% of particles (d_5) removed by the MTD during the 40 L min^{-1} m^{-2} removal test may be subtracted from the effluent suspended solids results, up to a maximum d_5 particle size of 10 microns. This provision helps to ensure that effluent SSCs only include sediment particle size fractions that can be realistically retained by MTDs. If applicable, the test report shall include the particle size fractions removed and scoured from the MTD, as well as the scour effluent concentrations before and after adjustment of results. An example calculation is provided in Appendix B.

7.0 Light Liquid Retention Simulation Test

The light liquid retention simulation test shall be conducted on the same unit tested for sediment removal to assess whether light liquids are effectively captured by the MTD after a spill and are effectively retained in the spill capture area at high flow rates. The test uses low density polyethylene (LDPE) plastic beads as a surrogate for light liquids. The test is optional depending on whether the vendor is making a claim that light liquids trapped in the MTD are effectively captured and retained. The flow rates and duration of the test are the same as in the scour test.

7.1 LDPE Plastic Beads Specification

LDPE plastic beads used in the test shall have a specific gravity similar to motor oil, since oil spills are the most common type of light liquid spill. The specified test material shall be Dow Chemical Dowlex™ 2517 (s.g. = 0.917). Should the specified test material become unavailable, the alternate test material shall be Dow Chemical Dowlex™ 722 (s.g. = 0.918), or equivalent with a specific gravity no greater than 0.918.

7.2 Test Conditions

This test is run with clean water on a MTD with a false floor set at 50% of the maximum recommended sediment storage depth to ensure hydrodynamics of the MTD are representative of an average condition. If additional oil capture features are added to the MTD, these same features shall also be present during the sediment removal performance test. Water temperatures shall not exceed 25°C.

The presence of screens or other components that may affect light liquid retention must be reported in the Test Plan indicating whether the screen or other components may bias or prevent the collection of representative results. If bias is present (e.g. a screen mesh size restricts the release of beads), the Test Plan shall clearly state how the device may be set-up to generate unbiased results without altering the design hydraulics of the tested unit. The Test Body shall also verify that the oil capture zone in the MTD is watertight and not prone to leakage of light liquids during normal operation. If leaks are present or will likely form as the device ages, the manufacturer shall not submit a performance claim for the capture and retention of light liquids.

The MTD shall be preloaded with a volume of plastic beads sufficient to fill the Effective Treatment Area (sedimentation area) to a depth of 5 cm. This volume shall be referred to as the Oil Retention Volume (ORV). Since the ORV is based on horizontal treatment area and not spill capture area, MTDs with an oil capture zone area that is different than the Effective Treatment Area will preload beads to a depth that is not equal to 5 cm. For convenience it is permitted to determine the bulk density of the beads using a 1 L sample and then work with the mass equivalent of the required volume.

Pre-loading the beads shall be accomplished by filling the unit to the static water level at a constant flow rate determined by the Test Body, then adding beads to the inflow pipe while water flows through the unit. Following pre-loading of beads, flow to the MTD will be stopped for at least 5 minutes to allow the MTD to reach a dry-state equilibrium. Any beads that do not make their way into the spill capture zone and any beads that pass into the effluent during pre-loading shall be captured and their volume measured and recorded. This volume is the uncaptured volume.

There shall be no additional flow through the unit prior to the commencement of re-entrainment testing described in section 7.3.

7.3 Test Parameters and Requirements

7.3.1 Flow Rates

The potential for oil re-entrainment and washout is determined at five SLRs that shall be increased in 5-minute intervals from 200 to 800 to 1400 to 2000 to 2600 L min^{-1} m^{-2}. Higher SLRs may be tested at the manufacturer's discretion. If the manufacturer wishes to test additional SLRs less than 2600 L min^{-1} m^{-2}, these shall be conducted as a separate test. The results of these additional tests shall be reported in the Test Report and considered for inclusion in the verification statement. Flows shall be measured with calibrated instruments.

7.3.2 Flow Durations

Flow rates shall be recorded at no longer than 30 second intervals over the duration of the test and be maintained within ±10% of the target flow rate with a COV less than 0.04. The time for flows to increase initially, and from one rate to the next, shall not exceed 1 minute. If the flow rate needs to be stopped in the middle of the testing to change flow meters, the transition time to the next flow rate should not exceed 1 minute from the end of the previous 5 minute interval. Thus, the maximum duration of the test for the 5 SLRs shall not exceed 30 minutes.

7.3.3 Effluent Screening and Analysis

All effluent shall be screened for the entire duration of the test. Appropriate screen mesh size shall be used such that all plastic beads washed out of the MTD are retained on the screens while allowing water to pass through. Screening methodology shall provide for the collection and quantification of plastic beads washed out of the MTD during the flow interval associated with each specified SLR. The volume, mass, and percentage of plastic beads washed out of the MTD shall be determined for each SLR. Additionally, these values shall be summed to determine the cumulative volume, mass, and percentage of plastic beads washed out of the MTD for the entire test duration. The cumulative volume of beads washed out of the MTD combined with the uncaptured volume recorded in section 7.2 are used to determine the total volume, mass and percentage of plastic beads retained by the unit. Vendors of light liquid capture MTDs wishing to claim a larger ORV may repeat the test with a larger volume of beads.

8.0 Scaling

The sediment removal rate at the specified SLRs determined for the tested full scale, commercially available MTD may be applied to similar MTDs of smaller or larger size by proper scaling. Scaling the performance results of the tested MTD to other model sizes without completing additional testing is acceptable provided that:

1. The maximum treatment SLR prior to the onset of bypass for the similar MTD shall be the same or less than the tested MTD;
2. The claimed sediment removal efficiencies for the similar MTD are the same or lower than the tested MTD at identical SLRs; **and**
3. The similar MTD is scaled geometrically proportional to the tested unit in all inside dimensions of length and width and a minimum of 85% proportional in depth, where the depth dimension is measured from the outlet pipe invert to the floor of the unit.

If requirements (1), (2) and (3) are not met, then a second full scale, commercially available MTD with a difference in maximum treatment SLR prior to the onset of bypass of at least 250% shall be tested to validate the alternative scaling methodology. Testing of the similar models shall follow the same sediment removal performance testing procedures described in section 5.0. The alternative scaling methodology is deemed to be valid if the sediment removal efficiencies do not differ by more than 2% for SLRs up to 200 L min^{-1} m^{-2} , and 3% for SLRs greater than 200 L min^{-1} m^{-2}.

Manufacturers shall submit available or proposed model sizes, names and scaling calculations and methodologies as part of the ISO 14034 verification to confirm how performance results from the tested model can be applied to other unit sizes based on the scaling rules above.

9.0 Analytical Methods

All analytical laboratories performing sample analysis shall meet the requirements of ISO 17025, or equivalent. The following analytical methods shall be used in the test *Procedure*.

9.1 Particle Size Distribution

Test Sediment shall be analyzed in accordance with ASTM D6913-17: *Standard Test method for the Particle Size Distribution (Gradation) of Soils using Sieve Analysis* and ASTM D7928: *Standard Test method for Particle Size Distribution (Gradation) of Fine Grained Soils using the Sedimentation (Hydrometer) Analysis.*

Aqueous samples shall be analyzed for PSD using laser diffraction following ISO 13320 (2020) *Particle Size Analysis – Laser Diffraction Methods*.

9.2 Sediment Drying and Moisture Content

The moisture content of the sediment shall be determined in accordance with ASTM D2216 (2019), *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*.

9.3 Suspended Solids

The SSC test method shall be used on aqueous samples: ASTM D3977-97 (2019) *Standard Test Methods for Determining Sediment Concentration in Water Samples.*

9.4 Hydraulic Testing

If available at the time of testing, the measurement of MTD hydraulic characteristics shall follow the latest revision of*: ASTM C1745/C1745M-18: Standard Test Method for Measuring Hydraulic Characteristics of Hydrodynamic Separators and Underground Settling Devices*. Note that at the time of writing the revised standard had not been released.

10.0 Reporting

The third-party technology performance Test Body responsible for testing prepares a Technology Specific Test Plan (i.e., Quality Assurance Project Plan) and Test Report. The VE shall review the Test Body documents and prepare a verification report. Minimum content requirements for the publicly available verification statement are provided in Appendix E. A checklist of key testing and reporting parameters is provided in Appendix D.

The report prepared by the technology performance Test Body should address, at a minimum, the following topics:

1. Laboratory and staff qualifications
2. Description of the technology – function, operation and basic design hydraulic parameters (e.g. design head loss, maximum hydraulic capacity)
3. Experimental set-up – test equipment descriptions, data acquisition and management procedures and equipment calibration reports
4. Testing procedures - preparation of test sediment, sampling and analytical laboratory methods, and the quality assurance and control plan
5. Results of Sediment Removal Performance Test, reported by total mass and particle size fraction
6. Results of Sediment Re-suspension Test, reported by effluent concentration, mass load and particle size fraction
7. Results of Light Liquid Retention Simulation Test, reported by volume, mass and percentage of beads captured and retained, where applicable
8. Results of hydraulic performance testing and specification of the maximum treatment system SLR prior to bypass

9. Potential sources of error for each of the tests, and other important considerations that may affect performance, inspection, maintenance or other operational functions of the MTD in field settings
10. Signatures from performance Test Body staff verifying that the testing was carried out in accordance with the *Canadian Procedure for Laboratory Testing of Oil-Grit Separators*.

Further guidance on the required content of the Test Report is provided in Appendix C.

APPENDIX A: Effluent sampling procedure

The following description of the specified effluent sampling method has been adapted from the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device*-January 25, 2013.

Effluent Grab Sampling Method

This method allows for conducting manual sample collection procedures. The effluent sample location shall be either end of pipe or in-line, and should consider the distance from the MTD, sample container size to minimize the potential for spilling, and sediment capture method (e.g., sweeping motion).

APPENDIX B: Procedure for correcting the effluent sediment results from the sediment scour test

This Appendix provides an example of the procedure for correcting the effluent suspended solids concentration results from the sediment scour test specified in section 6.0.

1. Determine the smallest 5% of particles (d_5) removed during the 40 L min^{-1} m^{-2} test, as per Table B1. In this example, the interpolated d_5 is 4.7 microns.

Table B1: PSD data for sediment retained in 40 L min^{-1} m^{-2} run

Particle size of retained sediment (µm)	Cumulative percent less than (%)
1000	100
500	85
250	72
150	35
50	26
20	20
10	13
8	9
7	8
5	6
4	2.6
3.5	2.3
3.1	2
2.9	1.5
2.7	1.4
2.5	1.2
1.5	1
1	0

2. Determine from the effluent PSD results the percentage of the effluent sediment that is smaller than the d_5, which is 4.7 microns in this example. Table B2 shows sample scour effluent PSD data at 200 L min^{-1} m^{-2}, with the cumulative percent less than value highlighted for the 4.7 micron particle size.

Table B2. Scour test effluent sample PSD from the 200 L min^{-1} m^{-2} run

Particle size of scoured sediment (µm)	Cumulative percent less than (%)
704	100.0
7.8	100.0
7.1	99.8
6.5	99.9
6.0	99.5
5.5	99.5
5.0	99.3
4.6	99.2
4.2	99.1
3.9	98.9
3.6	98.7
3.3	98.6
3.0	98.5
2.8	98.4
2.5	97.4
2.3	93.9
2.1	89.7
1.9	84.9
1.8	79.3
1.6	72.9
1.5	65.6
1.4	57.8
1.3	49.4
1.2	41.2
1.1	33.7
1.0	27.1
0.9	21.7
0.8	17.3
0.8	13.9
0.7	11.1
0.6	8.8
0.6	6.9
0.5	5.3
0.5	3.9
0.4	2.8
0.4	1.9
0.4	1.1
0.3	0.6
0.3	0.2
0.3	0.0

3. Calculate the d_5 correction is as follows:

Effluent sample concentration * ((100 - d_5 percentile)/100)

4. After the d_5 correction is applied, the background SSC is subtracted, and the final result is the effluent concentration to be reported. Table B3 shows an example of the table that would be

included in a test report and verification statement showing the effluent sample concentration before and after correction

Table B3: d_5 corrected and background adjusted scoured sediment concentration

Flow rate	Background sample concentration (mg/L)	Effluent sample Concentration (mg/L)	d_5 correction (see equation above) (mg/L)	Adjusted concentrations after correction for d_5 and background concentration (mg/L)
200	2	50	50 * ((100 - 99.2)/100) = 0.4	(0.4 -2) = -1.6 = 0
800	etc…	etc…	etc…	etc…
1400				
2000				
2600				

APPENDIX C: Test Report template

Table C1. Required content of the Test Report

Sections/subsections	Brief Content Description	Tables and/or Figures
Table of Contents and List of Figures and Tables		
1.0 Introduction	Overview of the scope and purpose of testing	
2.0 Manufactured Treatment Device Description	Description of the MTD, including overview of device function, operation, design hydraulic parameters (e.g. design head loss, maximum hydraulic capacity), number of chambers, chamber dimensions, baffle configurations, inlet and outlet pipe diameters and invert elevations, function of bypass component (if present), details of debris screens (if present), and other components. A specific statement shall be added that clarifies whether or not the bypass component allows high flows to fully bypass all areas where sediment was found to settle during testing.	Figures: Schematic showing MTD dimensions and pipe/baffle locations/sizes. Photo of MTD installed in the laboratory.
3.0 Materials and Methods 3.1 Experimental Design	Describes the test parameters and procedures and deviations from the procedure (if any). [1]	Figure: Schematics showing set -up of experimental test apparatus in plan and profile views, including location of valves, pumps, storage tanks and measurement equipment.
3.2 Description of instrumentation and measurement methods	Describes equipment used to pump water, inject sediment, measure flow and temperature, collect samples, perform mass balance testing and measure other components as needed.	Photos of instrumentation as needed to clarify test methodologies

[1] Known deviations from the procedure should be discussed with the VE prior to testing.

3.3 Data management and acquisition	Describes methods and equipment used to record and manage data. Includes details on data measurement and recording frequencies.	
3.4 Preparation of test sediment.	Provides details on how the test sediment was prepared and analyzed, and the results relative to the test PSD.	<u>Table and Figure:</u> PSD test results verifying that the particles were uniformly distributed based on the individual run sample testing, and that the average and individual run PSDs meet the required specification.
3.5 Data Analysis	Describes the equations and procedures used to analyze the data.	
3.6 Laboratory Analysis	Description of laboratory methods used to analyze aqueous samples and particulate matter (sediment and oil).	
3.7 Quality Assurance and Control	Describes methods used to ensure measurement accuracy and quantify potential errors.	
4.0 Results and Discussion 4.1 Sediment Removal Performance	Presents and discusses treatment efficiency from the modified mass balance test as a function of flow rate. Sediment removal results are reported as a percentage of influent mass retained, both for the total mass and the mass of individual particle size fractions. Measurements of hydraulic capacity and hydraulic characteristics can be included as a separate subsection.	<u>Table(s):</u> operational parameters and treatment results, including SLR, flow rate (target and actual) test duration, turnover rate, treated volume and influent mass, sediment concentration, captured mass, calculated effluent mass and treatment efficiency. <u>Figures:</u> Cumulative PSD (percent finer than) of the influent and captured PSDs for all SLRs. <u>Figures:</u> Removal efficiency as a function of SLR – both for total sediment mass and for mass by particle size class.
4.2 Sediment Re-suspension and Washout	Presents and discusses effluent sediment concentrations for the re-suspension and washout test as a function of SLR. Re-suspension test results are discussed in relation to the	<u>Figure:</u> SLR vs time. <u>Figure:</u> Effluent sediment concentration over time for each SLR.

	PSD of captured material during the sediment removal test. Calculate the effluent sediment load and concentration of particles larger than the smallest particles captured during the sediment removal test, and express as a percentage of the total effluent load and concentration at each SLR.	<u>Table and Figure:</u> Average effluent concentration by SLR. Observed and adjusted based on the sediment particles captured during the sediment removal test.
4.3 Light Liquid Retention Test	Describes the type and density of plastic beads used to pre-load the unit in relation to test requirements. Presents and discusses wash out of plastic beads as a function of SLR. The volume, mass and percentage of plastic beads discharged from the unit are presented and discussed in relation to each flow rate tested and cumulatively over the full test duration.	<u>Figure:</u> SLR vs time. <u>Table and Figure(s)</u>: Mass, volume and percentage of glass beads discharged by SLR, and cumulatively over the full test duration.
5.0 Conclusions	Summarize key results and conclusions	
Nomenclature and Abbreviations	Defines symbols and abbreviations used in the report	
References	Full citation of all documents referenced in the report	
Appendix A	Summary of laboratory and staff qualifications	
Appendix B	Instrument calibration reports	Table and Figures as needed
Appendix C	Signatures from performance Test Body staff verifying that the testing was carried out in accordance with the OGS test *Procedure*.	
Appendix D	Manufacturer Treatment Device specifications and scaling calculations and methodologies/assumptions.	Table from the manufacturer at the time of testing showing all unit sizes (depth and diameter/length/width), treatment flow rates, and sediment/oil capacities, with scaling calculations.

APPENDIX D: Checklist of testing requirements

Table D1. The following checklist may be used by the third-party Test Body and ISO 14034 VE to verify that requirements have been met and identify variances from the *Procedure*. Explanations for variances or criteria should be provided in the Verification Reports.

Ref.	Criteria	Meets Criteria		
		Yes	**No**	**NA**
4.0	**Performance Test Body and Verification Requirements**			
4.1	**Technology Performance Test Body**			
4.1a	Test Body qualifies as a third-party expert and is certified to ISO 17025 or equivalent	☐	☐	☐
4.2	**Verification Expert**			
4.2a	VE meets ISO 17020 requirements	☐	☐	☐
5.0	**Sediment Removal Performance Test**			
5.0a	MTD is full scale, commercially available and same as used for an actual installation.	☐	☐	☐
5.1	**Test Sediment**			
5.1a	Comprised of inorganic ground silica with specific gravity of 2.65.	☐	☐	☐
5.1b	The 7 individual test run samples and one scour test sample are analyzed for PSD in accordance with ASTM D6913/7928 and meet PSD in Table 1 of the *Procedure.* The average and individual run sample PSDs are within the allowable error range specified in the *Procedure* (3% for the average and 5% for individual run PSDs).	☐	☐	☐
5.2	**Test Conditions**			
5.2a	The system is clean with no preloaded sediment, with clean water which has a background TSS concentration below 20 mg/L.	☐	☐	☐

5.2b	False floor is installed to simulate the sediment retention chamber being filled to 50% of manufacturer's recommended Maximum Sediment Storage Depth.	☐	☐	☐
5.2c	Manufacturer`s installation recommendations are followed.	☐	☐	☐
5.2d	Temperature of the water used does not exceed 25°C.	☐	☐	☐
5.2e	The inlet and outlet pipes have a minimum slope of 1% and a diameter not exceeding 25% of the diameter or width of the unit.	☐	☐	☐
5.3	**Test Parameters and Requirements**			
5.3.1	**Flow Rates and Hydraulic Characteristics**			
5.3.1a	A minimum of 7 steady state SLRs are tested: 40, 80, 200, 400, 600, 1000, and 1400 L min^{-1} m^{-2} of Effective Treatment Area.	☐	☐	☐
5.3.1b	Instruments measuring flow rates are calibrated and calibration reports are submitted.	☐	☐	☐
5.3.1c	Flow rates are recorded at no longer than 30 second intervals for flow durations less than 2 hours, and no longer than 1 minute for longer flow durations	☐	☐	☐
5.3.1d	Flow rates do not vary from target flow rate by more than +/- 10% and have a coefficient of variation (COV) of less than 0.04.	☐	☐	☐
5.3.1e	Head loss coefficients across the device are measured on a clean unit without sediment, over the full range of operational flow rates using calibrated instruments at appropriate locations.	☐	☐	☐
5.3.1f	Methodology for determining head loss is clearly described. If available at the time of testing, the measurement of MTD hydraulic characteristics follows the latest revision of*: ASTM C1745/C1745M-18: Standard Test Method for Measuring Hydraulic Characteristics of Hydrodynamic Separators and Underground Settling Devices*.	☐	☐	☐
5.3.2	**Test Duration**			
5.3.2a	The test is run for 25 minutes or for the time required for 8 complete volume exchanges in the primary sedimentation chamber (whichever is greater) to ensure stabilized flows and sediment fluxes.	☐	☐	☐

5.3.2b	A minimum of 11.3 kg of sediment is fed into the MTD to limit analytical errors associated with mass balance testing.	☐	☐	☐
5.3.3	**Influent Sediment Concentration**			
5.3.3a	Sediment feed system is calibrated to deliver a constant concentration of 200 mg/L (+/- 25mg/L) over the duration of the test.	☐	☐	☐
5.3.3b	The maximum length of pipe from the point where sediment is injected to the test unit shall not exceed 0.91 m (3 feet) upstream of the inlet	☐	☐	☐
5.3.3c	Sediment is injected only after a constant flow rate has been achieved.	☐	☐	☐
5.3.3d	Six calibration samples are taken from the injection point at evenly spaced intervals over the duration of the test to verify that the sediment is being injected at a constant rate.	☐	☐	☐
5.3.3e	Calibration samples are a minimum of 0.1 L, or the collection interval is less than one minute, whichever comes first.	☐	☐	☐
5.3.3f	Samples are weighed to the nearest 10 milligrams and the concentration COV does not exceed 0.10.	☐	☐	☐
5.3.3g	Average influent concentration is determined using the mass injected divided by the volume of water flowing through the unit during the period of sediment injection.	☐	☐	☐
5.3.3h	The moisture content of the test sediment used for each flow rate is measured in accordance with ASTM D2216 (2019)	☐	☐	☐
5.3.4	**Modified Mass Balance**			
5.3.4a	The influent sediment mass load (mass of the test sediment injected over the duration of the test) is measured for each flow rate.	☐	☐	☐
5.3.4b	At the end of the test, the water is decanted over a period not exceeding 30 hours and the remaining sediment in the MTD retention chamber is dried in a nonferrous tray and weighed following ASTM D2216 (2019). A sample is analyzed for PSD in accordance with ASTM D6913/7928.	☐	☐	☐
5.3.5	**Background Samples**			
5.3.5a	Aqueous background suspended solids samples are taken over the entire testing period at minimum one hour increments and a minimum of 5	☐	☐	☐

	samples are taken at equally spaced intervals for test run durations less than 5 hours.			
5.3.5b	Samples are analyzed by the SSC method (ASTM D3977-97(2019)), and SS concentrations are less than 20 mg/L.	☐	☐	☐
5.4	**Sediment Removal Calculation**			
5.4a	The mass and PSD of residual sediment in the inlet pipe is measured and reported separately. Removal efficiencies are calculated both for combined inlet/sump(s) mass and for the sump(s) mass alone.	☐	☐	☐
5.4b	If appreciable quantities of sediment are found to accumulate on ledges or shelves outside of the main sump(s), the mass and PSD of sediment deposited in these areas shall be measured and reported separately.	☐	☐	☐
5.4c	Removal efficiency (%) is calculated as $\frac{Total\ Mass\ Retained}{Inlet\ Mass\ Injected}$*100 where the mass of the retained sediment includes sediment in the chamber and residual sediment accumulated in the inlet pipe. Residual sediment accumulated in the inlet pipe is measured and reported separately.	☐	☐	☐
5.4d	Sediment removal results are reported as percentage of influent mass retained of the total mass and for each individual particle size fraction. At a minimum, size fractions include: <5um, 5um-8um, 8um-20um, 20um-50um, 50um-75um, 75um-100um, 100um - 150um, 150um-250um, 250um-500um, >500um.	☐	☐	☐
6.0	**Sediment Scour and Re-suspension Test**			
6.1	**Preloaded Test Sediment**			
6.1a	The test sediment preloaded into the chamber is from the batch prepared and tested for PSD as described in section 5.1.	☐	☐	☐
6.1b	Ledges or surfaces within the unit other than the main sump(s) were preloaded with sediment if (i) the total mass was greater than 5% of the total sediment captured in the retention chamber during the 40 L min^{-1} m^{-2} sediment removal test, and (ii) the median particle size of the sediment captured during the same sediment removal test was equal to or less than 150 µm.	☐	☐	☐
6.2	**Test Conditions**			

6.2a	Test is run with clean water at temperatures not exceeding 25°C.	☐	☐	☐
6.2b	If the false floor is used, it is set at 10.2cm below the 50% maximum sediment storage and filled to the 50% capacity with sediment; sediment is evenly distributed.	☐	☐	☐
6.2c	The MTD is filled with clear water (background concentration of TSS below 20mg/L) to a normal operating depth prior to initiating flows and the test is initiated within 96 hours of pre-loading.	☐	☐	☐
6.3	**Test Parameters and Requirements**			
6.3.1	**Flow Rates**			
6.3.1a	To determine the re-suspension and washout of sediments, five SLRs (200 to 800 to 1400 to 2000 to 2600 L min^{-1} m^{-2}) are used in 5-minute intervals.	☐	☐	☐
6.3.1b	Additional flow rates (optional) lower than 2600 L min^{-1} m^{-2} are tested separately.	☐	☐	☐
6.3.2	**Flow Durations**			
6.3.2a	Flow is measured with calibrated instruments, recorded at no longer than 30 second intervals, and maintained within +/- 10% of the target flow rate with a COV less than 0.04.	☐	☐	☐
6.3.2b	Where the flow rate is stopped to switch from one rate to the next the transition period does not exceed 1 minute; the duration of the total test for 5 loading rates does not exceed 30 minutes.	☐	☐	☐
6.3.3	**Sampling and Analysis**			
6.3.3a	Duplicate effluent samples are collected at 1 minute sampling intervals as soon as the target flow rate is achieved (within 1 minute of initializing a flow rate).	☐	☐	☐
6.3.3b	Only flows that have passed through the MTD retention chamber(s) are sampled and the effluent concentration is determined using the grab sample method	☐	☐	☐
6.3.3c	The effluent samples are collected in min 500 mL bottles and analyzed for TSS concentrations using the SSC analytical method (ASTM D3977-97 (2013)).	☐	☐	☐
6.3.3d	The PSD of the samples are determined in accordance with ISO 13320 (2020).	☐	☐	☐

6.3.3e	PSD, suspended sediment loads, and scour test results are reported for each of the SLRs.	☐	☐	☐
6.3.3f	In addition to effluent samples, a minimum of 5 aqueous background samples are taken of the clear water (TSS concentration less than 20 mg/L) over the testing period at regular increments; if TSS concentration exceed 20mg/L the sample concentrations are adjusted accordingly.	☐	☐	☐
6.4	**Sediment Scour Test Analysis**			
6.4a	Scour effluent concentrations are adjusted by background concentration and (if necessary) the smallest 5% of sediment (d_5) removed by the MTD during the 40 L min^{-1} m^{-2} removal test are subtracted from the effluent suspended solids results, up to a maximum d_5 particle size of 12 microns.	☐	☐	☐
6.4b	Report contains particle size fractions removed and scoured by the MTD, as well as the scour effluent concentration before and after adjustment of results.	☐	☐	☐
7.0	**Light Liquid Retention Simulation Test**			
7.0a	The light liquid re-entrainment simulation test is done on the same unit tested for sediment removal/scouring.	☐	☐	☐
7.1	**LDPE Plastic Beads Specification**			
7.1a	The test material used is the Dow Chemical Dowlex™ 2517 (specific gravity = 0.917), or if unavailable the Dow Chemical Dowlex™ 722 (specific gravity = 0.918); the density of the material is independently measured and reported by the technology performance Test Body.	☐	☐	☐
7.2	**Test Conditions**			
7.2a	The test is run with clean water (temperature does not exceed 25°C) with a false floor set at 50% of the maximum recommended sediment storage depth.	☐	☐	☐
7.2b	Debris screens or other oil containment system components are reported and evaluated to ensure they do not introduce bias into the test. If bias is present, the Test Plan clearly explains how the bias was addressed in a manner that maintains the integrity of results and does not significantly influence the design hydraulics of the unit.	☐	☐	☐
7.2c	If additional oil capture features are added to the device, they are also present during sediment removal performance tests.	☐	☐	☐
7.2d	The MTD is preloaded with a volume of plastic beads sufficient to fill the Effective Treatment Area to a depth of 5 cm or equivalent for devices in	☐	☐	☐

	which the spill capture zone area is different than the Effective Treatment Area			
7.2e	Beads not captured during the preloading process are measured and recorded.	☐	☐	☐
7.2f	The oil capture zone in the MTD has been verified as being watertight and not prone to leakage of light liquids during normal operation.	☐	☐	☐
7.3	**Test Parameters and Requirements**			
7.3.1	**Flow Rates**			
7.3.1a	To determine the potential for oil re-entrainment and washout, five SLRs (200 to 800 to 1400 to 2000 to 2600 L min^{-1} m^{-2}) are used in 5 minute intervals,	☐	☐	☐
7.3.1b	Additional flow rates (optional) lower than 2600 L min^{-1} m^{-2} are tested separately.	☐	☐	☐
7.3.2	**Flow Durations**			
7.3.2a	Flow is measured with calibrated instruments, recorded at no longer 30 second intervals, and maintained within +/- 10% of the target flow rate with a COV less than 0.04.	☐	☐	☐
7.3.2b	Where the flow rate is stopped to switch from one rate to the next the transition period does not exceed 1 minute; the duration of the total test for 5 loading rates does not exceed 30 minutes.	☐	☐	☐
7.3.3	**Effluent Screening and Analysis**			
7.3.3a	Appropriate screen mesh size is used such that all washed out plastic beads are retained on the screen.	☐	☐	☐
7.3.3b	Screening methodology provides the means for quantifying the volume, mass, and percentage of plastic beads washed out of the MTD for each SLR.	☐	☐	☐
7.3.3c	Values are summed for the entire test duration along with the uncaptured volume to determine cumulative volume, mass, and percentage of plastic beads retained.	☐	☐	☐
7.3.3d	The cumulative volume washed out of the unit for the entire test plus the uncaptured volume is not greater than 15% of the oil retention volume. If this is not true, the MTD can not claim to effectively capture and retain light liquids.	☐	☐	☐

8.0	**Scaling**			
8.0a	If the scaling rules are not met then a second full scale, commercially available MTD with a difference in maximum treatment SLR prior to the onset of bypass of at least 250% has been tested. Testing of the similar models followed the same sediment removal performance testing *Procedure*s described in section 5.0. The alternative scaling methodology is deemed to be valid if the sediment removal efficiencies do not differ by more than 2% for SLRs up to 200 L min^{-1} m^{-2} , and 3% for SLRs greater than 200 L min^{-1} m^{-2}.	☐	☐	☐
8.0b	The scaling rule is included in the publicly available verification report and available model sizes and weir scaling methodologies are provided by the vendor to confirm applicability of test results to other model sizes	☐	☐	☐
9.0	**Analytical Methods**			
9.0a	Analytical laboratories performing sample analysis is accredited to ISO 17025 or equivalent.	☐	☐	☐
9.1	**Particle Size Distribution**			
9.1a	Test sediment is analyzed in accordance with the ASTM D6913/7928.	☐	☐	☐
9.1b	Aqueous samples are analyzed for PSD in accordance with ISO 13320 (*2020)*.	☐	☐	☐
9.2	**Sediment Drying and Moisture Content**			
9.2a	The moisture content of the sediment is analyzed in accordance with ASTM D2216 (2019).	☐	☐	☐
9.3	**Suspended Solids**			
9.3a	The SSC test method *ASTM D3977-97 (2019)* is used on aqueous samples.	☐	☐	☐
9.4	**Hydraulic Testing**			
9.4a	If available at the time of testing, the measurement of MTD hydraulic characteristics shall follow the latest revision of: ASTM C1745/C1745M-18: S*tandard Test Method for Measuring Hydraulic Characteristics of Hydrodynamic Separators and Underground Settling Devices*.	☐	☐	☐

APPENDIX E: Minimum content requirements for ISO 14034 Verification Statement

Table E1. The following content shall be provided in the publicly available Verification Statement to ensure that the document provides a sufficient basis for decision making and is consistent for all ISO 14034 verified Oil and Grit Separators. Additional descriptive notes, photos, figures and tables may be provided as required.

Sections/subsections	Brief Content Description	Tables and/or Figures
General Information	Names of vendor, verified MTD model, VE and VB. Organization addresses. Brief information on the ISO ETV 14034 standard. Contact information for the Vendor and Verification Body.	none
Manufactured Treatment Device Description and Application	Description of the MTD, including overview of device function, operation, design hydraulic parameters (e.g. design head loss, maximum hydraulic capacity), number of chambers, chamber dimensions, baffle configurations, inlet and outlet pipe diameters and invert elevations, bypass weir (if applicable), screens and other components.	Schematic showing MTD dimensions and pipe/baffle locations/sizes, location and mesh size of screens, etc.
Performance Conditions	References the OGS laboratory testing *Procedure* as the basis for testing along with other relevant conditions that may apply.	none
Performance Claim	Performance claims for the sediment removal, scour and light liquid retention tests. Standard wording for all OGS is used for consistency.	none
Performance Results	Brief description of the method used to arrive at results along with actual results and interpretation as required. Subsections for each of up to three tests. The mass and PSD of sediment in the inlet pipe and sump(s) shall be reported separately. A specific	PSD data shall be included in graphs; Tables show performance results for all tests. Scour test results shall show scour rates before and after the d_5 and

	statement shall be added that clarifies whether or not the bypass component allows high flows to fully bypass all areas where sediment was found to settle during testing. The light liquid retention test section shall include a statement about the water tightness of the light liquid capture area.	background concentration corrections
Operational Parameters	In addition to test data relevant to the performance claim, the following operational data shall also be provided: measured energy loses (head loss), measured bypass flow rate.	Optional table
Scaling	A list of models that the performance claims can be applied to based on manufacturer submissions showing conformity of model sizes to the scaling rules. Scaling methodologies shall also be referenced.	Table showing model sizes and scaling calculations.
Variances from the *Procedure*	Describes any variations from the *Procedure* with comments on significance of the variances in relation to the Performance Claims.	none