Compendium of Archived Documents (2014 – 2023)

Procedure for Laboratory Testing of Oil-Grit Separators

Used for the

Canadian Environmental Technology Verification (ETV) Program &

ISO 14034:2016

NOTE: This compendium serves as a reference document exclusively. It encompasses the following archived documents utilized for the testing and ETV verification of Oil-Grit Separator stormwater management devices intended for commercialization in Canada between June 2014 and June 2023.

- *Procedure for Laboratory Testing of Oil-Grit Separators - v3 (June 2014)*
- *ETV Bulletin CETV 2014-05-0001*
- *ETV Bulletin CETV 2014-06-0010*
- *ETV Bulletin CETV 2016-09-0001*
- *ETV Bulletin CETV 2016-11-0001*
- *ETV Bulletin CETV 2018-09-0001*
- *ETV Bulletin CETV 2021-04-0001*
- *ETV Bulletin CETV 2022-01-0001*
- *ETV Bulletin CETV 2022-02-0001*

These archived documents have been superseded by an updated *Canadian Procedure for Laboratory Testing of Oil-Grit Separators* which may be accessed at the Sustainable Technologies Evaluation Program (STEP) website for the Canadian Stormwater Environmental Technology Verification (SETV) Project.

Procedure for Laboratory Testing of Oil-Grit Separators

Prepared by:

Toronto and Region Conservation Authority

For:

The Canadian Environmental Technology Verification Program

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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 intent of this "*Procedure for Laboratory Testing of Oil-Grit Separators*" prepared by Toronto and Region Conservation Authority for the Canadian Environmental Technology Verification Program is to provide a common procedure for testing and verifying the actual performance of treatment devices under controlled conditions, in an independent, transparent manner. It is anticipated that independent verification of the performance data will assist regulatory agencies, permitting authorities and other affected stakeholders in evaluating treatment technology options.

Although the proposed performance testing procedure is not intended to be a compulsory standard, it does represent an effective approach for conducting testing in order to produce verifiable performance data on specific technologies under defined operating conditions. Environment Canada's *Canadian ETV Program* supports the use of this protocol to reduce uncertainty and improve acceptance of independently generated performance data, thereby contributing to informed technology decisions.

It is understood that the ultimate decision to approve, select and implement a particular technology rests with the technology buyer, guided by the requirements of the respective permitting authorities within the affected jurisdiction(s). As stated in the document, "application of this procedure will assist in the calibration of hydraulic models that can be applied by regulators and the regulated community to predict the effectiveness of these devices in meeting regulatory goals and other storm water management requirements." The Canadian ETV Program *General Verification Protocol* (GVP) guides the verification process, accountabilities and related quality requirements.

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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 Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device,* finalized on January 25, 2013.

Table of Contents

1.0 Introduction

This document specifies the technology performance testing laboratory procedures required for oil-grit separator (OGS) manufactured treatment devices (MTDs) seeking verification under the Canadian Environmental Technology Verification (ETV) Program. This document shall be adhered to by entities performing or overseeing the testing of an OGS MTD to meet the verification requirement. A glossary of terms used in this document is provided in Appendix A.

1.1 Objectives of the Procedure

This standardized testing procedure will be used as a basis for comparing the capacity of OGS MTDs to capture and retain sediment and light liquids under the specified test conditions. Application of this procedure will assist in the calibration of hydraulic models that can be applied by regulators and the regulated community to predict the effectiveness of these devices in meeting regulatory goals and other storm water management requirements.

The specific objectives of the protocol are to:

- quantify the sediment removal performance, by particle size fraction, of a device under different surface loading rates;
- 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, and
- assess the quantity of light liquid that may be re-entrained and washed out from a MTD at high flow rates.

2.0 Performance Testing Laboratory and Verification Requirements

2.1 Technology Performance Testing Laboratory

The testing shall be conducted by an independent 3rd party technology performance testing laboratory approved by the Canadian ETV Program. The technology performance testing laboratory shall be familiar with the test and lab methods specified in this protocol and have the infrastructure and expertise needed to perform the full range of testing in a manner that generates reliable and repeatable results. In addition, testing laboratory staff must have a thorough understanding of the operation of OGS devices, acquired by lab or field work hydraulics (including particle settling) and stormwater sampling, including expertise in the statistical analysis of the data being collected.

2.2 Verification Organization

An independent, impartial verification organization (VO) is required to review the analysis and deliver a verification report, as per the Canadian ETV Program *General Verification Protocol*. The Toronto and Region

Conservation Authority (TRCA) has the available expertise to support this role. In this capacity, the TRCA will not generate the required data for any performance claim, as this would present a conflict of interest with respect to the verification. The Canadian ETV Program *General Verification Protocol* (GVP) guides the verification process, accountabilities and related quality requirements.

3.0 Sediment Removal Performance Test

The tested manufactured treatment device (MTD) must be a full scale, commercially available device with the same configuration and components as would be typical for an actual installation. The set-up for the sediment removal test requires the (MTD) to be in a condition comparable to that of 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 below 20 mg/L. A false floor must be installed to simulate having the sediment retention chamber filled to 50% of the manufacturer's recommended maximum sediment storage depth.

3.1 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 particle size distribution shown in Table 1. The PSD includes a broad range of particles from clay to coarse sand.

Table 1: Particle Size Distribution of Test Sediment

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	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

Three samples of the well mixed test sediment shall be collected and analyzed for PSD in accordance with *Standard Test Method for the Particle Size Analysis of Soils* ASTM D422 – 63 (2007)e1. The PSD of the three sample average of the test sediment shall be allowed to vary from the specified percent less than value in Table 1 by six percentage points as long as the median particle size (d_{50}) does not exceed 75 µm.

In addition to the three samples of the test sediment batch, one sample of the test sediment used for each flow rate test shall be collected and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1. Although not a requirement of the Procedure, the PSD of each of these individual test run samples would be expected to meet the six percent allowance threshold. 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 3.4). If the particle size percent less than values of an individual test run sample varies by more than six percentage points from the particle size percent less than values of the three sample average of the batch, the test lab shall report removal efficiencies by particle size fraction both for the individual flow test PSD sample and the three sample average PSD of the batch.

3.2 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. Manufacturer's installation recommendations shall be followed with a pipe of a diameter that is consistent with the manufacturer's recommendations. Temperature of the water used in the test shall not exceed 25 degrees Celsius

3.3 Test Parameters and Requirements

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

3.3.1 Flow rates and hydraulic characteristics

The flow rates tested should be sufficient to characterize the performance curve across different loading rates. A minimum of seven steady state surface loading rates shall be tested: 40, 80, 200, 400, 600, 1000 and 1400 Liters per minute (L/min) per square metre (m^2) of Effective Treatment Area, where the Effective Treatment Area is defined as the area in the MTD over which sedimentation occurs. Testing at additional surface loading rates may be conducted at the manufacturer's discretion. These shall be considered in the final verification report. The flow rates associated with each surface loading rate shall be determined based on the specified surface loading rates and the Effective Treatment Area of the tested MTD.

Flow rates from calibrated flow instruments shall be recorded at no longer than 30 second intervals over the duration of the test. Instrument calibration reports shall be submitted with the final technical evaluation 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 device shall be measured on a clean unit without sediment over the full range of operational flow rates using calibrated instruments installed at appropriate locations. The specific methodology for measuring head losses shall be determined by the independent test laboratory, and described clearly in the technical evaluation report. Loss coefficients shall be reported over the full range of test flow rates.

3.3.2 Test duration

The test is to continue for 25 minutes or the time required for 8 complete volume exchanges in the primary sedimentation chamber, whichever is greater. The test must 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.

3.3.3 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 test sediment shall be injected into the flow stream at the lesser of 3 metres or 5 pipe diameters upstream of the inlet to the MTD. 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 samples shall be weighed to the nearest milligram 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 Method D 4959- 07, *Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating*. The test sediment used in each test shall be sampled and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1, as described in section 3.1.

3.3.4 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. For this purpose, 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 D 4959- 07, the sediment is to be evenly mixed and a sample of the well-mixed sediment shall be collected and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1.

3.3.5 Background samples

A minimum of 5 aqueous background samples of the source water shall be taken over the testing period at regular increments. Background samples should be collected on an hourly basis for all sediment removal tests greater than 5 hours. These samples are to be analyzed by the SSC method (ASTM D3977-97 (2013)). Suspended Solids concentrations of background samples shall be less than 20 mg/L.

3.4 Sediment removal calculation

The sediment removal efficiency shall be calculated 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 device after completion of the test, including any residual sediment accumulated in the inlet pipe. The mass of sediment accumulated in the inlet pipe shall be measured and reported separately.

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 particle size distribution 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:

< 5 µm
5 µm - 8 µm
8 µm - 20 µm
20 µm - 50 µm
50 µm - 75 µm
75 µm - 100 µm
100 µm - 150 µm
150 µm - 250 µm
250 µm - 500 µm
> 500 µm

Lab 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.

4.0 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 to mimic a device 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 device during the sediment removal performance tests.

4.1 Test Sediment

The test sediment preloaded in the sedimentation chamber shall be the same test sediment used in the sediment removal test (see Table 1, Section 3.1). The three sample average of the batch shall be considered to be representative of the PSD of the preloaded test sediment.

4.2 Test Conditions

This test is run with clean water at temperatures not exceeding 25 degrees Celsius. 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 concentrations of the clear water used to fill the device shall be less than 20 mg/L. The test shall be initiated within 96 hours of pre-loading of the unit.

4.3 Test Parameters and Requirements

4.3.1 Flow Rates

Re- suspension and washout of sediments is determined at five surface loading rates that shall be increased in 5 minute intervals from 200 to 800 to 1400 to 2000 to 2600 L/min/m^2. Higher surface loading rates may be tested at the manufacturer's discretion. If the manufacturer wishes to test additional surface loading rates less than 2600 L/min/m^2, these must be conducted as a separate test. The results of these additional tests shall be considered in the verification report. Flows shall be measured with calibrated instruments. 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. Thus the maximum duration of the test for the 5 surface loading rates shall not exceed 30 minutes.

4.3.2 Sampling and analysis

Paired effluent samples shall be collected throughout the test 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 concentration will be determined based on any of the three effluent sampling methods cited in 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 (reproduced in Appendix B for reference). Alternative effluent sampling methods, or variants of the NJDEP methods, may be employed, pending approval by the Canadian ETV program prior to testing. Only flows that have passed through the MTD treatment chamber(s) shall be sampled.

The samples are to be analyzed for suspended sediment concentrations using the Suspended Solids Concentration (SSC) analytical method (ASTM D3977-97 (2013)). The PSD of the samples shall be determined in accordance with ISO 13320(2009). Discrete samples collected for PSD analysis may be combined to form two composite samples at each surface loading rate.

The scour test results for suspended solids, PSD and suspended sediment loads shall be reported for each of the surface loading rates tested. In addition to effluent samples, a minimum of 5 aqueous background samples of the clear water shall be taken over the testing period at regular increments. Concentrations of background samples shall be less than 20 mg/L, and effluent sample concentrations shall be adjusted accordingly.

4.4 Sediment Scour Test Analysis

To assess the potential for sediment scour, the effluent suspended solids concentration shall be adjusted based on the results of the sediment performance removal tests. Any scoured suspended solid particles that are finer than those removed by the MTD during the 40 L/min/m^2 removal test should be excluded from the scour results. As such, the adjusted effluent concentration would only include sediment particle size fractions that were retained by the MTD. The technical evaluation report shall include the particle size fractions removed and scoured by the MTD, as well as the scour effluent concentrations before and after adjustment of results.

5.0 Light Liquid Re-entrainment Simulation Test

The light liquid re-entrainment simulation test is done on the same unit tested for sediment removal to assess whether light liquids captured in the MTD after a spill are effectively retained 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 retained. The flow rates and duration of the test are the same as in the scour test.

5.1 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). The density of the test material shall be independently measured and reported by the technology performance testing laboratory.

5.2 Test Conditions

This test is run with clean water on a device 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 device, these same features must also be present during the sediment removal performance test. Water temperatures shall not exceed 25 degrees Celsius.

The MTD shall be preloaded with a known volume and mass of plastic beads to a depth of 5 cm over an area equivalent to the MTD sedimentation area, also referred to in this document as the Effective Treatment Area. Thus smaller units shall use a smaller volume of plastic beads than larger units, however, the depth of plastic beads shall remain identical. If the MTD separates oil over an area smaller than its sedimentation area, the depth of plastic beads preloaded in the smaller oil separation area shall exceed 5 cm, since the preloaded volume of plastic beads shall be based on a 5 cm depth over the sedimentation area. This ensures that MTDs with equal sedimentation area are preloaded with equal volumes of plastic beads, representing oil spill capture of identical volume. MTDs with a maximum light liquid storage depth of less than 5 cm over the sedimentation area shall preload with plastic beads to a depth equal to the maximum light liquid storage depth.

5.3 Test Parameters and Requirements

5.3.1 Flow Rates

The potential for oil re-entrainment and washout is determined at five surface loading rates that shall be increased in 5 minute intervals from 200 to 800 to 1400 to 2000 to 2600 L/min/m^2. Higher surface loading rates may be tested at the manufacturer's discretion. If the manufacturer wishes to test additional surface loading rates less than 2600 L/min/m^2, these must be conducted as a separate test. The results of these additional tests shall be considered in the verification report. Flows shall be measured with calibrated instruments. 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. Thus the maximum duration of the test for the 5 surface loading rates shall not exceed 30 minutes.

5.3.2 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 surface loading rate. The volume, mass, and percentage of plastic beads washed out of the MTD shall be determined for each surface loading rate. 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.

6.0 Scaling

The sediment removal rate at the specified surface loading rates 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 claimed sediment removal efficiencies for the similar MTD are the same or lower than the tested MTD at identical surface loading rates; **and**
2. 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.

If requirements (1) and (2) are not met, then three full scale, commercially available MTDs of different sizes are required to 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 3.0.

7.0 Analytical Methods

All analytical laboratories performing sample analysis shall be accredited to ISO 17025 or equivalent. The following analytical methods shall be used in the test procedure.

7.1 Suspended Solids

The SSC test method shall be used on aqueous samples: *Standard Test Methods for Determining Sediment Concentration in Water Samples* ASTM D3977-97 (2013)e1

7.2 Particle Size Distribution

Test Sediment shall be analyzed in accordance with *Standard Test method for the Particle Size Analysis of Soils* ASTM D422 - 63(2007)e1
Aqueous samples shall be analyzed for PSD using laser diffraction following ISO 13320:2009 *Particle Size Analysis – Laser Diffraction Methods*:

7.3 Sediment Drying

ASTM Method D 4959- 07, *Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating*.

8.0 Reporting

The third party technology performance testing laboratory responsible for testing prepares a Quality Assurance Project Plan and Technical Evaluation report. As the Verification Organization, the Toronto and Region Conservation Authority shall review the laboratory documents and prepare a verification report.

The report prepared by the technology performance testing laboratory 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 Re-entrainment Simulation Test, reported by concentration and load
8. Potential sources of error for each of the tests
9. Signatures from performance testing laboratory staff verifying that the testing was carried out in accordance with the Canadian ETV Program OGS test protocol.

Further guidance on the required content of the technical evaluation report is provided in Appendix C.

APPENDIX A: Terms and Definitions

Oil-Grit Separator

Oil and grit separators are structures consisting of one or more chambers that remove sediment, screen debris, and separate oil from stormwater. These devices are also referred to as hydrodynamic separators.

Effective Treatment Area

The area within the Manufactured Treatment Device where sedimentation occurs.

General Verification Protocol

The General Verification Protocol (GVP) provides guidance on Environmental Verification Program procedures and data requirements. The GVP specifies that technology operating conditions must be clearly specified and the performance parameters must be measurable using quality-assured test procedures and analytical techniques

Head Loss

A measure of the reduction in total head of the liquid as it moves through the system

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.

Maximum Sediment Storage Depth and Volume

The maximum 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. This term is also referred to as the *maintenance sediment storage depth and volume*.

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.

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.

Surface Loading Rate

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

$$Surface\ Loading\ Rate = \frac{Flow(\frac{L}{minute})}{Effective\ Treatment\ Area\ of\ the\ Device\ (m^2)}$$

Where the effective treatment area is the area in the MTD where sedimentation occurs.

Verification Organization

For the purposes of this document, the Verification Organization (VO) is the third party, impartial technical reviewer sub-contracted by the Canadian ETV Program to supply assessment and validation expertise and services. The VO 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.

APPENDIX B: Effluent Sampling Procedures prescribed by the New Jersey Department of Environmental Protection

For ease of reference, the following description of effluent sampling methods has been reproduced 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. Where relevant, units have been converted to metric.

Effluent sampling shall be performed through the use of one of the following methods; depending on flow rate: the Effluent Grab Sampling Method, Isokinetic Sampling Method or the Automatic Effluent Sampling Method. For flows less than 14 L/s the Effluent Grab Sampling Method must be utilized. For flow greater than 14 L/s, either the Isokinetic Sampling Method or the Automatic Effluent Sampling Method may be employed. These sampling methods are used to establish an MTD's sediment removal efficiency under the following conditions:

1. The average influent suspended solids concentration shall be calculated using the total mass of the test sediment added during dosing divided by the volume of water that flowed through the MTD during dosing as follows: The volume of water that flows through the MTD shall be calculated by multiplying the average flow rate by the time of sediment injection only.

2. Once a constant feed of test sediment and flow rate are established, the first effluent sample shall be collected after a minimum of three MTD detention times have passed;

3. The time interval between sequential samples shall be evenly spaced during the test sediment feed period to achieve 15 samples. However if the test sediment feed is interrupted for measurement, the next effluent sample shall be collected following a minimum of three MTD detention times;

4. A minimum of 15 effluent samples shall be taken downstream of the MTD such that any internally bypassed water is also sampled; and

5. All effluent samples shall be analyzed for SSC in accordance with *Standard Test Methods for Determining Sediment Concentration in Water Samples*: ASTM D3977-97 (2013)

3.2.6.1 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).

3.2.6.2 Isokinetic Sampling Method

The use of isokinetic sampling procedures may be applicable for this method depending on water depth in the effluent piping. This procedure must include a minimum of three evenly spaced, vertically and centrally aligned sampling tubes. Flows from the tubes shall be composited. With isokinetic sampling, the tube intake flow velocity is equal to the pipe flow velocity at the sample tube location. For flows greater than 14 L/s, three intake points must be used in the pipe. For flows less than 14 L/s, only the Effluent Grab Sampling Method is acceptable.

3.2.6.3 Automatic effluent sampling method

This method allows for the use of automated sampling equipment positioned downstream of the MTD. This procedure requires three automatic samplers each having its own inlet tube. The three inlet tubes shall be evenly spaced, vertically aligned and centrally located. The intake elevations shall be at approximately 25, 50 and 75% of flow depth.

The sampling equipment shall be positioned at a distance of no more than three feet from the outlet of the MTD. Each sample container within the automatic sampler shall be at least one liter in size.

The automatic sampler equipment shall be calibrated and properly cleaned in compliance with the manufacturer's recommendations.

APPENDIX C: Technical Evaluation Report Template

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, bypass weir (if applicable), and other components.	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
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 NJDEP PSD.	Table and Figure: PSD test results verifying that the particles were uniformly distributed based on the three sample test, and that the PSD meets 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).	

[1] Known deviations from the procedure should be discussed with ETV Canada staff prior to testing

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 surface loading rate, 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 particle size distribution (percent finer than) of the influent and captured PSDs for all surface loading rates. <u>Figures:</u> Removal efficiency as a function of surface loading rate – 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 surface loading rate. Re-suspension test results are discussed in relation to the particle size distribution 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 surface loading rate.	<u>Figure:</u> Surface loading rate vs time. <u>Figure:</u> Effluent sediment concentration over time for each surface loading rate. <u>Table and Figure:</u> Average effluent concentration by surface loading rate. Observed and adjusted based on the sediment particles captured during the sediment removal test. <u>Table and Figure:</u> cumulative particle size distributions by surface loading rate. <u>Figure:</u> Comparison of the PSD of sediment captured during the sediment removal test and PSD of sediment discharged from the MTD during the sediment re-suspension test. (The graph is to be formatted in a manner that makes it clear where there is overlap)
4.3 Light Liquid Re-entrainment Simulation 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 surface	<u>Figure:</u> Surface loading rate vs time. <u>Table and Figure(s)</u>: Mass, volume and percentage of glass beads discharged by surface loading rate,

	loading rate. 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.	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 testing laboratory staff verifying that the testing was carried out in accordance with the Canadian ETV Program OGS test protocol.	
Appendix D	Manufacturer Treatment Device specifications	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.

Canadian Environmental Technology Verification (ETV) Program Information Bulletin

Bulletin Number: CETV 2014-05-0001

Subject: Revisions to the Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators

Date: May 1, 2014

Prepared by: Tim Van Seters, Toronto and Region Conservation Authority (TRCA)

Approved by: GLOBE Performance Solutions (GPS), Delivery Agent for the Canadian ETV Program

Outline:
1. Background
2. Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale
3. Additional Information
4. References

1. Background

The "*Procedure for Laboratory Testing of Oil-Grit Separators*", prepared by Toronto and Region Conservation Authority for the Canadian Environmental Technology Verification Program, provides a common procedure for independent testing and verification of the actual performance of treatment devices under controlled conditions. It is anticipated that independent verification of performance data will assist regulatory agencies, permitting authorities and other affected stakeholders in evaluating treatment technology options.

Although the performance testing procedure is not intended to be a compulsory standard, it does represent an effective approach for conducting testing in order to produce verifiable performance data on specific technologies under defined operating conditions. Environment Canada's *Canadian ETV Program* supports the use of this protocol to reduce uncertainty and improve acceptance of independently generated performance data.

It is understood that the ultimate decision to approve, select and implement a particular technology rests with the technology buyer, guided by the requirements of the respective permitting authorities within affected jurisdictions.

Version 1.0 of the Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators was released in September 2013. After further review and consideration of comments received since that time, revisions to the procedure have been made to strengthen the procedure and address practical challenges associated with meeting the specified particle size distribution (PSD).

These changes are outlined below under *#2 Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale.*

This Bulletin also includes additional information about possible scour test flow rates that may be required by some jurisdictions in Canada.

Any comments or questions regarding this Bulletin or Version 2.0 of the "*Procedure for Laboratory Testing of Oil-Grit Separators*", should be directed to the Canadian ETV Program Delivery Agent (GLOBE Performance Solutions).

2. Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale

	Original wording	Modified wording	Rationale for Change
3.1 Test Sediment	The well mixed test sediment shall be placed in separate containers in the quantities required for each of the individual test runs. Samples of the dry sediment test mix shall be taken from each container for PSD analysis prior to running the tests to verify that the gradation is uniformly distributed and meets the specified PSD. To verify that the particles are uniformly distributed, each of the individual samples shall have a measured percent less than value within three percentage points of the sample average percent less than value. Further mixing and re-testing will be required if the PSD does not meet this requirement. Once the test sediment PSD is confirmed to be uniformly distributed, the PSD of the average measured value of all samples shall be allowed to vary from the specified percent less than value in Table 1 by three percentage points as long as the median particle size (d_{50}) does not exceed 75 µm. Test sediment PSD analysis shall be conducted in accordance with ASTM D422 – 63.	Three samples of the well mixed test sediment shall be collected and analyzed for PSD in accordance with *Standard Test Method for the Particle Size Analysis of Soils* ASTM D422 – 63 (2007)e1. The PSD of the three sample average of the test sediment shall be allowed to vary from the specified percent less than value in Table 1 by six percentage points as long as the median particle size (d_{50}) does not exceed 75 µm. In addition to the three samples of the test sediment batch, one sample of the test sediment used for each flow rate test shall be collected and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1. Although not a requirement of the Procedure, the PSD of each of these individual test run samples would be expected to meet the six percent allowance threshold. 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 3.4). If the particle size percent less than values of an individual test run sample varies by more than six percentage points from the particle size	Sediment mixing companies have had difficulties in achieving the test sediment PSD specification within the three percentage point margin of error, particularly in the size ranges below 75 µm. This has, and was expected to continue to result in significant delays. The modification to the error ranges and the number of PSD samples collected and analyzed against the specification makes testing to the Procedure more achievable from a practical standpoint, while maintaining the scientific rigor of the testing.

		percent less than values of the three sample average of the batch, the test lab shall report removal efficiencies by particle size fraction both for the individual flow test PSD sample and the three sample average PSD of the batch.	
3.2 Test Conditions (last sentence)	Temperature of the water used in the test shall be maintained between 12 and 25°C.	Temperature of the water used in the test shall be maintained between 6 and 19°C.	The test temperatures were lowered to better reflect the average temperature of urban runoff in Canadian cities. The 13°C range between the lowest and highest allowable temperature remains unchanged
3.3.1 Flow Rates (addition)		Modified subheading to Flow Rates and Hydraulic Characteristics Head loss across the device shall be measured on a clean unit without sediment over the full range of operational flow rates using calibrated instruments installed at appropriate locations. The specific methodology for measuring head losses shall be determined by the independent test laboratory, and described clearly in the technical evaluation report. Loss coefficients shall be reported over the full range of test flow rates.	Head loss is a key parameter required by municipalities and road authorities as part of the approval process and provides a context for interpretation of performance results. Approval agencies have asked that this test be added to the Procedure. Independent hydraulic laboratories are in the best position to select the specific methodology for head loss testing based on the specifics of their laboratory set-up.
3.3.2 Test Duration (2nd sentence)	The test must also ensure that a minimum of 12 kg of sediment is fed into the MTD during the test, even if the duration and volume exchange criteria have been satisfied.	The test must 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.	Some sediment mixing companies supply the test sediment in 25 lb (11.3 kg) bags. The small reduction in the minimum amount for each test will not affect the overall results, but will help to ensure that the hydraulic lab does not modify the

			original PSD by mixing partial bags of sediment.
3.3.3 Influent Sediment Concentration (last paragraph)	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 test sediment used in each test shall be sampled and analyzed for PSD prior to each test to ensure the sediment particles are uniformly distributed and match the specified PSD, as described in section 3.1.	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 Method D 4959- 07, *Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating*. The test sediment used in each test shall be sampled and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1, as described in section 3.1.	Moisture content of the test sediment is required to calculate the mass injected, which is required to determine the influent concentration. The change in section 3.1 necessitated further wording changes in this section.
3.3.4 Modified Mass Balance (last paragraph)	After drying and weighing following ASTM D 4959- 07, the sediment is to be evenly mixed and a minimum of three samples of the sediment are to be collected and analyzed for PSD in accordance with ASTM D422 – 63. Each of the individual samples shall have a measured percent less than value for each size fraction within three percentage points of the three sample average percent less than value to verify that particles in the collected sediment are uniformly distributed. If they do not meet this condition, further mixing will be required and new samples shall be retested.	After drying and weighing following ASTM D 4959- 07, the sediment is to be evenly mixed and a sample of the well-mixed sediment shall be collected and analyzed for PSD in accordance with ASTM D422 – 63 (2007)e1.	The change in section 3.1 necessitated further wording changes in this section.

3.3.5 Background Samples	A minimum of 5 aqueous background samples of the source water shall be taken over the testing period at regular increments. These samples are to be analyzed by the SSC method (ASTM D3977-97 (2013)). Suspended Solids concentrations of background samples shall not exceed 20 mg/L.	A minimum of 5 aqueous background samples of the source water shall be taken over the testing period at regular increments. Background samples should be collected on an hourly basis for all sediment removal tests greater than 5 hours. These samples are to be analyzed by the SSC method (ASTM D3977-97 (2013)). Suspended Solids concentrations of background samples shall be less than 20 mg/L.	The low flow tests can have a duration of over 20 hours. Five background samples would not be sufficient to characterize background sediment concentrations during these longer tests. Hence the number of samples required for tests with a duration longer than 5 hours has been increased to one per hour. For consistency, the background concentration requirement has been modified to read 'less than 20 mg/L' rather than 'shall not exceed 20 mg/L'.
3.4 Sediment Removal Calculation (last two paragraphs)	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 average particle size distribution of the three samples taken from each of the influent and retained mass, as described earlier, 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: < 4 µm 4 µm - 21 µm 21 µm - 42 µm 42 µm - 63 µm 63 µm - 88 µm 88 µm - 125 µm 125 µm - 250 µm 250 µm - 500 µm > 500 µm	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 particle size distribution 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: < 5 µm 5 µm - 8 µm 8 µm - 20 µm 20 µm - 50 µm 50 µm - 75 µm 75 µm - 100 µm 100 µm - 150 µm 150 µm - 250 µm 250 µm - 500 µm > 500 µm	The change in section 3.1 necessitated further wording changes in this section. The particle size ranges were modified to correspond with the ranges provided in Table 1 in order to minimize the need for interpolating PSD data.

	Lab 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 must be based on measurements of no fewer than 22 discrete size fractions.	Lab 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.	
4.1 Test Sediment	The test sediment preloaded in the sedimentation chamber shall be the same test sediment used in the sediment removal test (see Table 1, Section 3.1). Three samples of the dry sediment test mix shall be collected for PSD analysis from the preloaded material in the sedimentation chamber prior to running the test to verify that the gradation meets the specified PSD and is uniformly distributed. To verify that the particles are uniformly distributed, each of the three individual samples shall have a measured percent less than value within three percentage points of the three sample average percent less than value. Further mixing and re-testing will be required if the PSD does not meet this requirement. Once the test sediment PSD is confirmed to be uniformly distributed, the PSD of the three sample average measured value shall be allowed to vary from the specified percent less than value in Table 1 by three percentage points as long as the median particle size (d_{50}) does not exceed 75 µm.	The test sediment preloaded in the sedimentation chamber shall be the same test sediment used in the sediment removal test (see Table 1, Section 3.1). The three sample average of the batch shall be considered to be representative of the PSD of the preloaded test sediment.	The change in section 3.1 necessitated further wording changes in this section. Since the quantity of pre-loaded material is large, the batch sample for PSD is considered to be sufficiently representative, eliminating the need for unnecessary PSD testing.

4.3.2 Sampling and Analysis (last sentence)	Concentrations of background samples shall not exceed 20 mg/L.	Concentrations of background samples shall be less than 20 mg/L, and effluent sample concentrations shall be adjusted accordingly.	The change in wording improves consistency throughout the document. Previously it was assumed that effluent sample concentrations would be adjusted for background concentrations. In this version it is made into a requirement.
7.1 Suspended Solids	The SSC test method shall be used on aqueous samples: *Standard Test Methods for Determining Sediment Concentration in Water Samples* ASTM D3977-97 (2013).	The SSC test method shall be used on aqueous samples: *Standard Test Methods for Determining Sediment Concentration in Water Samples* ASTM D3977-97 (2013)e1	The ASTM procedure was updated.
7.2 Particle Size Distribution	Test Sediment shall be analyzed in accordance with *Standard Test method for the Particle Size Analysis of Soils* ASTM D422 - 63(2007)	Test Sediment shall be analyzed in accordance with *Standard Test method for the Particle Size Analysis of Soils* ASTM D422 - 63(2007)e1	The ASTM procedure was updated.

3. Additional Information

Manufacturers should be aware that some jurisdictions in Canada, such as Quebec, may require that scour tests be done at a minimum of 200% of the maximum treatment flow rate (MTFR). The MTFR is defined as the maximum flow rate that can be conveyed through the device while still achieving a predefined performance claim for sediment removal (typically 50%, but the target may vary by jurisdiction). If the highest flow rate specified in the CETV Procedure is lower than 200% of the device MTFR being tested, it may be advisable to conduct additional testing at flow rates higher than those specified in the Procedure.

4. References

Memorandum regarding “Proposed Revisions to CETV OGS Procedure” from Tim Van Seters of TRCA to GLOBE Performance Solutions, April 23, 2014.

Canadian Environmental Technology Verification (ETV) Program Information Bulletin

Bulletin Number: CETV 2014-06-0010

Subject: Revisions to the Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators

Date: June 10, 2014

Prepared by: Tim Van Seters, Toronto and Region Conservation Authority (TRCA)

Approved by: GLOBE Performance Solutions (GPS), Delivery Agent for the Canadian ETV Program

Outline:
1. Background
2. Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale
3. References

1. Background

The “*Procedure for Laboratory Testing of Oil-Grit Separators*”, prepared by Toronto and Region Conservation Authority for the Canadian Environmental Technology Verification Program, provides a common procedure for independent testing and verification of the actual performance of treatment devices under controlled conditions. It is anticipated that independent verification of performance data will assist regulatory agencies, permitting authorities and other affected stakeholders in evaluating treatment technology options.

Although the performance testing procedure is not intended to be a compulsory standard, it does represent an effective approach for conducting testing in order to produce verifiable performance data on specific technologies under defined operating conditions. Environment Canada's *Canadian ETV Program* supports the use of this protocol to reduce uncertainty and improve acceptance of independently generated performance data.

It is understood that the ultimate decision to approve, select and implement a particular technology rests with the technology buyer, guided by the requirements of the respective permitting authorities within affected jurisdictions.

Version 1.0 of the Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators was released in September 2013. An updated version, Version 2.0, was released in May 2014. After further review and consideration of comments received since that time, revisions to the procedure have been made to strengthen the procedure and address practical challenges associated with meeting the specified particle size distribution (PSD).

These changes are outlined below under *#2 Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale.*

This Bulletin specifically offers guidance relating to the temperature of water used during laboratory testing.

Any comments or questions regarding this Bulletin or Version 3.0 of the "*Procedure for Laboratory Testing of Oil-Grit Separators,*" should be directed to the Canadian ETV Program Delivery Agent (GLOBE Performance Solutions).

2. Modifications to the Procedure for Laboratory Testing of Oil-Grit Separators and Supporting Rationale

	Original wording	Modified wording	Rationale for Change
Section 3.2, p. 3	Temperature of the water used in the test shall be maintained between 6 and 19°C	Temperature of the water used in the test shall not exceed 25 degrees Celsius	Although the 6 to 19°C water temperature range is preferred based on the rationale provided in the original revision, the upper temperature limit is not achievable by independent labs operating in warm climates. Eliminating qualified test labs based on this criterion alone could not be justified given the already narrow pool of labs available for testing. Performance results from labs using source water with temperatures less than 6°C would be conservative, and therefore the lower limit was not considered strictly necessary to support the verification.
Section 4.2		The test is run with clean water at temperatures not exceeding 25 degrees Celsius	Same rationale. Added to this section for consistency.
Section 5.2.		Water temperatures shall not exceed 25 degrees Celsius	Same rationale. Added to this section for consistency.

3. References

Memorandum regarding "Proposed Revisions to CETV OGS Procedure" from Tim Van Seters of TRCA to GLOBE Performance Solutions, June 6, 2014.

Canadian Environmental Technology Verification (ETV)

Information Bulletin

Bulletin Number: CETV 2016-09-0001

Subject: Rationale and Procedure for D5 Correction Factor applied to Oil-Grit Separator Scour Test Data

Date: September 30, 2016

Prepared by: Tim Van Seters and Yuestas David, Toronto and Region Conservation Authority (TRCA); Gregory Williams, Ph.D., P.Eng., Good Harbour Laboratories (GHL)

Approved by: GLOBE Performance Solutions (GPS), Delivery Agent for Canadian ETV

Overview

The capacity for Oil Grit Separators (OGS) to retain deposited sediments over the full range of flow rates to which they are subjected during storm events is an important performance parameter. The ability of OGS to retain sediments is evaluated in the CETV *Procedure for Laboratory Testing of Oil Grit Separators* by means of a 'sediment scour and resuspension test'. This test involves pre-loading fresh test sediment into devices and running clean water through the unit to determine how much of the pre-loaded sediment is scoured and discharged from the unit at high flow rates. Since the pre-loaded sediment contains very fine particles that may not be captured during normal operation, the *Procedure* allows fine particles to be mathematically removed from scour test effluent concentrations based on known particle size distributions (PSD) of retained and discharged sediment. Specifically, particles that are finer than those removed by the device during the lowest sediment capture test flow rate (40 L/min/m^2) specified in the *Procedure* may be mathematically removed.

Since only a small proportion of very fine particles are typically found in the retained sediment, a threshold particle size needs to be determined to guide the process of mathematical removal. This is necessary because of relative differences in the amount of very fine particles available for scour during the sediment capture and scour tests. During the 40 L/min/m^2 sediment capture test, a quantity of test sediment is injected into the influent flow stream. Very fine particles with low settling velocities may be captured under this condition through processes of particle flocculation and/or incidental contact with the sediment bed (and 'armouring' by coarser particles), which would render the fine particles less susceptible to resuspension. Unlike the sediment capture test, the scour test involves preloading of test sediment into the sedimentation chamber of the device. The test sediment contains 35% of particles less than or equal to 20 microns, which is a much larger proportion than would be normally captured during the 40 L/min/m^2 test. Under the preloaded condition, not only are there more fine particles available for scour, but the preloaded sediment particles will have had less opportunity than the injected sediment to interact and flocculate, potentially making them more available for scour. For this reason, CETV is allowing the smallest 5% of sediment (the D5) removed during the 40 L/min/m^2 capture test to be subtracted from the sediment scour effluent results, up to a maximum D5 particle size of 15 microns.

<u>The procedure for the D5 correction is as follows:</u>

First, the D5 of the PSD for the retained sediment in the 40 L/min/m2 test is determined. For example:

Table 1: PSD data for sediment retained in 40 L/min/m^2 run

Table 1. Particle size distribution of retained sediment at surface loading rate of 40 L/min/m^2	
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

Here the D5 is found by interpolation to be 4.7 microns

The next step is to look at the PSD for the effluent from each of the scour test flow rates and determine what percentage of the effluent sediment is smaller than the D5, 4.7 microns in this example. Table 2 shows sample scour effluent PSD data at 200 L/min/m^2.

Table 2. Scour test effluent sample PSD from the 200 L/min/m^2 run

Particle size of scoured sediment (µm)	Cumulative percent less than (%)
704	100
7.778	99.99
7.133	99.8
6.541	99.87
5.998	99.52
5.5	99.48
5.044	99.3
4.625	99.2
4.241	99.1
3.889	98.9
3.566	98.7
3.27	98.6
2.99	98.5
2.75	98.4
2.522	97.449
2.312	93.885
2.121	89.716
1.945	84.865
1.783	79.288
1.635	72.897
1.499	65.648
1.375	57.761
1.261	49.434
1.156	41.228
1.06	33.693
0.972	27.093
0.892	21.692
0.818	17.336
0.75	13.882
0.688	11.11
0.63	8.822
0.578	6.919
0.53	5.302
0.486	3.938
0.446	2.805
0.409	1.87
0.375	1.122
0.344	0.572
0.315	0.198
0.289	0

99.2% of the particles in the effluent sample are smaller than 4.7 microns. The formula for the D5 correction is as follows:

Effluent sample concentration * ((100 - D5 percentile)/100)

Once the D5 correction is applied, the background concentration is subtracted and the final result is the effluent concentration to be reported. Table 3 shows an example of the table that would be included in a final technical evaluation or verification report.

Table 3: D5 corrected and background adjusted scoured sediment concentration

Flow rate	Background sample concentration	Effluent sample concentration	Adjusted concentrations after correction for D5 and background concentration (mg/L)
200	2	50	0
800	etc…	etc…	etc…
1400			
2000			
2600			

Canadian Environmental Technology Verification (ETV)

Information Bulletin

Bulletin Number: CETV 2016-11-0001

Subject: Errors associated with calculating removal efficiencies by particle size fraction

Date: November 10, 2016

Prepared by: Toronto and Region Conservation Authority

Approved by: GLOBE Performance Solutions (GPS), Delivery Agent for Canadian ETV

Overview

The CETV *Procedure for Laboratory Testing of Oil Grit Separators* specifies that sediment removal results shall be reported by total mass and individual particle size fractions. The particle size distributions (PSD) of the samples taken from each of the injected and retained sediment for each run are the basis for reporting removal efficiencies by particle size fraction.

It was recognized during the preparation of the Procedure that there would be inherent errors and procedural difficulties associated with the generation of highly accurate and precise removal efficiencies from particle size distribution data. For this reason, claims for sediment capture by Oil Grit Separators were to be limited to the modified mass balance results. Removal efficiencies by particle size class were to be calculated in order to provide readers with a general understanding of the capacity of tested devices to remove different particle size fractions.

A comprehensive assessment of the source of errors associated with the collection and analysis of PSD samples has not been undertaken. However, it would appear that at least some of the error relating to removal efficiency calculations may be associated with the inconsistent capacity of the PSD analytical method (ASTM D422) to break down particles into their finest grain size components. While the dry injected sediment is already somewhat disaggregated, the wet retained sediment contains clumps of coagulated sediment that persist through the drying process. Failure to completely break down the coagulated sediment into their finest grain size components can introduce biases when comparing injected and retained sediment PSDs. The presence of removal efficiencies above 100% for some particle size fractions suggests that the retained sediment may still contain some aggregates not present in the dry injected sediment mass (although there are alternate explanations for such a result). Other sources of error may relate to the collection of representative sub-samples of the injected and retained sediments, and/or inaccurate interpolation of reported size classes into the size classes specified for reporting in the Procedure. Accredited test laboratories exert considerable efforts to collect representative samples for submission to analytical laboratories, and interpolate particle size fractions correctly, but inadvertent errors may still persist.

The ASTM D422 - 63(2007)e1 method was specified for the analysis of the sediment particle size distribution. This method was withdrawn by ASTM in 2016 with no replacement because "…*Regulations Governing ASTM Technical Committees*… requires that standards shall be updated by the end of the eighth year since the last approval date" (accessed October 20, 2016). Since the method was withdrawn for procedural reasons, rather than reasons associated with the accuracy of the test, CETV continues to support ASTM D422 - 63(2007)e1 as the best available method for the analysis of sediment particle size distribution.

Due to the withdrawal of the ASTM D422 method and the problems associated with calculating removal efficiencies by particle size fraction noted above, removal efficiency results based on PSD data should be interpreted with caution.

Canadian Environmental Technology Verification (ETV)

Information Bulletin

Bulletin Number: CETV 2018-09-0001

Subject: Modifications to *Section 5.2 "Test Conditions -- Light Liquid Re-entrainment Simulation Test"* of the CETV *Procedure for Laboratory Testing of Oil Grit Separators*

Date: September 18, 2018

Prepared by: Good Harbour Laboratories

Approved by: Toronto and Region Conservation Authority and GLOBE Performance Solutions (GPS)

Overview

The CETV *Procedure for Laboratory Testing of Oil Grit Separators* Section 5.0 specifies how to test for Light Liquid Re-entrainment. Running the test has revealed that making some clarifications in Section 5.2 would help make set-up easier and more consistent.

This bulletin proposes to change the name of the test to "*Light Liquid Retention Simulation Test*" and to replace the second paragraph of section 5.2:

"The MTD shall be preloaded with a known volume and mass of plastic beads to a depth of 5 cm over an area equivalent to the MTD sedimentation area, also referred to in this document as the Effective Treatment Area. Thus smaller units shall use a smaller volume of plastic beads than larger units; however, the depth of plastic beads shall remain identical. If the MTD separates oil over an area smaller than its sedimentation area, the depth of plastic beads preloaded in the smaller oil separation area shall exceed 5 cm, since the preloaded volume of plastic beads shall be based on a 5 cm depth over the sedimentation area. This ensures that MTDs with equal sedimentation area are preloaded with equal volumes of plastic beads, representing oil spill capture of identical volume. MTDs with a maximum light liquid storage depth of less than 5 cm over the sedimentation area shall preload with plastic beads to a depth equal to the maximum light liquid storage depth."

With the following:

"The MTD shall be preloaded with a volume of plastic beads sufficient to fill the effective treatment 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 treatment area and not spill capture area, for devices in which the spill capture zone area is different than the effective treatment area the depth will be different than 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, then adding beads while water flows through the unit. Following the pre-load, flow to the OGS will be stopped for at least 5 minutes to allow the device 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 testing, as described in section 5.3."

In addition, this bulletin adds the following text to the end of Section 5.3.2:

"If the cumulative volume washed out of the unit for the entire test plus the uncaptured volume recorded in Section 5.2 totals >15% of the ORV then the device may not be designated as a spill capture device.

Vendors of spill capture devices wishing to claim a larger ORV may repeat the test with a larger volume of beads."

Canadian Environmental Technology Verification (ETV)

Information Bulletin

Bulletin Number: CETV 2021-04-0001

Subject: Modifications to Section 3 *Sediment Removal Performance Test* in the CETV *Procedure for Laboratory Testing of Oil Grit Separators*

Date: April 30, 2021

Prepared by: Tim Van Seters, TRCA

Joe Costa, Good Harbour Laboratories

Reviewed by: James Mailloux, Alden Laboratories

Approved by: GLOBE Performance Solutions

The CETV *Procedure for Laboratory Testing of Oil Grit Separators* Section 5.0 specifies the procedure for assessing the sediment removal performance of Oil Grit Separators. A key provision of the test is the allowance for inclusion of residual sediment that accumulates in the inlet pipe to be included as part of the retained mass in the sediment removal calculation. This provision was included in the *CETV Procedure* based on the assumption that only coarse sediment with high capture rates would settle in the inlet pipe.

Laboratory testing has shown that sediment accumulation in the inlet pipe varies considerably among MTDs, which may in part be due to differences in inlet pipe diameters and slopes specified by vendors. The following modifications are intended to better standardize test conditions, reduce the potential for fine sediment settling within the inlet pipe and improve reporting requirements.

Section 3.2: Test Conditions

The sentence, "*Manufacturer's installation recommendations shall be followed with a pipe of a diameter that is consistent with the manufacturer's recommendations*", will be replaced with: "*The inlet pipe shall have a minimum slope of 1% and a diameter not exceeding 25% of the diameter or width of the MTD. The inlet and outlet pipes shall have the same diameter.*"

Section 3.3.3: Influent Sediment Concentration

The sentence, "*The test sediment shall be injected into the flow stream at the lesser of 3 metres or 5 pipe diameters upstream of the inlet to the MTD.*" will be replaced with: "*The* *maximum length of pipe from the point where sediment is injected to the test unit shall not exceed a distance of 0.91 m [3ft] upstream of the inlet."*

Section 3.4: Sediment Removal Calculation

The sentence, "*The mass of sediment accumulated in the inlet pipe shall be measured and reported separately*" shall be replaced with: "*The mass and PSD of sediment accumulated in the inlet pipe shall be measured and reported separately. Both measurements shall be included with the sediment removal efficiency results in the ISO Verification Report and Statement for the tested MTD.*"

Canadian Environmental Technology Verification (ETV) Information Bulletin

Bulletin Number: CETV 2022-01-0001

Subject: Use of sediment removal data generated through the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device, January 1, 2021* for ISO 14034 verification of Oil Grit Separators tested in accordance with the TRCA's *Procedure for Laboratory Testing of Oil Grit Separators*"

Date: January 6, 2022

Prepared by: Joe Costa, Good Harbour Labs

Tim Van Seters, Toronto and Region Conservation Authority

Reviewed by: James Mailloux, Alden Laboratories

Approved by: GLOBE Performance Solutions (GPS)

The 2021 update to the *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device January 1, 2021* is now more closely aligned with the TRCA *Procedure for Laboratory Testing of Oil Grit Separators* than was previously the case. Both protocols specify similar test parameters (*e.g*. pipe size limits, injection point location, background sediment concentrations), require 7 flow rates and mass recovery testing for determining sediment removal performance. Although the protocols still have key differences, the recent alignments open up the possibility of using some sediment removal test data for both verifications.

Given that all MTDs will need to be re-tested to the new NJDEP protocol by the end of 2024, there will be significant testing activity in the next few years. Hence, there is value to the industry in allowing some flexibility for using the same test data for NJDEP and ISO 14034 verification, which in Canada follows the TRCA *Procedure for Laboratory Testing of Oil Grit Separators.* This bulletin provides details on (i) minor changes to the TRCA *Procedure* to promote better alignment between protocols and (ii) the requirements for using NJDEP sediment removal test data for meeting ISO 14034 verification approval criteria in Canada (hereafter referred to as Canadian Environmental Technology Verification or CETV).

The following minor changes to the TRCA *Procedure* will be accepted to help bring the protocols into alignment:

1. Change the analytical method for PSD from ASTM D422-63 to ASTM D6913 & D7928
    a. Rationale: D422 included the sieve and hydrometer methods. It was allowed to lapse and was split into two standards, D6913 & D7982, one each for the sieve and hydrometer portion. The analytical requirement ends up being the same.

2. Sediment feed sample weighing: Change precision from 1 mg to 10 mg.
    a. Rationale: 1 mg precision requires an analytical balance and these balances typically cannot handle the mass of samples obtained from the higher flow runs. Going to 10 mg allows the use of top loading balances while maintaining 3 significant figures for *even the smallest samples.*

3. Flow rate recording: Flow rate recordings from calibrated flow instruments for the determination of Sediment Removal shall be recorded at intervals no longer than 1 minute instead of 30 seconds for all runs with flow durations greater than 2 hours (The recording interval for the TRCA *Procedure* Scour Test shall remain at 30 s).
    a. Rationale: Recording flow rates at one-minute intervals for sediment removal testing provides sufficient confirmation of maintaining the target flow rate. The less frequent data recording allows for the reduction in the amount of data that needs to be recorded which can be substantial for some of the longer runs.

While both protocols require testing 7 flow rates, the NJDEP protocol determines flow rates as a percent of the Manufacturers Treatment Flow Rate (MTFR) while the TRCA *Procedure* requires testing to specific surface loading rates (SLRs). Therefore, the flow rates for the two protocols are different.

The manufacturer has 3 options for using NJDEP laboratory test data to satisfy CETV test requirements:

1. Claim the removal for the nearest larger NJDEP flow rate, as long as the nearest flow rate is within 30% of the CETV target rate. This will be conservative since a larger flow normally yields a lower removal. Flow rate divergence greater than 30% requires re-testing.

2. Linearly interpolate between the nearest two NJDEP flow rates, with a percentage point penalty of 0.6% (absolute) on the resulting removal number, as long as the two target flows are within 2 to 12% of each other. If the CETV flow rate is lower than the target NJDEP flow rate, the NJDEP removal efficiency may be claimed without penalty. CETV flow rates less than 2% greater than NJDEP flow rates can be linearly interpolated without a penalty. [1]

3. Re-test and claim the result from the second number. If re-testing is done, the manufacturer must use this result for CETV.

Option one or two may not be used if the removal efficiencies on either side of the target CETV flow rate either increased with flow rate or showed a decline of 2.5 percentage points or less. Normally the verifier would apply this rule only in instances where a clear trend reversal has occurred. If the spread between all NJDEP flow rates is 2 to 3 percent, an exception to this rule could be considered by the verifier.

The example in Table 1 will use an MTFR of 28.3 L/s (1cfs, 449 gpm) for a unit with a 1.22 m (4 ft) diameter.

[1] While it is recognized that the current OGS *Procedure* allows for a 10% divergence in flow rates from the target flow rate without penalty, test labs attempt to minimize this error to the extent possible. They are often successful in these attempts. Accepting NJDEP test RE data corresponding to flow rates 2 to 10% lower than the target CETV rate without penalty undermines the intent of the lab effort to avoid errors, which may confer a potential advantage to vendors using external data to satisfy CETV requirements.

Table 1: Hypothetical NJDEP test results and options for claiming removal rates for CETV

	NJDEP			CETV			
Run #	%MTFR	Flow Rate *(GPM)*	Hypothetical NJDEP Removal rate	Loading Rate ($L/min/m^2$)	Flow Rate (GPM)	(NJDEP-CETV)/CETV % Diff	Claimed removal rate for CETV
1	-	-	-	40	12	275%	Difference between next highest NJDEP rate is too great. Re-test
2	-	-	-	80	*25*	80%	Same as one
3	10	45	60	200	62	-27%	Accept the 112 gpm results (55%) or re-test
4	25	112	55	400	123	-9%	Linear interpolation of REs between 112 and 225 gpm to get the 123 gpm removal rate, minus 0.6% = 53.9%, or re-test
5	50	225	50	600	185	22%	Accept the 225 gpm result (50%) or re-test
6	75	337	45	1000	308	9%	Accept the 337 gpm result (45%) or re-test. Linear interpolation between 225 and 337 gpm to get 308 gpm removal rate, minus 0.6% = 45.7%
7	100	449	40	1400	432	4%	Accept the 449 gpm result (40%) or re-test. RE Linear interpolation between 337 and 449 gpm to get 432 gpm removal rate, minus 0.6% = 40.2%
8	125	561	38	-	-	NA	Not needed
9	150	674	35	-	-	NA	Not needed

This example allows up to 5 runs to be used twice and would require 2 additional runs on top of the NJDEP 7 runs: 40 & 80 L/min/m^2. The net result would be 9 runs, instead of 14, for both verifications, assuming the manufacturer does not choose any re-tests.

If vendors are planning to use NJDEP data for ISO 14034 verification in Canada, they should carefully review the *Procedure* prior to NJDEP testing to ensure full compliance as there are key differences that will require additional testing during the NJDEP testing. The verifier will have the right to allow or reject use of NJDEP data at his/her discretion. Proposals to use NJDEP data to satisfy CETV testing should be reviewed and approved by the verifier prior to the start of testing.

Canadian Environmental Technology Verification (ETV)

Information Bulletin

Bulletin Number: CETV 2022-02-0001

Subject: Clarification on the type of Manufactured Treatment Device suitable for testing under the *Procedure for Laboratory Testing of Oil Grit Separators*

Date: February 28, 2022

Prepared by: Tim Van Seters, Senior Manager, Sustainable Technologies, Toronto and Region Conservation Authority

Reviewed by: John Antoszek, Pollution Control Engineering Advisor, Technical Assessment and Standards Development Branch, Ontario Ministry of the Environment, Conservation and Parks

Martin Bouchard-Valentine, Co-ordinator, Overflow and Stormwater Management Team, Quebec Ministry of the Environment and the Fight against Climate Change

Bert Van Duin, Drainage Technical Lead, Development Planning Infrastructure Planning, Water Resources. City of Calgary

Approved by: Globe Performance Solutions

The *Procedure for Laboratory Testing of Oil Grit Separators* was developed in 2013 by TRCA in association with a 32-member advisory committee for the then *Canadian Environmental Technology Verification (ETV) Program*. The *Procedure* was based on an earlier protocol developed by the Stormwater Equipment Manufacturers Association (SWEMA) for the New Jersey Department of Environmental Protection (NJDEP).

The *Procedure* was meant to be applied to Oil Grit Separators (OGSs), installed within a storm sewer drainage system. OGSs are defined in Appendix A of the document as Manufactured Treatment Devices (MTDs) with “structures consisting of one or more chambers that remove sediment, screen debris, and separate oil from stormwater.” These devices are also referred to as Sedimentation MTDs, because they rely primarily on the process of sedimentation to remove solids, and are thereby distinguished from Filtration MTDs, which employ filters to enhance solids and pollutant removal.

A filter is an engineered component within a Filtration MTD that is designed to remove fine sediment and associated pollutants through physical filtration mechanisms. Some filters are also designed to enhance removal of targeted dissolved pollutants such as phosphorus or metals through adsorption and ion exchange processes. While the pore openings in filters may be small or large, they will invariably restrict flow either initially and/or after exposure to stormwater runoff over time. For this reason, Filtration MTDs are typically designed for much smaller hydraulic loading rates than Sedimentation MTDs.

This flow restriction in filters occurs due to clogging of pores and/or the formation of films either on the surface of the filter or within the filter matrix. While in rare cases Filtration MTDs may be designed with initial hydraulic loading rates comparable to traditional OGS, and resist clogging in laboratory tests with non-cohesive ground silica sediment, a similar result would not be expected when the filters are subjected to cohesive sediments comprised of a mixture of sand, silt, clay, organic matter, emulsified oils, fine debris and other pollutants commonly present in stormwater sediments. Cohesive sediment particles are prone to physical, chemical and biologically mediated processes of coagulation and flocculation through which primary particles bind together to form aggregates. Since these flocs or aggregates can quickly clog filters by building up on filter surfaces and/or penetrating into the filter structure, the size of the filtering area needs to be carefully considered to ensure adequate flows through the system are sustained over the recommended maintenance interval.

It follows that an appropriate test for a filtration MTD should reflect the conditions that these devices are subjected to in real-world applications. Typically, this means monitoring of the device in a field setting over a typical recommended maintenance period (or ideally longer). The test would help to determine clogging dynamics, provide information on recommended maintenance requirements and inform sizing guidance for unit sizes smaller or larger than the tested unit. While a standard protocol for filtration MTDs has not been developed in Canada, other test protocols, such as the Washington Technology Acceptance Protocol – Ecology (TAPE), may be considered to provide a sufficient basis for technology verification as long as the monitoring program includes weather and site conditions appropriate for the geographic area in which the device is intended to be installed.

In advance of testing, vendors should provide details on any components that may act as a filter and consult with the technology verifier to determine whether the tested MTD should be classified as a sedimentation or filtration MTD. In general, filters with large or small pore openings that may be prone to clogging by cohesive sediments, sediment flocs or fine debris would fall into the class of a 'filtration MTD' and would therefore not be suitable for testing through the OGS *Procedure*. Screens designed to trap gross debris in an OGS would not typically be deemed to function as a stormwater filter.

Finally, it should be understood that the ultimate decision to approve, select and implement a particular technology rests with the technology buyer, guided by the requirements of the respective permitting authorities within the affected jurisdiction(s).