BRITISH WATER

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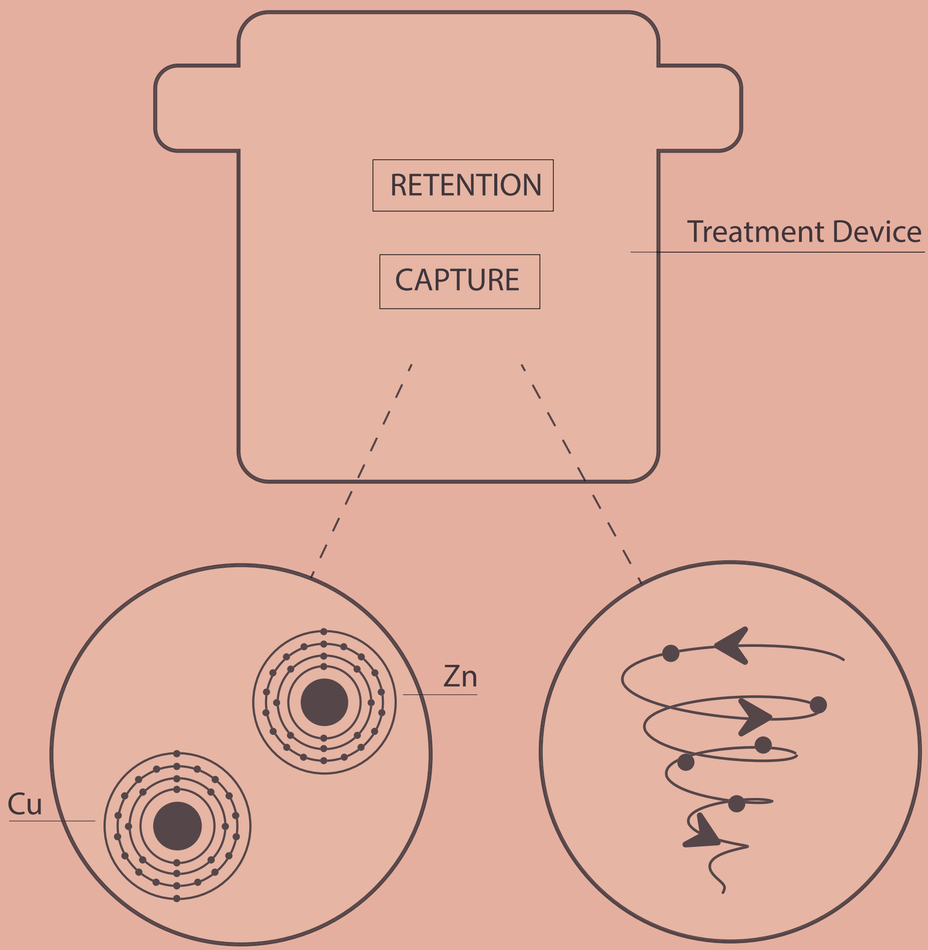
Code of Practice

Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff



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British Water Code of Practice for the Assessment of Manufactured Treatment Devices Designed to Treat Surface Water Runoff

Foreword

"At the Environment Agency we encourage the use of SuDS, and recognise that the right operational guidance for them is important. We have been pleased to work with the industry in creating its own code of practice. I am delighted to see the results, which will further support the implementation of SuDS in England".

Helen Wakeham, Environment Agency Deputy Director (Water Quality, Groundwater and Contaminated Land)

1 Introduction

This Code of Practice has been developed by a group of British Water members representing regulators and manufacturers of surface water treatment devices. Part of the project was delivered by HR Wallingford, who was contracted by British Water to supply the necessary supporting information.

The Code of Practice defines an assessment method which allows the manufacturers of surface water treatment devices to measure the pollutant capture and retention capability of their device and to declare those capabilities as they offer their product for sale on the UK market.

This Code of Practice has been developed because there is no existing published Standard test in the UK and allows manufacturers to complete an agreed test protocol. Approval and certification under this Code of Practice will allow manufacturers to demonstrate that their published capture and retention capabilities have been tested with appropriate evidence, confirmation from an independent testing body, and relevant test data.

The philosophy of this Code of Practice is to allow designers and approvers to apply a risk based approach, based on the type of application, to minimise the environmental impact of diffuse pollution associated with runoff. The declaration of capture and retention capabilities for a variety of pollutants will allow regulators, designers, specifiers and local authorities to select the most appropriate treatment device for the treatment of contaminated surface water in different situations.

2 Scope

This Code of Practice applies to treatment devices that are designed to remove anthropogenic pollutants from rainfall dependent surface water runoff. The tested devices will typically be used to treat runoff from urban and residential surfaces such as roads, car parks, industrial areas and commercial areas.

It does not cover devices that are designed to treat domestic sewage, trade effluent or other runoff caused by washing activities. The impact of firefighting water run off entering the drainage system is not considered.

It has been developed to test manufactured devices with fixed design parameters and is not suitable for testing vegetative devices which vary in construction from site to site. It only applies to devices that are permanently installed on a site in accordance with the installation instructions provided by the manufacturer: it does not apply to mobile or temporary devices. It does not apply to devices that require chemical dosing for their operation.

Devices designed to remove free-phase hydrocarbons from surface runoff should be tested separately in accordance with BS EN 858:1.

It is a voluntary Code of Practice and its application cannot be enforced. However, the completion of the test described in this Code of Practice will also allow manufacturers to calculate and declare the pollution mitigation index of their device for designers to apply when they are using the CIRIA SuDS Manual as a design guide [1]. It also allows manufacturers to satisfy the requirements within the SuDS Manual for declared retention capabilities of surface water treatment devices to be verified by independent scientific testing.

The Code of Practice does not consider important aspects such as manufacturing quality or installation requirements. However, the systems must be structurally stable under the envisaged installation conditions (for example, traffic loads). They must be fit for purpose and resilient to all design loads in line with valid technical regulations. Also, the Code does not refer to the maintenance requirements of the devices although it is recognised that maintenance is essential if devices are to be expected to treat the storm water to the standard achieved under these test conditions. Operators of the devices must operate and maintain the devices in accordance with the manufacturer's instructions and carry out all necessary maintenance procedures at required intervals.

The intention of the Code of Practice tests is to evaluate capture and retention of pollutants; it is incumbent on the treatment device manufacturer to evaluate and prove the device's hydraulic characteristics with respect to treatment flow rate and maximum capacity flow rate (see definitions below). This is necessary to inform the calculation of test flow rates and pollutant load.

The Code of Practice testing is aimed at determining three functional requirements of treatment devices:

1. Typical pollutant capture efficiency for frequent, sub-annual rainfall events.
2. Sediment retention capability for up to 1:2 year rainfall events likely to cause washout.
3. Capability of filter media to retain dissolved pollutants under the influence of de-icing salt

The Code of Practice requires that the manufacturer tests for two functional requirements of the treatment device:

1. Quantification of connectable area and treatment flow rate based on a 1:1 year rainfall event in the UK (mean intensity = 27 mm/hr).
2. Capability to safely pass a maximum capacity flow rate equivalent to a 1:30 year rainfall event, utilising bypass design as appropriate.

The tests can be completed by the manufacturer or at a commercially available test facility. In either case, the test must be witnessed by an approved independent UKAS accredited third-party who can verify the completion of the test in accordance with this Code of Practice. The UKAS accreditation must be held in an appropriate related laboratory analysis or assessment standard.

3 Definitions

Capture efficiency: The ability of a device to remove a pollutant from the flow. Using mass balance:

$$\mu = \left(1 - \frac{Q_o.C_o}{Q_i.C_i}\right).100 \qquad (1)$$

where μ is the capture efficiency, Q is the flow-rate, C is the measured concentration and the subscripts o and i represent the outlet and inlet conditions, respectively.

Connectable area: The impervious area which a treatment device may drain to produce its rated treatment flow-rate and maximum flow-rate. The connectable area shall be declared in the Product Performance Declaration (see Appendix A)

A device's connectable area (m^2) is determined from the treatment flow-rate (l/s) that the device is able to treat, assuming 100% runoff. The connectable area is given by:

$$A = 3600 * \frac{Q}{I} \qquad (2)$$

Where A is the connectable area (m^2), Q is the treatment flow rate (l/s) and I is the rainfall intensity (mm/hr)

External bypass: A flow path outside the treatment device that circumvents the unit.

Filter element: A filter media or membrane within the treatment device for the purpose of removing one or a number of pollutant groups.

1 The SuDS Manual, CIRIA, C753, ISBN 978-0-86017-760-9 available from www.ciria.org

Groundwater: all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil

Head loss: The hydraulic pressure required for the flow to pass through the treatment device. This is quantified as static head loss, measured between the inlet and outlet of the unit.

Internal bypass: A flow path within the treatment device that circumvents some or all treatment processes.

Manufactured treatment device: A proprietary piece of equipment for use in urban drainage systems with the specific target of removing pollutants carried by rainfall runoff.

Maximum capacity flow-rate (provided by the manufacturer): An input flow resulting from an M30:15 rainfall event for a stated catchment size. This originates from the requirements for all parts of a surface water drainage system to safely pass a 1:30 rainfall event without the occurrence of surface water flooding. Internal or external bypass mechanisms are permitted.

Pollutant retention flow rate: The capability of a treatment device to retain captured pollutants over subsequent rainfall events, the flow being the mean input flow resulting from an M2:15 rainfall event (40mm/hr) for a stated catchment area.

Sub Annual rainfall event: A rainfall event with an intensity and duration likely to occur in any given annual period.

Surface water: Any water on the surface of the ground including that in lakes, ponds, watercourses and rivers, estuaries, coastal waters and the territorial sea out to 3 nautical miles

Test flow rates: Input flow rates for testing are derived from a specially commissioned HR Wallingford report [2] that ranked rainfall distributions across 9 locations in England over a 7 year period. Four rainfall intensities are specified for evaluating pollutant removal efficiencies, which equate to the median intensities of each quartile of the ranked event distribution derived by HR Wallingford. These intensities are selected to give a representative measure of how a treatment device will perform under typical operating conditions. The test flow-rates may be calculated from the product of the rainfall intensities and the stated connectable area of the treatment device.

Table 1. Flow rates determined by the quartile median rainfall events

Rainfall rank percentile	Flow rate l/s/ha (mm/hr)
12.5	5 (1.7mm/hr)
37.5	10 (3.6 mm/hr)
62.5	15 (5.3 mm/hr)
87.5	31.5 (11.3 mm/hr)

Treatment flow rate (provided by the manufacturer). A mean input flow resulting from an M1:15 rainfall event (27mm/hr) for a stated catchment area. This originates from the requirement for the treatment device to treat all rainfall events with a sub-annual intensity. This flow-rate must pass through all of the treatment processes employed in the device, i.e. no external bypass is allowed. The treatment flow rate, connectable area and separation efficiency shall be declared in the Product Performance Declaration (see Appendix A).

4 Manufactured Treatment Devices in Sustainable Drainage Systems

The introduction of Sustainable Drainage Systems as a planning requirement across the UK on new developments (and redevelopments) makes it necessary to provide designers of SuDS systems with reliable information on a component's performance. It is envisaged that manufactured treatment devices will be particularly useful in removing targeted pollutants where space, and therefore opportunity to deploy multiple component management trains, is limited. Equally, manufactured devices may be deployed in tandem with other management train components where greater confidence in performance is required. Manufactured treatment devices can also be installed upstream of vegetative treatment devices to protect them from gross pollution and to make the removal of captured pollutants more cost effective. As such, this work aligns with the intent of the Water Framework Directive.

2 HR Wallingford report MAM7393-RT002-R02-00 was commissioned by British Water and funded by ACO Technologies plc, Hydro International, Polypipe Civils and the Environment Agency.

5 Application areas and application requirements

Typically, manufactured treatment devices will be used to remove pollutants from storm water in urban areas, treating runoff from surfaces such as car parks, industrial areas, pedestrian areas and roads. Manufactured treatment devices may also be used for the treatment of urban runoff in areas where an Environmental Permit or Licence applies, when agreed with the regulator. When designing management trains for such permitted discharges to surface water or groundwater, additional design requirements will need to be accommodated and the necessary treatment measures taken to comply with the Permit or Licence. For discharges to ground that will infiltrate down toward underlying groundwater, the requirements for pollutant retention capability may be higher than for discharges to surface water systems. Additional requirements may be defined by The Environmental Permitting (England and Wales) Regulations 2010 and in Scotland, the Water Environment (Controlled Activities) (Scotland) Regulations 2011.

Note – some National Infrastructure Organisations have their own standards and guidance which need to be adhered to.

6 Device Assessment Procedures

Maximum capacity flow-rate and Treatment Flow Rate of the treatment device are to be determined by the manufacturer, under the conditions specified by the manufacturer with respect to any internal or external bypass mechanisms. The reported Treatment Flow Rate is then used to calculate the connectable area and determine the test flow rates.

A statement of performance must be declared by the manufacturer for claims for capture and retention of

- Sediment
    - Capture and retention capabilities are assessed for a defined sediment size range and load
    - Flow rates above the treatment flow-rate are used to assess sediment retention and susceptibility to sediment washout

and/or

- Dissolved metals
    - Capture and retention capabilities are assessed for dissolved metals: copper and zinc are used as indicators for other dissolved metals.
    - Retention capability of the captured dissolved fraction is assessed under the influence of salt.

The equipment and methodology for sediment capture and retention and metal capture and retention are described below.

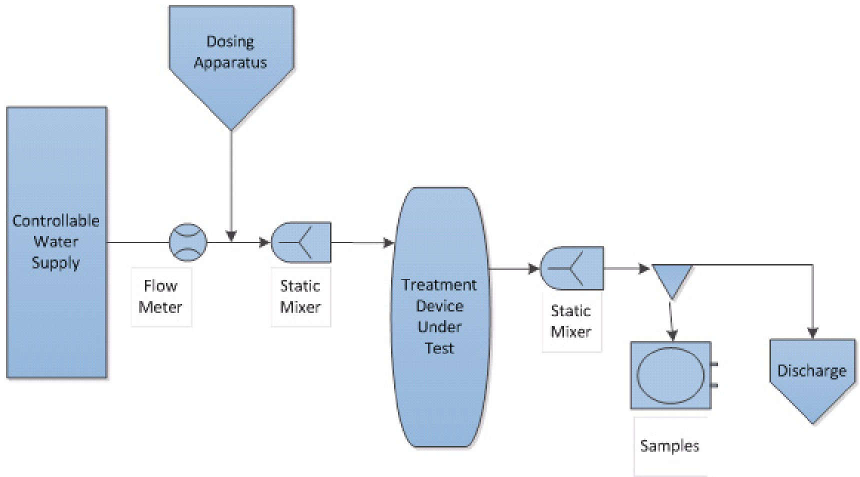
7 Sediment capture and retention

Assessment of sediment capture efficiency must be conducted at full-scale. Test arrangement 1 specifies the full-scale equipment configuration required for assessing treatment flow-rate and sediment capture efficiency. The configuration of the test equipment is defined in section 7.1.

The test apparatus must satisfy the requirements of the appropriate clauses below. If the test is completed by the manufacturer, the test equipment must be inspected and verified by a UKAS accredited body[3] to check the apparatus is acceptable in all dimensions and measurement devices are appropriately calibrated.

3 The UKAS accreditation must be held in an appropriate related laboratory analysis or assessment standard.

7.1 Test arrangement 1 (Sediment capture)



The test unit shall be setup to reflect the manufacturer's standard installation details.

The test arrangement consists of the following elements:

- a controllable water supply.
  - Influent water temperature shall be between 12.5 and 20 degrees Celsius.
- a flow meter.
  - The flow meter must be capable of measuring flow through the delivery pipe to a tolerance of +/- 5% over the volume exchange period of the device.
- a sediment dosing apparatus.
  - The dosing apparatus must be capable of dosing to a tolerance of +/- 5% over the volume exchange period of the device.
  - The sediment injections point shall be at the crown of the pipe, 1 pipe diameter upstream of the static mixer. The sediment delivery system shall be comprised of suitable equipment to provide consistent sediment feed rate of solids (e.g. an auger, vibratory hopper) well-mixed slurry injection system, or other.
- static mixers
  - Static mixers at the inlet and outlet are used to improve the spatial homogeneity of sediment in the flow, which facilitates more accurate sampling. Blade type static mixers should be used.
  - The static mixers should be selected so that they are operating within their recommended flow-rate range during the sediment capture efficiency assessments.
- the manufactured treatment device
  - The treatment device is to be tested with inlet and outlet sizes and configurations as specified by the manufacturer. Where a range of inlet pipe or inlet port diameters is offered the minimum should be used for testing purposes. All components of the treatment device should satisfy the supplier's standard specifications and configurations.

The flow supply pipe (between the static mixer and treatment device) should be 10 pipe diameters (+/- 0.1D) in length and inclined at 2% +/- 0.5%, so that the treatment device is at a lower elevation than the upstream static mixer.

The outlet pipe should be 3 pipe diameters (+/- 0.1D) in length.

A recirculation flow-loop may be used where the background influent concentration of sediment is shown to remain below 10% of the target influent concentration or 20mg/l, whichever of these represents the lower value. This should be accounted for as a statement of error in the final test results. To achieve this, a minimum of eight background samples will be taken upstream of the sediment injection point at evenly spaced intervals during test flow-rate 4 (31.5 l/s/ha). All samples (background and effluent) shall be analysed for Total Suspended Solids (TSS) in accordance with BS EN 872. The maximum allowable background concentration shall not exceed 20 mg/L. If any of the background concentrations exceed 20 mg/L the water must be replaced or filtered to reduce background concentration to acceptable levels.

Flocculants cannot be used to reduce background sediment concentrations.

7.2 Test flow rates:

Assessment of pollutant capture and retention efficiency must be carried out in the fixed sequence of Table 1 following the flow-rates and test durations specified. Test flow-rates 1 - 4 represent a distribution of mean sub annual rainfall event intensities for England derived from data covering 9 sites for a 7 year period. The test flow rates 1-4 are the median values of the interquartile ranges established from the sub annual rainfall distributions. Test flow-rate 5 represents a 1:2 year 15 minute rainfall event and is conducted to prove that substances already captured by a treatment device will not be flushed out during heavy rainfall. During testing the flow-rate must be controlled within a tolerance of +/- 5%.

Table 2. Assessment order, flow rates and volumes.

Assessment subject	Assessment order	Flow-rate l/s/ha (mm/hr)	Minimum number of volume exchanges[1]
Particle capture	1	5 (1.7mm/hr)	10
	2	10 (3.6 mm/hr)	10
	3	15 (5.3 mm/hr)	10
	4[2]	31.5 (11.3 mm/hr)	10
Particle retention	5[2]	110 l/s/ha (1:2 year 15 minute event 40mm/hr)	20

[1] Regardless of flow volume exchanges, the minimum time of the test must be 15 minutes.
[2] Head loss measurements are to be recorded at these flow-rates. The head loss will be measured as the static head loss between the water level taken from a tapping in the inlet pipe and the outlet water level of the treatment device. The inlet pipe tapping must be 5 pipe diameters (+/- 0.1D) upstream of the treatment device.

7.3 Assessment of sediment capture and retention efficiency

The assessment determines the treatment device's capability to capture and retain a pre-determined particle size distribution of silica sediment. The particle size distribution is chosen to give a correlation to that observed in urban runoff (Table 3), and to which the greatest concentrations of hydrocarbons, including PAH, and heavy metals are bound.

The test sediment to be used is a quartz powder with a grain size distribution as per Table 3 (for example Millisil W 4 from Quarzwerke GmbH). The test sediment shall have a $D_{50\%}$ (mass median particle size) value of 63µm.

Table 3. Particle size distribution of quartz powder to be used

Sieve analysis with air jet sieve		Analysis with Cilas granulometer	
Clear mesh width [µm]	Sum of retentions [mass percentage]	Grain diameter [µm]	Sum of retentions [volume percentage]
400	0.1	32	70
315	0.2	16	80
200	4	8	88
160	10	6	91
125	22	4	93
100	30	2	96
63	51		
40	66		

Particle Size Distribution of the actual test (feed) sediment shall be determined using BS EN 14488. Three samples of the test sediment shall be taken for particle size distribution analysis and the results reported accordingly. The average of the three samples shall be used to assess compliance with the target particle size distribution in Table 3.

The sediment load to be used is 200 mg/l. The dosing rate should be calculated according to the flow rates per hectare listed in Table 4.

Table 4. Test sediment load

Assessment order	Flow rate (l/s/ha)	Sediment load (mg/l)
1	5	200
2	10	
3	15	
4	31.5	

The quartz powder should be added to the system continuously to a tolerance of +/- 5%. Dosing of the quartz powder should commence when stable flow conditions have been established within the system.
A break of 16h to 24h should be maintained between the end of assessment flow rate 4 and the start of assessment flow rate 5. The flow rate of 110 l/s/ha for assessment 5 must be achieved within 30 seconds of starting the test.

Effluent samples for the determination of sediment retention rates should be taken in clean glass bottles. Following the start of supply plus the calculated flow period for a single volume exchange of the system, 5 pairs of samples of 1 litre each (two samples for each repeat determination) should be taken at regular intervals across the remainder of the test period (calculated from the number of volume exchanges specified in Table 1) for assessment flow rates 1 to 4.

15 samples should be taken at intervals of one minute each for assessment flow rate 5. Sampling should commence one minute after reaching the required test flow-rate.

Each sample should be filtered by means of a previously weighed and dried filter with a mesh width of 0.45 µm according to BS EN 872. Following filtration the same should be dried to mass consistency in a drying cabinet and then weighed to establish sediment quantity. All sample analysis must be completed by or witnessed by an independent UKAS Accredited laboratory.

The sediment weight is then converted to a concentration, in mg/l based on the sample volume.

7.4 Calculation of sediment capture and retention efficiency

For each test flow rate, the non-retained sediment concentration per litre is calculated as the average value of the five double samples for each of the test flow rates 1-4 and the 15 individual samples for assessment flow rate 5. From the total volume of water used for each test flow rate, the total mass of non-retained sediment can then be calculated (Equation 3).

$$M_{out} = V_{fr,1} \cdot C_1 + V_{fr,2} \cdot C_2 + V_{fr,3} \cdot C_3 + V_{fr,4} \cdot C_4 + V_{fr,5} \cdot C_5 \qquad (3)$$

M_{out} Total mass of non-retained sediment, in mg

$V_{fr,n}$ Supply volume for test flow rate “n”, in l

C_n Averaged sediment concentration in discharge for test flow rate “n”, in mg/l

Capture and retention efficiency is then calculated as a percentage by (Equation 4)

$$\mu = \left(1 - \frac{M_{out}}{M_{in}}\right).100 \qquad (4)$$

M_{in} Total input mass, in mg, of sediment delivered over all test flow-rates

8 Metals capture and retention

This test procedure determines a filter element’s capability to capture dissolved heavy metals. Furthermore, retention is inspected under the influence of de-icing salt to assess the filter media’s resistance to remobilisation of captured metals. Zinc and copper are used as the indicator parameters.

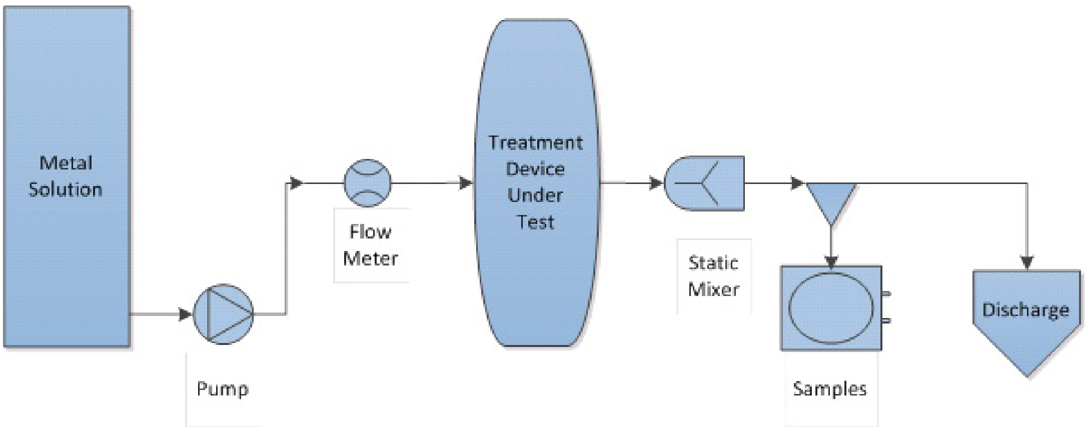
To reduce the impact of managing high dissolved metal content in test waters and effluents, the test volumes are reduced by a factor of up to 100. Because of this, **it is imperative that the filter is tested so that contact time and flow velocity in the media is equal to the full scale system.**

Assessment of dissolved metals capture efficiency may be carried out on partial elements of the primary filter element if it can be demonstrated the media is homogenous in nature and is not inhibited by any configuration or secondary elements integral to the commercially available treatment product submitted for evaluation. For multi stage filters, where there is no overriding evidence that the different stages presented for evaluation act independently, test arrangement 1 should be used.

Test arrangement 2 specifies the configuration for testing partial elements of a treatment devices media e.g. for testing the capture and retention of dissolved metals. The configuration of the test equipment is defined in section 8.1.

The test apparatus must satisfy the requirements of the appropriate clauses below. If the test is completed by the manufacturer, the test equipment must be inspected and verified by a UKAS accredited body[4] to check the apparatus is acceptable in all dimensions and measurement devices appropriately calibrated.

8.1 Test arrangement 2 (metals capture)



The test arrangement consists of:

- a reservoir containing the metal solution.
  - Influent water temperature shall be between 12.5 and 20 degrees Celsius.
  - The pH range of the water should be stated as limits within the treatment protocol.
- a controllable pump.
  - The pump should be capable of delivering greater than 120% of the maximum test flow to ensure a stable flow-rate.
  - The pump should be capable of controlling flow rate to within +/- 5% of the target flow rate.
  - The pump should not be used to deliver a pressurised flow to the filter element unless this is part of the full-scale system presented for evaluation. Where a pressurised flow is required to represent the complete treatment device this should be provided via a static head of water which represents the manufacturers claimed minimum (or maximum if this results in the worst case performance) installed depth. Evidence to support the use of maximum or minimum installed depth should be provided. If the filter element is to be evaluated for a range of pressure heads the maximum and minimum installed operating head levels must form part of the range.
- a flow meter.
  - The flow meter must be capable of measuring flow through the delivery pipe to a tolerance of +/- 5% over the volume exchange period of the device.
- the filter element or media to be tested.
  - The filter element to be tested will consist of a representative filter section (segment), whereby the actual full-scale system flow conditions must be taken into consideration: contact time and flow velocity in the media must be equal to the full scale system.
  - The test flow-rate should be presented to the partial filter element as it would within the full-scale treatment device presented for evaluation. This may require the manufacture / replication of the filter housing within the treatment device, which is acceptable provided no inlet or boundary effects that would not be experienced within the full-scale treatment device are created

4 The UKAS accreditation must be held in an appropriate related laboratory analysis or assessment standard.

8.2 Test flow rates

Assessment of metal capture and retention efficiency must be carried out in the fixed sequence of Table 5 following the flow-rates and test durations specified. Test flow-rates 1 - 4 represent a distribution of mean sub annual rainfall event intensities for England derived from data covering nine sites for a 7 year period. The test flow rates 1-4 are the median values of the interquartile ranges established from the sub annual rainfall distributions. Test flow-rate 5 represents a medium rainfall event and is conducted to prove that substances already captured by a treatment device will not be remobilised by the influence of de-icing salt.

During testing the flow-rate must be controlled within a tolerance range of +/- 5%.

Table 5. Assessment order, flow rates and volumes

Assessment subject	Assessment order	Flow-rate l/s/ha (mm/hr)	Minimum number of volume exchanges[1]
Metals capture	1	5 (1.7mm/hr)	10
	2	10 (3.6 mm/hr)	10
	3	15 (5.3 mm/hr)	10
	4[2]	31.5 (11.3 mm/hr)	10
Metals retention	5[2]	10 (3.6 mm/hr)	10

[1] Regardless of flow volume exchanges, the minimum time of the test must be 15 minutes.
[2] Head loss measurements are to be recorded at these flow-rates. The head loss will be measured as the static head loss between the water level taken from a tapping in the inlet pipe to the outlet water level of the treatment device. The inlet pipe tapping must be 5 pipe diameters (+/- 0.1D) upstream of the treatment device.

8.3 Assessment of zinc and copper capture

For test flow rates 1 to 4, a solution of zinc and copper salts (nitrates are suggested) should be prepared that is equivalent to the expected annual load from the connectable area. The average annual load of dissolved zinc is taken as 135.0 mg/m^2, that of copper 15.5 mg/m^2.

The metal solution should be contained within a maximum volume of 200 l. Zinc and copper should be added to deionised/ demineralised water (conductivity ≤ 200 µS +/- 5%) together in the form of a concentrated solution. The diluted solution should then be adjusted to a pH value of 5.0 +/- 0.5 by adding nitric acid or sodium hydroxide solution. The determination method and limits of the analysis methods should be taken into consideration and documented.

The filter element should be supplied with the metal solution over the entire test period. Supply concentrations must be maintained with an accuracy of +/- 10%. Two water samples of at least 100 ml volume should be taken from the outlet four times at identical intervals over the test period. At the start of each test the first sample should be taken only after the water in the filter element has been exchanged once. The remaining test period should be divided into three equal time intervals for a total of four samples to be taken. All samples must be tested for zinc and copper according to standard methods for determining heavy metals in water. The standard methods currently in use in the UK can be identified in the relevant version of the Environment Agency 'Blue Book' **Index of Methods for the Examination of Waters and Associated Materials** [5].

8.4 Calculation of dissolved metal capture

The concentration of each metal at each test flow rate should be determined as the arithmetic average value of the concentrations of the eight individual samples. Then an arithmetic average concentration of the four test flow rates should be calculated for each metal species (Equation 5).

$$C_{out} = (C_1 + C_2 + C_3 + C_4)/4 \qquad (5)$$

C_{out} Non-captured metal concentration, in mg/l

C_n Averaged metal concentration in run-off for test flow rate n, in mg/l

Capture efficiency is then calculated, as a percentage, for each metal species:

$$\mu = \left(1 - \frac{C_{out}}{C_{in}}\right).100 \qquad (6)$$

C_{in} Concentration of metal in starting test solution, in mg/l

5 www.gov.uk/government/uploads/system/uploads/attachment_data/file/316742/SCA_Blue_Book_236.pdf

8.5 Zinc and copper retention under salt influence

16 hours after completion of the assessment of zinc and copper capture the same filter element should be tested for a possible remobilisation of heavy metals from the filter media through de-icing salts. For this, a solution of salt (sodium chloride) in deionised/demineralised water should be used.

Note: normal de-icing salt should not be used due to the variability in impurity content. Commercially available Evaporated or Solar Salt (as used in the regeneration of water softeners), with a purity greater than 99.5% should be used.

The retention test water volume shall be the same as used for determination of metals capture. The salt solution should be started in a suitable container. The salt should be added at the rate of 10g/l (+/- 5%). The zinc and copper content of the salt solution should be determined according to standard methods for determining heavy metals in water. These values are recorded as the background concentration of each.

The test flow rate and volume exchange to be used is Assessment order 5 in Table 5.

Two water samples of at least 100 ml volume should be taken from the outlet four times at identical intervals over the test period. At the start the first sample should be taken only after the water in the filter element has been exchanged once. The remaining time of the part inspection period should be divided into three equal time intervals for four samples to be taken and metal content determined according to standard methods for determining heavy metals in water.

The standard methods currently in use in the UK can be identified in the relevant version of the Environment Agency 'Blue Book' **Index of Methods for the Examination of Waters and Associated Materials** [5].

8.6 Calculation of dissolved metal remobilisation under salt influence

The concentration of each metal in the discharged salt solution should be determined as the average value of the concentrations of the eight individual samples. From the mass balance, the percentage of each metal released from the media under the influence of salt is given by:Y

$Y=$ $$\gamma = \frac{(C_{salt} - C_{background}).V_{salt}}{(C_{in} - C_{out}).V_{in}}.100 \qquad (7)$$

Y	ratio of metal released from media of metal captured in previous test runs
C_{salt}	Concentration of metal in salt solution discharged, in mg/l
$C_{background}$	Background concentration of metal in salt solution, in mg/l
V_{salt}	Volume of salt solution, in l
C_{in}	Concentration of metal in starting test solution, in mg/l (Equation 6)
C_{out}	Non-captured metal concentration, in mg/l (Equation 5)
V_{in}	Volume of metal solution used in metal capture test, in l

The efficiency of the filter media in retaining previously captured metals is:

$$\varepsilon = \left(1 - \frac{(C_{salt} - C_{background}).V_{salt}}{(C_{in} - C_{out}).V_{in}}\right).100 \qquad (8)$$

9 Operational requirements

Systems must be designed to ensure conveyance of rainwater run-off and retention of polluting substances. Where a filter media is present, it must be non-sensitive towards colmatation (packing) and cleaning of the same must be possible. The colmatation characteristics of filter substrates must be tested.

The ability of the system to convey rainwater run-off will be assessed through measuring the hydraulic loss (head loss) of the system at the inspection flow-rates under test conditions.

The cleanability of the system must be confirmed by the manufacturer and maintenance requirements documented. **Pollutant storage capacities must also be stated.** Because the proper operation and maintenance of these devices is essential, manufacturers must provide details of the maintenance and inspection regimes and their frequency in or with the product literature provided to the customer.

10 Lifetime of filter material

The filter material lifetime estimation stated by the applicant should be determined according to the plant function, the operation principle of the filter material, and the colmatation (packing) characteristics of the material.

It is necessary to determine filter capacity degradation for:

- Sediment impact on permeability,

and, where part of declared performance for dissolved heavy metal removal,

- Adsorption / precipitation.

The manufacturer will declare filter degradation characteristics in terms of 'half-life' or load that reduces flow and capture potential by 50%. The manufacturer should also provide information about the recycling or reuse opportunities for filter materials so that sustainability assessments can be completed.

11 Requirements regarding the construction products.

The construction products (components and materials) used for producing the systems must comply with relevant technical regulations.

12 Test Report and Inspection Certificate

The test report documenting the substance retention capacity must include the following minimum

information:

- Manufacturer/supplier of the treatment device.
- Identification of the treatment device (brand name, model).
- Envisaged application for the treatment device.
- Information concerning the capture and retention mechanisms that operate in the filter (where appropriate), including the pollutants captured.
- Information about the construction of the system (description of construction products used, drawings with measurements and material information).
- Treatment device capacity and sediment storage capacity.
- Treatment flow rate, connectable area, pollutant retention flow rate and maximum capacity flow rate.
- Details of tests undertaken including test arrangement and reduction factor of filter element (where appropriate).
- Test results.
- Evaluation of test results:
  - Device head loss (at Treatment flow rate).
  - Device head loss (at Maximum capacity flow rate).
  - Sediment capture and retention efficiency (if tested).
  - Zinc capture efficiency (if tested).
  - Zinc retention efficiency (if tested).
  - Copper capture efficiency (if tested).
  - Copper retention efficiency (if tested).

A Performance Declaration is made by the manufacturer based on the information above. A template for the Performance Declaration is provided in Appendix A.

13 Documents to be provided by the manufacturer

The manufacturer should submit the following minimum documentation for inspection by the independent UKAS accredited third party that will witness the test.

- Information concerning the envisaged application including maximum connectable area, the treatment flow rate and the maximum flow rate.
- Information concerning construction materials and components envisaged for the system
- Material data sheet for any filter material or media.
- Factory production control parameters and tolerances for the filter material.
- Information concerning system construction (construction and assembly including technical drawings and dimensions).
- Test certificate regarding characteristics of the filter material used.
- Cleaning and maintenance instructions.
- Information concerning the scaling of equipment for the completion of the metals capture and retention tests, including evidence of contact time and residence time scaling.

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Appendix A : Template for Performance Declaration

Surface Water Treatment Device Performance Declaration

Testing carried out according to British Water Code of Practice

Manufacturer:

Treatment Device Name/Model:

General description:

Envisaged application:

Pollutant(s) captured:

Treatment device capacity:	**l**
Sediment storage capacity:	**l**

Treatment flow rate:	**$l.s^{-1}$**
Connectable area:	**m^2**
Pollutant retention flow rate:	**$l.s^{-1}$**
Maximum capacity flow rate:	**l.s-1**
Device head loss (at Treatment flow rate)	**m**
Device head loss (at Maximum capacity flow rate)	**m**

Sediment capture and retention efficiency (if tested)	**%**

Zinc capture efficiency (if tested)	**%**
Zinc retention efficiency (if tested)	**%**

Copper capture efficiency (if tested)	**%**
Copper retention efficiency (if tested)	**%**

Dated: …………………………………………..

Witnessing party: ……………………………

In addition, the manufacturer shall provide the following information:

- Construction product characteristics:
    - EU safety data sheet according to Regulation (EC) No 1907/2006 (REACH)
    - Technical information sheet

These must provide sufficiently complete information concerning characteristics relevant for the safe handling of the product. Apart from physical/chemical parameters such as for example shape, density, viscosity, melting or boiling point or range, flash point, ignition temperature and explosion limits, these also include toxicological and ecological information as well as information for the classification according to Regulation (EC) No 1272/2008. This shall also include material data sheets for filter material/ media (where appropriate)

- Installation instructions (including technical drawings and dimensions) for both the device itself and any required system components).
- Cleaning and maintenance instructions.
    - For filters, the manufacturer will declare filter degradation characteristics in terms of 'half-life' (load that reduces flow and capture potential by 50%).
- Waste disposal and/or recycling information (for retained pollutants and spent filters).