EUROPEAN ASSESSMENT DOCUMENT

EAD 180023-00-0704

August 2018

VERTICAL CENTRIFUGAL STORM WATER FLOW REGULATOR

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The vertical centrifugal storm water flow regulator, CEV (Centrifugal Vertical) is a construction product providing storm water management in civil engineering constructions.

The CEV consists of a vortex chamber having an inlet and outlet. In the vortex chamber a vortex is created restricting the discharge of the water. The cylindrical shaped vortex chamber is installed in a vertical position using a mounting kit and is detachable from ground level for the ease of simple and regular inspection.

Graphically the performance of a CEV is described as a s-shaped discharge curve. A high discharge is achieved twice without exceeding the design flow. The s-shaped curve supports the design of a self-cleaning sewer system, in order to avoid overloading and flooding.

The CEVs are designed specifically for a maximum flow as a function of the maximum pressure height.

The CEV is delivered in variable sizes typically designed to give a maximum flow within the range of 0.2 l/s to 80 l/s up to a maximum pressure height of 2 m.

The CEV is made of corrosion resistant stainless-steel 1.4401/316 in accordance with EN 10088[1].

A schematic view of the CEV with inflow in the bottom is shown in annex A.

The product is not covered by a harmonized standard.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise clients on the transport, storage, maintenance, replacement and repair of the product as the manufacturer considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The purpose of the CEV is to protect the low-lying parts of sewer systems (downstream) against overloading and flooding. During rain events, including heavy rainfalls, storm water is stored upstream in a suitable retention facility (e.g. basins, infiltration boxes)

The CEV allows water to pass further down in the sewer system up to a predetermined maximum amount per time unit, regardless of the variation in feed flow and water level in the manhole. The mean discharge through the CEV is higher than through a comparable orifice. CEVs can be applied inline or where retention facilities are connected to the sewer system, depending on the piping network, in order to restrict the amount of storm water entering the system.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to consider a working life of the CEV for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

1 All undated references to standards or to EAD's in this document are to be understood as references to the dated versions listed in clause 4.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[2].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

2 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of a vertical centrifugal storm water flow regulator, CEV (CEntrifugal Vertical) is assessed in relation to the essential characteristics.

Table 1: Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Method of assessment	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class
Basic Works Requirement 3: Hygiene, health and environment			
2	Mechanical impact resistance	2.2.2	Level
3	Flow characteristics	2.2.3	Level

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Reaction to fire

The vertical centrifugal flow regulator is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire in accordance with the EC Decision 96/603/EC (as amended) without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore, the performance of the product is class A1.

2.2.2 Mechanical impact resistance

The center of the front, upstream-facing side, Figure 1 and the center of the curved volute, Figure 2. of the vortex chamber is tested for resistance to mechanical impact with a 6 kg test piece dropped directly onto its center from a height of 2 m.

During test the CEV is standing free (supported from the floor with no fixation) on a non-shock-absorbing concrete floor

The impactor is a cylindrical smooth solid stainless-steel rod with dimensions Ø 40 mm x 608 mm. The drop distance of 2 m is measured from the lower edge of the impactor to the surface of the impact area. A guiding tube with dimensions Ø50 mm x 2000 mm can be used. The guiding tube shall end 500 mm above the impact area.

The maximum permanent indentation from the impact is stated in the ETA.

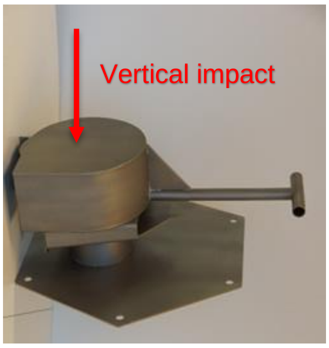

Figure 1.

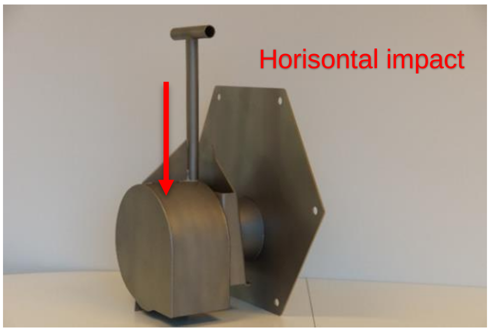

Figure 2.

2.2.3 Flow characteristics

The assessment of the flow characteristics is described in annex B.

The performance of the CEV is stated in the ETA as the outflow at the point immediately before the vortex is formed, Q_{bump}, and at the point of the maximum outlet, Q_{design}, as a function of the water level, H_{bump} and H_{design} respectively, compared with an orifice.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 2015/1959.

The system is: 4 for all uses

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Control of materials received	Visual inspection/Control of certificates	As given in the control plan	1	Each delivery
2	Dimensions of cutting drawing	Measurement	As given in the control plan	One for each dimension	1
3	Assembly control of parts	Measurement	As given in the control plan	One for each dimension	1

4 REFERENCE DOCUMENTS

EN 10088-1:2014	Stainless steels – Part 1: List of stainless steels
EN13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using test data from fire reaction to fire tests

ANNEX A DESCRIPTION OF THE PRODUCT

The below Figure 1B shows the flow through a CEV. With a 100% model, the maximum outlet, Q_{design}, is met twice; first immediately before the vortex is formed (the bump on the graph) and then at the specified H_{design}, where H_{design} is the distance from the invert of the discharge pipe to the maximum water level in the manhole (see Figure 1A). A 78% model is also shown; here the bump occurs at a flow of 78% of Q_{design}. The physical dimension of the 78% CEV is smaller, and the vortex is formed sooner than that of a 100% model.

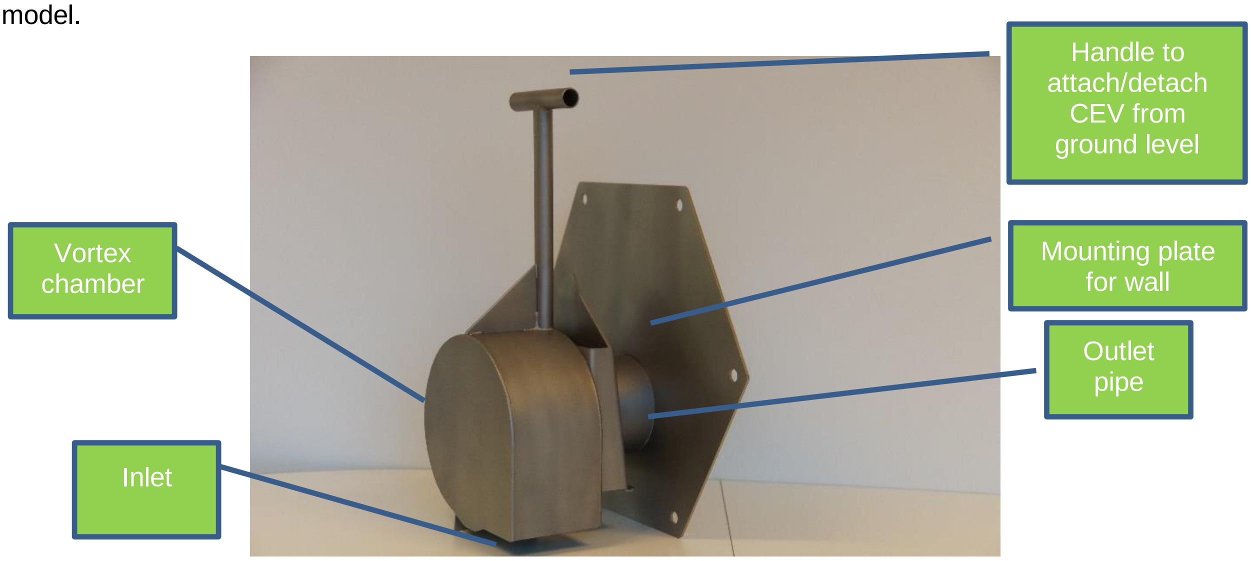

Photo of CEV with inlet at the bottom

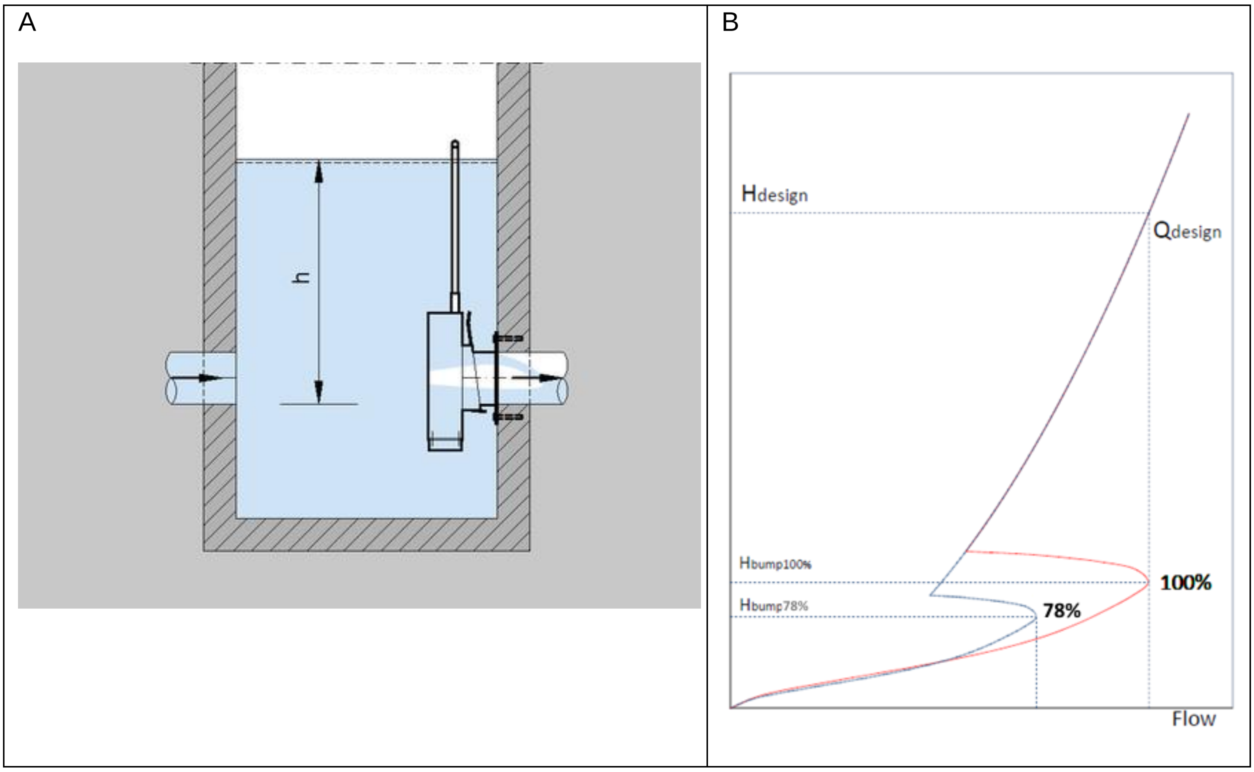

Figure 1

A) Sketch of a CEV installed in a manhole. H_{design} is the maximum h for the given design.

B) Graphic showing the general vortex brake effect on water outflow at increasing head, h, up to and above h_{design}, with two different CEVs having Q_{bump} at 78% respectively, 100% of Q_{design}.

ANNEX B TEST PROCEDURE FOR FLOW CHARACTERISTICS

Test set-up

The CEVs to be assessed shall have inflow in the bottom of the regulator, as shown in Figure 2. Equal hydraulic conditions are ensured by connection between the Inlet Tank and Manhole. In addition, it shall be ensured that inlet and outlet are located at the same level in the manhole (as depicted on Figure 1A). To be able to control the water level rise in the manhole optimally, the manhole is connected to an inlet tank, so that the inlet flow is lead via the inlet tank. This is illustrated in Figure 2. As the manhole and the inlet tank are connected the heads in the two compartments will be the same. The average increase of the water level is kept within 0.5 and 1.5 mm/s, which are common values in runoff systems. The rise of the water level is controlled by assessing the difference between the two flowmeters in relation with a knowledge of the volume in the inlet tank as well as the manhole, and the use of the valve to adjust the inlet flow. The flowmeters and valve are positioned as indicated on Figure 2. These conditions shall be used during testing.

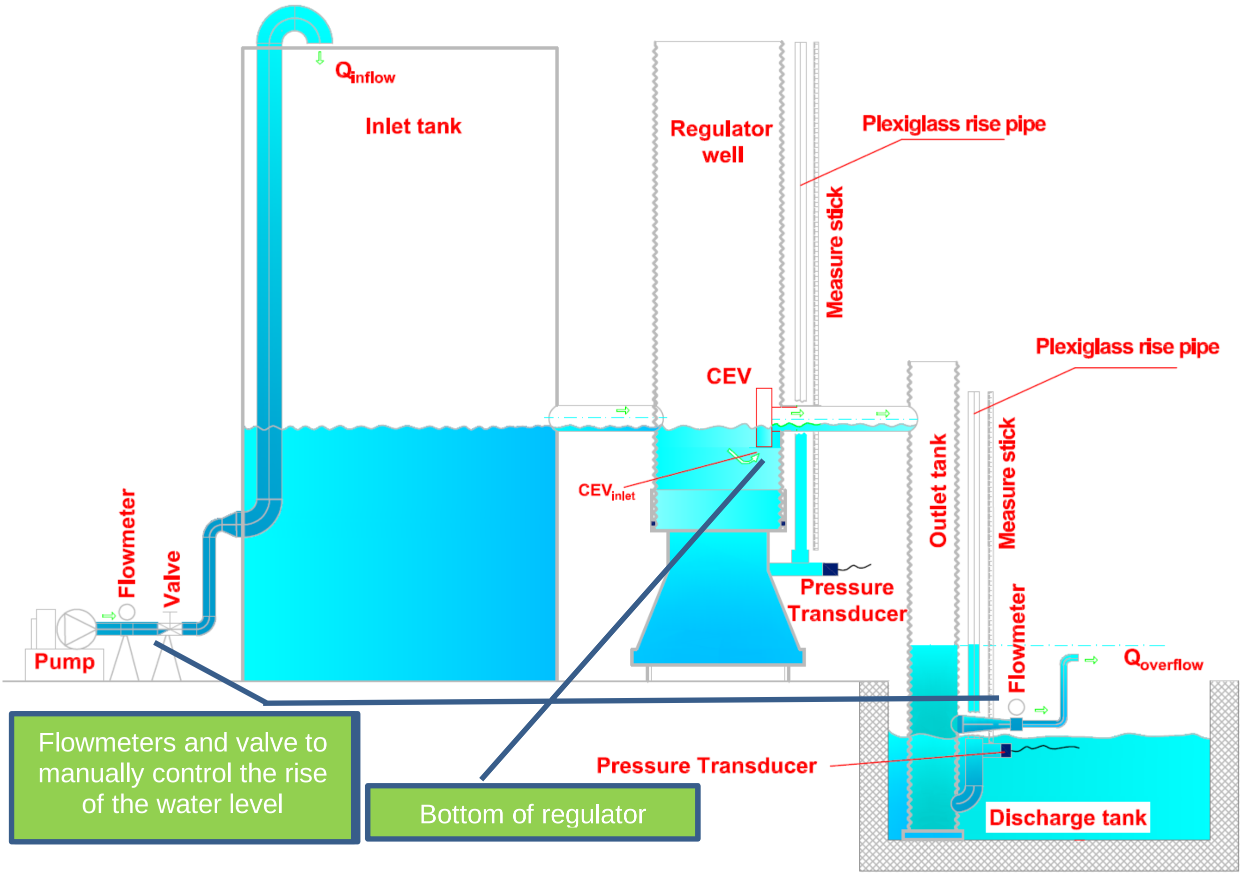

Figure 2. Test set-up

The testing is performed as follows:

Four trials for each CEV-model, shall be performed at different average rise of water level in the manhole, where the average rise in head shall be between 0.5 to 1.5 mm/s. To ensure a stable rise in head an inlet tank is installed next to the manhole (see Figure 2).

To determine the variation in the measurements of each trial, one of the trials for one of the CEV-models must be repeated 3 times. If the variation of the triplicate is more than 10% (e.g. in the bump), triplicate trials must be made for the remaining CEV-models too.

The trial is started with an empty manhole and continue until the design head, H_{design}, for the actual CEV, is reached. H_{design} is known from the calculation of the physical design of the CEV that is verified. Thereafter the manhole shall run dry.

Online measurement and evaluation of the flows and water pressure during the test trials

Monitoring of the outflow (e.g. water pressure in the outlet tank), inflow and water pressure in the manhole shall as far as possible continue through the whole trial.

During the test parameters measured are as follows:

- Inflow (Q_{inflow}) (l/s)
- Water level/pressure in manhole (m_{H_2O}/Pa)
- Water level/pressure in the outlet tank (m_{H_2O}/Pa)
- Outflow ($Q_{overflow}$) from the outlet tank (l/s)

All signals are collected at 10Hz.

The test rig with pressure transmitters and flow monitors is tested and calibrated using a known orifice instead of a CEV. Proper calibration as prescribed by manufacturer is to be done for pressure transmitters. Flow meters need to be certified for performance.

Evaluation of test results

The results from the testing are shown graphically and specific performance parameters are calculated.

For each of the CEV-models the test report should include graphs, including all test trials showing as follows:

A. Relation between inflow (l/s) and time (s)
B. Relation between time (s) and head in manhole (m_{H_2O})
C. Relation between calculated outflow (l/s) and time (s)
D. Relation between outflow (l/s) and head in manhole (m_{H_2O})

The outflow cannot be measured directly due to air and turbulence at the outlet. However, measurements of the head in the outlet tank and of the overflow from the outlet tank will be obtained. The $Q_{outflow}$ will be calculated in two ways as follows:

1)

$$Q_{outflow} = Q_{inflow} - \frac{\Delta Hmanhole \times Amanhole \times 1000}{\Delta t}$$

$Q_{outflow}$: Flow out of CEV (l/s)
Q_{inflow}: Flow into inlet tank (l/s)
$A_{manhole}$: Surface area in inlet tank + manhole + riser (m^2)
$H_{manhole}$: Pressure head above outlet invert level in the manhole (m_{H_2O})
Δt: Time for changing $H_{manholel}$ with $\Delta H_{manhole}$ (s)

2)

$$Q_{outflow} = Q_{overflow} + \frac{\Delta Hout \times Aout \times 1000}{\Delta t}$$

$Q_{outflow}$: Flow out of CEV (l/s)
$Q_{overflow}$: Overflow from the outlet tank (l/s)
A_{out}: Surface area in the outlet tank + riser (m^2)
H_{out} : Pressure head in the outlet tank (m_{H_2O})
Δt: Time for changing H_{out} with ΔH_{out} (s)

Equation 2) will be used in the performance evaluation, while 1) will only be used as indication and control of the result in 2).

Flow at H_{bump} and H_{design}

The performance of Q_{design} at H_{bump} and H_{design} is evaluated based on the results shown in the QH graph. See figure 3 indicating the variation of the measurements to the expected design point (that is the intersection of the Q_{design} and H_{design} lines). For each test trial, the flow at the bump (Q_{bump}'), placed as indicated by the purple dots in figure 3, and at H_{design} (Q_{design}'), placed as indicated by the Orange dots in figure 3, is derived.

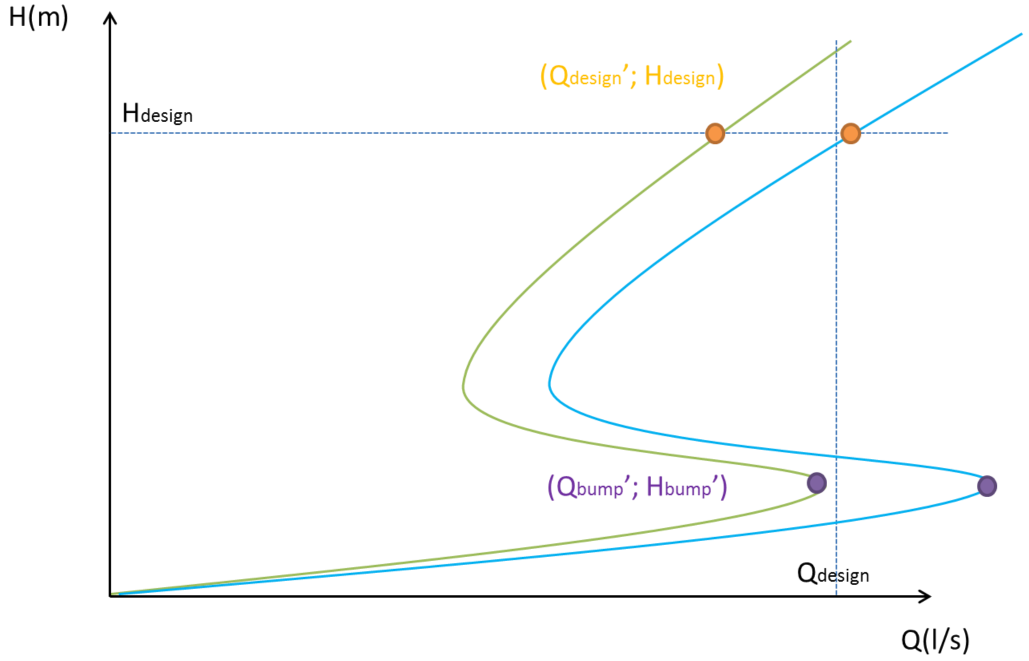

Figure 3. Schematic: Points to be used during evaluation of results

Based on the values obtained, average and precision for Q_{bump}' and Q_{design}' for each of the CEV-models shall be calculated. These calculations are made according to the equations as follows: (use the values for Q_{bump}' and Q_{design}' respectively as X_i)

Average:

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

$\bar{X}$: average of values
n: number of data points
X_i: individual value (that is: either Q_{bump}' or Q_{design}')

Precision:

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}}$$

$$RSD = \frac{SD}{\bar{X}}$$

SD: standard deviation
RSD: relative standard deviation
n: number of data points
X_i: individual value, (that is: either Q_{bump}' or Q_{design}')
$\bar{X}$: average of values