



CERTIFICATE FOR

QC WW5

BIOCHEMICAL OXYGEN DEMAND (BOD)

BATCH: VKI-21-7-1025

INSTRUCTIONS FOR USE OF THE REFERENCE MATERIAL

Description

This reference material consists of one ampoule with concentrate for preparation of reference sample for quality control after dilution with water. The certificate includes documentation for the analytical parameters BOD₅ and BOD₇.

Quantity and Preservation

QC WW5 consists of ampoules with a minimum of 25 mL concentrate in each. 250 mL reference sample is produced by dilution of 25 mL concentrate. The concentrates are preserved by autoclaving.

Use

The reference material is intended for quality control, i.e. measurement and control of the accuracy and precision of analyses. It is typically intended for analyses of biochemical oxygen demand after 5 days (BOD₅) or after 7 days (BOD₇) in wastewater. It may also be used in the quality control of other types of water samples and for the implementation and optimisation of analytical instruments and analytical methods.

It is important that the batch numbers of the reference material and on the certificate are identical.

Preparation for Use

Stabilise the ampoules at room temperature (approx. 20°C). Break the ampoule neck open at the mark, withdraw the concentrate with a pipette, and dilute 1:10 with water without a detectable content of BOD, e.g. 10,00 mL concentrate up to 100 mL with water. The approximate concentrations are 200 mg/L O₂. The certified concentrations are given in the table on page 3 of this certificate.

Analysis

For quality control the reference material is analysed at the same time and in the same manner as other samples.

Storage and Durability

Store the ampoules protected from sunlight, e.g. in the ampoule boxes, and at room temperature or in a refrigerator. The certificate is valid until **1st of April 2030** provided the material is stored under the recommended conditions.

After opening of the ampoule and dilution, the reference material has an expected storage time of up to 24 hours.

PRODUCTION OF THE REFERENCE MATERIAL AND DOCUMENTATION

Production

The production of this reference material is in accordance with the quality management procedures of Eurofins Miljø A/S, with the aim of obtaining the intended quality of the material.

Documentation of Content

All documentation for the reference material has been performed after dilution of the ampoule concentrates 1:10.

Internal control

The analytical quality of Eurofins Miljø has been documented and found satisfactory by regular participation in international proficiency tests.

Homogeneity:

The homogeneity has been confirmed by measurements of COD in randomly selected ampoules of QC WW5. Tests for homogeneity have been performed by comparing the standard deviation between the reference material units with the within batch standard deviation obtained from duplicate measurements of the reference material in the same sample (F-test, 95 %).

In addition, homogeneity testing in accordance with ISO 33405 /1/ was included for BOD₅ and BOD₇ in the external control. Homogeneity was confirmed for BOD₇, but not for BOD_{tit} in the external control. Since the two parameters are measures of the same content and there is a predominance of BOD₇ results, it is assessed that the product can be considered homogeneous.

Stability:

The stability of the reference material is being followed at 4°C, 20°C and 37°C, and no indication of instability was observed at the date of this certificate.

External control

The concentration of BOD₅ and BOD₇ in the reference material was determined by selected laboratories in an external documentation in November 2025 to January 2026. The participating laboratories are skilled and have documented good analytical quality by participation in interlaboratory comparisons and by analysis of a control sample in the certification. The laboratories were requested to analyse five samples of QC-WW5: three samples in the same analytical series, one by duplicate determination, and two samples in two different analytical series as single determinations. The statistics are in accordance with the international standard: ISO 33405 /1/. On the basis of the analytical results submitted by the laboratories the following statistical parameters have been calculated:

y_{char} : assigned value, calculated in accordance with ISO 33405 (section A.2.4)

$s(y)$: standard deviation between the laboratories, calculated in accordance with ISO 33405 (section A.2.5):

$$\sqrt{\frac{\sum (y_i - y_{char})^2}{p - 1}}$$

The 95 % confidence interval of the true mean value of analytical results is:

$$y_{char} \pm t_{0,025}(v) \cdot \frac{s(y)}{\sqrt{p}}$$

where

p: number of laboratories included in calculations

v: p-1, degrees of freedom

$t_{0,025}(v)$: t value of 0,025 level at v degrees of freedom.

The criteria for selection of laboratories were as follows:

- the laboratory results in proficiency tests diverged less than 2 standard deviations from the nominal value, and
- the laboratory analyses more than 20 analytical series each year or holds accreditation for the parameter.
- the laboratory result for the control sample in the certification study deviated less than 15 % from the nominal value, and
- the laboratory results in the certification study are not Cochran outliers or Grubbs outliers or deemed to be an outlier based on a scientific evaluation.

The data included in the external control and names of the participating laboratories are listed in an annex to this certificate. On the basis of the selected results, the following has been calculated:

Certified Values

DETERMINAND	UNIT	Assigned value y_{char}	BETWEEN LABORATORY STANDARD DEVIATION $s(y)$	95 % CONFIDENCE LIMITS OF THE AVERAGE VALUE $y_{char} \pm t_{0,025}(v) \cdot \frac{s(y)}{\sqrt{p}}$		NUMBER OF DATA SETS IN CALCULATIONS/METHOD (p)	EXCLUDED DATA SETS
				Lower	Upper		
BOD ₅	mg/L O ₂	199	12	191	207	3/A 8/K	2
BOD ₇	mg/L O ₂	211	11	205	217	3/A 14/K	2

Methods

BOD₅, BOD₇:

A Dilution method: EN 1899-1: 1998

K Dilution method: ISO 5815-1: 2019

Use of the Certified Values

For laboratories with an analytical quality that is comparable to that of the laboratories who have contributed to the external control data of this certificate, the following applies:

- 1) For single determinations, analytical results will with a probability of 95 % be in the interval:

$$y_{char} \pm t_{0,025}(v) \cdot s(y)$$

- 2) Analytical results, calculated as the average of two determinations will with a probability of 95 % be in the interval:

$$y_{char} \pm t_{0,025}(v) \cdot \frac{s(y)}{\sqrt{2}}$$

Metrological traceability

This Certified Reference Material (CRM) has been collaboratively determined to be traceable through a documented metrological traceability chain involving multiple participating laboratories. The metrological traceability of the certified value is established in compliance with the stated requirements of DS/EN ISO/EIC 17025:2017.

The certified value is obtained by combining different measurement procedures and laboratories accredited according to DS/EN ISO/EIC 17025:2017 or operating under a Quality Management System with comparable requirements. The individual values contributing to the certified value are considered independently metrological traceable.

Eurofins Miljø A/S is accredited according to ISO 17034:2016 by DANAK under accreditation number 535, and the scope of accreditation includes the collaborative certification of reference materials.

REFERENCES

- /1/ ISO 33405:2024 Reference materials – Approaches for characterization and assessment of homogeneity and stability.
- /2/ ISO 33401:2024: Reference materials - Contents of certificates, labels and accompanying documentation.

Date of issue: February 2026

RESPONSIBLE SCIENTIST



Peter Rerup
Eurofins Miljø A/S
DK-8464 Galten

E-mail: refmat@etn.eurofins.dk

Website: www.eurofins.dk/refmat

Certificate revision history: February 2026 (original certificate date)

ANNEX TO CERTIFICATE QC WW5

Laboratory Measurements

BOD ₅					
y_i mg/L O ₂	s_{ri} mg/L O ₂	n_{ri}	s_{Li} mg/L O ₂	n_{Li}	Method
203.87	2.4	4	2.4	3	K
186.07	9.1	4	6.7	2	A
194.00	2.9	4	6.0	3	K
211	3.6	4	-	-	K
208.67	5.7	4	3.7	3	A
199.95	7.5	4	5.7	3	A
180.17	4.8	4	1.5	3	K
218.33	4.1	4	1.2	3	K
189.77	9.5	4	4.6	3	K
188.67	3,0	4	4.6	3	A
206.5	2.2	4	7.8	3	K

BOD ₇					
y_i mg/L O ₂	s_{ri} mg/L O ₂	n_{ri}	s_{Li} mg/L O ₂	n_{Li}	Method
210.74	5.0	4	3.8	2	A
201.7	6.1	4	6.5	3	K
201.85	1.8	4	3.7	3	K
227.88	2.4	4	1.3	3	K
224.42	2.1	4	6.3	3	K
208.86	2.2	4	4.9	3	A
197	5.0	4	10.5	3	K
211	2.2	4	7.2	3	K
199.05	3.4	4	2.9	3	K
197.77	5.8	4	9.1	3	K
209.83	2.5	4	3.4	3	K
203	4.1	4	18.6	3	A
210.33	3.5	4	11.0	3	K
233.67	3.3	4	15.1	3	K
206.07	8.6	4	7.6	3	K
214.83	8.5	4	5.9	3	K
226.33	4.7	4	7.5	3	K

External Control Values

- y_i : average for laboratory i
- s_{ri} : standard deviation for laboratory i within an analytical series
- n_{ri} : number of results for determination of s_{ri}
- s_{Li} : standard deviation for laboratory i between analytical series
- n_{Li} : number of results for determination of s_{Li}

Methods: See explanation on page 3

ANNEX TO CERTIFICATE QC WW5

Certifying Laboratories

Denmark

ALS Denmark A/S, Humlebæk
SGS Analytics Denmark, Nørresundby
Eurofins Miljø, Vejen
Højvang Laboratorier A/S, Dianalund

Finland

Eurofins Environment Testing Finland Oy, Lahti
Water and Environment Research of South-West Finland, Turku

Germany

Eurofins Umwelt Ost GmbH, Freiberg
Eurofins Umwelt West GmbH, Wesseling

Norway

Eurofins Environment Testing Norway AS, Moss
Labora AS, Bodø
Nedre Romerike Vann- og avløbsselskap IKS, Strømmen

Sweden

DGE Mark och Miljö AB, Västra Frölunda
Ernemar laboratorium, Oskarshamn
VA-lab Jönköpings kommun, Jönköping
Kalmar Vatten AB VA-lab, Kalmar
Karlskrona kommun, Lyckeby
VIVAB Laboratoriet Smedjeholms avloppsreningsverk, Falkenberg
Mittsverige Vatten & Avfall AB, Sundsvall
Nordic Sugar Örtofta, Eslöv
VA SYDs laboratorium, Malmö
Mjölkkulla Laboratorium, Mjölby
VIVAB Getteröverket, laboratoriet, Varberg
Östersund provningslaboratorium, Östersund

Åland

ÅMHH-Laboratoriet, Jomala