Technical Note ForMEQ (NT 10/2026)

The use of blanks in chemical analysis.

(English version)

1. Introduction

Blank analysis in chemical testing is a tool used by laboratories both during the validation phase of test procedures and as a routine quality-control measure.

By definition, a blank – also called a reagent blank, chemical blank or analytical blank – is a sample that ideally has all the characteristics of a real sample except for the measurand to be analysed and is subjected, wholly or partly, to the same procedures as the sample. In practice, the blank should represent the real sample as closely as possible and may contain the measurand in non-detectable or trace amounts.

During the procedure-validation phase (also referred to as method validation), blank analysis is generally intended to estimate and assess performance characteristics of the procedure [1], such as the Limit of Detection and Limit of Quantification; as a quality-control measure, its purpose, according to the US EPA [2], is to trace sources of artificially introduced contamination. This implies that blanks themselves may be a source of contamination arising from their preparation. Eurachem [3, 4], on the other hand, notes that the use of various types of blanks makes it possible to determine which part of the response is attributable to the measurand and which part comes from other sources.

Choosing appropriate blanks to analyse allows the result obtained for the measurand to be properly corrected by eliminating any contributions to the response that originates from contamination – that is, effects not characteristic of the measurand.

2. The importance of blanks in uncertainty assessment

The blank plays an essential role in an analytical measurement process, in which its response is considered metrologically and is physically cancelled or algebraically subtracted from the responses of the standard and the sample. Such subtraction may be performed only when the blank value is truly representative of the effect influencing the sample analysis. If the blank value is excessively high or variable, the subtraction will be unreliable.

For instrumental analytical methods, the instrument signal produced by the blank is different from zero. This signal is subject to errors like those affecting other points on the analytical calibration curve and, therefore, it is incorrect to subtract this value from other standard readings before constructing the curve. When two quantities are algebraically subtracted, the error in the final result cannot be obtained by simple subtraction but by the square root of the sum of the squared errors of those variables. Subtracting the blank value from each instrumental reading before establishing the analytical curve can thus give misleading information about calibration errors. Ideally, the analytical blank response should be obtained from materials whose composition closely resembles the sample matrix being analysed but is free from the analytes.

In the linear regression of an analytical curve, the term "blank" refers to the value of the regression line's intercept with the vertical (y) axis, where all independent variables are – or should be – zero. This value represents the starting point of the regression line and is important for interpreting the relationship between dependent and independent variables.

In Analytical Chemistry, data often display—or are assumed to display—homoscedastic behaviour, meaning that variances are statistically homogeneous across the working range. When an unweighted linear regression is used under such conditions, the blank's contribution assumes significant weight, often greater than that of the measurand of interest. Consequently, this source of uncertainty cannot be ignored and becomes relevant in the analysis.

Generally, for chemical tests, blank determinations are considered acceptable if they are below the Limit of Detection, or less than one-third of the Limit of Quantification, or below one-twentieth of the value of the sample with the lowest concentration. The last criterion is unsuitable for chemical measurements with relative expanded uncertainties below 15 %.

Following method validation, it is demonstrated that the methodology incorporates adequate blank control if ten acceptable blanks are obtained.

3. Main types of blanks

Where applicable, the different types of blanks cover every phase of analytical work, from sampling through to the measurement stage itself. In this context, the principal categories are field blanks, matrix blanks, reagent blanks, procedure blanks and instrumental blanks.

Depending on the nature and specific requirements of the work, other types of blanks may also be employed, such as Transport Blanks or Equipment (sampling) Blanks. However, discussion of those is considered outside the scope of this Technical Note.

The characteristics of the main blank types and the recommended frequency for their use are described below. It should be stressed that the frequency may be adapted to the reality of each laboratory, if result quality is not compromised.

3.1 Field Blank

It is a blank that is placed in the appropriate container during field work, preserved, and transported to the laboratory under the same conditions as the samples collected. Its purpose is to assess contamination caused by environmental conditions during sampling. When used on its own, it merely indicates the presence of contamination without revealing whether it originated in the field or in the laboratory.

It is recommended that one field blank be analysed per laboratory work batch. This requires that the number of field blanks collected be aligned with the laboratory work schedule.

3.2 Matrix Blank

It is a (real) sample that contains all the components and substances present in the original sample except the analyte. Its purpose is to assess the specific effect of the matrix on the measurement, that is, to check whether other matrix components generate a response that could be mistaken for that of the analyte.

During the method-validation phase it is essential for determining the Limit of Detection and the Limit of Quantification (LOQ), as it enables the minimum response that can be distinguished from matrix noise to be defined.

When a matrix blank is unavailable, it may be replaced, for example, by analysing synthetic samples that mimic real samples.

A Matrix Blank is, for instance, the extract of a sample that does not contain the target compound, subjected to the entire preparation process and injected into the chromatograph (used to assess interferences from the matrix itself), whereas the Procedure Blank consists only of the solvent and reagents taken through all stages of the method (used to detect contamination introduced by the analytical process) (see 3.4).

3.3 Reagent Blank

It is a blank to which the reagents are added, and it is analysed as if it were a real sample. Its purpose is to check whether the reagents are contaminated or whether they contribute to the measured response.

The Reagent Blank is also called a Procedure Blank when it involves every step of the analytical process (see 3.4).

It is recommended that one reagent blank be analysed per laboratory work batch.

3.4 Procedure Blank

It is a blank that is subjected to every step of the laboratory procedure, including activities such as extraction, digestion, and so on. When this blank is used, the analysis of the reagent blank is not required. Its purpose is to assess contaminations introduced during sample-preparation activities and it serves only to indicate the presence of contamination originating in the laboratory.

It is recommended that one procedure blank be analysed per sample preparation batch.

3.5 Instrumental Blank

It is a blank that undergoes no prior treatment and is analysed as if it were a real sample. Its purpose is to assess the presence of instrumental contamination arising, for example, from previous analyses of samples with high concentrations of the measurand. Like Procedure Blank, it serves only to demonstrate the presence of contamination originating in the laboratory.

Because its use depends heavily on the nature of the samples being analysed, it should be carried out whenever deemed necessary.

4. Conclusion

Blank analysis is an important analytical tool for quality control of results.

By selecting the appropriate types of blanks to analyse, this tool makes it possible to identify and assess the origin of potential sources of contamination introduced either in the field or in the laboratory, and to take the necessary actions—whether preventive measures, such as introducing steps to minimise the effects of the identified sources, or corrective measures, such as adjusting the sample results.

5. References

[1] Eurachem/CITAC, "*Blanks in Method Validation, Supplement to Eurachem Guide The Fitness for Purpose of Analytical Methods*" (2019). [Link]

[2] EPA, "Quality Control Tools: Blanks" (2009). [Link]

[3] Eurachem/CITAC, "*The Fitness for Purpose of Analytical Methods – A Laboratory Guide to Method Validation and Related Topics*", 3rd Ed. (2025). [Link]

[4] Eurachem/CITAC, "*Guide to Quality in Analytical Chemistry - An Aid to Accreditation*", 4th Ed. (2026). [Link]

Nota Técnica ForMEQ NT 10, 1ª Ed., junho 2026.

Editores: C. Borges e E. C. Oliveira
Grupo de trabalho: A. I. Mosca, F. Lourenço, M. Matos e R. Bettencourt da Silva.