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**Milk — Quantitative determination of
microbiological quality — Guidance
for establishing and verifying a
conversion relationship between
results of an alternative method and
anchor method results**

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*Lait — Détermination quantitative de la qualité microbiologique —
Recommandations pour établir et vérifier une relation de conversion
entre les résultats de la méthode alternative et les résultats de la
méthode d'ancrage*

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Contents

Page

Foreword	v
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principles	2
4.1 General.....	2
4.2 Guidance for applied methods and laboratories.....	2
4.3 Organizational set-up.....	3
5 Consideration of factors influencing the conversion relationship	3
5.1 General.....	3
5.2 Environmental factors.....	3
5.2.1 General.....	3
5.2.2 Animal species.....	4
5.2.3 Bulk milk storage conditions.....	4
5.2.4 Seasonal variations.....	4
5.2.5 Sampling and pre-treatment of the test samples.....	4
5.2.6 Test sample preservation.....	4
5.2.7 Milk production conditions.....	4
5.3 Analytical factors.....	5
5.3.1 Instrument make and model.....	5
5.3.2 Chemicals.....	5
5.3.3 High somatic cell counts.....	5
6 Test samples	5
6.1 Calculation of number of test samples.....	5
6.2 Range of test samples.....	6
6.3 Representativeness of samples.....	6
6.4 Pre-treatment of test samples.....	6
6.4.1 General.....	6
6.4.2 Preparation of sub-samples.....	6
6.4.3 Storage and transport of sub-samples.....	7
7 Analysis	7
8 Establishing a conversion relationship	7
8.1 General.....	7
8.2 Validity of results.....	7
8.3 Conversion relationship.....	8
8.4 Calculations.....	8
8.4.1 General.....	8
8.4.2 Removal of outliers.....	8
8.4.3 Conversion relationship.....	8
9 Verification of a conversion relationship	9
9.1 Frequency of verification.....	9
9.2 Calculation.....	9
10 Test report	9
Annex A (informative) Number of test samples for linear regression	11
Annex B (informative) Example identification of outliers and calculation of conversion relationship	14
Annex C (informative) Example — Calculation of significance (verification of conversion relationship)	15

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 5, *Milk and milk products*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 302, *Milk and milk products* — *Methods of sampling and analysis*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement), and the International Dairy Federation (IDF). It is being published jointly by ISO and IDF.

This second edition cancels and replaces the first edition (ISO 21187 | IDF 196:2004), which has been technically revised. The main changes compared with the previous edition are as follows:

- the formula describing the conversion relationship has been based on grouped data rather than data from individual samples;
- examples of how to perform outlier tests, and calculation and verification of conversion relationships have been given in a spreadsheet.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

IDF (the International Dairy Federation) is a non-profit private sector organization representing the interests of various stakeholders in dairying at the global level. IDF members are organized in National Committees, which are national associations composed of representatives of dairy-related national interest groups including dairy farmers, dairy processing industry, dairy suppliers, academics and governments/food control authorities.

ISO and IDF collaborate closely on all matters of standardization relating to methods of analysis and sampling for milk and milk products. Since 2001, ISO and IDF jointly publish their International Standards using the logos and reference numbers of both organizations.

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This document was prepared by the IDF *Standing Committee on Statistics and Automation* and ISO Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 5, *Milk and milk products*. It is being published jointly by IDF and ISO.

The work was carried out by the IDF/ISO Action Team (S11) of the *Standing Committee on Statistics and Automation* under the aegis of its project leaders, Ms B. Asmussen (DK), Ms V. Tzeneva (NL), Mr R. Kissling (NZ) and Ms B. Müller (DE).

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Introduction

Conversion in quantitative microbiology means expressing the result of a quantitative determination of the microbiological status of a test sample obtained with an alternative method in units of another method, generally an anchor method. Through this, quantitative results obtained with alternative methods can be compared to values or limits that are stated in anchor method units. For establishing and applying a conversion relationship, a number of prerequisites should be met. These are referred to in this document, but are generally described elsewhere.

Although a considerable part of the applied principles for conversion coincides with those applied for the calibration of indirect or alternative methods against an anchor method, or by means of (certified) reference materials, it is stressed that the background and aims for applying conversion are different from those for calibration. Calibration involves the determination of the adjustment needed for each level of an analyte to closely approximate the true value of its concentration or number. However, in quantitative microbiology, a true value in its strict sense cannot be established and is only defined by the method description applied. When applying alternative methods in the quantitative determination of microbiological quality, one is often dealing with different methodological principles and therefore also other units. Conversion is used to transfer results obtained with different methods to a common scale.

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Milk — Quantitative determination of microbiological quality — Guidance for establishing and verifying a conversion relationship between results of an alternative method and anchor method results

1 Scope

This document gives guidelines for the establishment of a conversion relationship between the results of an alternative method and an anchor method, and its verification for the quantitative determination of the microbiological quality of milk.

NOTE The conversion relationship can be used a) to convert results from an alternative method to the anchor basis or b) to convert results/limits, expressed on an anchor basis, to results in units of an alternative method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8196-1 | IDF 128-1, *Milk — Definition and evaluation of the overall accuracy of alternative methods of milk analysis — Part 1: Analytical attributes of alternative methods*

ISO 8196-2 | IDF 128-2, *Milk — Definition and evaluation of the overall accuracy of alternative methods of milk analysis — Part 2: Calibration and quality control in the dairy laboratory*

ISO 16140-1, *Microbiology of the food chain — Method validation — Part 1: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8196-1 | IDF 128-1, ISO 8196-2 | IDF 128-2, ISO 16140-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 alternative method

method of analysis allowing quantification of the microbiological status of a test sample

Note 1 to entry: The method can be proprietary or non-commercial.

Note 2 to entry: The term “alternative” in this document refers to the entire method. It includes all aspects (such as test sample pre-treatment, materials and instruments) required for the execution of the method.

3.2 anchor method

method of analysis internationally recognized by experts or by agreement between parties, and used, for instance, in legislation when expressing official limits for microbiological quality

Note 1 to entry: It is stressed that, in quantitative microbiology, any obtained value is only defined by the method description applied. This applies to any alternative method as well as, for instance, to the standard plate count for the enumeration of microorganisms.

3.3 analyte

component or property which is measured by the method of analysis

Note 1 to entry: The analyte can be the microorganism, stained particles (e.g. microscopic count), components of microorganisms (e.g. lipopolysaccharides), the result of their ability to multiply (e.g. colony-forming units) or their metabolic activity (e.g. change in conductivity/impedance).

3.4 organizing body

organization, possibly appointed by a competent authority, having the qualified staff and skills to organize, coordinate and report on the outcome of the activities for the establishment and/or the maintenance of a conversion relationship

3.5 measuring range

range wherein data with known precision and accuracy can be obtained

Note 1 to entry: Precision and accuracy data are determined in a validation study (e.g. by the instrument manufacturer or a responsible organization).

3.6 range of interest

numerical values for alternative method results, typical of routine samples when analysing in a laboratory

Note 1 to entry: If applicable, the range of interest shall include official limits and limits related to specific quality schemes.

4 Principles

4.1 General

The establishment and verification of a conversion relationship is based on the examination of test samples with an alternative method and the anchor method.

4.2 Guidance for applied methods and laboratories

For establishing and verifying a conversion relationship between the results of an alternative method and the anchor method, the following prerequisites apply.

The alternative method should have been evaluated and validated in accordance with ISO 16140-2 and/or ISO 16297 | IDF 161. Procedures for sampling, test sample preservation, test sample transport, test sample storage, sample pre-treatment, analysis and calculation of results should be documented, strictly standardized and controlled in agreement with ISO/IEC 17025, the Eurachem Guide^[6] or comparable standards.

Regular participation in proficiency tests and training according to the relevant standards, e.g. ISO 4833-1, ISO 14461-2 | IDF 169-2, is strongly recommended.

The anchor method should have been validated, documented, strictly standardized and controlled in agreement with ISO/IEC 17025, the Eurachem Guide or comparable standards.

The protocol for the establishment of the conversion relationship and its verification should be documented. It should follow the guidelines of this document.

4.3 Organizational set-up

There are various possible organizational set-ups, e.g. both the alternative and the anchor method are fully carried out in the same laboratory, or several laboratories are involved in the trial.

Due to the instability and variability of the microbiological status of milk samples, the most robust conversion relationships will be obtained where the alternative method and the anchor method are undertaken on the same test samples, at the same place, at the same time. It is recommended to ensure that either the sequence of testing does not impose significant influence on the test results or the method with the lowest influence on the milk sample is applied first.

Subsampling should be avoided. However, in case of two or more participating laboratories subsamples may be necessary.

In all cases, the organizational set-up should include all the necessary provisions to guarantee that the obtained conversion relationship is representative of the circumstances under which the alternative method is carried out and the resulting conversion relationship is later applied. Factors to consider are listed in [Clause 5](#).

The organizing body should provide guidance to the collaborating laboratories. Furthermore, it should collect information on critical points in the procedure. All collaborators should be asked to record relevant information, such as details on the method(s) used, details on the testing of samples, quality control data, and possibly data about storage and transport conditions.

5 Consideration of factors influencing the conversion relationship

5.1 General

A number of factors can influence the outcome of alternative method or anchor method determinations, or both. The relative magnitude of the effects can differ between test samples and is not necessarily the same for both methods. This implies that certain factors can also influence the conversion relationship. In the evaluation of an alternative method, all relevant factors should be identified and should be considered since it is necessary to cover the consequences of their variation in one conversion relationship, or otherwise to establish distinct conversion relationships.

In general, when distinction between test samples cannot be made, or is not being made in routine testing circumstances, the variation in the underlying variables should be covered in one conversion relationship. Where a factor is shown to have a significant effect on the conversion relationship, more than one conversion relationship may need to be established and applied, e.g. with collection of milk from farms twice daily and every three days.

Influencing factors are grouped into environmental factors affecting the milk sample, e.g. content of type of bacterial flora or background noise from the sample matrix, and analytical factors which relate to the analysis itself, e.g. reagents. Some factors that can influence the conversion relationship in raw milk analysis are given in [5.2](#) and [5.3](#). Some of these factors can also be applied to other situations.

5.2 Environmental factors

5.2.1 General

The microbiological flora of a milk sample, i.e. the type of microorganisms, their growth phase or metabolic activity, influences the outcome of the measurement depending on the principle of the