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CCM
CENTRO DE CIÊNCIAS MOLECULARES E MATERIAIS

Translating customers' needs to method validation requirements

Setting the target measurement uncertainty

Ricardo Bettencourt da Silva

Faculdade de Ciências
UNIVERSIDADE DE LISBOA

Overview

1. Introduction
2. Scenarios for defining target MU
3. How to deal with ambiguous information or not updated terminology
4. How to deal with performance variation with the analyte content
5. Highlights

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1. Introduction

Measurement procedure validation involves comparing measurement performance parameters with target values to decide about measurement fitness for the intended use.

Measurement procedure validation:

- (…)
- (…)
- Evaluation of the measurement uncertainty.

Measurement procedure is shown to be valid if measurement uncertainty is smaller than a target maximum value (U_{tg}) within the analytical range.

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1. Introduction

Measurement procedure validation involves comparing measurement performance parameters with target values to d

2.34
target measurement uncertainty
target uncertainty
measurement uncertainty specified as an upper limit and decided on the basis of the intended use of **measurement results**

nty.

Mea if
measurement uncertainty is smaller than a target
maximum value within the analytical range.

1 - Joint Committee for Guides in Metrology, International vocabulary of metrology – basic and general concepts and associated terms (VIM), JCGM 200, BIPM, 2012 (www.bipm.org/vim).

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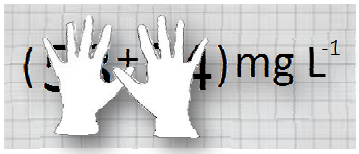
1. Introduction

The definition of target values for the measurement uncertainty can contribute decisively to the widespread use and reporting of this parameter.



Frequently, analysts use target values of the standard deviation of precision to assess the expanded measurement uncertainty.

This information is also useful for producers of CRM…

$$U_{Tg}(CRM) = \frac{U_{Tg}(Lab)}{3}$$

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2. Scenarios for defining target MU

2.1. Target MU is defined

2.2. No target MU is defined

- 2.2.1. Criterion for assessing performance in proficiency test is defined
- 2.2.2. Target values for early performance parameters are defined
- 2.2.3. Limit values for the measurand are defined
- 2.2.4. No target values for performance parameters or limits to the measurand value are set

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2. Scenarios for defining target MU

2.1. Target MU is defined

- Pertaining legislation or specification defines target MU;
- Direct customer define the target MU;

[For tests and other conformity assessments the requirements of authorities or legal provisions are to be considered (ISO/IEC 17025:2005)]

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2. Scenarios for defining target MU

2.1. Target MU is defined

COMMISSION REGULATION (EC) No 401/2006 of 23 February 2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs

L 70/30-34 EN Official Journal of the European Union 9.3.2006

ANNEX II

CRITERIA FOR SAMPLE PREPARATION AND FOR METHODS OF ANALYSIS USED FOR THE OFFICIAL CONTROL OF THE LEVELS OF MYCOTOXINS IN FOODSTUFFS

(...)

4.3.2. *'Fitness-for-purpose' approach*

In the case where there are a limited number of fully validated methods of analysis, alternatively, a 'fitness-for-purpose' approach, defining a single parameter, a fitness function, to evaluate the acceptability of methods of analysis may be used. A fitness function is an uncertainty function that specifies maximum levels of uncertainty regarded as fit for purpose.

(...) The laboratory may use a method which produces results within the maximum standard uncertainty. The maximum standard uncertainty may be calculated using the following formula:

$$Uf = \sqrt{(\mathrm{LOD}/2)^2 + (\alpha \times C)^2}$$

where:

— *Uf* is the maximum standard uncertainty (μg/kg)

— LOD is the limit of detection of the method (μg/kg)

— α is a constant, numeric factor to be used depending on the value of C. The values to be used are set out in the table hereafter

— C is the concentration of interest (μg/kg).

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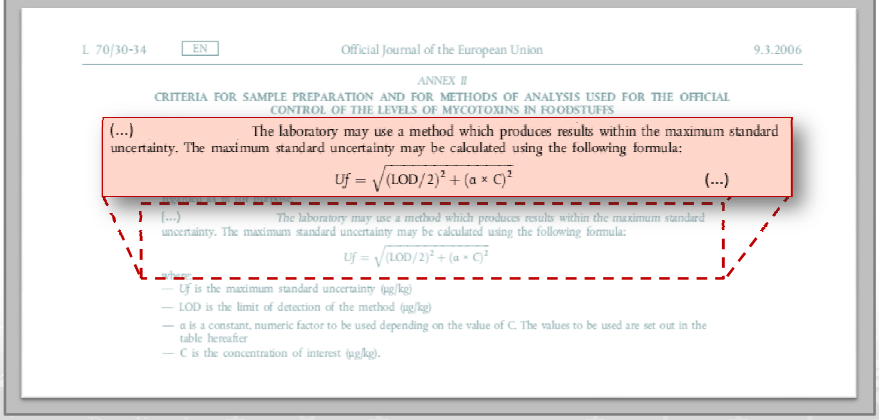

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2. Scenarios for defining target MU

2.2. No target MU is defined

2.2.1. Criterion for assessing performance in proficiency test is defined

$$z_i = \frac{x_i - X_{Ref}}{\sigma_{fiu}}$$

σ_{fiu} – fit for the intended use target stand. deviation.

Ex. 1: $\sigma_{fiu} = 0.25 X_{Ref} \rightarrow U'_{Tg} = 50\%$ (relative target MU);

Ex. 2: $\sigma_{fiu} = \sigma'_H \cdot X_{Ref}$ (Horwitz eq.) $\rightarrow U_{Tg} = 2 \cdot \sigma'_H \cdot X_{Ref}$

$$U_{Tg} = 2 \cdot \sigma_{fiu} \ (conf.level\ 95\%)$$

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2. Scenarios for defining target MU

2.2. No target MU is defined

2.2.2. Target values for early performance parameters are defined

COUNCIL DIRECTIVE 98/83/EC of 3 November 1998
on the quality of water intended for human consumption

EN Official Journal of the European Communities

COUNCIL DIRECTIVE 98/83/EC

of 3 November 1998

on the quality of water intended for human consumption

(...)

PART B

Chemical parameters

Parameter	Parametric value	Unit	Notes
Cadmium	5,0	µg/l	

(...)

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Parameters	Trueness % of parametric value (Note 1)	Precision % of parametric value (Note 2)	Limit of detection % of parametric value (Note 3)	Conditions	Notes
Cadmium	10	10	10		

(...)

Note 1 (*): Trueness is the systematic error and is the difference between the mean value of the large number of repeated measurements and the true value.

Note 2 (*): Precision is the random error and is usually expressed as the standard deviation (within and between batch) of the spread of results about the mean. Acceptable precision is twice the relative standard deviation.

(*) These terms are further defined in ISO 5725.

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COUNCIL DIRECTIVE 98/83/EC of 3 November 1998
on the quality of water intended for human consumption

$$U_{Tg} = 2\sqrt{u(R_w)^2 + u(bias)^2} =$$

$$= 2\sqrt{\left(\frac{0.1 \cdot 5}{2}\right)^2 + (0.1 \cdot 5)^2} = 1.12\ \mu g\ L^{-1}$$

2 - Nordtest, Handbook for the calculation of measurement uncertainty in environmental laboratories, Nordtest TR537, 2nd edn., Nordtest, 2004.

3 - A. M. E. Viana da Silva, R. J. N. Bettencourt da Silva, M. F. G. F. C Camões, "Optimization of the determination of chemical oxygen demand in wastewaters", Analytica Chimica Acta, 699, 161-169, 2011 ..

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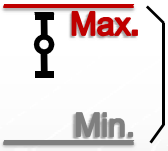
2. Scenarios for defining target MU

2.2. No target MU is defined
2.2.3. Limit values for the measurand are defined

i) A Maximum or minimum value is defined
Quantifications at this level should be above the Limit of Quantification: $U'_{Tg} = 20\%$;

ii) Maximum and minimum values are defined:



A Expanded uncertainty should not be larger than one fourth of the interval amplitude: $U'_{Tg} = \frac{A}{4}$.

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2. Scenarios for defining target MU

2.2. No target MU is defined
2.2.4. No target values for performance parameters or limits to the measurand value are set

• Target MU depends on the trend to be studied » in those cases, target values for the quantitative value of this trend should be defined;

• Target MU of other analytical fields can be used:

U'_{Tg}	Water (simple matrix)	Biological matrices (complex matrix)
Inorganic analyte	20%	40%
Organic analyte	40%	50%

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3. How to deal with ambiguous information or not updated terminology

- Consult related references…

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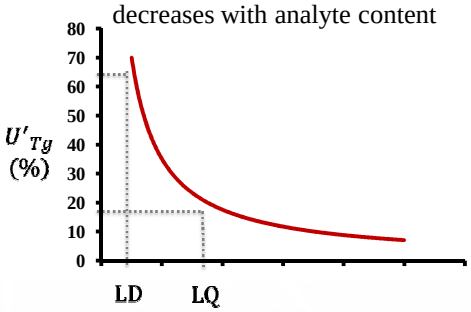
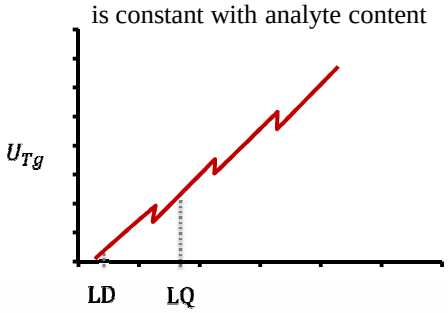
4. How to deal with the performance variation with the analyte content

Relative expanded uncertainty decreases with analyte content



Expanded uncertainty increases or is constant with analyte content



[LD, 2LQ] – Use constant U_{Tg}=0.2LQ;
]2LQ, (…)] – Use constant U'_{Tg}.

Can be used to extrapolate target values to a wider range.

Assumption: Below 2LQ the uncertainty budget is dominated by the precision component.

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5. Highlights

- Definition of realistic target MU can contribute to widespread reporting of this parameter;

- Target MU should be defined, prior to measurement procedure validation, even when no guidelines are available;

- The assessment of measurement fitness for the intended used may consist in checking if MU is smaller than a target value within the analytical range;

- Guidance on setting target MU is needed…