



Organisation Internationale de Métrologie Légale

International Organization of Legal Metrology

Uncertainty in Legal Metrology

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BIML



Content

- Uncertainty in OIML documents
- Requirements for Legal Metrology testing
- OIML Certification System



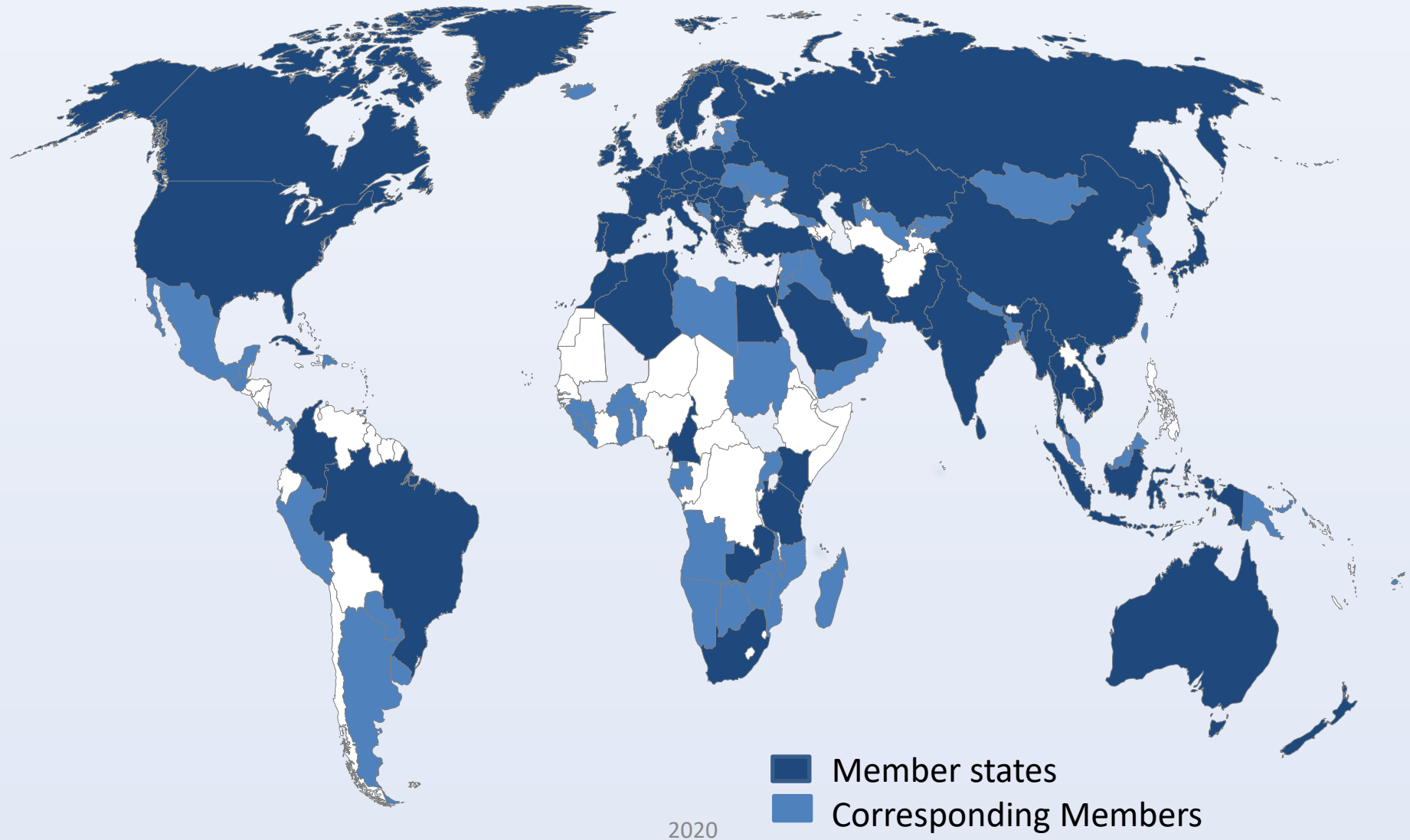
OIML Documents

The OIML is an international organization that develops documents to be used by its Member States as models for their Legislation and regulations.

Documents are developed in Project Groups, with the participation of technical representatives from Member States and Corresponding Members.

The documents are freely available in the OIML website.

www.oiml.org





Technical work

50 projects are active at present

Resulting in

- **105** OIML Recommendations
- **27** OIML Documents
- **12** Basic Publications
- **2** Vocabularies
- **18** Guides



OIML Documents

OIML Recommendations

Set the requirements for measuring instruments

OIML Documents

Requirements that apply to all Recommendations

OIML Guides

Non mandatory technical information

OIML Basic Publications

Regulate the work of the OIML



OIML Recommendations

Standards to be used as models for the development of national regulations.

Part 1: Technical requirements

Part 2: Metrological control and performance test

Part 3: Test report formats

Part 4: Test evaluation reports

Part 5: Periodic verification



OIML Recommendations

Standards to be used as models for the development of national regulations.

Part 1: Technical requirements

Part 2: Metrological control and performance test

Part 3: Test report formats

Part 4: Test evaluation reports

Part 5: Periodic verification



¿ What are recommendations used for?

- Type approval
- Initial verification
- Periodic verification
- Conformity to type (CTT)
- Market surveillance



OIML Guides

- G 1-100-en Evaluation of measurement data - Guide to the expression of uncertainty in measurement
- G 1-101-en Evaluation of measurement data - Supplement 1 to the "Guide to the expression of uncertainty in measurement" - Propagation of distributions using a Monte Carlo method
- G 1-102-en Evaluation of measurement data - Supplement 2 to the "Guide to the expression of uncertainty in measurement" - Extension to any number of output quantities



OIML Guides

- G 1-104-en Evaluation of measurement data - An introduction to the "Guide to the expression of uncertainty in measurement" and related documents
- G 1-106-en Evaluation of measurement data - The role of measurement uncertainty in conformity assessment

¿ Do recommendations have requirements for uncertainty?

OIML B6-2:2011 – Technical regulations

- 4.12 Test methods

This element shall give instructions concerning the test procedure for checking compliance with the stated metrological and technical requirements with a view to ensuring the reproducibility of the test results.

This element may be subdivided in the following order (where appropriate):



¿ Do recommendations have requirements for uncertainty?

OIML B6-2:2011 – Technical regulations

- Principles
- Test equipment
- Preparation for tests
- Test procedure
- **Presentation of results, including the method of calculation and the uncertainty of the test method**

The test methods may be presented in a mandatory Annex.



Uncertainty in OIML publications

- D5:1982 Principles for the establishment of hierarchy schemes for measuring instruments
- D6: 1983 Documentation for measurement standards and calibration devices
- D7: 1984 The evaluation of flow standards and facilities used for testing water meters
 - D7 follows ISO 5168 – 1978, and still mentions random and systematic components.
- D 8: 2004 -Measurement standards. Choice, recognition, use, conservation and documentation
 - Requires that the standards used for the tests have the uncertainty evaluated according to the GUM

Uncertainty in OIML publications

- D 11:2013 General requirements for electronic measuring instruments

The following text should be included in all OIML Recommendations that are based on OIML D 11:

“Every test is subject to uncertainty. The uncertainty of a measurement is defined as:

“parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand” [VIM 3.9].

The uncertainty of the test method shall be taken into account in the decision on the applicability of the test method.”



Uncertainty in OIML publications

D17 :2013 Hierarchy scheme for instruments measuring the viscosity of liquids

1.1.3. The primary standard reproduces the values of viscosity with an uncertainty of measurement between 0.03 % to 0.5 %, depending on the measuring range of viscosity; the standard deviation of the measurement results at the lower end of the measuring range shall not exceed 0.03 % (see note 1).

1.2.2. The uncertainty of measurement of the secondary standard shall be between 0.05 % and 0.8 %, depending on the measuring range of viscosity; the standard deviation of the measurement results at the lower end of the measuring range shall not exceed 0.05 % (see note 1).



Uncertainty in OIML publications

OIML D 21: 1990 - Secondary standard dosimetry laboratories for the calibration of dosimeters used in radiotherapy

Establishes the uncertainty requirements for each of the measured parameters, and makes the uncertainty information mandatory in the reports.

OIML D 28: 2004 Conventional value of the result of weighing in air

The full method for the uncertainty calculation according to the GUM is included.



OIML Recommendations

OIML Recommendations define the Maximum Permissible Errors (MPE) that the instruments may have.

Not all Recommendations have requirements for the uncertainty associated to the methods.

However, most Legal Metrology laboratories follow ISO 17025, therefore the uncertainty has to be evaluated although is not generally reported.

Maximum permissible errors

Using Error of Indication (E_I) and
Maximum Permissible Error (MPE)
for making a Conformity Decision
(Not Explicitly Incorporating Measurement Uncertainty)

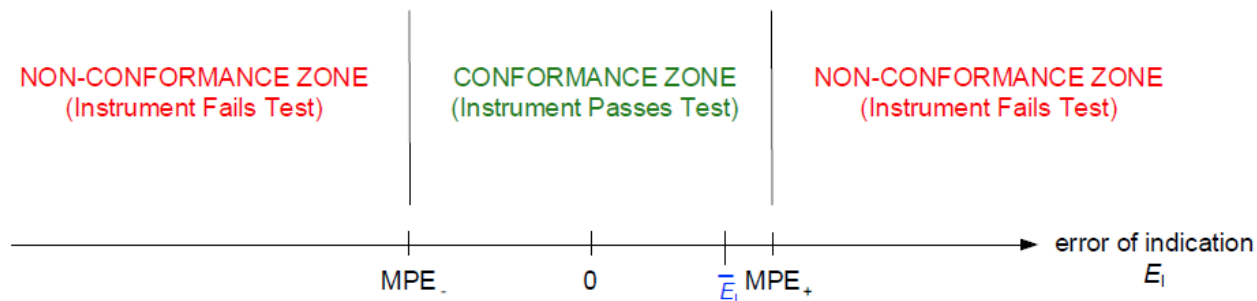
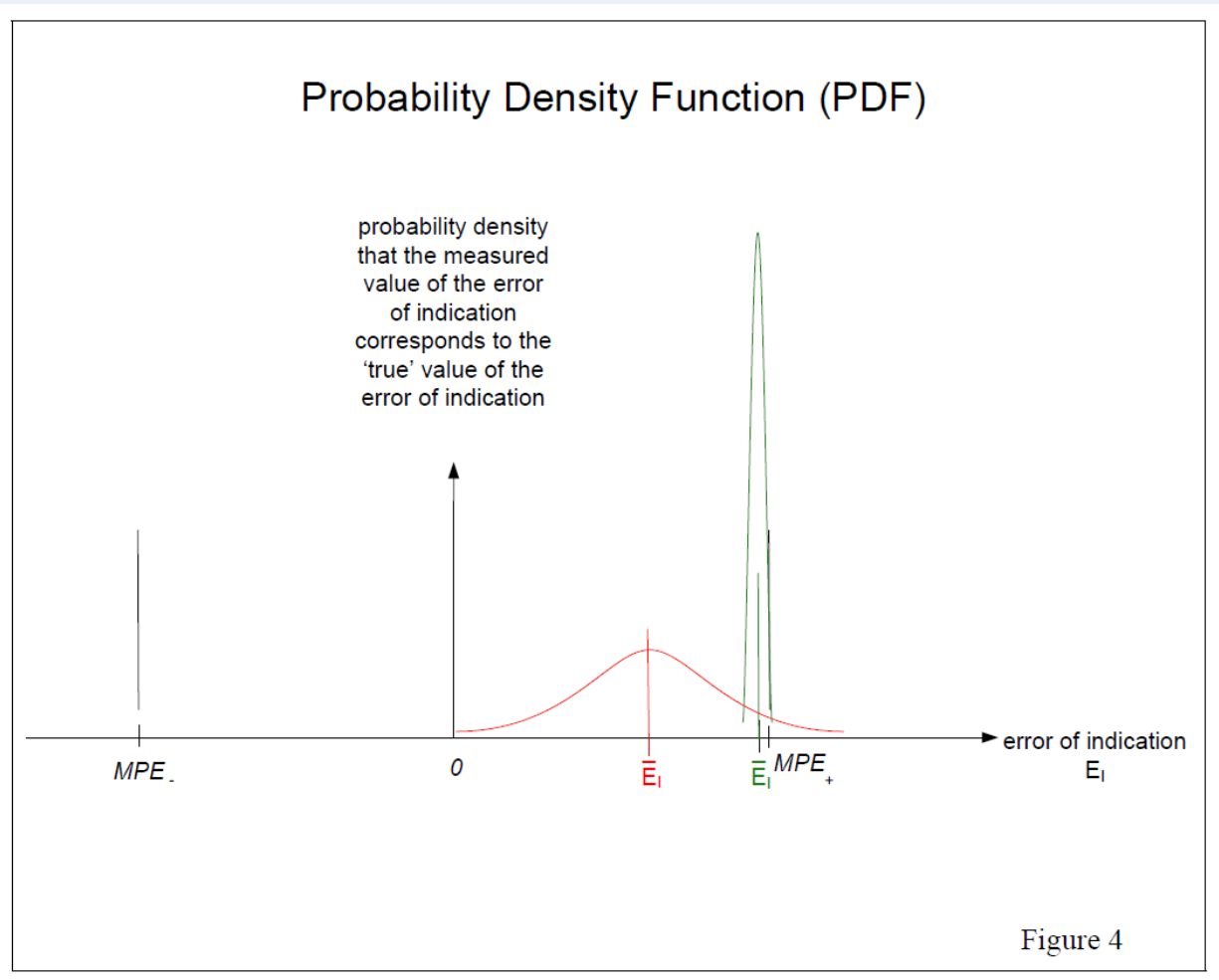
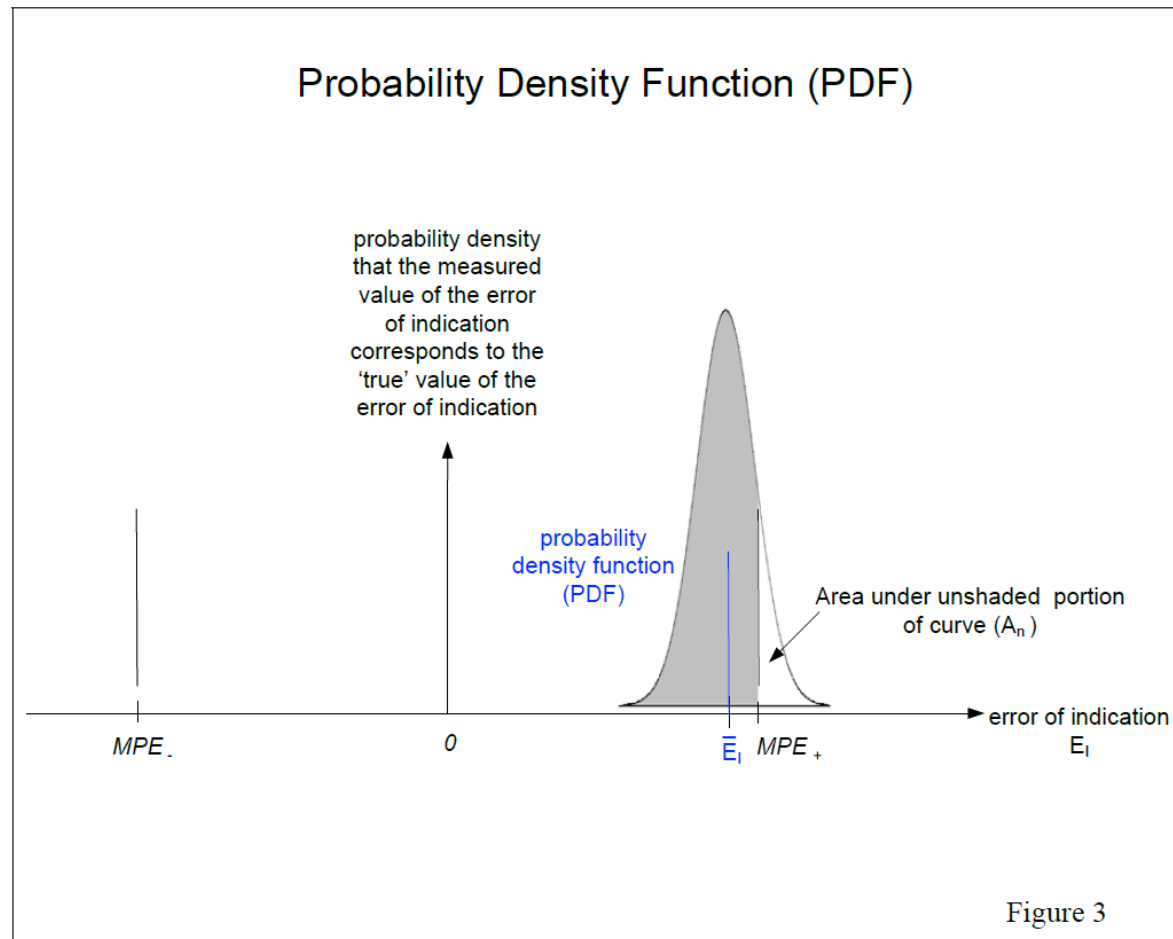


Figure 1

Maximum permissible errors



Maximum permissible errors

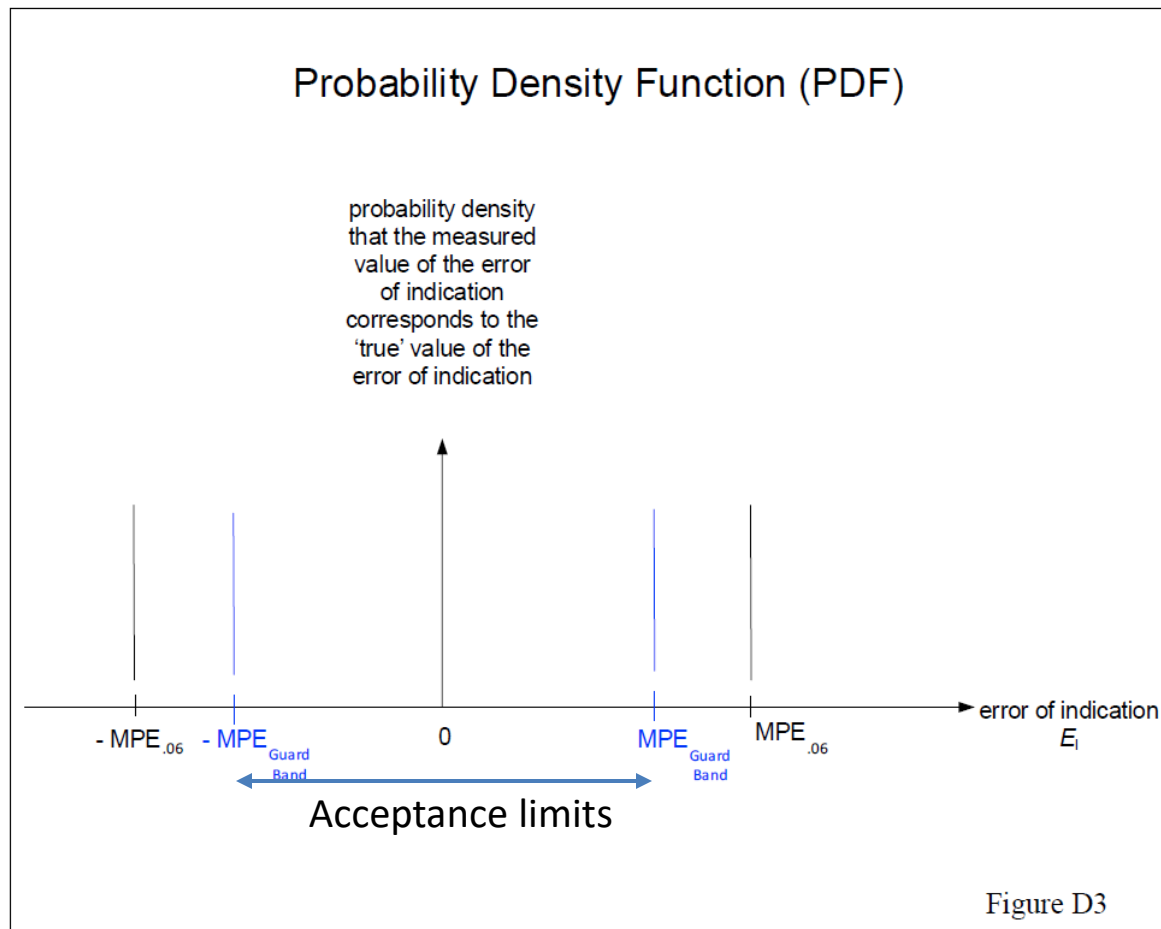




OIML Guide 19

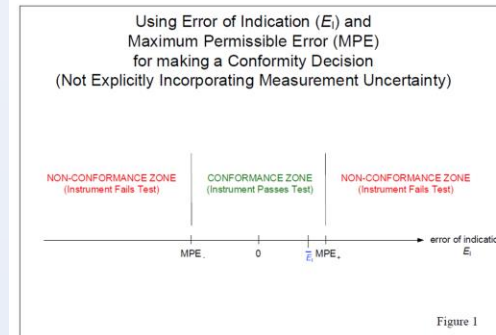
The role of measurement uncertainty in conformity assessment decisions in legal metrology.

Maximum permissible errors – Guard bands



Maximum permissible errors – common practice

Accept a “shared risk”.

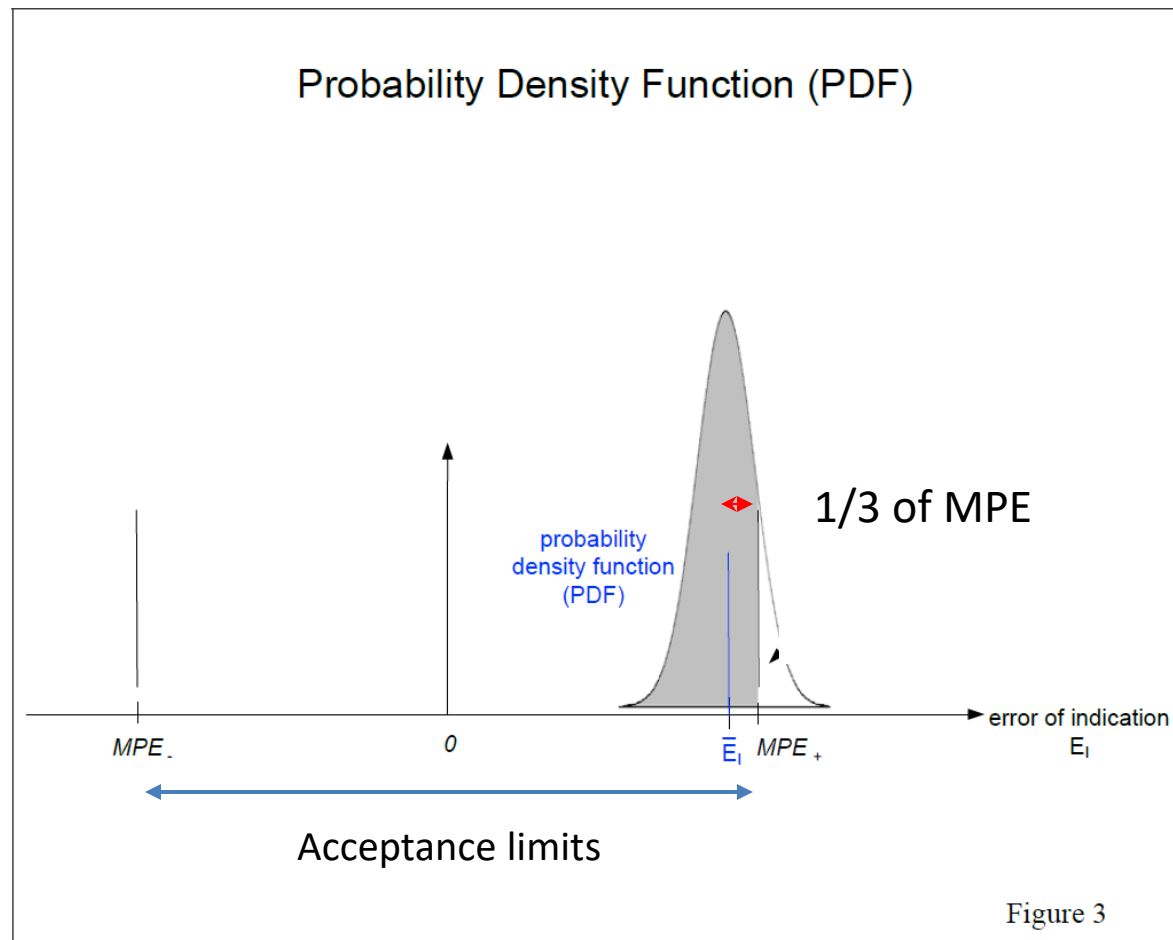


Have a limit for the uncertainty (maximum permissible uncertainty, MPU)

$$\text{MPU} \equiv f \cdot \text{MPE}$$

f value is normally taken to be 1/3 or 1/5 and acceptance limits = MPE

Maximum permissible errors – common practice





Example OIML-R 117

Dynamic measuring systems for liquids other than water

A.2 Uncertainties of measurement

When a test is conducted, the expanded uncertainty of the determination of errors on indications of volume or mass shall be less than **one-fifth of the maximum permissible error** applicable for that test on type approval and **one-third of the maximum permissible error** applicable for that test on other verifications.

The estimation of expanded uncertainty is made according to the “Guide to the expression of uncertainty in measurement” (1995 edition) with $k = 2$.



Example OIML-R 111

Weights of classes E1, E2, F1, F2, M1, M1–2, M2, M2–3 and M3

5 MAXIMUM PERMISSIBLE ERRORS ON VERIFICATION

5.2 Expanded uncertainty

For each weight, the expanded uncertainty, **U, for k = 2**, of the conventional mass, **shall be less than or equal to one-third of the maximum permissible error** in Table 1.

$$U \leq 1/3 \delta m$$



Example R 76

Non-automatic weighing instruments

3.7.1 Weights

In principle, the standard weights or standard masses used for the type examination or verification of an instrument shall meet the metrological requirements of OIML R 111. They shall not have **an error greater than $1/3$** of the maximum permissible error of the instrument for the applied load.

If they belong to class E2 or better, their **uncertainty (rather than their error) is allowed to be not greater than $1/3$** of the maximum permissible error of the instrument for the applied load, provided that the actual conventional mass and the estimated long-term stability is taken into account.

Example R 87

Quantity of product in prepackages

- **4.1.3** The expanded uncertainties (at the $k=2$ level of confidence) associated with measuring instruments and test methods used for determining quantities shall not exceed **0.2 %**. Examples of the source of uncertainty include the maximum permissible error and repeatability in weighing and measuring instruments, variations in packing material and fluctuations in density determinations caused by the differing amounts of solids in the liquid or temperature changes.



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Uncertainty in the OIML - CS





How does it work

- Test laboratories perform the tests and report it to the Issuing Authority (in many cases is the same institution).
- The Issuing Authority does the evaluation of the results and verifies that it is conforming.
- The Issuing Authority emits an OIML Certificate.
- The National Authority does the type approval.

Other Issuing Authorities may use the results of the tests and recommend the National Authority to do the type approval based on these results.



Requirements for the testing laboratories

Laboratories must comply with the requirements of ISO 17025.

Therefore must have in place methods for the evaluation of the uncertainty of the results.

However, there is no prescription to include these results in the reports.

Periodic verifications

Highly dependent of the type of instrument.

- Instruments verified in controlled laboratory environment.
- Instruments verified in the field.
 - In this case, it is usual to have standardized instruments to do the verification
 - The uncertainties associated with the method are usually small compared to the MPE in service.



Conclusions

It is mandatory to evaluate the uncertainty for Legal Metrology activities.

Conformity evaluations do not (generally) take into account uncertainty as long as it follows the $1/3 - 1/5$ rule.



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Thank you for your attention

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