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## Economic Commission for Europe

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### Working Party on the Transport of Perishable Foodstuffs

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Item 6 (a) of the provisional agenda
**Proposals of amendments to ATP:**
**pending proposals**

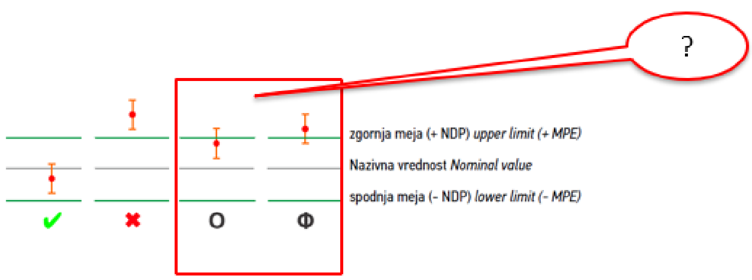
# The role of measurement uncertainty in conformity assessment decisions in ATP

### Transmitted by the Government of Slovenia

## Context

1. Since ATP stations need to estimate uncertainties of their measurements, the rules regarding conformity assessment decisions and the role of measurement uncertainty within conformity assessment should be introduced to ATP following metrology standards.

Figure 1
**Outline of four possible measured results options which need to be assessed in conformity assessment decision. Red marking of border line options of results**




2. Conformity assessment should follow the approach outlined in international metrological practice which can be found in ILAC-G8:09/2019, JCGM 106:2012, OIML G 19 /2017, and Welmec 4.2.-1 / 2006.

## State of art

3. In conformity assessment, decision is based on observable data (measured quantities). Because of uncertainty in measurement, there is always the risk of incorrectly deciding.

Incorrect decisions are of two types: an item accepted as conforming may actually be non-conforming (this case is called false acceptance or consumer's risk), and an item rejected as non-conforming may actually be conforming (this case is called false rejection or producer's risk).

4. In ATP test procedure for all methods performed by measurements, there exists a definition of maximum acceptable measurement uncertainty (by definition of reference equipment and instruments and tests procedures accuracy demands.

5. Use of simple acceptance rule = shared risk rule is recommended by ILAC- Guidelines on the Reporting of Compliance with Specification G8:09/2019, in point 4.2:

"A binary decision rule exists when the result is limited to two choices (pass or fail)."

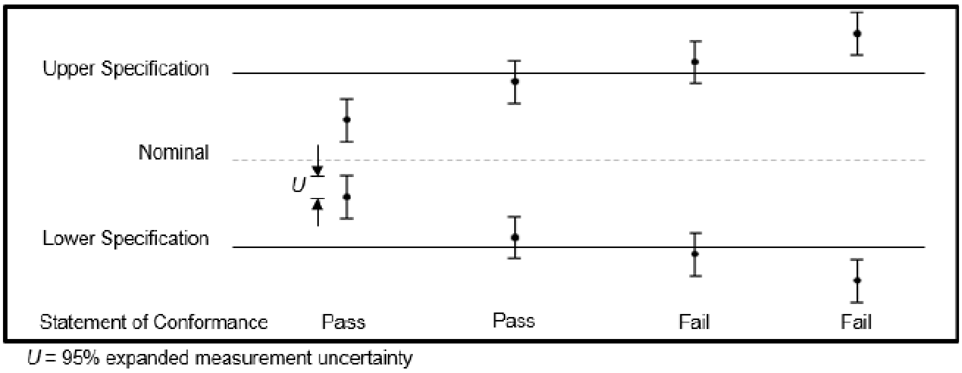
6. Binary Statement for Simple Acceptance Rule is defined:

"4.2.1 Binary Statement for Simple Acceptance Rule

Statements of conformity are reported as:

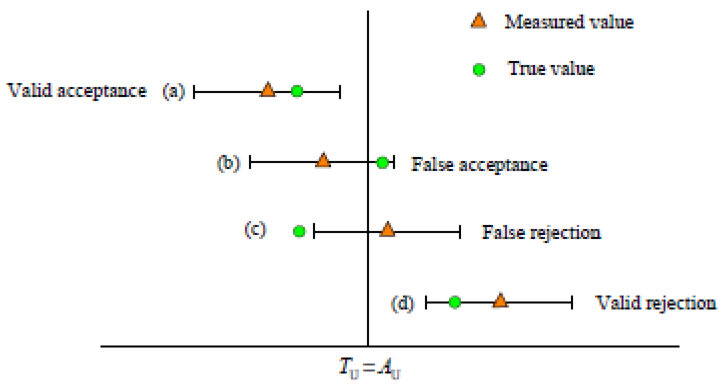
- Pass - the measured value is below the acceptance limit
- Fail - the measured value is above the acceptance limit"

Figure 2
**ILAC-G8:09/2019: Graphical representation of a Binary statement - Simple Acceptance**




7. Therefore, shared risk rule may be used when making conformity assessment for each measurement result: K coefficient, effective refrigerating capacity, temperature, time, surface, electrical energy, speed of rotation, pressure, etc.

Figure 3
**Acceptance and rejection introduction (Figure 8 JCGM 106 :2012)**




8. According to JCGM 106 :2012, ATP decision rule on tests performed by measurements should follow shared risk rule.

JCGM 106 :2012 Evaluation of measurement data – The role of measurement uncertainty in conformity assessment introduces shared risk rule in point 8.2:

***"8.2 Decision rule based on simple acceptance***

*8.2.1 An important and widely used decision rule is known as simple acceptance or shared risk. Under such a rule, the producer and user (consumer) of the measurement result agree, implicitly or explicitly, to accept as conforming (and reject otherwise) an item whose property has a measured value in the tolerance interval. As the alternative name `shared risk' implies, with a simple acceptance decision rule the producer and user share the consequences of incorrect decisions.*

*8.2.2 In practice, in order to keep the chances of incorrect decisions to levels acceptable to both producer and user, there is usually a requirement that the measurement uncertainty has been considered and judged to be acceptable for the intended purpose.*

*8.2.3 One approach to such consideration is to require, given an estimate of a measured quantity, that the associated expanded uncertainty U; for a coverage factor k = 2; must satisfy* $U < U_{max}$*; where* $U_{max}$ *is a mutually agreed maximum acceptable expanded uncertainty. This approach is illustrated by the following example.*

*EXAMPLE In legal metrology, a decision rule based on simple acceptance has been used in the verification of measuring instruments. Consider such an instrument that is required to have an error of indication in the interval* $[-E_{max};E_{max}]$*. The instrument is accepted as conforming to the specified requirement if it meets the following criteria:*

*(a) in measuring a calibrated standard, the best estimate e of the instrument error of indication E satisfies*

$|e| \leq E_{max}$*; and*

*(b) the expanded uncertainty for a coverage factor k = 2 associated with the estimate e satisfies*

$U \leq U_{max} = E_{max}/3$*:*

*In terms of the measurement capability index, criterion (b) is equivalent to the requirement that* $C_m \geq 3$*."*

9. The same rule is recommended in Welmec 4.2-1 / 2006 and OIML G 19 /2017.

Welmec 4.2-1 / 2006 - article 6 : Measurement uncertainty and decision making:

***"General requirements on measurement uncertainty***

*In order to make a decision of conformity assessment based on quantitative testing of an instrument, the result of a reading of a particular measuring instrument should be accompanied by its measurement uncertainty, usually a so-called 'expanded' uncertainty U. The interval of measurement uncertainty is often y ± U.*

***Decision-making with measurement uncertainty***

*The two main stages in handling uncertainty in decision-making:*

*(i) setting a limit on a maximum permissible measurement uncertainty (MPU);*

*(ii) allowing for risks due to uncertainty by 'sharing' risks*

***Accounting for uncertainty in decision-making***

*The two main stages in handling uncertainty in decision-making identified above can be applied to conformity assessment for both new instruments and instruments in-service."*

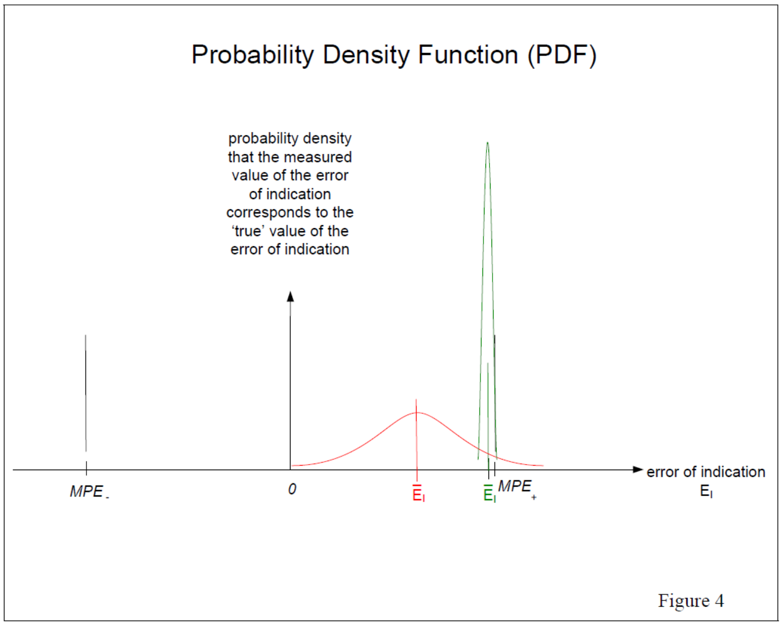
*OIML G 19 /2017 - point 5.3.3 and 5.3.4:*

***"5.3.3 Shared risk***

*Shared risk, on the other hand, is an agreement between the parties concerned with the outcome of the testing that neither will be given an advantage or disadvantage concerning consideration of measurement uncertainty. Implicit in such an agreement is that the expanded measurement uncertainty* $U_{EI}$ *is 'small' with respect to the MPE (i.e. the ratio*

*($U_{EI}$/MPE) is 'small') so that the significant risk of an erroneous decision exists for values of $\bar{E}_I$ that are only very close to the MPE boundaries. This is illustrated in Figure 4 for two possible different PDFs for a given measurement. The uncertainty $U_{EI}$ associated with the leftmost (red) Gaussian curve is probably too large for a shared risk arrangement, whereas the uncertainty $U_{EI}$ associated with the rightmost (green) Gaussian curve would probably be acceptable for most applications.*

Figure 4
**OIML G 19:2017– Fig. 4**




…

*Note that with the shared risk approach it is still necessary to calculate the measurement uncertainty $U_{EI}$ so that the ratio ($U_{EI}$/MPE) can be examined to see if it is 'small enough', as discussed in 5.3.4. Also note that if the maximum permissible errors are to be adjusted for some reason (for example, allowance for in-service conditions) using the guard band method (see 5.3.6), the shared risk approach can still be used with the new or guard banded MPEs.*

***5.3.4 Maximum permissible uncertainty of error of indication***

*It is becoming common to refer to the maximum value that the ratio ($U_{EI}$/MPE) is allowed to have in terms of a "maximum permissible uncertainty" (denoted symbolically by $MPU_{EI}$) of the error of indication, defined by:*

$MPU_{EI} \equiv f_{EI} \cdot MPE$

*where $f_{EI}$ is a specified number less than one, usually of the order 1/3 or 1/5 (0.33 or 0.2).*

…

*Note that 1/$f_{EI}$ is sometimes called the test uncertainty ratio (TUR). …"*

## Technical impact of the proposed measure

10. Harmonisation of conformity assessment decisions for all ATP test stations.

## Economic impact of the proposed measure

11. N/A

## Environmental impact of the proposed measure

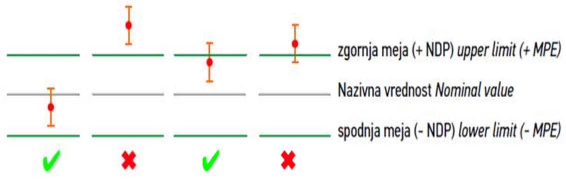
12. N/A

## Conclusion

13. ATP stations do need to estimate measurement uncertainties of their measurements. Conformity acceptance in ATP should follow shared risk rule.

Figure 5

**Outline of 4 possible measured results options which need to be assessed in conformity assessment decisions and decisions made by simple acceptance rule**




## ATP Proposal of amendment (if applicable)

14. Section of ATP concerns by the proposal:

**ATP Handbook: Add at the end of Annex I, Appendix 2 the following comment:**

**"CONFORMITY ACCEPTANCE**

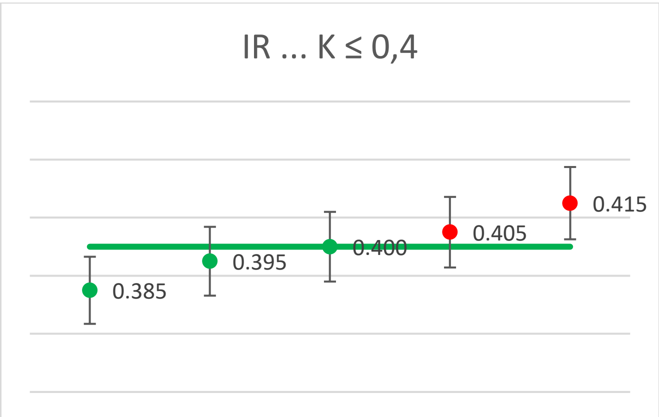
Measurement results in all sections of Annex I, Appendix 2 should include estimation of measurement uncertainty. To achieve demanded level of measurement uncertainty Test stations should follow definition of procedures as defined by test procedure in each section of Annex I, Appendix 2.

Conformity acceptance in all sections of Annex I, Appendix 2 should be done without taking measurement uncertainty into account, using *binary decision*[1] or *shared risk*[1,2,3,4] decision rule.

***Examples of conformity acceptance decisions for insulation box classification:***

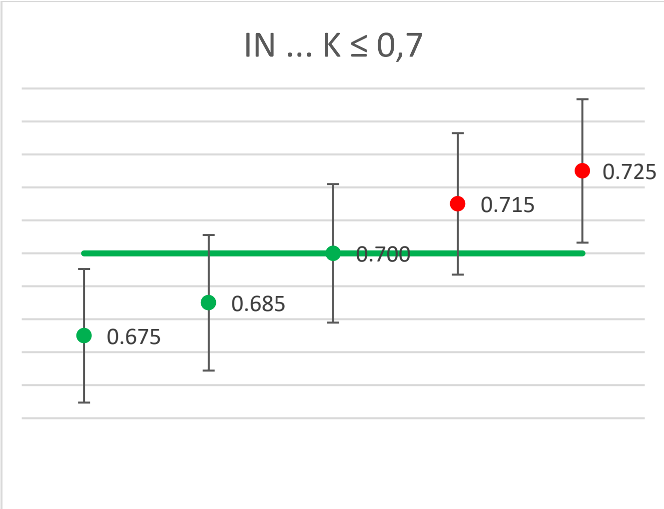
***Case 1 – insulation box to be classified as IR:***

*All results for K factor which are smaller or equal to 0,4 conform with IR class (green points). All results for K factor which are greater than 0,4 do not conform with IR class (red points).*



***Case 2 – insulation box to be classified as IN:***

*All results for K factor which are smaller or equal to 0,7 conform with IN class (green points). All results for K factor which are greater than 0,7 do not conform with IN class (red points).*




**Footnote:**

[1] *ILAC- ILAC- Guidelines on the Reporting of Compliance with Specification G8:09/2019, - 2.7*

[2] *JCGM 106 :2012 Evaluation of measurement data – The role of measurement uncertainty in conformity assessment - 8.2*

[3] *Welmec 4.2-1 / 2006 – 6*

[4] *OIML G 19 /2017 - 5.3.3, 5.3.4".*