Use of uncertainty for compliance assessment

Principles of the Eurachem/CITAC Guide

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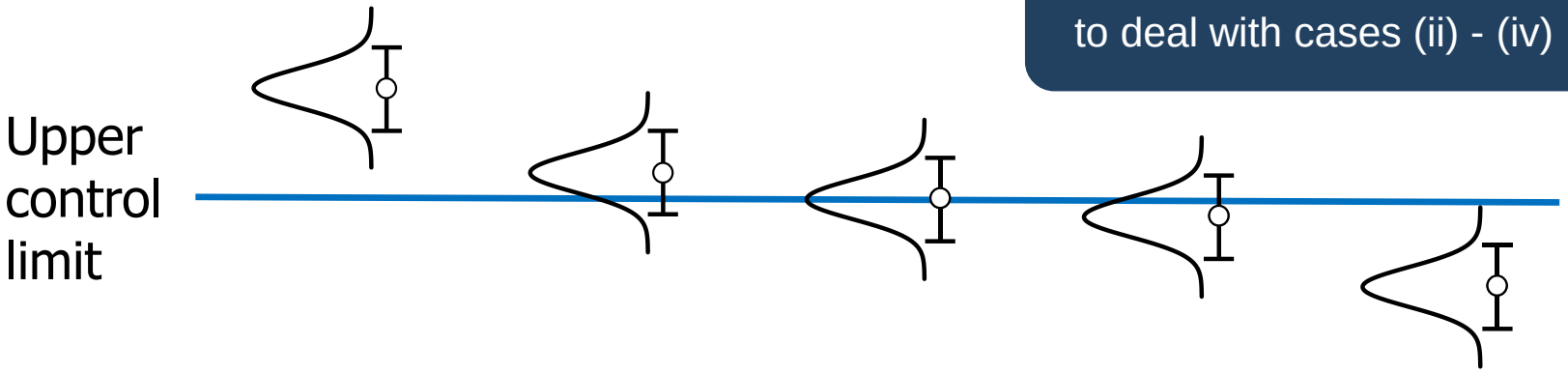
Introduction

- Many analyses carried out to check compliance with a specification or regulation
- Necessary to take into account the measurement uncertainty when assessing compliance
- How can this be done?

Basic guidance

Need additional information to deal with cases (ii) - (iv)



(i) Measured value above limit: limit outside uncertainty interval

(ii) Measured value above limit; limit within uncertainty interval

(iii) Measured value at limit; limit within uncertainty interval

(iv) Measured value below limit; limit within uncertainty interval

(v) Measured value below limit; limit outside uncertainty interval

Consistent decisions need rules

Required information

ASME B89.7.3.1-2001 and similar guidance

- A specification giving upper and/or lower permitted limits
- A decision rule that describes how the uncertainty will be taken into account
- The limit(s) of the acceptance or rejection zone (i.e. the range of results), derived from the measurement result and a stated uncertainty

ISO/IEC 17025:2017

- Decision rule:

  "rule that describes how measurement uncertainty is accounted for when stating conformity with a specified requirement"

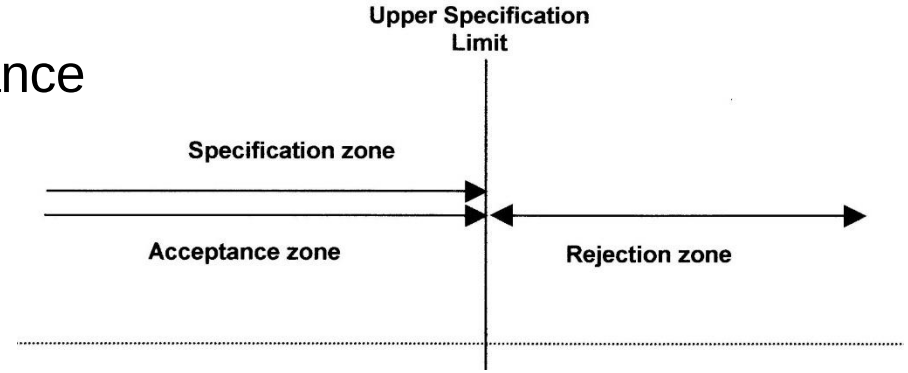
- §7.1.3: "When the customer requests a statement of conformity…the decision rule shall be clearly defined."

Example of a decision rule

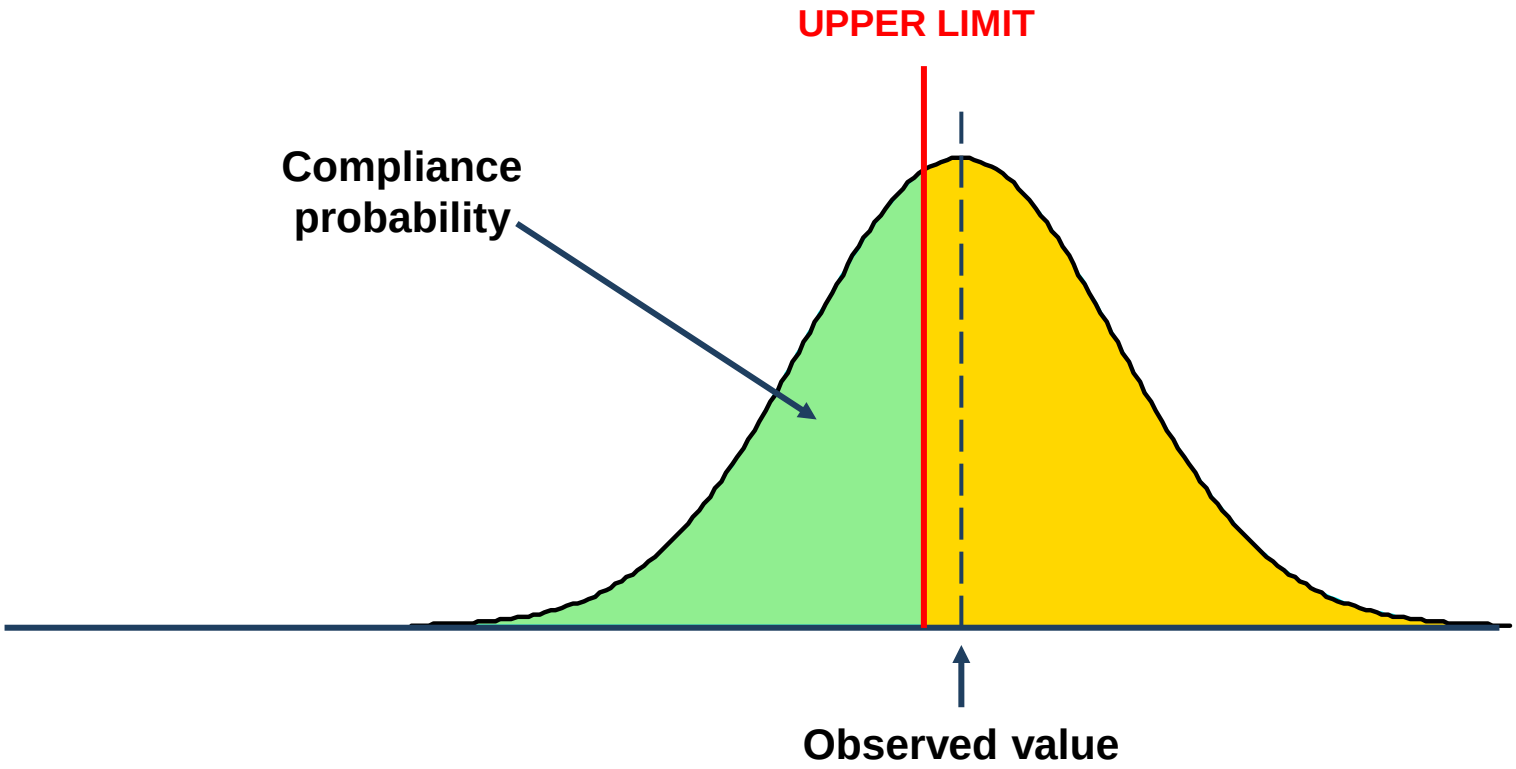
- A result equal to or above the upper limit implies non-compliance
  - result below the limit implies compliance

"Simple acceptance"

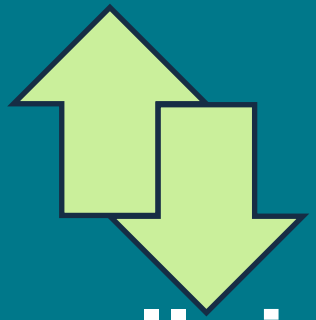
Also called "shared risk"



Probability of compliance



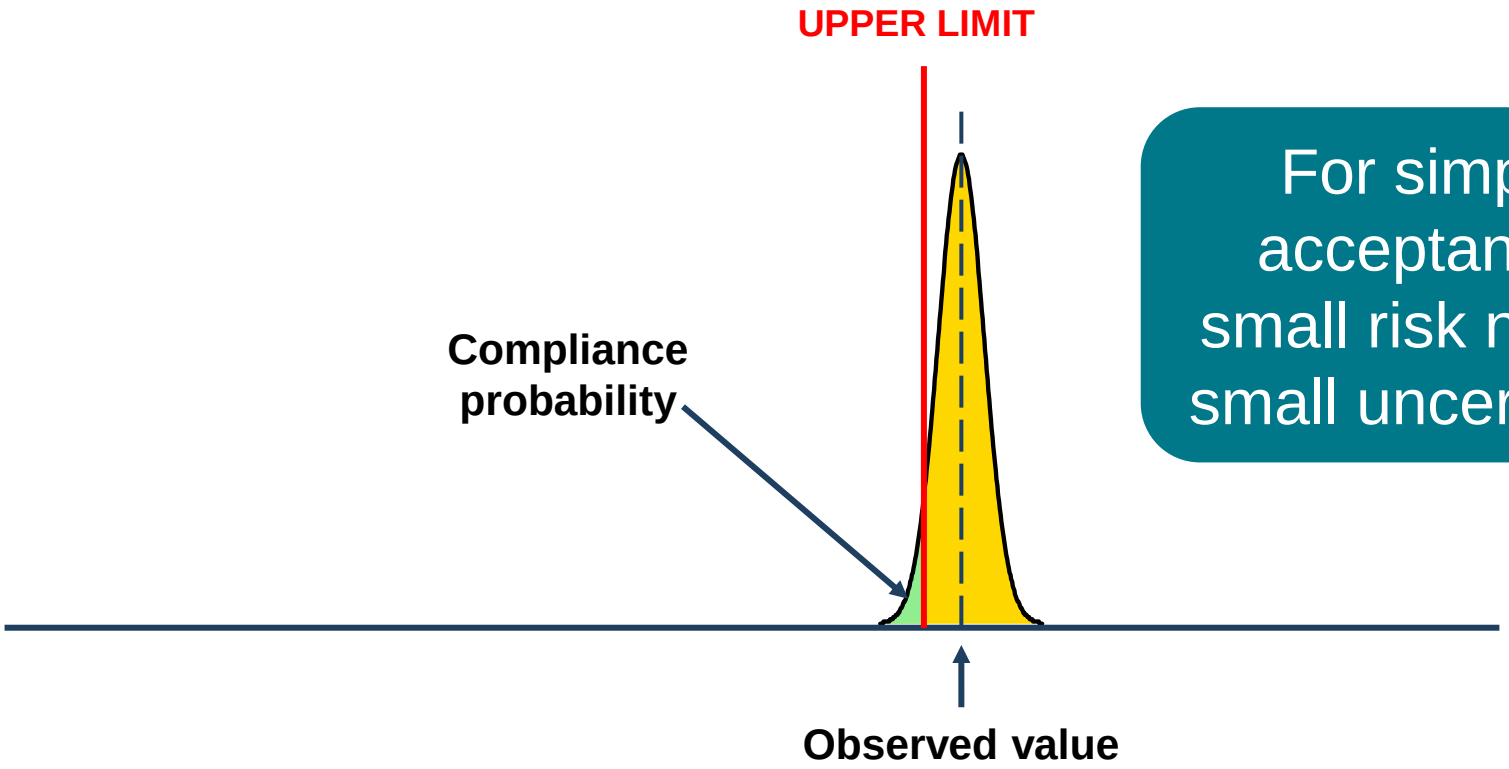
Small uncertainty



Small risk

NML
UK NATIONAL MEASUREMENT LABORATORY
FOR CHEMICAL AND BIO-MEASUREMENT
HOSTED AT LGC

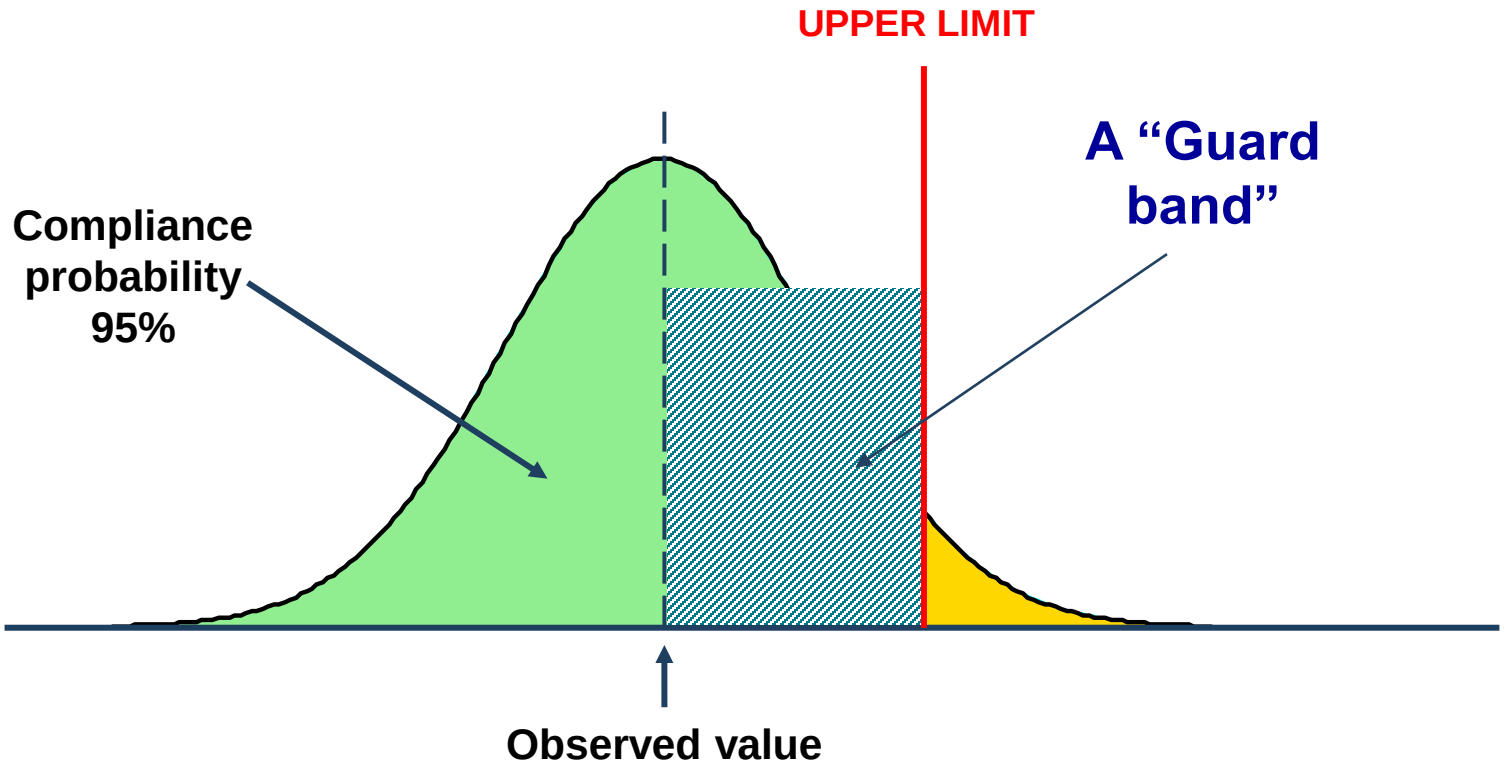
Probability of compliance



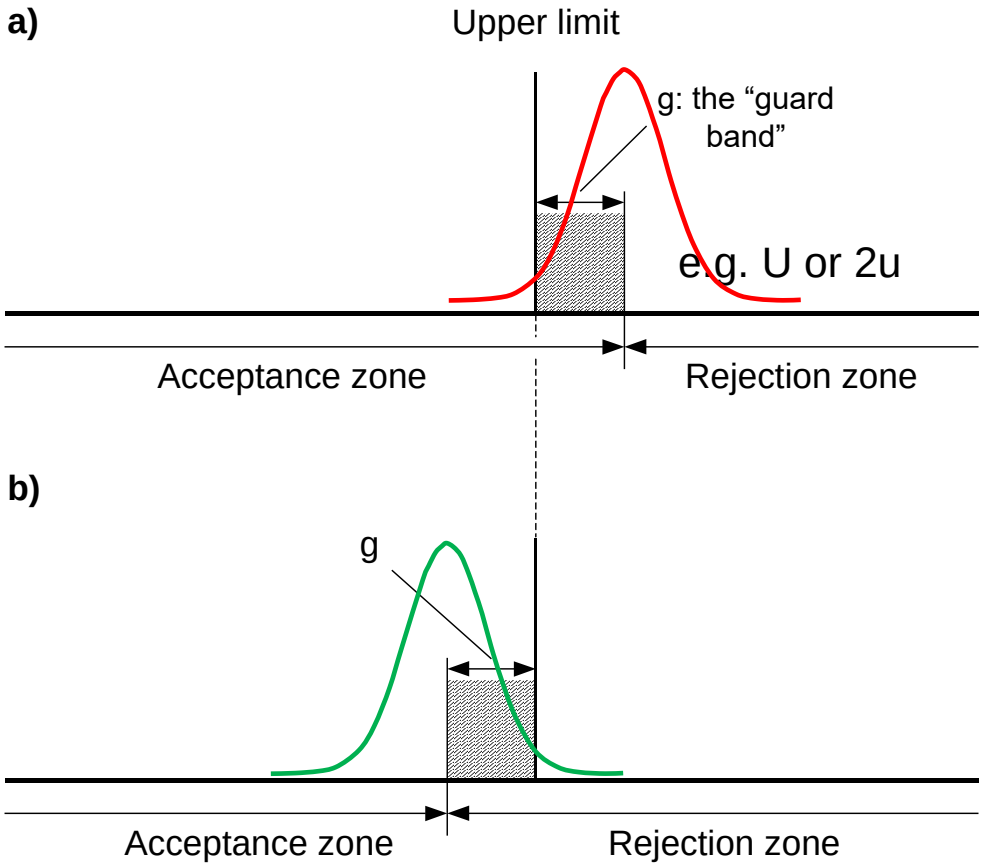
For simple acceptance, small risk needs small uncertainty

Decision rules can control probabilities of false decisions

Probability of compliance



Decision rules & guard bands

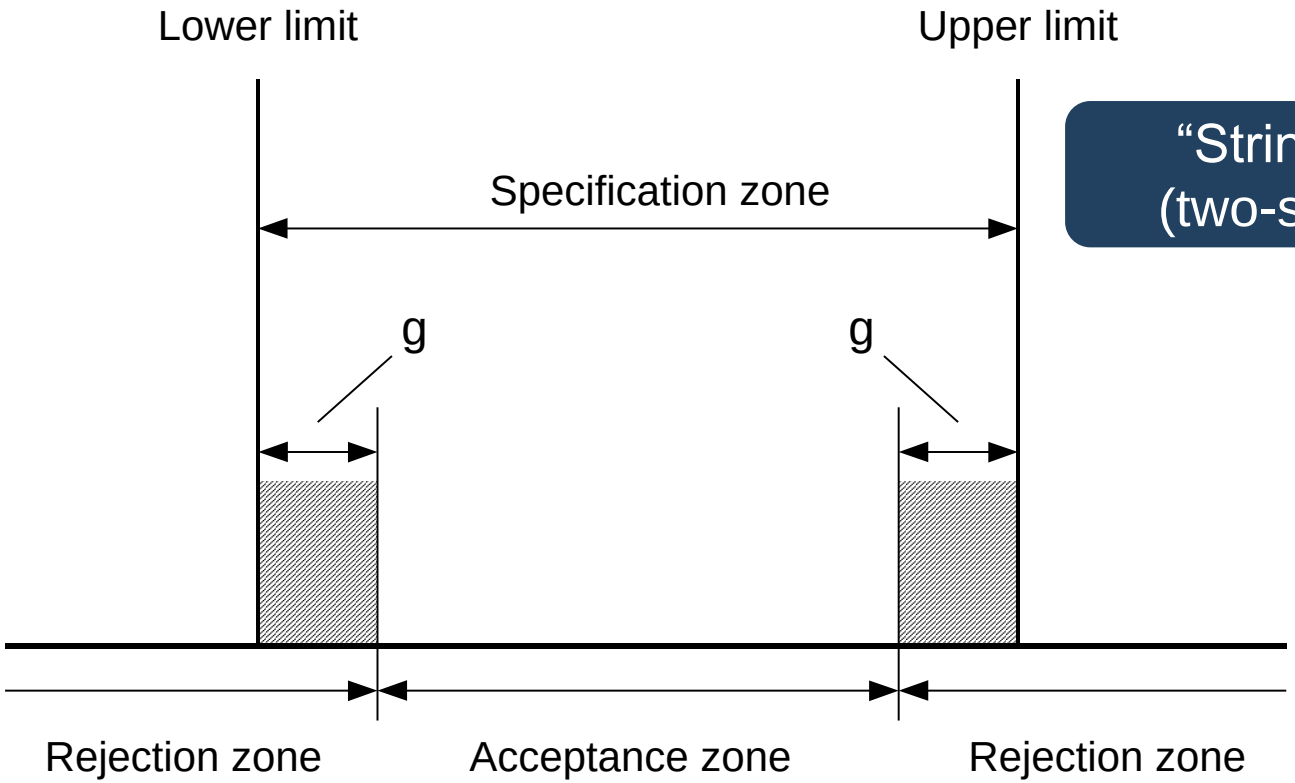


“Relaxed acceptance”
(test for *non*-conformity)

“Stringent acceptance”

ILAC G-8 default

Decision rules & guard bands



"Stringent acceptance"
(two-sided specification)

Decision rules & guard bands

- Clear method of determining the location of acceptance and rejection zones
- Minimum acceptable level of the probability that the value of the measurand lies within the specification limits

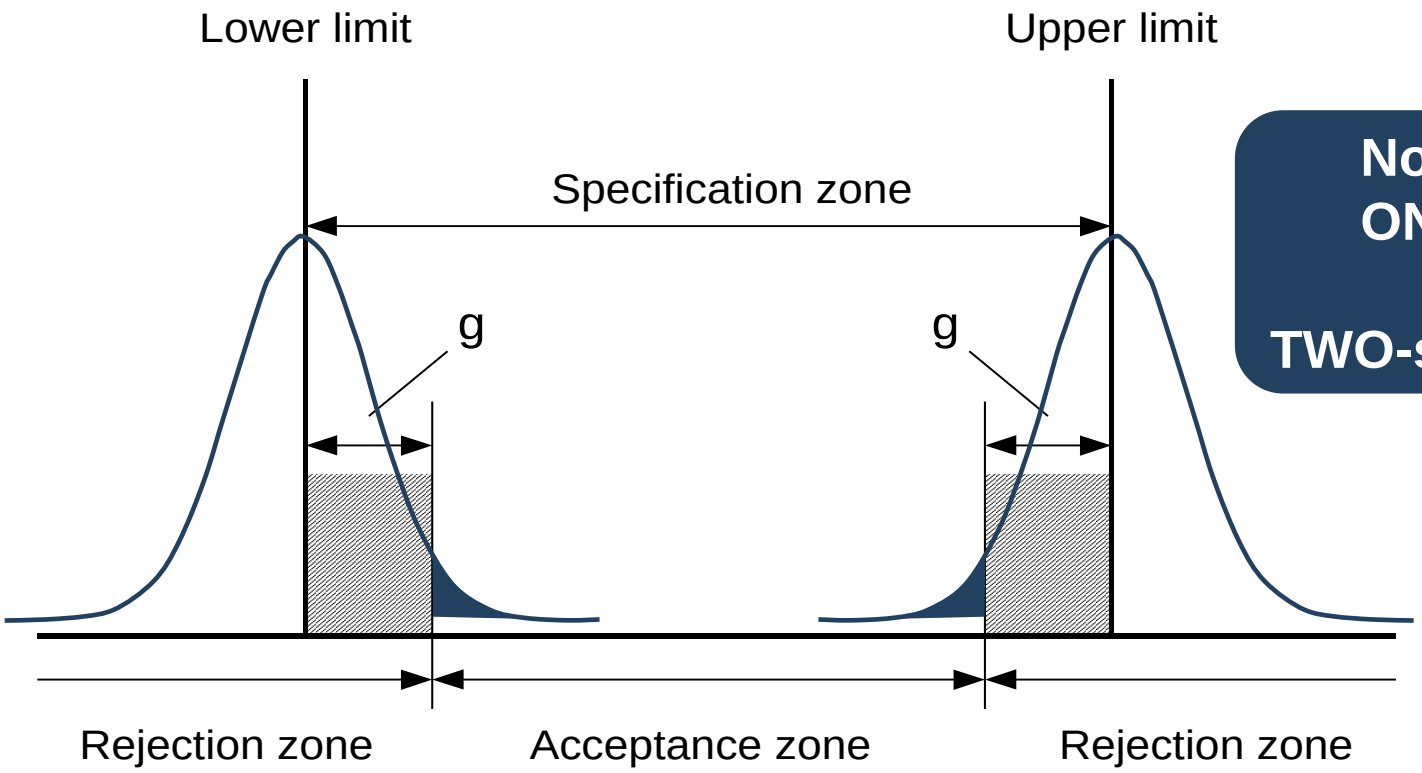
- Procedure for dealing with repeated measurements and outliers

Additional technical problems

Other technical issues

- Relative uncertainty (uncertainty as % of value)
  - Affects guard band – set for limit, not for measurement result
- Asymmetry
  - May require special consideration
- Inconclusive results
  - Can be accommodated in the decision rule
- Setting coverage factor *k*

Choosing *k:*
k for 2-sided intervals



Note use of ONE-sided *t* for TWO-sided interval

Summary

Assessment of compliance requires:

a) a measurement result and a stated uncertainty

b) a specification giving the upper and/or lower permitted limits of the characteristics (measurands) being controlled

c) a decision rule that describes how the measurement uncertainty will be taken into account

d) a reference to the decision rules used when reporting on compliance

Further reading

Use of uncertainty information in compliance assessment

Eurachem/CITAC Guide

www.eurachem.org