VIM

WMO TRAINING WORKSHOP ON METROLOGY FOR SOUTHWEST PACIFIC RA V ENGLISH SPEAKING COUNTRIES

Melbourne, Australia, 21-25 November 2011

INTERNATIONAL VOCABULARY OF METROLOGY

BASIS AND GENERAL CONCEPTS AND ASSOCIATED TERMS,

VIM

(ISO/IEC Guide 99-12:2007, *International Vocabulary of Metrology — Basic and General Concepts and Associated Terms*, VIM

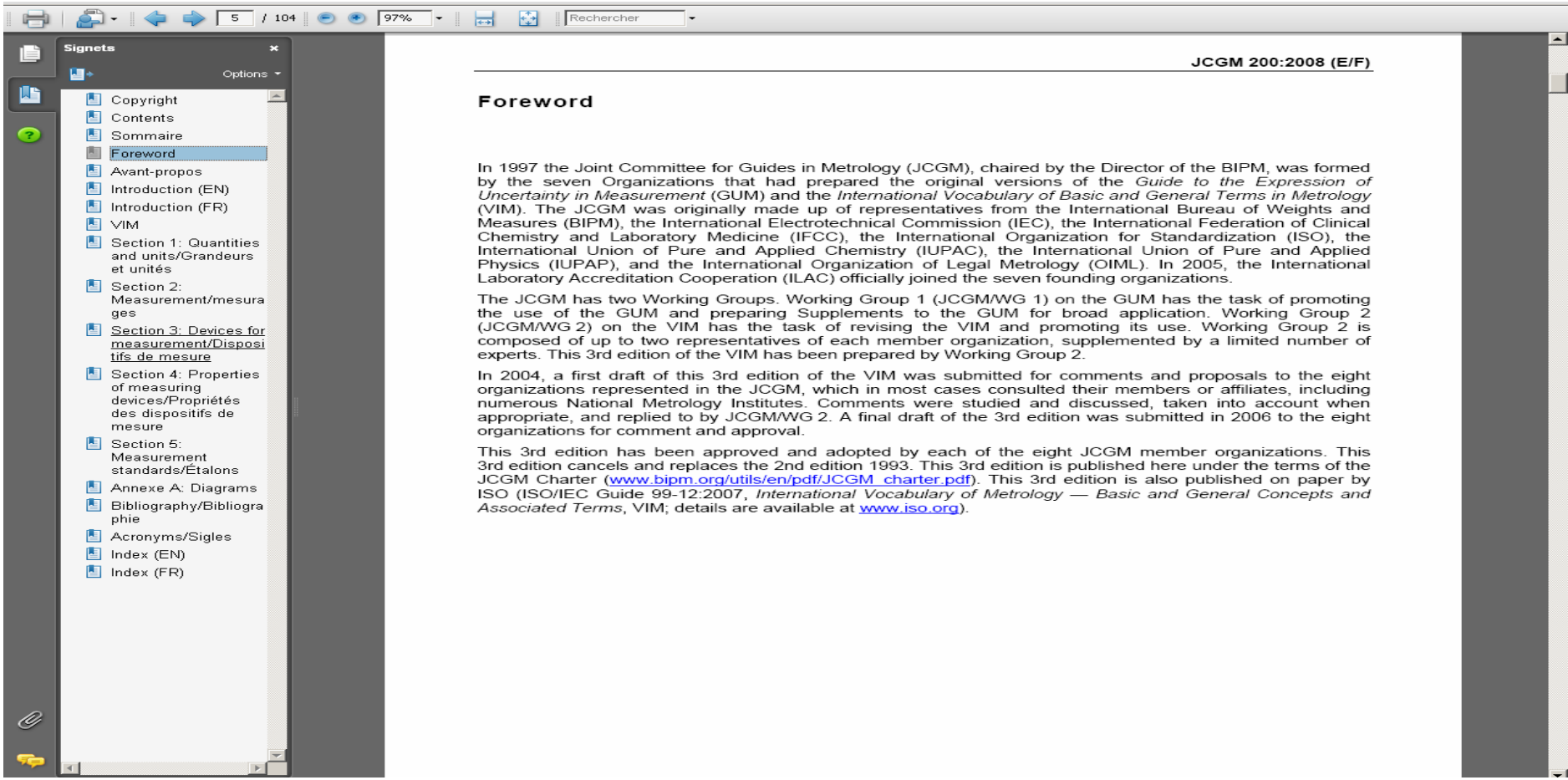
http://www.bipm.org/fr/publications/guides/vim.html

Scope

…« Nevertheless, this Vocabulary is intended to promote global harmonization of terminology used in metrology. »…

http://www.bipm.org/fr/publications/guides/vim.html

VIM



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CIMO Guide WMO-8

WMO | CIMO Guide

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World Meteorological Organization
Working together in weather, climate and water

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Instruments and Methods of Observation

GOS > IMOP > Guide to Meteorological Instruments

Draft First Supplement to the Seventh Edition (2008) of the CIMO Guide
- including proposed modifications, as of 15 June 2010 -

WMO GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION
WMO-No. 8 (Seventh edition)
(6 August 2008)

CHAPTER	TITLE	EDITION
PART I:	MEASUREMENT OF METEOROLOGICAL VARIABLES	
1	General	Seventh edition
2	Measurement of temperature	Seventh edition
3	Measurement of atmospheric pressure	Seventh edition
4	Measurement of humidity	Seventh edition
5	Measurement of surface wind	Seventh edition
6	Measurement of precipitation	Seventh edition
7	Measurement of radiation	Seventh edition
8	Measurement of sunshine duration	Seventh edition
9	Measurement of visibility	Seventh edition
10	Measurement of evaporation	Seventh edition
11	Measurement of soil moisture	Seventh edition
12	Measurement of upper air pressure, temperature, humidity	Seventh edition
13	Measurement of upper wind	Seventh edition
14	Observation of present and past weather; state of the ground	Seventh edition
15	Observation of clouds	Seventh edition
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17	Measurement of atmospheric composition	Seventh edition
PART II:	OBSERVING SYSTEMS	
1	Measurements at automatic weather stations	Seventh edition

IMOP

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CIMO
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- AWS Portal
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- Manufacturers (HMEI)

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Terminé

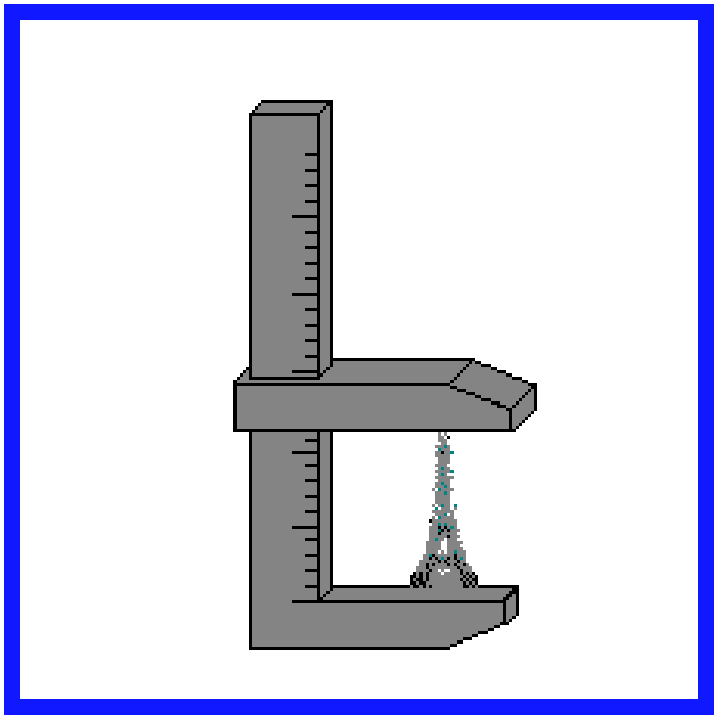
http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html

METROLOGY

•WMO TRAINING WORKSHOP ON METROLOGY FOR SOUTHWEST PACIFIC RA V ENGLISH SPEAKING COUNTRIES

- What is Metrology ?

- Science of Measurement
  and
  its application



MEASUREMENT

Process of experimentally obtaining one or more **quantity values** that can reasonably be attributed
to a **quantity**

And, what is a **measurement result**?

MEASUREMENT RESULT

Result of measurement

set of **quantity values** being attributed to a m**easurand** together with any other available relevant information

So, what is a **Measurand**?

MEASURAND

quantity intended to be measured

So, what is a **quantity**?

QUANTITY

- property of a phenomenon, body, or substance,where the property has a magnitude that can be expressed as a number and a reference

CALIBRATION

- operation that, under specified conditions, in a first step, establishes a relation between the **quantity values** with **measurement uncertainties** provided by **measurement standards** and corresponding **indications** with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a **measurement result** from an indication

QUANTITY VALUE

Value of a quantity value

- number and reference together expressing magnitude of a **quantity**

- EXAMPLE 1 Length of a given rod:
- 5.34 m or 534 cm
- EXAMPLE 2 Mass of a given body:
- 0.152 kg or 152 g

NUMERICAL QUANTITY VALUE

Numerical value of a quantity

Numerical value

- number in the expression of a **quantity value,** other than any number serving as the reference

- EXAMPLE For a quantity value of 5.7 kg, the numerical quantity value is $\{m\}$ = (5.7 kg)/kg = 5.7.
- The same quantity value can be expressed as 5 700 g in which case the numerical quantity value $\{m\}$ = (5 700 g)/g = 5 700.

MEASUREMENT UNIT

unit of measurement unit

real scalar **quantity,** defined and adopted by convention, with which any other quantity of the same **kind** can be compared to express the ratio of the two quantities as a number

UNITS

Coherent system of units

system of units, based on a given **system of quantities,** in which the **measurement unit** for each **derived quantity** is a **coherent derived unit**

UNITS

International System of Units, SI

SI

system of units, based on the **International System of Quantities,** their names and symbols, including a series of prefixes and their names and symbols, together with rules for their use, adopted by the General Conference on Weights and Measures (CGPM)

http://www.bipm.org/en/si/si_brochure/

UNITS

International System of Units, SI

Base quantity	Base unit	Base unit
Name	**Name**	**Symbol**
length	metre	M
mass	kilogram	kg
time	second	S
Electric current	ampere	A
Thermodinamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

TRUE QUANTITY VALUE

True value of a quantity

True value:

- **quantity value** consistent with the definition of
  a **quantity**

TRUE QUANTITY VALUE

NOTE 1 In the Error Approach to describing **measurement,** a true quantity value is considered unique and, in practice, unknowable.

The Uncertainty Approach is to recognize that, owing to the inherently incomplete amount of detail in the definition of a quantity, there is not a single true quantity value but rather a set of true quantity values consistent with the definition. However, this set of values is, in principle and in practice, unknowable.
Other approaches dispense altogether with the concept of true quantity value and rely on the concept of **metrological compatibility of measurement results** for assessing their validity.

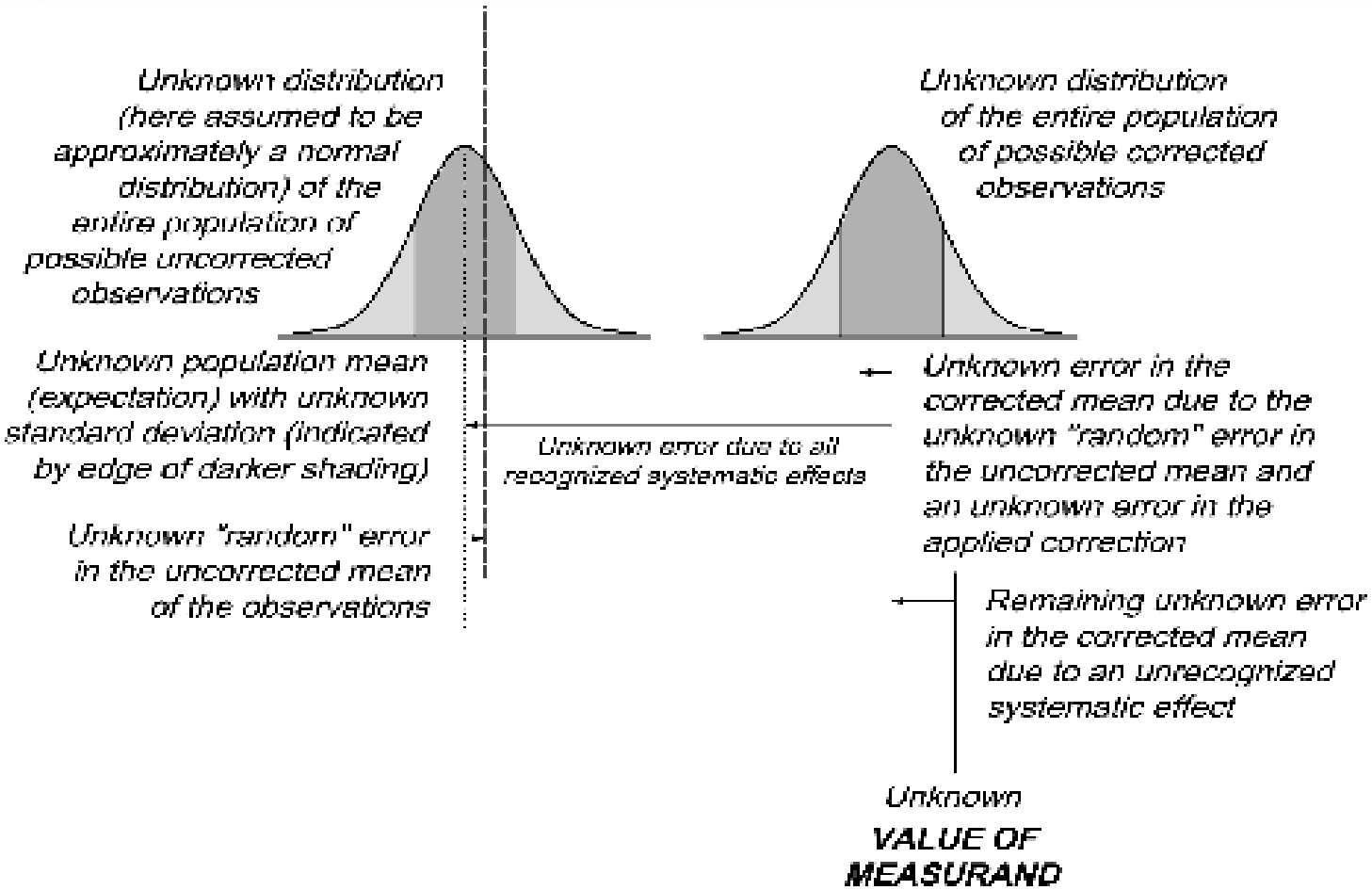
TRUE QUANTITY VALUE

WMO CIMO Guide

True value (of a quantity): A value consistent with the definition of a given particular quantity.

<true value> = <measured value> ± <uncertainty>

TRUE QUANTITY VALUE



b) ***Ideal concepts based on unknowable quantities***

http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf

CONVENTIONAL QUANTITY VALUE

Conventional value of a quantity

Conventional value

- **quantity value** attributed by agreement to a **quantity** for a given purpose

EXAMPLE 1 Standard acceleration of free fall (formerly
called “standard acceleration due to gravity”),
$g_n = 9.806\,65\ \mathrm{m \cdot s^{-2}}$.

INFLUENCE QUANTITY

- **quantity** that, in a direct **measurement,** does not affect the quantity that is actually measured, but affects the relation between the **indication** and the **measurement result**

CALIBRATION

- operation that, under specified conditions, in a first step, establishes a relation between the **quantity values** with **measurement uncertainties** provided by **measurement standards** and corresponding **indications** with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a **measurement result** from an indication

MEASURING INSTRUMENT

device used for making **measurements,** alone or in conjunction with one or more supplementary devices

NOTE 1 A measuring instrument that can be used alone is a **measuring system.**
NOTE 2 A measuring instrument may be an **indicating measuring instrument** or a **material measure.**

SENSOR

- element of a **measuring system** that is directly affected by a phenomenon, body, or substance carrying a **quantity** to be measured

Properties of measuring devices

Indication:

- **quantity value** provided by a **measuring instrument** or a **measuring system**

Adjustment of a measuring system

ADJUSTMENT

- set of operations carried out on a **measuring system** so that it provides prescribed **indications** corresponding to given **values** of a **quantity** to be measured

Properties of measuring devices

Resolution:

- smallest change in a **quantity** being measured that causes a perceptible change in the corresponding **indication**

Properties of measuring devices

Resolution:

Question: the resolution of my watch without the seconde hand?

- smallest change in a **quantity** being measured that causes a perceptible change in the corresponding **indication**

Resolution is 20s

Properties of measuring devices

maximum permissible measurement error:

maximum permissible error

limit of error

extreme value of **measurement error,** with respect to a known **reference quantity value,** permitted by specifications or regulations for a given **measurement, measuring instrument,** or **measuring system**

Properties of measuring devices

maximum permissible measurement error:

maximum permissible error

limit of error

Question: who gives the maximum permissible error?

Answer : Requirement, standard, ISO, WMO, OACI, customer…

Properties of measuring devices

Stability of a measuring instrument

Stability :

- property of a **measuring instrument,** whereby its metrological properties remain constant in time

CALIBRATION

- operation that, under specified conditions, in a first step, establishes a relation between the **quantity values** with **measurement uncertainties** provided by **measurement standards** and corresponding **indications** with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a **measurement result** from an indication

MEASUREMENT STANDARDS

VIM Etalon:

- realization of the definition of a given **quantity,** with stated **quantity value** and associated **measurement uncertainty,** used as a reference

- NOTE 1 A “realization of the definition of a given quantity” can be provided by a **measuring system,** a **material measure,** or a reference material.

MEASUREMENT STANDARDS

WMO Etalon:

- *(Measurement) standard:* A material measure, measuring instrument, reference material or measuring system intended to define, realize, conserve or reproduce a unit or one or more values of a quantity to serve as a reference.

INTERNATIONAL MEASUREMENT STANDARDS

International measurement standard:

VIM

- **measurement standard** recognized by signatories to an international agreement and intended to serve worldwide

EXAMPLE 1 The international prototype of the kilogram.

WMO International standard:

A standard recognized by an international agreement to serve internationally as the basis for assigning values to other standards of the quantity concerned.

NATIONAL MEASUREMENT STANDARDS

VIM National standard

measurement standard recognized by national authority to serve in a state or economy as the basis for assigning **quantity values** to other **measurement standards** for the **kind of quantity** concerned

WMO National standard:

A standard recognized by a national decision to serve, in a country, as the basis for assigning values to other standards of the same quantity.

MEASUREMENT STANDARDS

PRIMARY STANDARD:

measurement standard established using a **primary reference measurement procedure,** or created as an artifact, chosen by convention

WMO Primary standard:

A standard that is designated or widely acknowledged as having the highest metrological qualities and whose value is accepted without reference to other standards of the same quantity.

MEASUREMENT STANDARDS

REFERENCE STANDARD:

- standard, generally having the highest metrological quality available at a given location or in a given organization, from which measurements made there are derived.

WMO Reference standard:

A standard, generally having the highest metrological quality available at a given location or in a given organization, from which the measurements taken there are derived.

MEASUREMENT STANDARDS

WORKING STANDARD:

- standard that is used routinely to calibrate or check material measures, measuring instruments or reference materials.
- *WMO Working standard:*

  A standard that is used routinely to calibrate or check material measures, measuring instruments or reference materials.

MEASUREMENT STANDARDS

TRANSFER STANDARD:

- standard used as an intermediary to compare standards

WMO Transfer standard:

A standard used as an intermediary to compare standards.

MEASUREMENT STANDARDS

WMO Travelling standard:

- A standard, sometimes of special construction, intended for transport between different locations.

WMO Collective standard:

A set of similar material measures or measuring instruments fulfilling, by their combined use, the role of a standard.

Example: The World Radiometric Reference

MEASUREMENT RESULT

Result of measurement

set of **quantity values** being attributed to a m**easurand** together with any other available relevant information

MEASUREMENT RESULTS

Measurement error

Error (of measurement):

- **measured quantity value** minus a **reference quantity value**

MEASUREMENT RESULTS

systematic measurement error

systematic error of measurement

systematic error

- component of **measurement error** that in replicate **measurements** remains constant or varies in a predictable manner

MEASUREMENT RESULTS

measurement bias

bias

- estimate of a **systematic measurement error**

MEASUREMENT RESULTS

random measurement error

random error of measurement

random error

- component of **measurement error** that in replicate **measurements** varies in an unpredictable manner

MEASUREMENT RESULTS

correction

compensation for an estimated systematic effect

MEASUREMENT RESULTS

measurement accuracy

accuracy of measurement

accuracy

- closeness of agreement between a **measured quantity value** and a **true quantity value** of a **measurand**

MEASUREMENT RESULTS

measurement trueness

trueness of measurement

trueness

- closeness of agreement between the average of an infinite number of replicate **measured quantity values** and a **reference quantity value**

MEASUREMENT RESULTS

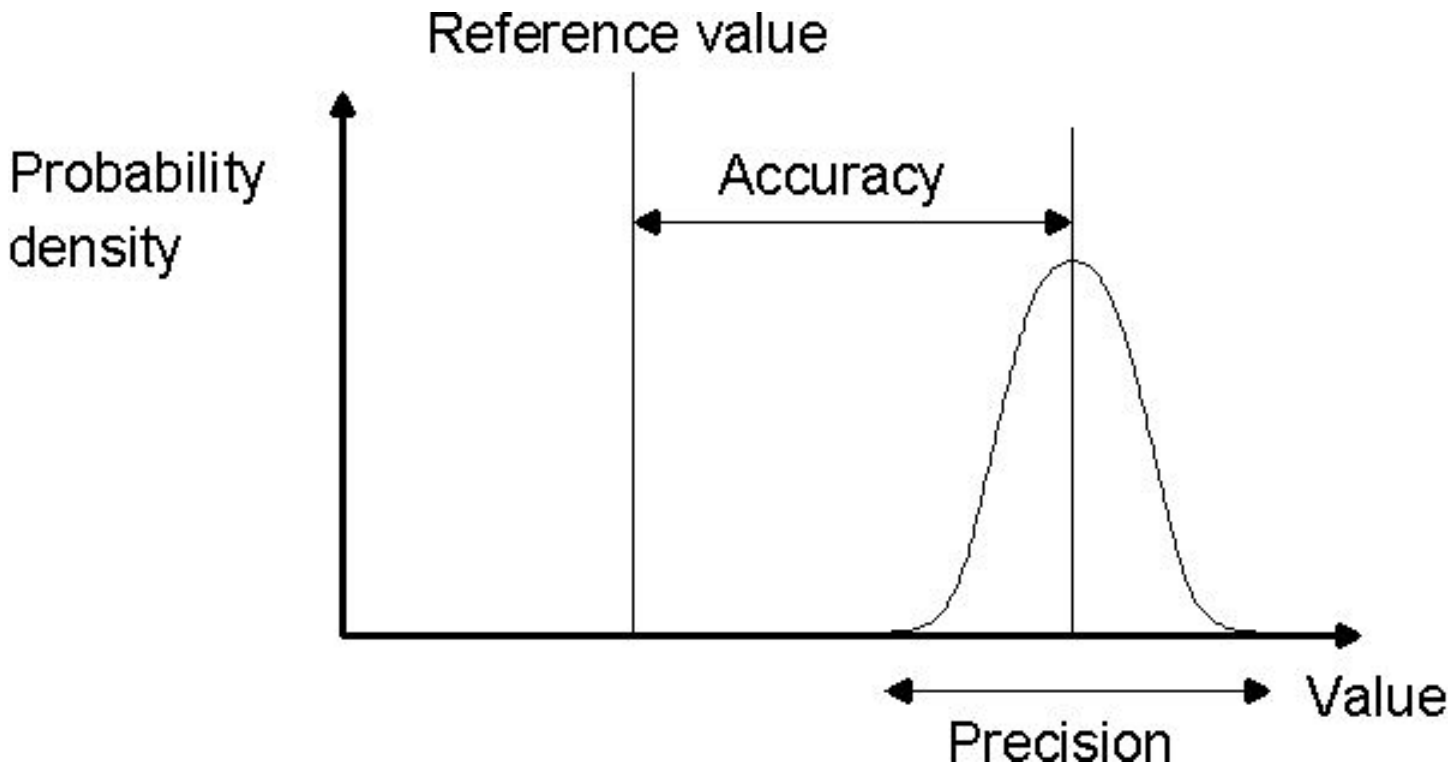
measurement precision

precision

- **measured quantity values** obtained by replicate **measurements** on the same or similar objects under specified conditions

MEASUREMENT RESULTS

Accuracy / precision



MEASUREMENT RESULTS

measurement uncertainty
uncertainty of measurement
uncertainty

- non-negative parameter characterizing the dispersion of the **quantity values** being attributed to a **measurand,** based on the information used

MEASUREMENT RESULTS

Uncorrected observations

Uncorrected mean of observations

Correction for all systematic effects

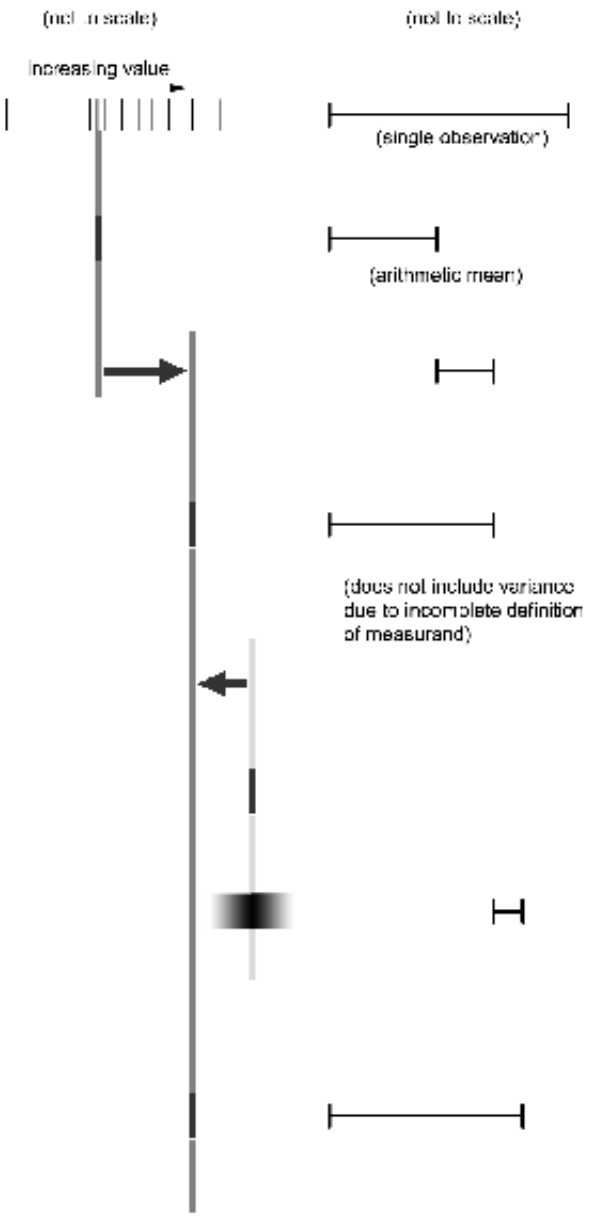
Result of measurement

Remaining error

Value of measurand (unknown)

Value of measurand due to incomplete definition

Final result of measurement with uncertainty



TRACEABILITY

metrological traceability

- property of a **measurement result** whereby the result can be related to a reference through a documented unbroken chain of **calibrations,** each contributing to the **measurement uncertainty**

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http://www.bipm.org/utils/common/documents/jcgm/JCGM_200_2008.pdf

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ΜΕΤΡΩ ΧΡΩ

First edition September 2008

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http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf

CALIBRATION

- operation that, under specified conditions, in a first step, establishes a relation between the **quantity values** with **measurement uncertainties** provided by **measurement standards** and corresponding **indications** with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a **measurement result** from an indication

Conclusion

$$P = 998{,}4 \pm 0.2 \text{ hPa}$$

Measurand

Value

uncertainty

unit

Conclusion

- Right now, we have the same vocabulary
- So we may start working together.