GULFMET.M.M.K1-2017 comparison on 1 kg mass standards

Project Number: GULFMET.M.M.K1-2017

(GULFMET XXX)

Technical Protocol

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1. Introduction

The proposed comparison, titled GULFMET.M.M.K1-2017 comparison on 1 kg mass standards, is planned to be carried out within at most 16 months period.

1.1 Purpose of Comparison

The aim of the proposed comparison is to demonstrate the measurement capabilities of the National Metrological Institutes (NMIs), to set a ground for the existing or planned calibration measurement capabilities (CMC), to establish a link on 1 kg via the NMIs participating in CCM.M-K4 Key comparison of 1 kg stainless steel mass standards.

This document is prepared in an attempt to

- define the procedures of the comparison,
- provide instructions to the participating laboratories on the transportation of the travelling standards,
- explain the participants how to handle the travelling standards prior to and during the comparisons,
- clarify the method of reporting their measurement results.

1.2 Structure of the comparison

The comparison is organized by GULFMET. UME is assigned to be the Pilot Laboratory for this comparison.

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Table 1. Timetable for the comparisons.

Planned Activity	**Deadline**
Agreement on the Technical Protocol Assessment of the Questionnaire	May 2017
Circulation of travelling standards	Depends on the number of participating NMIs
Acquisition of the measurement results from each participating NMI	within 4 weeks after the concerned laboratory completes its measurements
Analysis of the reported results	within 4 weeks after collecting all the reports
Circulation of Draft A for comments/corrections	4 weeks
Circulation of Draft B for comments /corrections	4 weeks
Final report	4 weeks

The two stainless steel 1 kg travelling mass standards will be provided by the pilot laboratory, UME.

The circulation of the travelling standards will be scheduled in groups such that each group will have three participants. The participating NMIs will have three weeks for comparisons and one week for transporting the travelling standards. Each participant is expected to report their results within four weeks after the completion of their measurements. UME, being the pilot laboratory, will carry out a comparison among these standards before and after the circulation within each group is completed.

KRISS, NPL, METAS will be serving as link laboratories. It is agreed that a better overlap between the CCM and GULFMET key comparisons would be achieved, if these three laboratories make their measurements sequentially. With this exception only, the circulation is arranged so that the transportation distance between any two successive laboratories is kept minimum.

In case of unexpected delays (like custom difficulties and so on), the institute involved must give the details to the pilot laboratory as soon as possible about the cause and expected duration of the delay. If the delay is considered to take very long, the pilot laboratory may reschedule the institute in question by replacing its turn with another one.

Each participant is expected to report its results to the pilot laboratory within 4 weeks after completing the measurements.

1.3. Transfer Standards

The travelling standards are two mass standards with 1 kg nominal value of different density. Each participating NMI is requires to determine the mass value of the two 1 kg stainless steel travelling standards **against their stainless steel standard**(s). The properties of the travelling standards are determined by UME. The stability of the standards will have been regularly monitored by comparison with four stainless steel standards of UME via standard deviation. Linear drifts will be estimated for the travelling standards and will be taken into account while analyzing the results of other institutes. No cleaning procedure will have been carried out.

2. General Measurement Procedure

2.1. Transportation of the travelling standards

The transportation case is aluminium / wooden suitcase. It is the responsibility of the participating laboratory to organize the transportation of the travelling standards to the next NMI - preferably by hand-carrying. When the transport case enters or leaves the country, the appropriate templates (Template 2 & Template 3) will have to be filled in very carefully. Perchance hand-carrying is not possible; a courier or delivery company shall be used. Upon transportation of the weights, the person organizing it should ensure that all necessary customs and importation documents are in order. In cases where the artefacts may have been polluted or damaged, the pilot laboratory and the organizer should be informed as soon as possible and the observation should be documented. In addition, the pilot laboratory and the organizer should be informed if any delay of the time schedule is present.

It is important to note that during comparisons or preparations for transportation the mass standards should only be manipulated with suitable tools and should never be touched with bare hands.

2.2. Measurements to be performed

Each participating institute is required to determine

- the mass value of two travelling standards in air to the best of its ability and their standard uncertainty (k=1),
- the mass difference between 1 kg travelling standards and its associated uncertainty (k=1)..

2.3. Reporting

The templates for reporting the results of measurements, data of the ambient conditions, instruments used and traceability of the reference standards of participating laboratories should be filled out and sent to the pilot laboratory within one month after the measurements are completed.

- Participating NMIs shall determine the mass values of the travelling standards and their associated uncertainties by comparing against their own stainless steel working

standards together with the environmental conditions. The uncertainty must include details of traceability to the International Prototype of the Kilogram. All uncertainties should be reported in accordance with the Guide to the expression of uncertainty in measurements (GUM) using a coverage factor of unity (k = 1). The results are expected to be reported by filling Template 4.

- A complete table of uncertainty budget (including estimated degrees of freedom) is requested. Template 5 will be used for providing the required information.
- Each participant will be responsible for giving the pilot laboratory general information on its calibration abilities. Template 6 and Template 7 will be used for presenting the necessary information.
- Template 8 will be filled by the pilot laboratory.

3. Annexes

3.1. Timetable for the circulation of standards

3.2. Transportation protocols and visual inspection forms

3.3. Calibration results and environmental conditions for participating NMIs

3.4. Uncertainty budget

3.5. Reporting forms such as balances used for calibrations, air density determination

3.6. Description of the measuring room and traceability

3.7. Data determined by the pilot laboratory

3.8. Contents List

3.9. Work Package

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Template 1: Timetable for the circulation of standards

Group	NMI	Date of arrival	Date of departure	Date of initial report
0	**KRISS** **METAS** **NPL**			
1	**UME** **Participant1** **Participant2** **Participant3** **UME**			
2	**UME** **Participant4** **Participant5** **Participant6** **UME**			

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Template 2: Transportation protocol (arrival)

Arrival of the transfer standards:

Date:		From:		To:	

Conditions of the transfer standards on arrival:

Transportation box:	
Surface conditions: (use record sheets)	
Other remarks:	

Contact person of the laboratory:

Name:	
Full mailing address:	
Telephone:	
Telefax:	
e-mail	

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Template 3: Transportation protocol (departure)

Departure of the transfer standards:

Date:		From:		To:	

Conditions of the transfer standards on departure:

Transportation box:	
Surface conditions: (use record sheets)	
Other remarks:	

Contact person of the laboratory:

Name:	
Full mailing address:	
Telephone:	
Telefax:	
e-mail	

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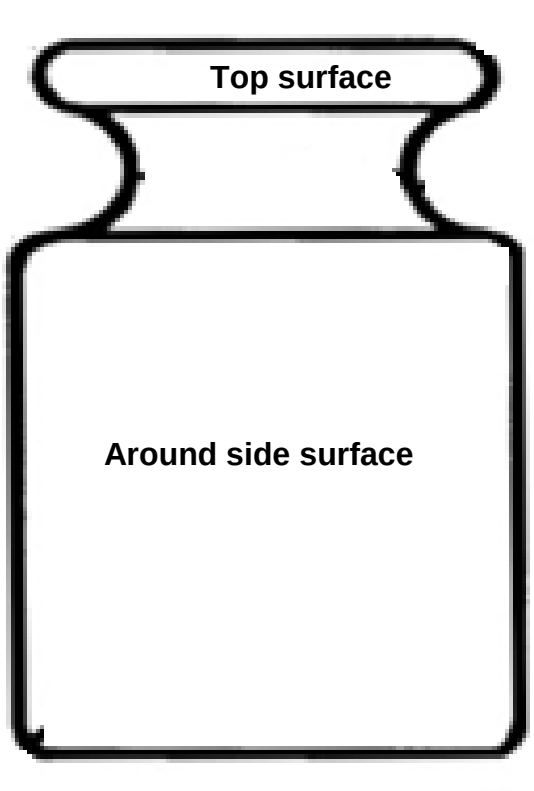
Record of the surface of the transfer standard

Laboratory:		Date:	

1kg_01



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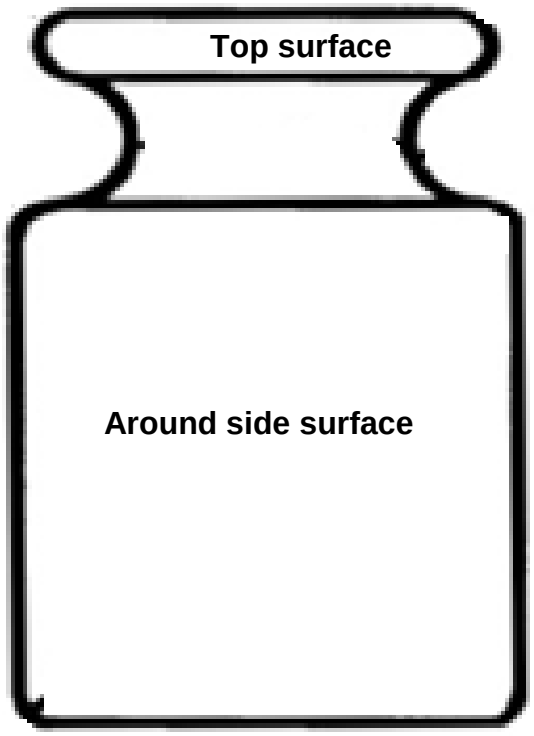
Record of the surface of the transfer standard

Laboratory:		Date:	

1 kg_02



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Template 4: Calibration results and environmental conditions

Laboratory:		Date:	

Mass Values:

Mass ID	Mass value – 1 kg (mg)	standard uncertainty (mg)	number of measurement cycles
1 kg_01			
1 kg_02			

Environmental data during calibration:

Insert the maximum and minimum values of the measured quantities and their uncertainties (1σ), *example: temperature t/^{o}C: 20.6 to 20.4 ± 0.1.*

Mass ID	Temperature (^{0}C)	Pressure (mbar)	Relative Humidity (%)	Dew Point Temperature (^{0}C)	$x(CO_2)$ x10^6	Air density (kg.m^{-3})
1 kg_01						
1 kg_02						

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Template 5: Uncertainty budget

Laboratory:		Date:	

Uncertainty Budget:

The uncertainties shall be estimated and combined following the ISO *Guide to the Expression of Uncertainty in Measurement.*

Uncertainty component*	1kg_01	1kg_02

**(e.g. air density, additional mass, etc)*

Template 6. Details of the balances used for the calibrations

Laboratory:		Date:	

Details of the balances used for the calibrations:

ID	Manufacturer	Type	Maximum load	Resolution	Standard deviation*	Manual/ automatic

***Please indicate the weighing procedure and number of measurements*

Details of the instruments used for air density determination:

	Manufacturer	Type	Range	Resolution	Uncertainty(1σ)
Temperature					
Pressure					
Humidity					
CO_2					

Description of air buoyancy determination:

Template 7. Description of the measuring room

Laboratory:		Date:	

Description of the measuring room:

Mean temperature	
Minimum, maximum temperature	
Maximum change of temperature during 8 hours	
Mean humidity	
Minimum, maximum humidity	

Traceability:

Insert the standards including additional weights used for the calibration and their traceability back to the international prototype of the kilogram.

Mass ID	Mass value – 1 kg (mg)	Mass Uncertainty (mg)	Volume (cm^3)	Volume Uncertainty (cm^3)	Calibration date

Template 8. Data for mass standards determined at the pilot laboratory

Laboratory:		Date:	

Data for mass standards determined at the pilot laboratory:

Mass ID	Density (kg/m^3)	Density Uncertainty (kg/m^3)	Volume (cm^3)	Volume Uncertainty (cm^3)
1 kg_01				
1 kg_02				

Mass ID	Magnetic Susceptibility	Magnetic Susceptibility Uncertainty	Magnetisation (μT)	Magnetization Uncertainty
1 kg_01				
1 kg_02				