TECHNICAL PROTOCOL

Bilateral Comparison of Mass Standards Between TÜBİTAK UME and SASO NMCC

UME-KU-D3-2.4.6.b

TÜBİTAK UME

(Rev. 1)
January 20, 2017

Contents

1. Introduction

It was planned to organise a bilateral comparison on mass calibration between SASO NMCC and TÜBİTAK UME, in the frame of the Project of Development and Realization Measurement and Calibration System for the National Measurement and Calibration Center (NMCC) at Saudi Standards, Metrology and Quality Organization (SASO).

The aim of the comparison" is to compare the results of true mass value and measurement uncertainty to be declared by the SASO NMCC for travelling standards and to evaluate the degrees of equivalence between TÜBİTAK UME and SASO NMCC .The travelling standards are 5 mg, 2 g, 50 g, 1 kg and 5 kg mass standards and are compared usually directly or indirectly by primary mass standards with substitution method. In this way, National Metrology Institutes (NMIs) disseminate the mass unit to calibration laboratories, verification offices or other NMIs.

UME is acting as the pilot institute. The travelling standard will be provided by TÜBİTAK UME. TÜBİTAK UME will be responsible to monitoring standard performance during the circulation and the evaluation and reporting of the comparison results.

2. Travelling Standard

The travelling standards (OIML R 111) are will be used as given below. They were produced by Häfner Gewichte GmbH. The density and the magnetic susceptibility of each mass standard (except for the 5 mg standard) will be determined by the pilot laboratory.

« 5 mg, 2 g, 50 g, 1 kg and 5 kg »

The travelling standards will be supplied by TÜBİTAK UME.

3. Participant Laboratories

The pilot institute for this comparison is TÜBİTAK UME (Turkey). The contact details of the coordinator are given below:

Pilot Institute	**:**	TÜBİTAK Ulusal Metroloji Enstitüsü (UME)
Coordinator	**:**	Sevda KAÇMAZ Tel: +90 262 679 50 00 Fax: +90 262 679 50 01 E-mail: sevda.kacmaz@tubitak.gov.tr

The participating institutes and contact persons with their addresses are given in Table 1.

Table 1. Participants

Country	Institute	Acronym	Shipping Address	Contact Person
Turkey	TÜBİTAK Ulusal Metroloji Enstitüsü	TÜBİTAK UME	TÜBİTAK Ulusal Metroloji Enstitüsü (UME) TÜBİTAK Gebze Yerleşkesi Barış Mah. Dr. Zeki Acar Cad. No:1 41470 Gebze-Kocaeli, TURKEY	Sevda KAÇMAZ sevda.kacmaz@tubitak.gov.tr Tel: +90 262 679 50 00
Saudi Arabia	SASO The National Measurement and Calibration Center	SASO NMCC	Saudi Standards, Metrology and Quality Organization of The Kingdom of Saudi Arabia (SASO) Riyadh 11471, P.O. Box 3437 KINGDOM of SAUDI ARABIA	Mohammad alghamdi ms.ghamdi@saso.gov.sa Tel: +966 55 520 60 42

4. Time Schedule

The time schedule for the comparison is given in the Table 2. The circulation of travelling standard will be organized so that to monitor the performance of the travelling standard.

Each laboratory will have 3 weeks to carry out the measurements and transportation. Any deviation in the agreed plan should be approved by the pilot institute.

Table 2. Circulation Time Schedule

Acronym of Institute	Country	Starting Date	Time for measurement and transportation
TÜBİTAK UME	Turkey	20.01.2017	3 weeks
SASO NMCC	Saudi Arabia	01.02.2017	3 weeks
TÜBİTAK UME	Turkey	12.03.2017	3 weeks

5. Transport Case

For transportation, the travelling standards will be housed in special wooden boxes. The transportation cases will be housed in a large aluminium container. The content of the transport case is given below:

1. 5 mg mass standard (1 piece)
2. 2 g mass standard (1 piece)
3. 50 g mass standard (1 piece)
4. 1 kg mass standard (1 piece)
5. 5 kg mass standard (1 piece)
6. Tweezers
7. Gloves
8. Technical protocol

6. Transportation of Travelling Standard

A visual inspection of the surfaces of the standard should be made and the results noted on the measurement report. Every incident during handling of the travelling standards, where the standard may have been polluted or damaged, should be documented and communicated to the pilot laboratory as soon as possible. Also, the pilot laboratory should be informed about any delay or required change of the time schedule. The standard should be stored at a place where it is protected from dust, aerosols and vapours all the time. They are not in the balance, for example in their travelling containers or in a suitable clean environment protected from dust, drafts and vapour. The travelling standards should be handled carefully and only ever with the appropriate tools.

The standards should never be touched with bare hands.

6.1. Failure of Travelling Standard

In case of any damage or malfunction of the travelling standards, the comparison will be carried out after the travelling standard is repaired.

6.2. Financial aspects

Each participant institute is responsible for its own costs for the measurements, transportation of the standards to the next participant, any customs charges as well as any damage that may occur within its country.

The overall costs for the organisation of the comparison are covered by the pilot institute. The pilot institute has no insurance for any loss or damage of the travelling standards

7. Measurement

The participating laboratory shall determine the mass of each standard according their normal calibration procedure. Measurements should be done after an appropriate acclimatization time (as specified in OIML R111 for class E1). Before the mass determination, dust particles should be removed from the surface of the standard by a soft brush**. No further washing should be performed.** All weighing should be performed in air. For the buoyancy correction, the air density should be determined using the laboratory's standard procedure, specified on the annexed form.

8. Measurement Uncertainty

The uncertainty of measurement must be calculated according to the JCGM 100 "Guide to the Expression of Uncertainty in Measurement" [1] for the coverage probability of approximately 95%.

All contributions to the measurement uncertainty should be listed in the report

9. Reporting of Results

The results should be reported and communicated to the pilot institute within 30 days of completing the measurements.

The participant shall report their results using the standard certificate that they would normally issue to a customer.

However, results shall also be reported in the pilot institute, in the format given in Annex 4. The report must contain at least:

- Details of participating institute,
- The date and time of the measurements,
- A detailed description of the method used,
- A detailed description of the balances and the instruments for determining air density value.
- The environmental conditions during the measurements,
- Description of the measuring room,
- Description of the measurement standards as reference standards used
- Results of measurement

10. Final Report of the Comparison

The pilot institute is responsible for the preparation of a comparison report.

The draft version of the comparison report will be issued within two months after receiving the participant report by the pilot institute. Draft report will be sent to the SASO NMCC for discussion and approval. This draft will be confidential to the participants.

The participant will have one week to send their comments on Draft Report. After approval, Draft Report will become the Final Report. The Final Report will form the basis for the publication of results.

11. References

[1] Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement (GUM), JCGM 100, First edition, September 2008 (available on the BIPM website: http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf)

Annex 1: Receiving-The-Standard Form

(Send this form to the pilot institute as soon as you have received the standards)

Arrival Date & Time		
Is the Transport case damaged?	Yes ☐	No ☐
	Comments:	
Is the surface of standard damaged?	Yes ☐	No ☐
	Comments:	
Other remarks:		

The transport case was received by:

(Please fill in your contact information)

Institute	
Contact Person	
Shipping Address	
E-mail Address	
Telephone No	
Fax No	

Annex 2: The Dispatch Form

(Send this form to the pilot institute as soon as the standard is shipped.)

The dispatch date of transport case	Date:_____Time:_____
The travelling standards are in good condition?	Yes ☐ No ☐
Means of transport	Airplane ☐ Other :_____
Shipping way **(Courier, in hand etc.)**	Courier Name: Tracking No: Airline: Flight No:
Shipping to **(Participant Name & Address)**	
Comments on shipment	

The transport case was dispatch by:
(Please fill in your contact information)

Institute	
Contact Person	
E-mail Address	
Telephone No	

Annex 3: Density of Mass Standards

Densities of each mass standard, determined by pilot laboratory are given below:

Mass Standard	Density ρ	Standard Uncertainty u_ρ
5 mg		
2 g		
50 g		
1 kg		
5 kg		

Annex 4: Participant Report

1. PARTICIPANT INFORMATION

Laboratory Name	
Contact Person	
Telephone No	
Fax No	
E-mail	
Address	

2. MEASUREMENT DATE

3. ENVIRONMENTAL CONDITIONS

Insert the maximum and minimum values of the measured quantities and their uncertainties (k=1), example: temperature *t:* 20.4 °C to 20.8 °C ± 0.2 °C.

Nominal Value	Temperature t (°C)	Pressure P (mbar)	Relative Humidity H (%rh)	Dew Point Temperature t_r (°C)	$x(CO_2)$ (10^6)	Air density ρ_a (kg·m^{-3})
5 kg						
1 kg						
50 g						
2 g						
5 mg						

4. REFERENCES USED IN MEASUREMENTS

Details of the balances used for the measurements

Standards	Manufacturer	Type	Maximum Load	Resolution	Standard Deviation*	Manual/ Automatic
5 kg						
1 kg						
50 g						
2 g						
5 mg						

*Please indicate the weighing procedure and number of measurements

Details of the instruments used for air density determination

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

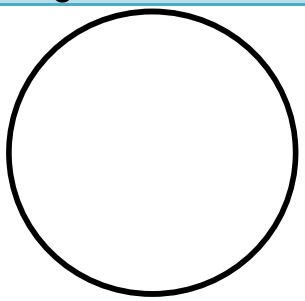
5. DESCRIPTION OF AIR BUOYANCY DETERMINATION

6. DESCRIPTION OF THE MEASURING ROOM

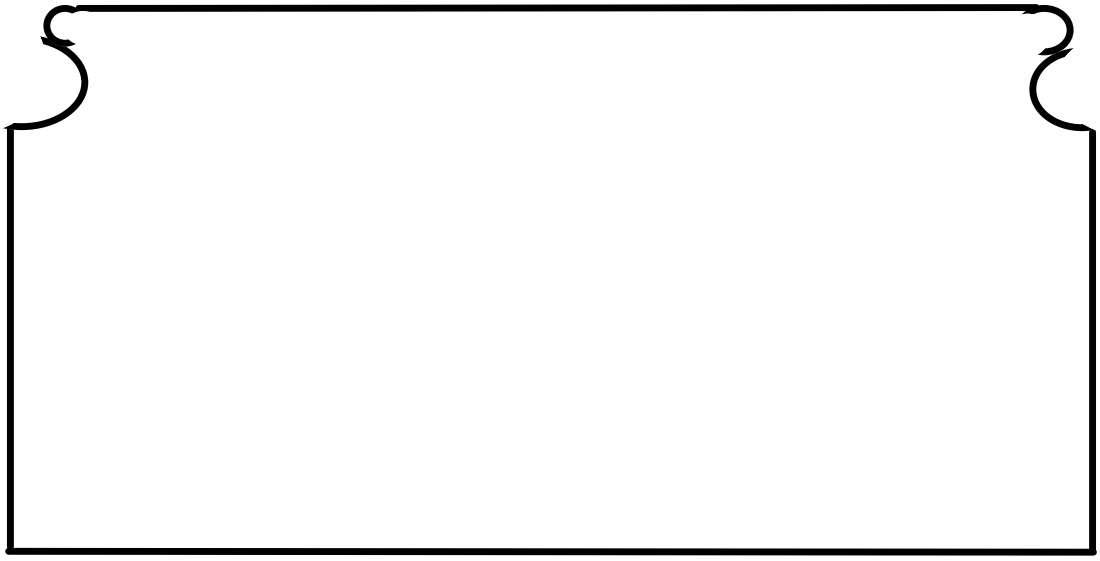
Mean temperature	
Minimum, maximum temperature	
Maximum change of temperature during 8 hours	
Mean humidity	
Minimum, maximum humidity	

7. RECORDS OF THE SURFACE OF THE TRAVELLING STANDARD

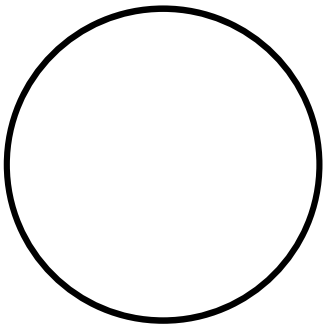
5 kg Mass Standard



Top surface



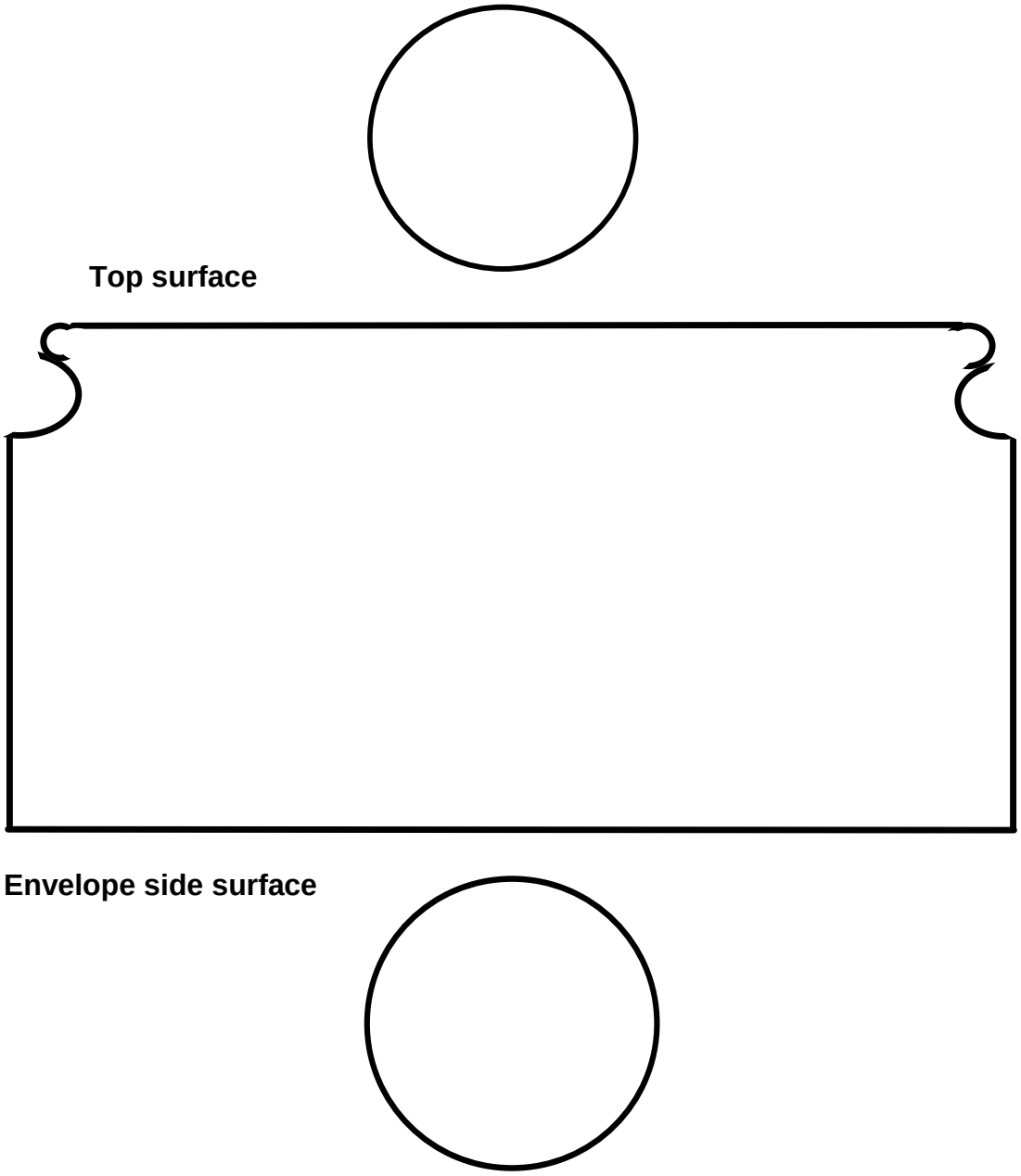
Envelope side surface



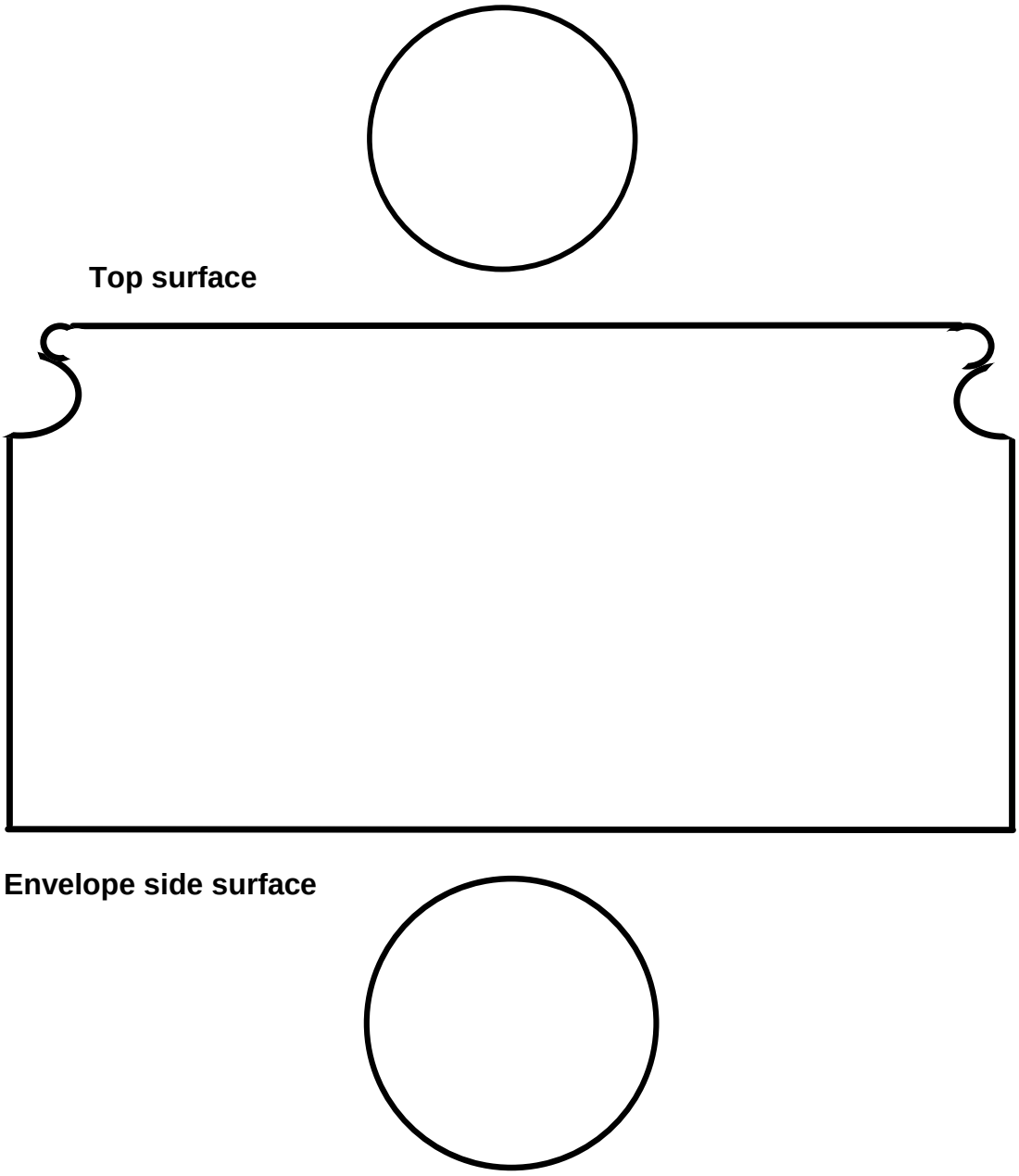
Base surface

1 kg Mass Standard

Standard



50 g Mass Standard

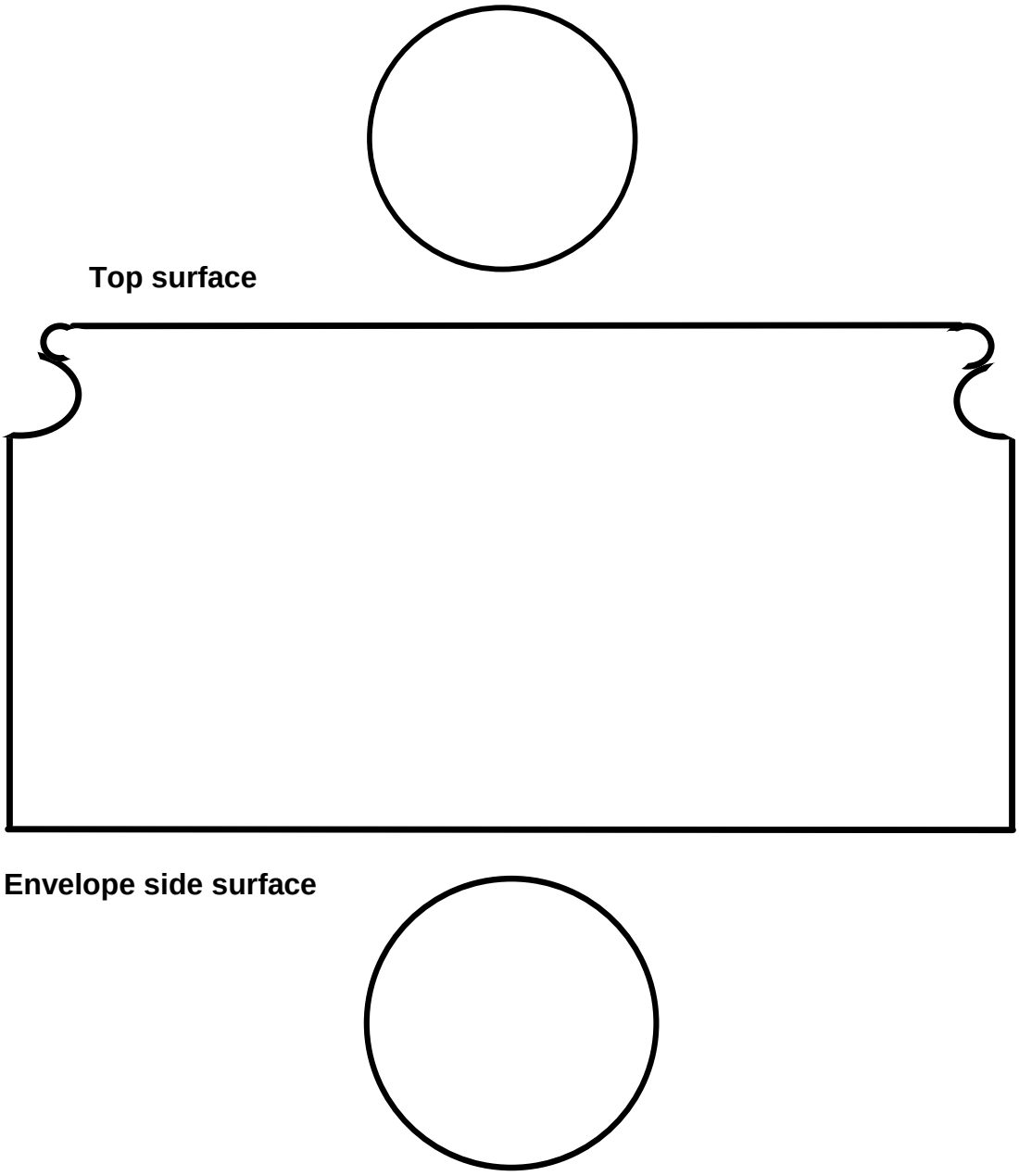


Top surface

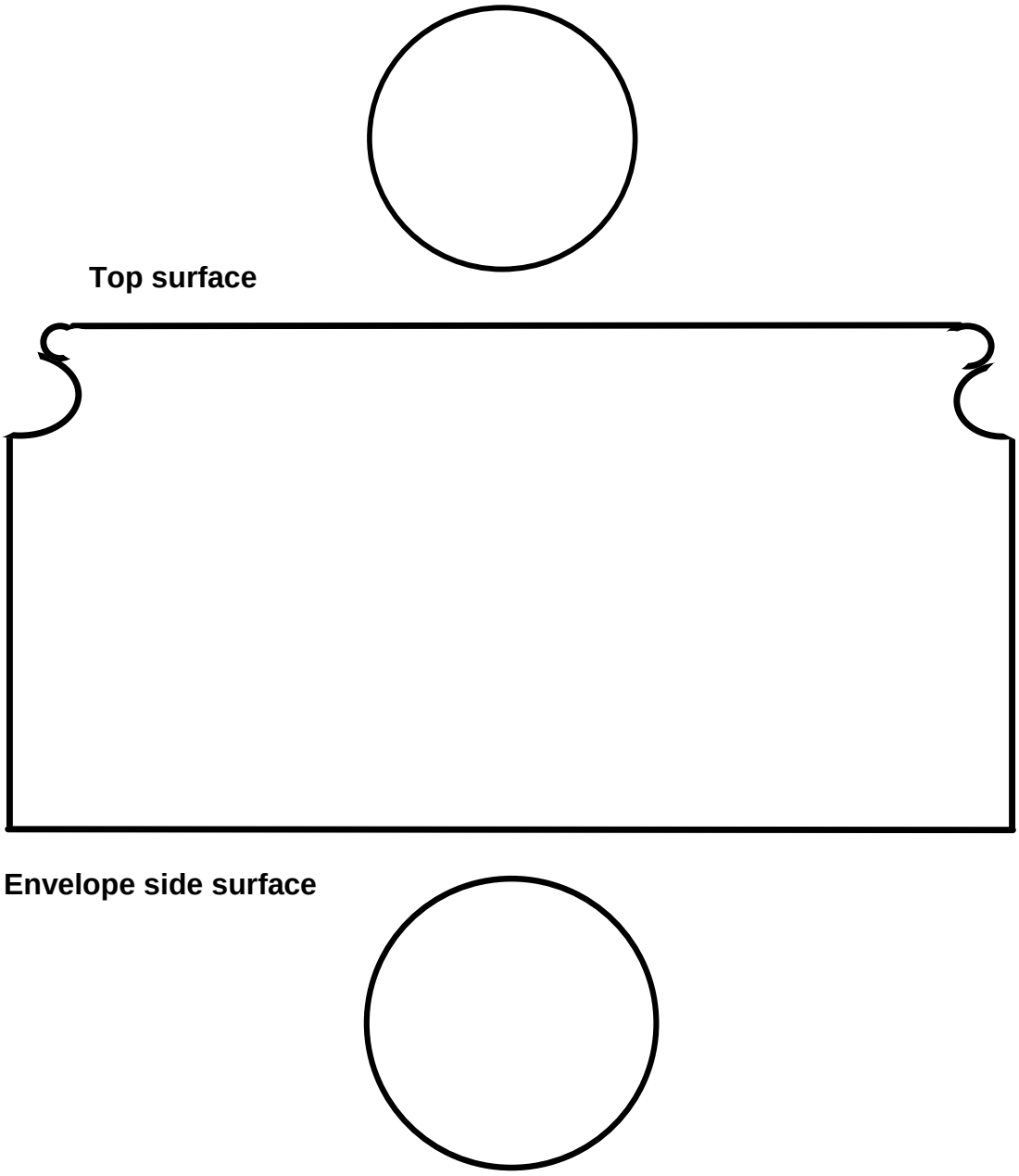
Envelope side surface

Base surface

2 g Mass Standard



5 mg Mass Standard



8. COMPARISON RESULTS

Nominal Value	Mass m	Standard Uncertainty u_c	No. of measurement cycles*
5 kg			
1 kg			
50 g			
2 g			
5 mg			

* If the calibration was made by other procedures than one-to-one comparison (e.g. subdivision using a system of weighing equations), give the degrees of freedom of this procedure.

9. UNCERTAINTY BUDGET

The uncertainties shall be estimated considering the JCGM 100 “Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement (GUM)” [2].

Uncertainty Component*	(Standard) Uncertainty Contributions / mg				
	5 kg	1 kg	50 g	2 g	5 mg

* Air density, additional weights, etc.