EURAMET Project 1300:
Comparison of 500 kg mass standard
EURAMET.M.M-S7

Technical protocol

June 2017

Contents

1. Objectives

The technical protocol specifies the conditions of a comparison of a 500 kg mass standard between several EURAMET NMIs. The objectives of the comparison are to facilitate the demonstration of metrological equivalence between the participating national laboratories and to check or improve the capabilities of quoted calibration measurement capabilities (CMC) at 500 kg.

2. Participants

A pilot laboratory for the comparison is Metrology Institute of the Republic of Slovenia (MIRS). A total number of participants in the comparison is 21. **A list of participants with their contact data is given in Annex 1**. On the list the following information is given for each participant:

1	Institute name
2	Contact person
3	Phone
4	Email
5	Address for delivery of the transfer standard
6	(For non-EU countries only) Is ATA Carnet necessary and accepted?

3. Transfer standard

The transfer standard for the comparison is a stainless steel cylindrical weight with nominal mass 500 kg provided by CMI. The density of the standard is 7888,2 kg/m^3, associated uncertainty (k=2) is 1,5 kg/m^3. Producer: ZDAS. Serial number: 1. Dimensions: diameter 60 cm, height 25 cm

Stability check of the transfer standard will be performed by CMI at the beginning, two times during and at the end of the circulation schedule (see Section 4 for details).
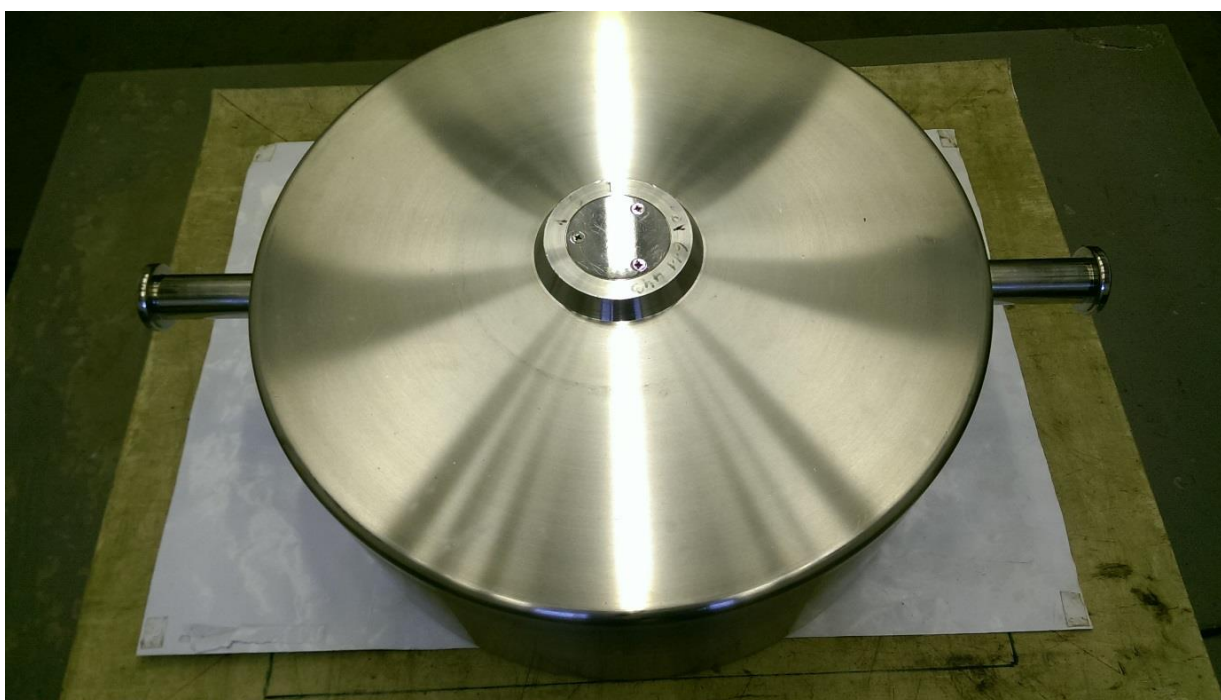
Figure 1: Transportation box

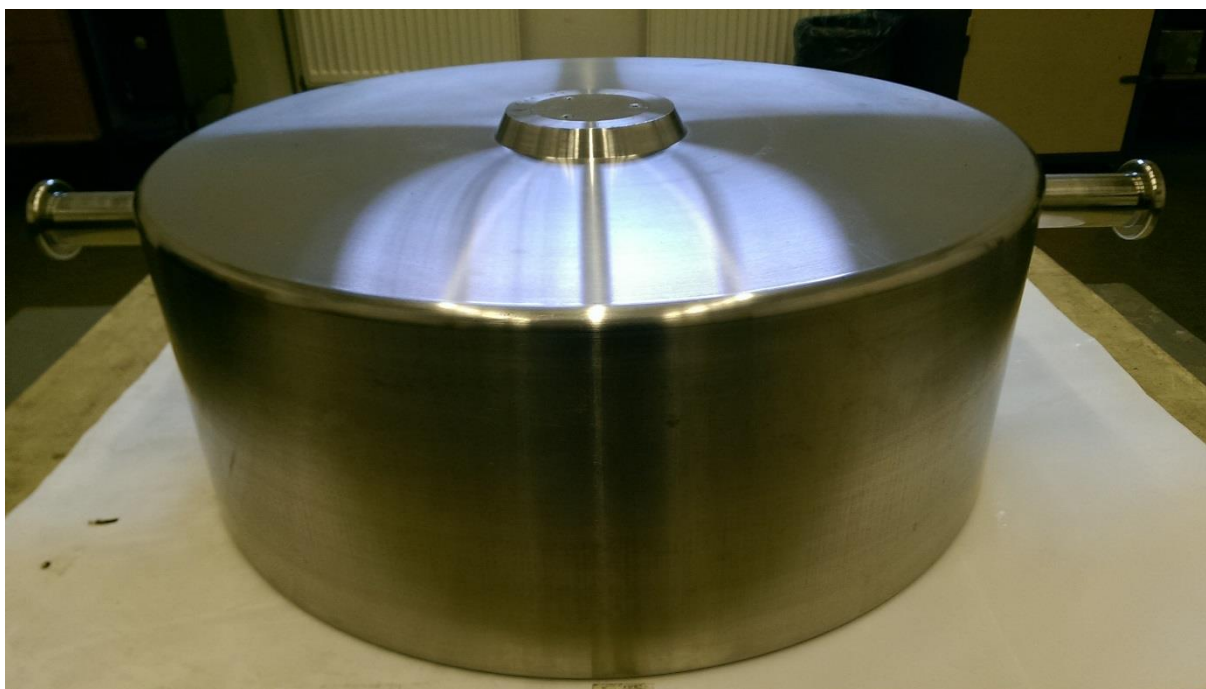Figure 2: Transfer standard - top view.

Figure 3: Transfer standard - side view.

4. Time schedule

The transfer standard will circulate between participants according to the following list. **The complete contact data of all participants are given in Annex 1**.

NMI	Country	Responsible	Date
CMI	Czech Republic	Jaroslav Zůda	June 2017
GUM	Poland	Wojciech Wiśniewski	July 2017
LATMB	Latvia	Tatjana Žandarova	August 2017
Metrosert	Estonia	Allar Pärn	September 2017
MIKES	Finland	Sauli Kilponen	October 2017
RISE	Sweden	Bengt Gutfelt	November 2017
Justervesenet	Norway	Henning Kolbjørnsen	December 2017
CMI	Czech Republic	Jaroslav Zůda	January 2018
BEV	Austria	Zoltan Zelenka	February 2018
MIRS	Slovenia	Goran Grgić	March 2018
METAS	Switzerland	Christian Wüthrich	April 2018
PTB	Germany	Michael Borys	May 2018
NMRO	United Kingdom	Mannie Panesar	June 2018
IPQ	Portugal	Pedro Conceição	July 2018
SMD	Belgium	Mieke Coenegrachts	August 2018
CMI	Czech Republic	Jaroslav Zůda	September 2018
BFKH	Hungary	Csilla Vámossy	October 2018
IMBIH	Bosnia and Herzegovina	Sejla Alisić / Azmir Alić	November 2018
MBM	Montenegro	Goran Vukoslavović	December 2018
DMDM	Serbia	Predrag Djurić	January 2019
BOM	Macedonia	Bianka Mangutova-Stoilkovska	February 2019
BIM	Bulgaria	Mariana Miteva	March 2019

| **INM** | Romania | George Florian Popa | April 2019 |
| **CMI** | Czech Republic | Jaroslav Zůda | May 2019 |

5. Transportation and costs

The transfer standard is housed in a metal container on a wooden pallet.

It is the responsibility of the participating laboratories to organize the transport to the next participant. The standard is accompanied by an ATA Carnet which is provided by CMI. The cost of the ATA carnet, will be divided between participating laboratories signatory of this agreement.

The transfer standard should be transported personally or by well-known courier company between the participating laboratories. Such companies are also used to handle ATA Carnet, which is need in some countries. Responsibility for complying with customs regulations rests with the participants. The value of the transfer standard for insurance purposes is: 4.100 €.

Each participating laboratories is responsible for its own costs of measurements, transportation to the next laboratory and any extra customs charges, as well as any damage caused on the travelling standard during the permanence at the laboratory facilities.

The transfer standard shall be insured when courier company is used for transportation to the next participating laboratory.

In case of total equipment lost, the comparison will be interrupted and the report will be developed based on the results collect until that moment.

6. Receipt, unpacking, handling and care of the standard

When the standard arrives at the participating laboratory, the transportation container and its contents should be checked for damage. A visual inspection of the surfaces of the standard should be made and the results noted on the measurement report. **The pilot laboratory should be informed about the arrival and departure time and about the result of the visual inspection as soon as possible by email using the reception form (Annex 2) and the departure form (Annex 3).**

Every incident during handling of the transfer standard, 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. If the weight is placed on a table, the table surface should be clean and covered by acid free tissue paper.

The transfer standard should be handled carefully and only ever with the appropriate tools. When being manipulated the weight should be handled by the lifting ring. The standard should never be touched with bare hands.

7. Measurements

The participating laboratories shall determine the conventional mass of the standard according their normal calibration procedure. An appropriate time should be allowed for the stabilisation of the weight following transportation. For the buoyancy correction, the air density should be determined using the laboratory's standard procedure.

8. Reporting

A completed measurement report (Annex 4) for the measurement results, data of the ambient conditions, instruments used and traceability of the participant's reference standards must be submitted to the pilot laboratory within two weeks after the completion of the measurements.

In the report, each laboratory has to describe the uncertainty components in order that each laboratory results can be compared on a common basis. Both values, i.e. standard uncertainty and expanded uncertainty shall be stated, along with the relevant coverage factor k.

For the evaluation of the measurement uncertainty, reference should be made to the Guide to the Expression of Uncertainty in Measurement [1].

The pilot laboratory will make the data analysis. First draft of the comparison report will be provided within eight weeks after the receipt of the final results for the data analysis.

9. Determination of the reference value

To determine the reference value the formula of the weighted mean will be used, using the inverses of the squares of the associated standard uncertainty as the weights [2]:

$$m_{ref} = \frac{m_1/u^2(m_1) + \ldots + m_n/u^2(m_n)}{1/u^2(m_1) + \ldots + 1/u^2(m_n)}$$

To determine the standard deviation $u(m_{ref})$ associated with m_{ref}:

$$u(m_{ref}) = \sqrt{\frac{1}{1/u^2(m_1) + \ldots + 1/u^2(m_n)}}$$

The mass difference of the reference value and each participant will be calculated from

$$\Delta m_i = m_i - m_{ref}$$

The uncertainty of the difference between the reference value and a participant's measurement $u_{\Delta m_i}$ will be generally made up of the following components:
- The uncertainty of the participant's measurement, $u(m_i)$
- The uncertainty due to the drift or instability of the transfer standard, $u(m_d)$
- The uncertainty of the reference value, $u(m_{ref})$

If a drift of the transfer standard is observed by CMI between their four measurements, a linear drift model is expected to be used.

For consistency check of the results obtained and detection of the possible outliers the procedures described in [2] will be used.

References

1. JCGM 100:2008, Evaluation of measurement data – Guide to the expression of uncertainty in measurement

2. M.G. Cox, The evaluation of key comparison data, Metrologia, 2002, Vol. 39, 589-595.

Annexes

Annex 1: List of participants with contact data
Annex 2: Reception form
Annex 3: Departure form
Annex 4: Measurement Report