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## Letter to the Editor

# Adjustment of the photometric standards maintained at the BIPM

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**Abstract.** The photometric standards for luminous intensity and luminous flux held at the Bureau International des Poids et Mesures (BIPM) consist of two groups of lamps. The values ascribed to these standards are derived from the mean values of the most recent international comparisons of national photometric standards. Following the recent key comparisons organized under the auspices of the Consultative Committee for Photometry and Radiometry (CCPR), CCPR-K3.a for luminous intensity and CCPR-K4 for luminous flux, the International Committee for Weights and Measures (CIPM) decided in 2001 that the values ascribed to the BIPM standards should be adjusted to bring them into agreement with the reference values of these comparisons.

### 1. Introduction

Historically, the photometric units of the BIPM for luminous intensity and luminous flux are maintained by two groups of lamps representing the mean values of the most recent international comparisons. These mean values are assumed to be close, if not the closest, representations of the corresponding SI units. Following the comparisons, the maintained units were adjusted to bring them into agreement with the mean of the comparison. The last adjustment was made in 1986. At that time, the values attributed to the luminous intensity lamps (based on a comparison in 1961) were increased by 1 %, and those attributed to the luminous flux lamps (based on a comparison in 1952) were decreased by 0.7 %. The comparisons carried out in 1997/98 in the framework of the Mutual Recognition Arrangement (MRA), CCPR-K3.a and CCPR-K4 [1], once again offer the possibility of comparing the units maintained at the BIPM with the rest of the world. Following these comparisons, an additional transfer of the key comparison reference value (KCRV) from the pilot laboratory (Physikalisch-Technische Bundesanstalt, Germany) to the BIPM was made to provide a more robust link.

### 2. Luminous intensity standards

The BIPM participated with six Osram Wi41/G lamps in the key comparison for luminous intensity. These lamps

were calibrated directly against the group of lamps conserving the 1986 mean value. During the comparison at the pilot laboratory (PTB) it was found that the values attributed to these lamps were in relative terms 0.003 larger than those based on the reference value of the comparison. The uncertainty of this deviation is 0.0004.

Following the key comparison, a bilateral comparison was made with the PTB to transfer the KCRV to the BIPM. Six lamps belonging to the PTB were calibrated in terms of the reference value and brought to the BIPM. The relative difference between their values based on the BIPM maintained units and the KCRV was 0.0028, which agrees very well with the result of the key comparison.

Based on these results, the CCPR proposed an adjustment of the BIPM maintained units of luminous intensity of 0.3 %, which was accepted by the CIPM in 2001.

### 3. Luminous flux standards

The BIPM participated in the key comparison of luminous flux with seven lamps of two different types (Osram Globe and Polaron). The relative difference between the calibrations made at the BIPM and that based on the KCRV was determined as 0.0032. The results were very uniform within each group of lamps, but there was a systematic relative difference of 0.003 between results for the Osram and the Polaron lamps.

Following the key comparison, a bilateral comparison with the PTB was held to give a robust link between the KCRV and the BIPM maintained units. The relative difference found with eight lamps was 0.0040. The

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relative difference between the results obtained with Polaron and Osram lamps was 0.0017. The uncertainty of the difference between the units maintained at the BIPM and the KCRV is 0.0026.

Based on these results, the CCPR recommended an adjustment of the units maintained at the BIPM of 0.36 %, which was accepted by the CIPM in 2001.

#### 4. CCPR Recommendation

Based on these results, the CIPM at its 90th Meeting in 2001 approved the CCPR's Recommendation P 1 (2001), that:

- the BIPM continue, as in the past, to maintain and disseminate realizations of the photometric units of the SI representing the means deduced from comparisons;
- the values attributed to the standards maintained by the BIPM as representing the candela and the lumen be reduced, with effect from 1st January 2002, by 0.30 % and 0.36 % respectively, so as to conserve and disseminate the reference values of the relevant key comparisons;
- these adjustments be published.

The full text of the Recommendation may be found in [2]. As a consequence, the value for a given luminous intensity lamp sent to the BIPM for calibration will

now be 0.30 % lower than before 1 January 2002. For a given luminous flux lamp, the calibration result will now be 0.36 % lower than before.

#### 5. Conclusions

The last adjustment of the BIPM scales in 1986 was made with the aim of good compatibility of luminous flux and luminous intensity units. It is satisfactory to find very similar differences between the maintained BIPM scales and the new KCRVs for both quantities, because in most laboratories the luminous flux unit is derived from the luminous intensity unit. Additionally, the adjustments are much smaller than those made in 1985 and than the standard uncertainties of 0.5 % for a calibration at the BIPM in luminous flux or luminous intensity units.

#### References

1. Sauter G., Lindner D., Lindemann M., *CCPR key comparisons K3a of luminous intensity and K4 of luminous flux with lamps as transfer standards*, PTB-Opt-62, Braunschweig, 1999.
2. *BIPM Proc.-Verb. Com. Int. Poids et Mesures*, 90th Meeting (2001), 2002, **69**.

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