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Bilateral Comparison of 1 Ω Resistance Standards between the CMI, Prague, Czech Republic and the BIPM, June 1998

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Comparisons of the reference standards of resistance of the BIPM and the Czech Metrology Institute were carried out at 1 Ω. Two 1 Ω standard resistors were brought from the CMI to the BIPM and measured from 6 June to 22 June 1998. The BIPM values are referenced to R_{K-90} realized with the BIPM quantum Hall resistance standard via a group of reference resistors. The type B uncertainty for this step is 1.5 parts in 10^8. The CMI values are referenced to R_{K-90} via extrapolation from the results of previous calibrations at the BIPM.

Table 1 lists the results of the comparison at 1 Ω. Details of the CMI values and uncertainties are contained in CMI Certificates Nos 111-CC-018/98 and 111-CC-019/98 dated 4 May 1998 and Nos. 111-CC-031/98 and 111-CC-032/98 dated 20 July 1998. Details of the BIPM results are reported on Calibration Certificates numbers 20 and 21 of 26 June 1998. The final result is calculated from the mean of the results obtained from the two travelling standards. From usual uncertainty propagation analysis, the type A variance of this value is the sum of the type A variances of the travelling standards divided by the square of the number of travelling standards. The total variance of the result is the sum of (1) the type A variance, (2) the type B variances and (3) the variance deduced from the transfer uncertainty.

The final results of the 1 Ω comparison are presented as the difference between the value assigned to a 1 Ω standard by the CMI, r_{CMI} and that assigned by the BIPM, r_{BIPM} on the reference date. This gives

$$r_{CMI} - r_{BIPM} = 0.11\ \mu\Omega; \qquad u_c = 0.10\ \mu\Omega, \text{ on } 1998/06/12,$$

where u_c is the combined type A and type B standard (1-σ) uncertainty from both laboratories.

The results of these comparisons are satisfactory in that the agreement between values assigned by the two laboratories falls within about one standard deviation. The behavior of the travelling standards was excellent. On the basis of this comparison, the CMI should consider readjusting its reference standard to bring the results into agreement.

Table 1. Results of the comparison at 1 Ω with standard uncertainties.

	64 185	64 184	
Mean date (yy/mm/dd)	98/6/12	98/6/12	
CMI value, R_{CMI} / Ω	0.999 997 622	0.999 998 041	
CMI relative uncorrelated unc. (A&B) × 10^6	0.118	0.118	g_1, g_2 See note a.
CMI relative correlated unc. (B) × 10^6	0.060	0.060	q
CMI relative unc. (A&B) × 10^6	0.150	0.150	s
BI value, R_{BI} / Ω	0.999 997 482	0.999 997 912	
BI relative unc. (A) × 10^6	0.000 4	0.000 3	h_1, h_2
BI relative unc. (B) × 10^6	0.015	0.015	v
BI relative unc. (A&B) × 10^6	0.015	0.015	
$[(R_{CMI}-R_{BI})/R] \times 10^6$	0.122	0.111	
Mean $[(R_{CMI}-R_{BI})/R] \times 10^6$	0.116		
Rel. unc. of transfer × 10^6	0.005		x See note b.
Total unc. of comparison × 10^6	.104		See note c.

Note a. This is calculated by applying elementary uncertainty propagation to a simple interpolation of the CMI results to the mean date of the BIPM measurements.
Note b. This is the standard deviation of the mean of the two results, one from each travelling standard.
Note c. The total uncertainty of the comparison is calculated from

$$u_c = \sqrt{x^2 + q^2 + \left(\frac{(g^2{}_1 + g^2{}_2)}{2^2}\right) + v^2 + \left(\frac{(h^2{}_1 + h^2{}_2)}{2^2}\right)}$$

This assumes correlation between the type B components of the CMI uncertainty due to the extrapolation of previous calibration results to the measurement mean date.