

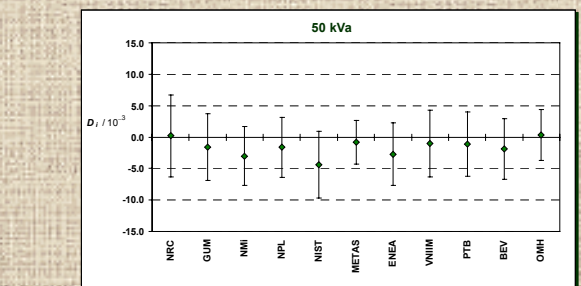
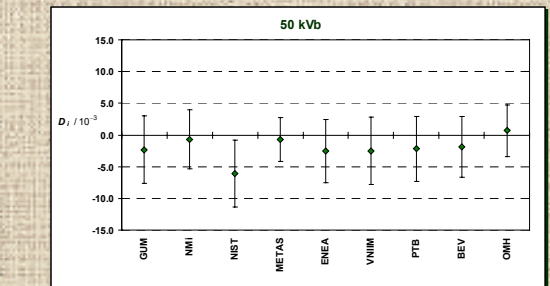
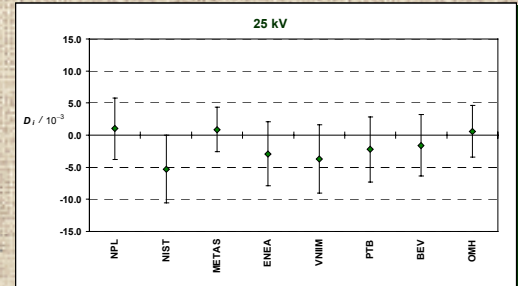
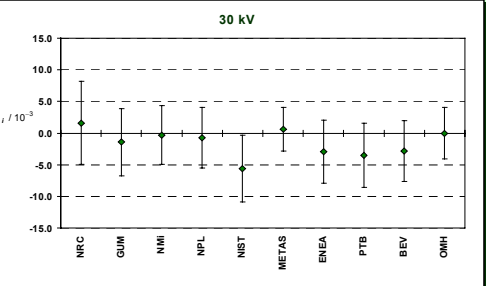
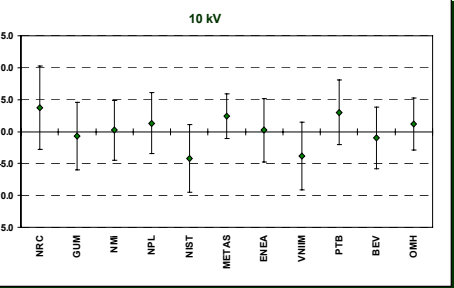
Degrees of equivalence between national primary standards for low- and medium-energy x-rays

Low-energy x-rays

BIPM key comparisons in the range from 10 kV to 50 kV, referenced as BIPM.RI(I)-K2, have been carried out on an ongoing basis since 1966. The comparisons are usually direct, the national standard being transported to the BIPM.



The results of comparisons are expressed as the ratio x_i of the air-kerma rate determination of laboratory i to that of the BIPM, and the combined standard uncertainty u_i of this ratio. Comparisons are carried out at five reference radiation qualities. The degrees of equivalence D_i (with expanded uncertainties U_i) arising from these comparisons are shown to the left. (*Metrologia* 40, Technical Supplement 2003, 06031)



Degrees of equivalence

The degree of equivalence D_i is defined as the difference $x_i - x_R$ between the BIPM comparison result x_i for laboratory i (with combined standard uncertainty u_i) and the key comparison reference value x_R .

Following a decision of the CCRI(I), the BIPM determination of the air-kerma rate is taken as the basis of the reference value. It follows that $x_R = 1$.

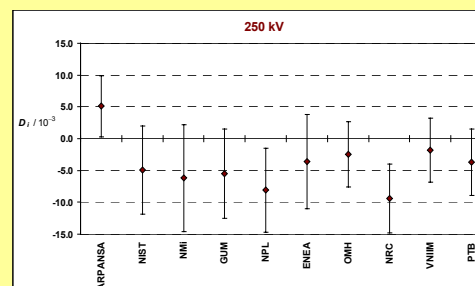
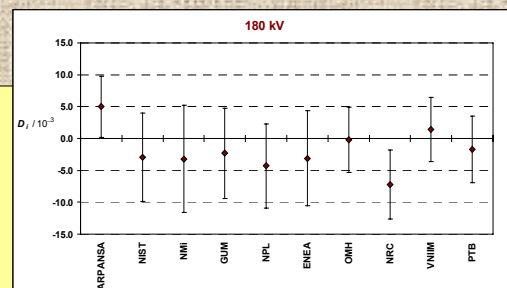
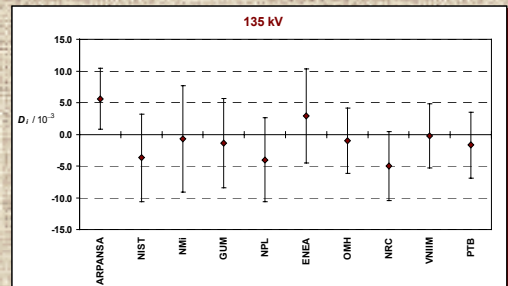
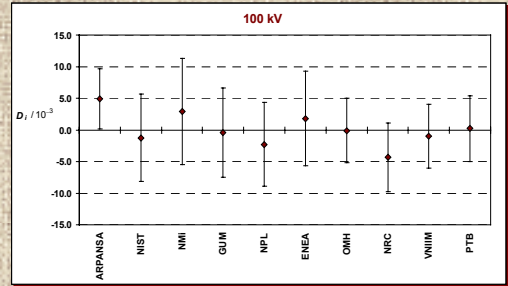
The expanded uncertainty of D_i is $U_i = 2 u_i$ (i.e. a coverage factor $k = 2$ is applied).

The degree of equivalence D_{ij} is defined as the difference $x_i - x_j$ between the comparison results for laboratories i and j . The uncertainty $U_{ij} = 2 u_{ij}$ takes into account correlations between the two standards.

Lab j →

Lab i ↓	$D_i, U_i / 10^{-3}$		ARPANSA		NIST		NMI		GUM		NPL		ENEA		OMH		NRC		VNIM		PTB		
	D_i	U_i	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	
ARPANSA	4.9	4.8	-	-	6.2	7.7	2.0	8.1	5.3	6.5	7.2	6.3	3.1	7.1	5.0	6.7	9.2	5.2	5.9	4.6	4.7	-	-
NIST	-1.3	6.9	-6.2	7.7	-	-	-4.2	10.3	-0.9	9.3	1.0	8.9	-3.1	9.6	-1.2	7.9	3.0	8.1	-0.3	7.8	-1.5	-	-
NMI	2.9	8.4	-2.0	8.1	4.2	10.3	-	-	-3.3	9.4	5.2	9.3	1.1	9.9	3.0	9.6	7.2	8.5	3.9	8.2	2.7	-	-
GUM	-0.4	7.1	-5.3	6.5	0.9	9.3	-3.3	9.4	-	-	-1.9	7.9	-2.2	8.5	-0.3	8.5	3.9	7.0	0.6	6.6	-0.6	-	-
NPL	-2.3	6.6	-7.2	6.3	-1.0	8.9	-5.2	9.3	-1.9	7.9	-	-	-4.1	8.4	-2.2	8.1	2.0	6.8	-1.3	6.4	-2.5	-	-
ENEA	1.8	7.4	-3.1	7.1	3.1	9.6	-1.1	9.9	2.2	8.5	4.1	8.4	-	-	1.9	8.8	6.1	7.6	2.8	7.2	1.6	-	-
OMH	-0.1	5.1	-5.0	6.7	1.2	7.9	-3.0	9.6	0.3	8.5	2.2	8.1	-1.9	8.8	-	-	4.2	7.2	0.9	6.9	-0.3	-	-
NRC	-4.3	5.4	-9.2	5.2	-3.0	8.1	-7.2	8.5	-3.9	7.0	-2.0	6.8	-6.1	7.6	-4.2	7.2	-	-	-3.3	5.3	-4.5	-	-
VNIM	-1.0	5.0	-5.9	4.6	0.3	7.8	-3.9	8.2	-0.6	6.6	1.3	6.4	-2.8	7.2	-0.9	6.9	3.3	5.3	-	-	-1.2	-	-
PTB	0.2	5.2	-4.7	6.1	1.5	8.0	-2.7	9.2	0.6	8.1	2.5	7.6	-1.6	8.4	0.3	6.5	4.5	6.7	1.2	6.4	-	-	-

Matrix of degrees of equivalence for the 100 kV radiation quality



Medium-energy x-rays

BIPM key comparisons in the range from 100 kV to 250 kV, referenced as BIPM.RI(I)-K3, have been carried out on an ongoing basis since 1975. The comparisons are indirect, transfer instruments being calibrated at both the BIPM and the national laboratory.



The results of comparisons are expressed as the ratio x_i of the air-kerma calibration coefficients N_K measured at laboratory i and at the BIPM, and the combined standard uncertainty u_i of this ratio. Comparisons are carried out at four reference radiation qualities. The degrees of equivalence D_i (with expanded uncertainties U_i) arising from these comparisons are shown to the right (in press).