**Euromet project 364**

**Comparison of primary air-kerma standards for x-ray qualities used in diagnostic radiology.**

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In 1996 a number of standards laboratories have agreed upon the intercomparison of their primary air kerma standards for a selected set of 17 x-ray qualities used for calibrations in the field of diagnostic radiology. PTB (DE) and BEV (AU) had a set of radiodiagnostic x-ray qualities available and used that set for the intercomparison. The other laboratories BIPM, NPL (UK), ENEA (IT) and NMi (NL) have established x-ray qualities according to the IEC 1267 standard. Not all laboratories were able to produce all radiation qualities described in the project management plan from May 1996. Those laboratories took part in the intercomparison for a limited set of radiation qualities. Two types ionisation chambers were put at the participants disposal as transfer chambers. A Keithley 96020C (150 $cm^3$) and a Keithley 96035B (15 $cm^3$) were used. The report of the comparison was published in April 2000.

The main results of the comparison were:

*Table 1. Calibration factors for the unattenuated x-ray qualities (RQR or equivalent). Ionisation chamber Keithley 96020C (150 $cm^3$) {TE "Table 5. Calibration factors for the unattenuated x-ray qualities (RQR or equivalent). Ionisation chamber Keithley 96020C (150 $cm^3$) " \f D}*

| Radiation quality | NMi $Gy.\mu C^{-1}$ 20EC,101.3 kPa | PTB $Gy.\mu C^{-1}$ 20EC,101.3 kPa | BEV $Gy.\mu C^{-1}$ 20EC,101.3 kPa | NPL $Gy.\mu C^{-1}$ 20EC,101.3 kPa | ENEA $Gy.\mu C^{-1}$ 20EC,101.3 kPa |
|---|---|---|---|---|---|
| RQR3 (50 kV) | 0.1882±0.0028 | 0.1890±0.0025 | 0.1882±0.0021 | 0.1897±0.0029 | 0.1898±0.0030 |
| RQR5 (70 kV) | 0.1857±0.0028 | 0.1872±0.0025 | 0.1865±0.0020 | 0.1872±0.0029 | 0.1871±0.0030 |
| RQR7 (90 kV) | 0.1840±0.0028 | 0.1854±0.0025 | 0.1852±0.0020 | 0.1856±0.0029 | 0.1850±0.0030 |
| RQR9 (120 kV) | 0.1828±0.0027 | 0.1838±0.0025 | 0.1832±0.0020 | 0.1844±0.0028 | 0.1814±0.0029 |
| RQR10 (150 kV) | 0.1814±0.0027 | 0.1827±0.0025 | 0.1821±0.0020 | 0.1825±0.0028 | 0.1801±0.0029 |

*Table 2. Calibration factors for the attenuated x-ray qualities (RQA or equivalent).Ionisation chamber Keithley 96020C (150 $cm^3$) {TE "Table 6. Calibration factors for the attenuated x-ray qualities (RQA or equivalent). Ionisation chamber Keithley 96020C (150 $cm^3$) " \f D}*

| Radiation quality | NMi $Gy.\mu C^{-1}$ 20EC,101.3 kPa | PTB $Gy.\mu C^{-1}$ 20EC,101.3 kPa | BEV $Gy.\mu C^{-1}$ 20EC,101.3 kPa | NPL $Gy.\mu C^{-1}$ 20EC,101.3 kPa | ENEA $Gy.\mu C^{-1}$ 20EC,101.3 kPa |
|---|---|---|---|---|---|
| RQA3 (50 kV) | 0.1854±0.0028 | 0.1868±0.0025 | 0.1859±0.0020 | 0.1858±0.0029 | 0.1795±0.0029 |
| RQA5 (70 kV) | 0.1806±0.0027 | 0.1820±0.0025 | 0.1818±0.0020 | 0.1827±0.0028 | 0.1811±0.0029 |
| RQA7 (90 kV) | 0.1769±0.0027 | 0.1805±0.0025 | 0.1796±0.0020 | 0.1811±0.0028 | 0.1796±0.0029 |
| RQA9 (120 kV) | 0.1759±0.0027 | 0.1790±0.0025 | 0.1785±0.0019 | 0.1802±0.0028 | 0.1808±0.0029 |
| RQA10 (150 kV) | 0.1756±0.0027 | 0.1775±0.0025 | 0.1782±0.0019 | 0.1800±0.0028 | 0.1801±0.0029 |

*Table 3 Calibration factors for the unattenuated x-ray qualities (RQR or equivalent). Ionisation chamber Keithley 96035B (15 $cm^3$ ).*

| Radiation quality | NMi $Gy.\mu C^{-1}$ 20EC, 101,3 kPa | BIPM $Gy.\mu C^{-1}$ 20EC, 101,3 kPa | NPL $Gy.\mu C^{-1}$ 20EC, 101,3 kPa |
|---|---|---|---|
| RQR3 | 1.835±0.027 | 1.820±0.011 | 1.850±0.027 |
| RQR5 | 1.789±0.027 | 1.785±0.011 | 1.803±0.027 |
| RQR7 | 1.759±0.027 | 1.768±0.011 | 1.783±0.027 |
| RQR9 | 1.747±0.027 | 1.747±0.011 | 1.765±0.027 |
| RQR10 | 1.736±0.027 | 1.737±0.011 | 1.751±0.027 |

**{TE "Table 7 Calibration factors for the unattenuated x-ray qualities (RQR or equivalent). Ionisation chamber Keithley 96035B (15 $cm^3$ ). " \f D}**

From the results of this intercomparison, it may be concluded that there is a reasonable agreement in the calibration factor for the IEC 1267 x-ray qualities RQR, RQA or for equivalent x-ray qualities. The diagnostic set of x-ray qualities that was available at PTB (Germany) as well as at BEV (Austria) gave the same calibration factors as the IEC1267-set of the other participating

laboratories. These differences in approach do not introduce additional deviations in the calibration factors given by the various standard laboratories.
The comparison has been published as NMi Report S-TS-2000-10 and can be downloaded from the website of NMi (http://www.nmi.nl).