



Von dem METAS ermächtigte Eichstelle  
Laboratoire de vérification habilité par METAS  
Laboratorio di verificaione autorizzato dal METAS

## Information concerning the verification of well ionisation chambers used for Ir-192 HDR brachytherapy

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### Framework of the verification

The application of the recommendations no 13 from the Swiss Society for Radiobiology and Medical Physics (*Dosimetry and Quality Assurance in High Dose Rate Brachytherapy with Iridium-192*) is mandatory according to the guidelines no L-09-05 from the Swiss Federal Office for Public Health.

These recommendations state that the air kerma strength of the iridium-192 source must be checked by the medical physicist using a well ionisation chamber, and that this instrument must be traceable to a national standard by an authorized verification laboratory.

The verification of the chamber is carried out by the IRA following the general rules of the *Messmittelverordnung / ordonnance sur les instruments de mesure* (15.02.06) and the *Verordnung über Messmittel für ionisierende Strahlung (StMmV) / ordonnance sur les instruments de mesure des rayonnements ionisants (OIMRI)* (7.12.12). The model of instrument must have been approved by METAS.

### Scope of the verification

The performance of the measuring assembly will be checked according to the manufacturer's specifications. Then the chamber will be calibrated in terms of air kerma strength by comparison with the IRA reference system, using the Ir-192 HDR brachytherapy source of the user.

The calibration factor is valid only for the measuring assembly as a whole i.e. well ionisation chamber, electrometer and source holder, used together for the air kerma strength measurement.

### Calibration procedure

The calibration factor in terms of air kerma strength is determined by comparing the measuring assembly to the IRA reference system. The latter is based on a PTW M33004 well ionisation chamber, a PTW Unidos 10001 electrometer, a PTW source holder and a Cs-137 QSA Global CDR562 (9.3 MBq) radioactive check source.

This reference system has been calibrated at the Physikalisch-Technische Bundesanstalt (PTB) by means of an afterloading source calibrated traceably to the PTB primary standards for air kerma.

The air kerma strength is measured successively with the reference system and the system to be verified, on the brachytherapy unit of the user.

The position of maximum ionisation current is checked moving the source along the axis within the catheter. Then the reference air kerma strength is determined with the source in this position.

This procedure is repeated with the system to be verified.

The calibration factor is obtained by the expression:

$$N_{S_k} = \frac{N_{S_k}^{ref} M^{ref}}{M}$$

where

$N_{S_K}$  calibration factor of the system to be verified at 20°C and 1013.25 hPa,

$N_{S_K}^{réf}$  calibration factor of the reference system at 20°C and 1013.25 hPa,

$M$  net indication of the system to be verified integrated on a given time duration and corrected for the air density at 20°C and 1013.25 hPa,

$M^{réf}$  net indication of the reference system for the same integration time and corrected for the air density at 20°C and 1013.25 hPa.

The value of the applied high voltage, the model of source holder and the ambient conditions during the calibration measurements are recorded.

The air kerma strength produced by an Ir-192 brachytherapy source is around 0.01 to 0.05 Gy·m<sup>2</sup>·h<sup>-1</sup>.

### Stability check

The use of a radioactive check source to assure the dosimeter stability is **mandatory**. According to the METAS rules, this source **is part of the measuring system**.

The indication obtained with the check source is determined before and after the calibration measurements. The mean value is indicated on the verification certificate.

### Interpretation of the calibration factor

The relation between air kerma strength, calibration factor and dosimeter indication is:

$$S_K = N_{S_K} \cdot M$$

where

$S_K$  air kerma strength in Gy·m<sup>2</sup>·h<sup>-1</sup>,

$N_{S_K}$  calibration factor in Gy·m<sup>2</sup>·h<sup>-1</sup>·A<sup>-1</sup> at 20°C and 1013.25 hPa,

$M$  dosimeter indication in A, corrected for the air density at 20°C and 1013.25 hPa.  $M$  is determined from the charge accumulated on a given time duration and converted in terms of current.

### Calibration uncertainty

The typical calibration uncertainty is 2.7% at the 95% confidence level.

### Validity

The validity of the verification is 4 years. If the stability checks do not stay within the 0.5% tolerance, the verification has to be redone.

### Cost of the verification

The cost of the verification is 1600 CHF.

It is TVA-exempted (legal metrology obligation).

The travel cost from Lausanne to the clinic has to be added (calculated with 0.80 CHF/km and 112 CHF/h).

### Contact persons at IRA

Claude Bailat (021 314 80 65) or Thierry Buchillier (021 314 81 51).