

Risø High Dose Reference Laboratory

**Note on NPL comparison 2015, verification of calibration, electrons
Alanine dosimeter batch AX600**

Irradiation of NPL dosimeters and Risø HDRL dosimeters at a 10 MeV electron accelerator (HDRL-I-48).

The comparison was carried out as a consequence of non-conformance described in corrective action 2014-13 NPL comparison 2014: Preventive action #9: “Make a blind comparison with NPL in 10 MeV e-beam when the next alanine batch is calibrated”.

Irradiation at Sterigenics, Espergærde 2015.02.17.

NPL alanine reference dosimeters: Batch 71, 301-309, in holder type E (standard holder).

HDRL dosimeters: Harwell alanine pellets, batch AX600, 10A, 10B, 10C, 20A, 20B, 20C, 40A, 40B, 40C, in standard holder.

Geometry: Risø HDRL standard absorber for irradiation of dosimeters at electron accelerators. Absorbers were placed in aluminum trays for irradiation at conveyor.

Irradiation data:

| Phantom | NPL dosim. | HDRL pellets | Req. dose | Temp. (start) | Temp. (end) |
|----------------|-------------------|---------------------|------------------|----------------------|--------------------|
| # | 71 | AX600 | [kGy] | [°C] | [°C] |
| 10A | 301 | 10A | 10 | 21.1 | 30.8 |
| 10B | 302 | 10B | 10 | 21.1 | 30.8 |
| 10C | 303 | 10C | 10 | 21.1 | 30.8 |
| 20A | 304 | 20A | 20 | 21.1 | 38.2 |
| 20B | 305 | 20B | 20 | 21.1 | 38.2 |
| 20C | 306 | 20C | 20 | 21.1 | 38.2 |
| 40A | 307 | 40A | 40 | 21.1 | 52.2 |
| 40B | 308 | 40B | 40 | 21.1 | 52.2 |
| 40C | 309 | 40C | 40 | 21.1 | 52.2 |



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Measurements:

Pellets, AX600:

| | | |
|---|-------------|---------------|
| 1 | Measured: | 2015.02.18 |
| | Instrument: | Bruker e-scan |
| 2 | Measured: | 2015.02.27 |
| | Instrument: | Bruker EMX |

Results from pellets measured on e-scan were reported to NPL in certificate 15C-19 (2015.02.19).

NPL certificate for alanine dosimeter measurements: 2015010278/1 and report with summary of results of comparison: 2015010278/1/report, received 2014.04.13.

Results:

1 Pellets measured on e-scan (blind comparison)

Uncertainty associated with NPL transfer dosimeter readings:

$$U(\text{NPL}) = 2.6\% \text{ (k=2)}$$

Uncertainty associated with HDRL dosimeter readings (e-scan). Excluding NPL transfer dosimeter uncertainty:

$$U(\text{HDRL}) = 1.88\% \text{ (k=2)}.$$

| Phantom | NPL Dose | HDRL dose (e-scan) | %Difference | E-value |
|---------|----------|--------------------|-------------|---------|
| # | [kGy] | [kGy] | [%] | k=2 |
| 10A | 9.84 | 9.83 | -0.1 | 0.03 |
| 10B | 9.94 | 9.89 | -0.5 | 0.15 |
| 10C | 9.88 | 9.87 | -0.1 | 0.03 |
| 20A | 19.83 | 19.9 | 0.6 | 0.18 |
| 20B | 20 | 19.8 | -0.8 | 0.26 |
| 20C | 19.79 | 19.7 | -0.2 | 0.08 |
| 40A | 39.9 | 40.2 | 0.8 | 0.25 |
| 40B | 39.8 | 40.1 | 0.6 | 0.20 |
| 40C | 39.6 | 40.0 | 1.0 | 0.30 |
| | | Average | 0.1 | 0.16 |

2 Pellets measured on EMX (not blind comparison)

Uncertainty associated with HDRL dosimeter readings (e-scan). Excluding NPL transfer dosimeter uncertainty:

$$U(\text{HDRL}) = 1.81\% \text{ (k=2)}.$$

| Phantom | NPL Dose | HDRL dose (EMX) | %Difference | E-value |
|---------|----------|-----------------|-------------|---------|
| # | [kGy] | [kGy] | [%] | k=2 |
| 10A | 9.84 | 9.89 | 0.5 | 0.16 |
| 10B | 9.94 | 9.95 | 0.1 | 0.02 |
| 10C | 9.88 | 9.90 | 0.2 | 0.05 |
| 20A | 19.83 | 20.0 | 0.7 | 0.23 |
| 20B | 20 | 19.8 | -0.8 | 0.25 |
| 20C | 19.79 | 19.8 | -0.1 | 0.02 |
| 40A | 39.9 | 40.1 | 0.6 | 0.17 |
| 40B | 39.8 | 39.8 | 0.1 | 0.02 |
| 40C | 39.6 | 39.4 | -0.4 | 0.14 |
| | | Average | 0.1 | 0.12 |



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Comments:

All E-values (both instruments) are less than 1, and the result of the comparison is acceptable.

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