IMPACT OF IEC 61066:2006 STANDARD TESTING TO THE JOINT RESEARCH CENTRE (JRC) DOSIMETRY SYSTEM

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1. INTRODUCTION

The JRC – ISPRA personal thermoluminescent dosimetry (TLD) system was tested according to the requirements of International Standard IEC 61066:2006 to evaluate the quality of the dosimetry system. The Standard is a revision of the first edition published in 1991. The main technical changes include: (a) to specify the use of operational quantities, (b) to harmonise the reference radiation and calibration with ISO Standards, (c) to integrate the basic uncertainty analysis, and (d) to align IEC uncertainty requirements on dosimetry system with those stated in ICRP Publication 75 "General Principles for the Radiation Protection of Workers".

2. OBJECTIVES

International Standard IEC 61066:2006 applies to thermoluminescence dosimetry systems used for measuring the personal and ambient dose equivalents Hp(10), Hp(0,07), and H*(10) for external photon or beta radiation within the dose range from 0,01 mSv to 10 Sv. The aim of the study was carrying out several type tests that are listed in the Standard for whole body dosemeters.

3. METHODS

The JRC-ISPRA Dosimetry System is composed of a transparent plastic outer casing with a Panasonic TLD badge (UD-802A series), a Panasonic UD-716 AGL automatic reader, a computer with appropriate software and algorithm. Two type test categories were performed: (a) radiation performance requirements and tests on the dosimetry system, (b) additivity of the indicated value on the dosimetry system. The category (a) is divided into four tests, namely: (1) coefficient of variation (2) non-linearity response, (3) angular and (4) energy response. For these tests the range was extended, both in terms of linearity (from 0,05 mSv to 1 Sv instead of 0,1 mSv to 1 Sv as requested by the Standard) and in terms of angles of incidence (± 80 degrees instead of ± 60 degrees as requested by the Standard). For category (b) the dosemeters were exposed to different angles of the incident radiation (from 0 to ± 60 degrees). Moreover, for each angle of incidence we simultaneously irradiated the dosemeters with different energy radiations.

4. RESULTS

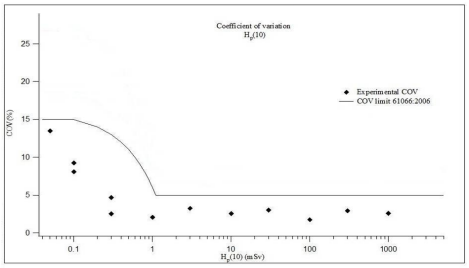

Fig. 1: Coefficient of Variation (COV) type test results: for each tested dose the relative COV of the system fall within the limit (between 5 and 15%) drawn in the IEC.

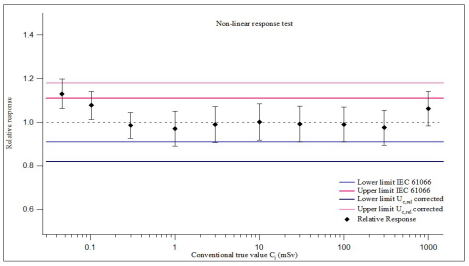

Fig. 2: Non-linearity response test results: all data points in the range of 0.1-1000 mSv (error bars included) fall within the limits given by the IEC corrected by the extended uncertainty (Ue,rel). Only one outlier was found at the dose of 0,05 mSv, however this dose was not provided for the limit of the IEC.

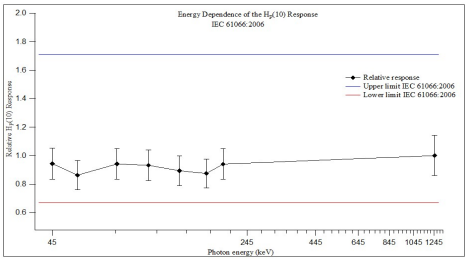

Fig. 3: Energy response results: the energy-response type test was calculated at normal incidence of the radiation normalised to the response of Co-60. All data points (error bars included) fall within the limits given by the IEC.

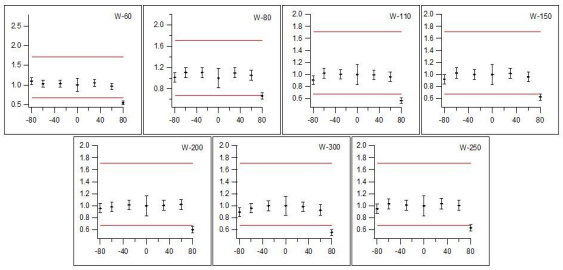

Fig. 4: Angular response results for Hp(10): The data points for each angular and energy incidence radiations given by the IEC (± 60 degrees, energy from W-60 up to Co-60) fall within the provided limits. Two outliers ware found at energies of W-60 and W-80 and for angles of -80 degrees, however such angles were not provided for the IEC.

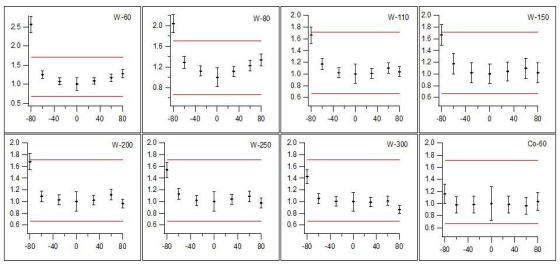

Fig. 5: Angular response results for Hp(0,07): The data points for each angular and energy incidence radiation given by the IEC (± 60 degrees, energy from W-60 up to Co-60) fall within the given limits. One outlier was found at each energy for angles of + 80 degrees, but such angles were not provided for the IEC.

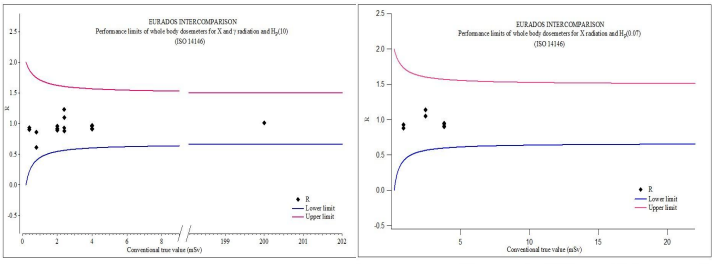

Fig. 6: Test on additivity on the dosimetry system: the curve ISO 14146 describes the ratio of the dose determined by a dosemeter to the value of the dose as function of the conventional true dose value. All data points fall within the limits given by the IEC for both Hp(10) and Hp(0,07).

6. CONCLUSIONS

This study confirmed the overall excellent quality of the JRC-ISPRA TLD system, which now also implementing basic uncertainty analysis, is hence ensuring a strict metrological traceability to personal dose equivalents Hp(10) and Hp(0,07), according to international Standards.

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