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PERFORMANCE CHARACTERISTICS OF A HOME-MADE TLD READER; PRELIMINARY RESULTS*

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Abstract. *A model of the 7200 hot gas automatic TLD card reader has been designed and manufactured in Iran. This study assesses some performance characteristics of the reader including the linearity of response, stability of readouts during a period of time as well as the reproducibility of TLD readouts. Furthermore, the coefficient of variations (COV) of the parameters has been studied and compared with those of standard criteria. The obtained results show that the TLD reader can be used efficiently in dosimetry laboratories.*

Keywords: *TLD, reader, IEC62387, type testing, standard*

1. INTRODUCTION

Different kinds of passive dosimetry techniques are used in individual monitoring. Among the methods, the thermoluminescence technique is the most common that provides accurate dose assessment for the staff in various radiation practices. According to the IAEA requirements for dosimetry laboratories, a quality management system (QMS) is always required, ensuring the compliance with the standard criteria [1]. Some investigations, such as type testing programs, have been performed for various models of TLD readers by other researchers [2-6].

In this research, some performance characteristics of a hot gas model of 7200 home-made TLD reader are studied.

2. MATERIAL AND METHODS

A hot gas model of 7200 TLD card reader (RSD Co., Iran) was investigated (Fig. 1). The reader consists of a two-PMTs model of 9143B electron which can measure double TLD chips simultaneously. The time-temperature profile can be determined separately by a user for each TLD chip via a comprehensive software program. The maximum heating temperature (up to 400±1 °C), heating rate (up to 40±1 °C/s), acquired times, preheat temperature, and post annealing time can be adjusted manually by a user. Moreover, the reader has been equipped with a built-in computer notebook, so it is not necessary to use any peripheral hardware devices to record the TLD readouts. All the readout information, such as the time temperature profiles, glow curve area and shapes, region of interest and other information can be recorded via the software.

TLD-100 chips were used in the performance test program. The glow curve peak area was used in all measurement procedures. The dosimeters were irradiated to the photons of ^{137}Cs or ^{60}Co sources. All the dose values were traceable to the national secondary standard dosimetry laboratory.

The linearity of response, stability of readouts during a period of time as well as the reproducibility of TLD readouts were investigated in the testing program.

All tests were performed on the reference condition of 23 °C temperature and normal light intensity in the laboratory (e. g. 150 lux).

The coefficient of variation (COV) is defined as the ratio of standard deviation of numbers of measurements to those of averaged value.

In order to assess the linearity response of the reader, eight groups of dosimeters were irradiated to a ^{60}Co reference source, to 0.3, 0.7, 1, 10, 30, 100, 300 and 1000 mSv. Four repeated measurements at each of the seven dose values were performed.

Figure 1. Model of 7200 TLD reader

In order to study the stability of the reader, nine groups of six dosimeters were used. The dosimeters were irradiated to a dose value of 3 mSv and read out starting one week later in nine weekly time intervals during two months.

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According to the ASTM standard [10], in order to test the reproducibility of the response of an individual reusable dosimeter, the individual TLD shall be irradiated and read out. This procedure should be repeated 30 times. Then the averaged value and standard deviation of the TLD must be determined.

In addition, the variations in PM tubes' reference light values have been recorded in the time intervals.

3. Results and discussion

Figure 2 presents the linearity response of the reader. The dots are calculated to the averaged value of each group. As it is shown, a linear curve can be fitted on the points calculating the calibration factor of the reader.

Figure 3 shows the COV of nonlinearity response of the reader. Considering the IEC62387 criteria, all the COV values were obtained below those of criteria of the IEC standard. Consequently, the reader meets the IEC criteria for the nonlinearity of response.

Figure 4 presents the results of the stability of the reader during a bimonthly measurement. The readouts ranged within a ±3% variation. The COV values were measured as less than 5%. Therefore, the reader meets the IEC criteria for the stability of response.

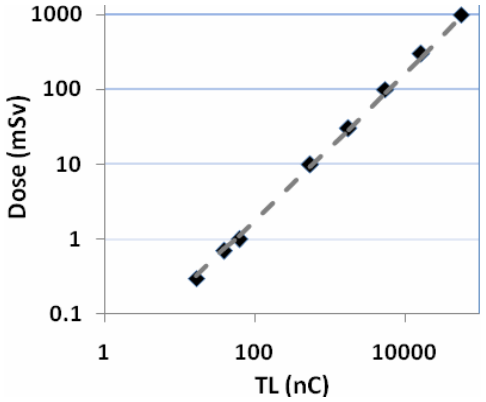

Figure 2. Linearity of response of TLD reader of model 7200

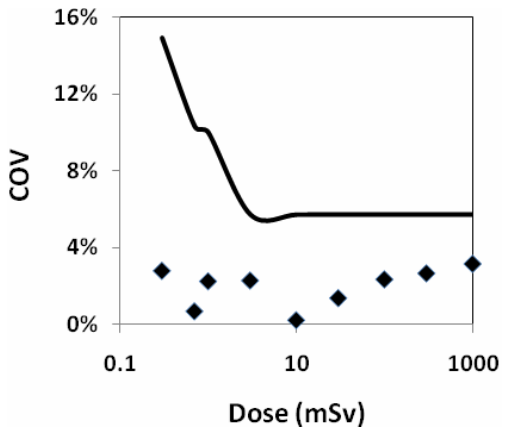

Figure 3.The obtained COV values (dots) for nonlinearity of response of TLD reader of model 7200. The solid line is the criteria of IEC 62387.

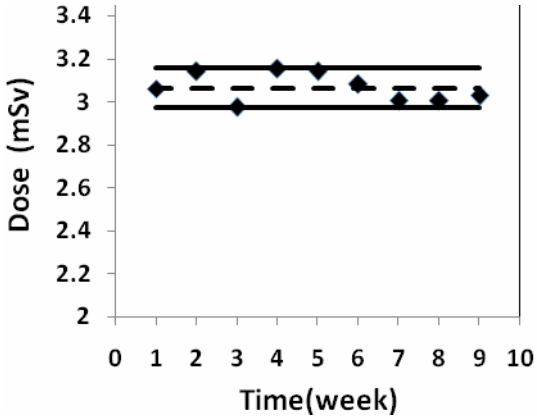

Figure 4. Stability of TLD reader of model 7200

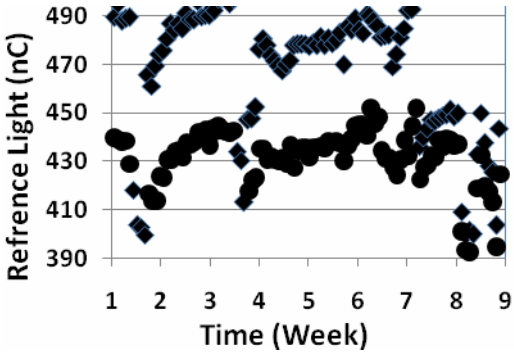

Figure 5. Stability of PM tubes TLD reader of model 7200 (• PM tube #1, ♦ PM tube #2)

Figure 5 presents the RL values of PM tubes during the bimonthly time interval. Although there are no criteria for the PMT values, the maximum variation of ±13% of RL values is acceptable and in accordance with those of the other models of commercial TLD readers [11].

For the reproducibility test, a curve was fitted to the data of response versus the number of cycles by a least- squares method. A measure of reproducibility was then given by the average standard deviation of the data points from the least-squares curve. The ratio of the standard deviation to the average value was obtained and it was 4.5%, which was less than the criteria of 5% in the ASTM standard [10].

4. Conclusion

Performance criteria of a model of 7200 home-made TLD reader were assessed. The model of the TLD reader was found to meet some of the important criteria of international standards by large margins. The readouts of the TLD reader show a good stability and reproducibility and, consequently, it can be applied reliably and efficiently in an accredited dosimetry laboratory.

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