SLAC-PUB-459
July 1968
(ACC)

USE OF LIGHT SOURCE FOR TESTING THERMOLUMINESCENT DOSIMETER READERS

R. C. McCall

It is a common practice to check the performance of a TLD reader by inserting a light source composed of a phosphor mixed with a radioactive material, e.g., ^{14}C. The response to the light source is used as a measure of a) the calibration or long-term stability of the reader and b) the ability of the reader to reproduce a constant signal. Usually the laboratory which measures a wide range of dose levels will desire several light sources of different intensities. Recently ConRad* has answered this need by providing sets of two light sources, A and B, differing by about a factor of 100 in intensity.

There are, however, some pitfalls in the use of such light sources. Although the authors use has been confined to the ConRad light sources, the problems are general and may apply to any light sources of this type.

In use (a) above, it is always necessary to place the source in the reader and wait long enough for the room light induced phosphorescence to decay away before measurement. Use of an internal light source to eliminate this wait is only a partial solution, since one may need several light sources of different intensities and colors. With the more intense light source, (ConRad LS-A) this requires not more than 1 minute wait. With LS-B, the weaker light source, a wait of at least

*Laboratory Products Division, Isotopes, Inc. 50 Van Buren Ave., Westwood, New Jersey

(Submitted as Letter to Health Physics)

6 minutes is necessary. These light sources are made up of approximately the same amount of phosphor but with differing amounts of ^{14}C added. Thus, the phorphorescence light from the two sources is of equal initial intensity and must decay about 100 times as much for the weaker source before it becomes negligible.

In use (b) above, successive measurements of the light source are made to provide a measure of the reproducibility of the reader itself. Typically with LS-A, a good reader will make 20 consecutive measurements with a Standard Deviation of $\pm$ 0.25% or better. Using LS-B it is not possible to obtain such good reproducibility even when the photomultiplier voltage is increased to give the same size electrical signal. ConRad informs me that LS-B has ~ 0.6 μCi of ^{14}C or 2.22×10^{4} dis/sec while LS-A has ~ 50 μCi ^{14}C or 1.85×10^{7} dis/sec. We have made tests with three different TLD readers using these sources as shown in Table I.* The high voltage on the photomultiplier was adjusted to give about the same size signal for each light source. The output was read to either 3 or 4 figures on the digital voltmeter readout.

The statistical variation (S.D.) in the number of β-rays per readout period would be less than $\pm 10^{-2}$% for both readers when LS-A is used. With LS-B, however, for the SLAC reader we would expect $\pm$ 0.21% and for the ConRad reader $\pm$ 0.18%. The differing values are due to the different integration times used. There are other parameters which will show a statistical spread also, e.g., the total energy of the β-rays, the number of light quanta per keV absorbed, the fraction of the β-rays which are absorbed in the plastic rather than the phosphor, etc. All of these will contribute to the observed S.D. of the measurements and will be more serious for the smaller source.

This imposes a definite limitation on the use of low intensity light sources. Better results would probably be obtained by use of filters or perforated screens over more intense light sources. For example, we attenuated the light from LS-A with translucent teflon tape until the intensity was the same as LS-B. We then obtained a S.D. of 0.14% with the SLAC reader at the same photomultiplier high voltage as was used for LS-B.

*I am indebted to Douglas Jones of Isotopes, Inc. for the data on the Model 7100 reader and for discussions of this problem.

TABLE I

Reader	Integration Time	S.D. from 20 Measurements with LS-A	S.D. from 20 Measurements with LS-B
ConRad Model 4100	14.3 seconds	± 0.18%	± 0.60%
SLAC Design	10.0 seconds	± 0.08%	± 0.61%
Isotopes Model 7100	12 seconds	± 0.06%	± 0.44%