INFORMATION NOTE
BUBBLE DETECTORS
ACCURACY OF DOSE DETERMINATION
NOVEMBER 2006

The BD-PND™s manufactured by BTI are currently the most accurate personal neutron dosimeters for monitoring of radiation workers. These dosimeters are rigorously tested by the manufacturer prior to shipping as part of the quality control process to meet the specified accuracy of the product.

In order to achieve the desired accuracy in the deployment of these detectors by the user, it is important for users to recognize that the bubbles that are formed by exposure to neutron fields are statistical in nature. In order to get high accuracy in dose determination, it is important to have an adequate number of bubbles. In practice, it is desirable to have approximately 100 bubbles as the expected number for a particular personal dosimetry application. For this number of bubbles, the expected standard deviation (s) is 10 and, at the 95% confidence interval, one would expect the detector readings to lie between 80 to 120 bubbles. In terms of accuracy in neutron dose determination, this represents an uncertainty of ±20%, which is quite satisfactory for personal neutron dosimetry.

Over the years, BTI has been contacted by a few users who have indicated that their detector readings appeared to be "inaccurate" and perhaps caused by detectors malfunction or poor calibration. In tracking these situations with the users, we invariably found that low bubble count and associate statistics were responsible for the observation. If a user exposes a bubble detector to produce, say, 25 bubbles, the standard deviation is 5 and there is an expected uncertainty (to 95% confidence) of 40% in the estimated dose provided by the detector. While this accuracy is still adequate for personal neutron dosimetry, many users assume that the 40% difference is outside the specified accuracy of the product (±20%) quoted by the manufacturer.

It is important for users to recognize that the quoted accuracy of the product refers to its absolute accuracy as ascertained by the manufacturer's QA process. This accuracy is attainable only by counting a large number of bubbles in a detector or many repeated measurements of a particular neutron field. In a particular measurement by a user, the actual accuracy of a dose determination using a bubble detector is still subject to the statistical uncertainty associated with the actual bubble count. To get increased accuracy in dose determination, the users must increase the total number of bubbles from an exposure. This can be done using bubble detectors of higher (specified) sensitivity or repeated measurements (or longer time of exposure) if the conditions of detector deployment permit.

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