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Standards on Gas-Filled Radiation Counter Tubes: Methods of Testing, 1952*

1. GENERAL

1.1 Environment

In setting up test procedures for radiation counter tubes, it is necessary to consider not only the test circuits but also the physical arrangements of test, such as nature of source, distance between source and counter, scattering by objects near the source or counter, shielding of the counter against unwanted radiations, and the background due to cosmic rays and general contamination. The relative importance of these various factors will depend on the type of counter under test.

In selecting a room for counter-testing purposes, it is advisable to pick one as far as possible from strong gamma-ray sources. It is particularly difficult to work in a room adjacent to one in which experiments are being performed involving the moving of a gamma-ray source from one location to another. A corner room is desirable from this standpoint.

Attention should be paid to the fact that the intensity of cosmic radiation depends strongly on the altitude and on the amount of material above the counters. Also, in testing counter tubes that are physically long there may be a noticeable difference in the background counting rate, depending on whether they are tested in a horizontal or vertical position. When measuring background counting rates, it is preferable that the tube be in a lead shield to reduce the effects of local contamination.

1.2 Radiation Sources¹

A source is standardized with respect to the total number of disintegrations per unit time, and it is neces-

* Reprints of this Standard, **52 IRE 7.S2**, may be purchased while available from The Institute of Radio Engineers, 1 East 79 Street, New York 21, N. Y., at \$0.75 per copy. A 20-per cent discount will be allowed for 100 or more copies mailed to one address.

¹ It is suggested that those who propose to handle radiation sources familiarize themselves with the possible hazards involved. See, for example, the National Bureau of Standards Handbook 42, "Safe Handling of Radiation Isotopes."

sary to compute the fraction of the emitted radiation intercepted by the sensitive portion of the counter tube. In the case of the alpha and beta sources, the material and thickness of the source support and/or matrix and the distance from the counter are important in this calculation since particles may reach the counter after having been scattered through a large angle by the support material. Also, the thickness of the source itself must be considered because of self-absorption and the attendant straggling.^{2,3}

These factors are not important in relative measurements if the distance from source to counter and disposition of surrounding material remain unchanged. However, self-absorption may make it impossible to get a good plateau on an alpha proportional counter.

Where gamma-ray sources can be used for calibration purposes, their use will be convenient because sufficient shielding of the counter to minimize interference from softer background radiation is possible. However, counters intended for beta or neutron detection should be tested on appropriate sources.

1.2.1 Gamma-Ray Sources

For gamma rays it is customary to use a source consisting of a radium salt of sufficient age (greater than one month) to insure that equilibrium has been attained with the decay products responsible for the greater part of the gamma radiation. Because of the long life of radium, a source of this type will remain constant in time, but for some purposes the complexity of the gamma-ray spectrum may be objectionable. In this case, it will probably be necessary to use an artificially radioactive isotope. The problem then is to find an isotope emitting the desired radiation and possessing

² A. H. Jaffee, T. P. Kohman, and J. A. Crawford, "A Manual on the Measurement of Radioactivity," MDDC-388, U.S.A.E.C., 36 pp.

³ D. W. Wilson, A. O. C. Nier, S. P. Reimann, "Preparation and Measurement of Isotopic Tracers," J. W. Edwards, Ann Arbor, Mich., 108 pp.; 1946.