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LOS ALAMOS HEALTH GROUP FILM BADGE PROCEDURES

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LOS ALAMOS NATIONAL LABORATORY
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UNCLASSIFIEDLos Alamos Health Group Film Badge Procedures1. Films Used

- a. Eastman Type K Industrial X-ray Safety Film (Dental packets). Pb cross shields are removed. High speed film for recording low range of exposures.
- b. Dupont Dental X-ray Packets, special type D-2. This special packet contains two films of different speeds. Both have medium sensitivity for recording medium range of exposures.
- c. Adlux, made by Dupont and Defender. This is a low speed translucent film for recording very high range of exposures.

2. Calibration

The film used most frequently is the Eastman Type K high speed film for the recording of low range of exposures, .013 through 6.83R. The calibration example set forth here is based upon the exposure of the Eastman Type K Film.

Twenty-six films are all placed in 26 separate brass containers called film badges (sample attached). Each film is taped in exactly the same area in each badge; then all are placed on a round calibration table 40 cm. from the center where a 100 mc. pure Radium or Radium Beryllium source is placed. Each badge is placed perpendicular to the board surface. The time is the only variable, running from 90 sec. to 13 hours.

Formula used is $R = \frac{8.4x \text{ mc. source size} \times \text{min. exposed}}{(Cm)^2 \times 60}$

When the time expires for each badge, the film is removed immediately and taken to another building to be stored behind lead, to await development.

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5. Development

Each film packet is identified, then placed on a rack for development. Our developing rack is 14 inches high, partially shop-made, using the Eastman dental film-developing hangers ~~40~~ as part of the final rack. Our final rack holds 140 films. Films are placed on the rack in a certain numerical order and recorded on paper as to the position of each. The capacity of developing and hypo tanks are both 10 gallons each (shop-made, stainless steel). We use a G.E. Model VK water cooler in conjunction with a G.E. automatic temperature regulator, 50 A unit, which mixes hot and cold water in the correct proportions for giving output water at 68°F. ~~±~~ one quarter degree unless the cooler or regulator goes faulty. This controlled water flows 24 hours a day through a large lead-lined tank which holds developing and hypo tanks. The water itself is used for rinsing. The large water bath keeps the processing chemicals at a very stable temperature. Developer used is Dupont concentrated X-ray Developer. Hypo used is Dupont concentrated X-ray Fixer.

Several experiments in agitation during development have been worked on. Only one proved to give even development and that is timed manual agitation in this manner: rack is removed by hand completely from the developing tank at the end of the first minute, replaced, removed again at the end of the 2nd minute, replaced, and removed again at the end of the 3rd minute, which is the total time of development. No other form of agitation is given. In this way more than one person can match developments resulting in corresponding densities at 68°F. Films are then rinsed 8 sec. and fixed in the hypo for 10 minutes; then washed in running water from 20 to 30 minutes; then sponged and dried in a General

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Electric dryer. Three blanks or non-exposed films of the same emulsion number of the calibration set are processed at the same time for three reasons.

- a. Check on the evenness of development density with the depth of developer.
- b. Check on the general activity of the developer and check on possible error in development time.
- c. To learn the fog density of the certain film used.

4. Density Reading

The films are measured on a Photo-volt-photo-electric densitometer. This instrument is an inferior machine that is quite expensive. However, it can be made to operate according to your specifications by your local electronics man. It is slightly sensitive to "Body Capacity" and to vibration; also needs frequent adjustment but results are accurate and creates less human error than visual densitometers. The fog density of the blank is subtracted on the densitometer before the exposure density is measured so that all readings will be above the blank density.

5. Calibration Curve

The density is plotted on the vertical axis with the R-exposure on the horizontal axis. A curve is drawn through the points, each made by the intersection of the theoretical R-exposure given a film and the corresponding response in density of each. From this curve a table is drawn up showing the R-exposure received for any given exposure density of any one particular emulsion number.

6. Types of Film Badges

- a. Catastrophe badge - contains the 3 types of films in the conventional brass container. Along with this container is an accurately

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weighed slug of cobalt for measurement of an integrated dose of slow neutrons or in the case of an accident in which a large amount of neutrons would be given at once. Tri-calcium phosphate is also used for the recording of fast neutrons. The powder is sealed in a glass capsule. All these items are enclosed in an envelope and sealed and identified with the badge number, name of person wearing badge, and date due.

b. Planted badges - these badges are so called due to the fact that they are placed in a stationary position for detecting the integrated amount of radiation from a radio-active material or producing instrument for a given period of time. The contents of these badges vary with the size of the active material to be used and with the probable chance of accident. The two main purposes of these badges are:

1. In case of accident, personnel not having their own film badge on their person, exposure to the person involved can be estimated from the relationship of his position to one or more planted badges for his approximate dosage.

2. To determine the positions most consistently "hot" and dangerous to personnel.

c. Film badge rings - experiments carried out prove that film badge rings give erroneous results and are therefore not used at this installation. Any change in position worn gives different results due to its irregular physical shape.

d. Film badge wrist bands - OHR Group is experimenting with plastic wrist bands for holding the X-ray film packets. Its even physical shape should insure correct readings. This type of badge is used when the hands are in close contact with radio-active sources.

e. Tech Area film badges - A new Tech Area badge has been designed for holding the film right on the badge itself by a small attached lucite jacket. The purpose of this type of badge is to control persons who forget their film badges and leave them at home. In this way they will not be admitted into the Tech Area unless the Tech Area badge is worn.

f. Special film badge problems - One of the greatest problems is the personnel film badges worn by the chemists working with RALM at Bayo Canyon. It has been found that these badges become very contaminated from this material and require outer envelope and string changes sometimes as often as one hour. These Bayo badges only contain the Eastman and Dupont film packets. The brass container is covered with a disposable envelope and string for placing around the neck. These badges are worn only for a one-day period due to the high exposures they tend to have. In this way a closer check can be made for daily tolerances. The brass containers are decontaminated in concentrated HCl. If contaminated envelopes or strings are allowed to remain on the film badge, the readings may increase 8 to 10 times over the true dosage to the person.

7. Film Accession Books

All films are given an accession number, filed, and its data recorded in the L.A. notebook. This book records the following for each film: film accession number, date entered, dates worn, badge number, person wearing the film, density, R-exposure, group or location of exposure emulsion number of film and the blank density.

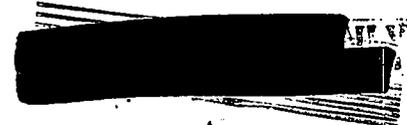
8. Reports

A summary of the results recorded in the film accession books are reported on inter-office memos to the group leader, section leader,

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Hematology Lab, person responsible for the group exposed, and one for our files. The individual exposures are then entered on the personal health record of the person exposed. All exposures above daily tolerances are investigated and given extensive detailed blood counts.



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