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Form AEC-313 (8-64) 10 CFR 30

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

Form approved. Budget Bureau No. 38-R027

INSTRUCTIONS.—Complete Items 1 through 16 if this is an initial application or an application for renewal of a license. Information contained in previous applications filed with the Commission with respect to Items 8 through 15 may be incorporated by reference provided references are clear and specific. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail two copies to: U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Isotopes Branch, Division of Materials Licensing. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT. (Institution, firm, hospital person, etc. Include ZIP Code.)

Department of the Army
Fitzsimons General Hospital and U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado 80240

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. (If different from 1(a). Include ZIP Code.)

Same as 1 (a)

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

Radioisotope Section

3. PREVIOUS LICENSE NUMBER(S). (If this is an application for renewal of a license, please indicate and give number.)

Amendment to license No. 05-00046-13

4. INDIVIDUAL USER(S). (Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)

As specified and approved by the Radioisotope Committee, Fitzsimons General Hospital

5. RADIATION PROTECTION OFFICER. (Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9.)

Same as No. 4

6. (a) BYPRODUCT MATERIAL. (Elements and mass number of each.)	(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. (If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)	Present Level	Desired Level
A) Strontium 85 (#6y of present license)	Nitrate & Chloride	1 MC	3 MC
B) Chromium 51 (#6R of present license)	Sodium Chromate & Chromic Chloride	4 MC	4 MC
C) Cs-137	Liquid	-	1 MC
D) Technetium 99m (#6EE of present license)	Same as in amendment #8		
E) Iodine I-131 (#6B of present license)	Iodinated Human Serum Albumin	5 MC	5 MC

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. (If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)

A) Bone Scanning as stated in present license.
B) Addition to approved uses as stated in present license. Measurement of Gastrointestinal protein loss.
C) For use as a standard to assay for Mo content of eluate of Mo generator.
D) Addition to approved uses as stated in amendment #8. Cardiac scans, placenta localization and vascular studies.
E) Addition to approved uses as stated under 9B of present license. Intrathecal injection for diagnosis of cerebrospinal Rhinorrhea, obstructive hydrocephalus and blocked shunts.

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(Continued on reverse side)

TRAINING AND EXPERIEI OF EACH INDIVIDUAL NAMED IN ITEM 4 (Use ,lemental sheets if necessary)

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection	See license # 05-00046-13		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION (Actual use of radioisotopes or equivalent experience)

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
		See license # 05-00046-13		

10. RADIATION DETECTION INSTRUMENTS (Use supplemental sheets if necessary)

TYPE OF INSTRUMENTS (Include make and model number of each)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm²)	USE (Monitoring, surveying, measuring)
See license # 05-00046-13					

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE

See license # 05-00046-13

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED (For film badges, specify method of calibrating and processing, or name of supplier)

See license # 05-00046-13

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS IN DUPLICATE

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached. (Circle answer) Yes No See license # 05-00046-13

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.

See license # 05-00046-13

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved. See license # 05-00046-13

CERTIFICATE (This item must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PART 30, AND THAT ALL INFORMATION CONTAINED HEREIN, INCLUDING ANY SUPPLEMENTS ATTACHED HERETO, IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF.

Dept. of the Army, FGH & US Army Med Rsch & Nutr Lab, Denver, Colo. 80240
Applicant named in item 1

Date 1 APR 1968

By: Edwin L. Overholt
Edwin L. Overholt, Col., MC
Chairman, Radioisotope Committee
Title of certifying official

RECEIVED MAY 2 1968 U.S. ATOMIC ENERGY COMMISSION REGULATORY FIELD OFFICE

WARNING—18 U. S. C., Section 1001, Act of June 25, 1948, 62 Stat. 749, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

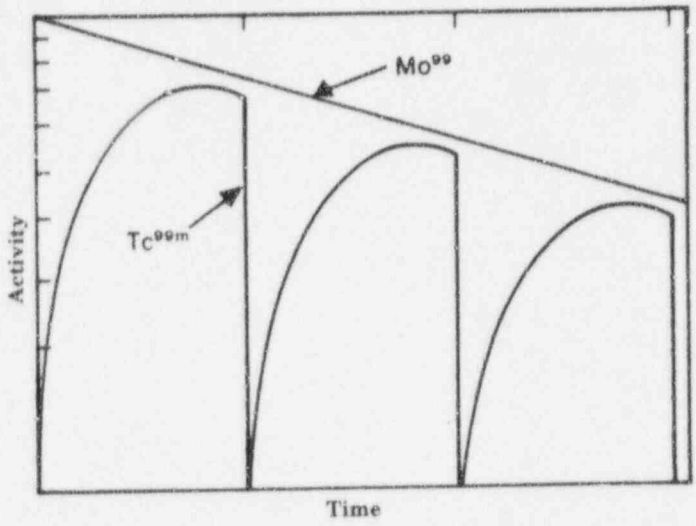
☆ U.S. GOVERNMENT PRINTING OFFICE : 1964 O—745-382

CAUTION: NEW DRUG—Limited by Federal law to investigational use

TECHNETOPE®
Squibb Technetium-99m
STERILE GENERATOR

The Technetope (Squibb Technetium-99m) Sterile Generator provides a means of obtaining a sterile, non-pyrogenic supply of Technetium-99m (Tc^{99m}), a versatile scanning agent that can be administered intravenously or orally. Tc^{99m}, the short-lived daughter ($T\frac{1}{2}$ = 6 hours) of Molybdenum-99 (Mo^{99}; $T\frac{1}{2}$ = 67 hours), is obtained from the generator by periodic elution. The amount (in millicuries) of Tc^{99m} obtained in the initial elution will depend on the original potency of the generator, while the activity obtained from subsequent elutions will depend on the time interval between elutions (see Graph).

Eluting the generator every 24 hours will provide optimal amounts of Tc^{99m}. Most laboratories therefore will find it convenient to elute the generator each day at a specific time. However, the generator may be eluted whenever sufficient amounts of Tc^{99m} have accumulated within the column.



Mo^{99} decay and Tc^{99m} growth after daily elutions

DESCRIPTION

The Technetope (Squibb Technetium-99m) Sterile Generator has been sterilized by autoclaving. The Molybdenum-99 used in the generator meets or exceeds the purity requirements of the Atomic Energy Commission with respect to allowable levels of Ruthenium-103, Tellurium-132, and Iodine-131 contamination. At the time of initial elution, the alumina concentration is less than 0.5 mg. per 10 millicuries of Tc^{99m} activity. The generator consists of a specially designed lead shield containing an alumina-packed glass column which releases Tc^{99m} upon elution. The lead shield has two access ports to the rubber closures at the top and bottom of the glass column, allowing aseptic elution and storage under conditions of constant shielding. Additional shielding during shipment is provided by a removable lead sleeve which surrounds the entire assembly.

Supplied with the generator are 6 bottles of sterile, non-pyrogenic eluent, and suitable equipment for eluting, collecting, and assaying the Technetium-99m.

WARNING

Maintain proper radiation safety precautions at all times. The glass column containing Mo^{99} need not be removed from the lead shield at any time. The radiation field surrounding an unshielded column is quite high. Solutions of Tc^{99m} withdrawn from the generator should always be adequately shielded. The early elutions from the generator are highly radioactive.

IMPORTANT

Since material obtained from the generator may be intended for intravenous administration, aseptic technique must be strictly observed in all handling. The stoppers of the eluent bottle and the collecting vial, and both rubber closures in the generator column should be swabbed with a suitable germicide before each entry. All entries into the generator column must be made with sterile needles. Either the eluent provided, or Sodium Chloride Injection U.S.P. should be used to elute the generator. Use a fresh disposable syringe, milking tube, breather needle, bottle of eluent, and collecting vial for each elution; sufficient equipment is provided for this purpose. All equipment used to collect or administer the Tc^{99m} must be sterile. Do not administer material eluted from the generator if there is any evidence of foreign matter.

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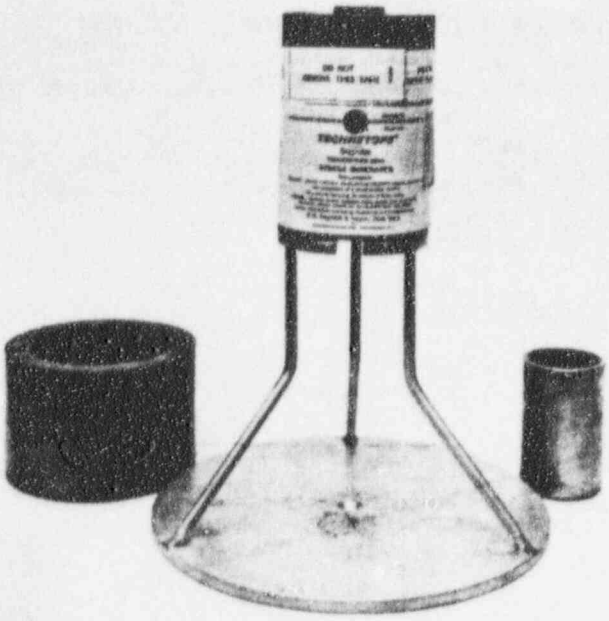
DI.. .CTIONS FOR ELUTING Tc^{99m}

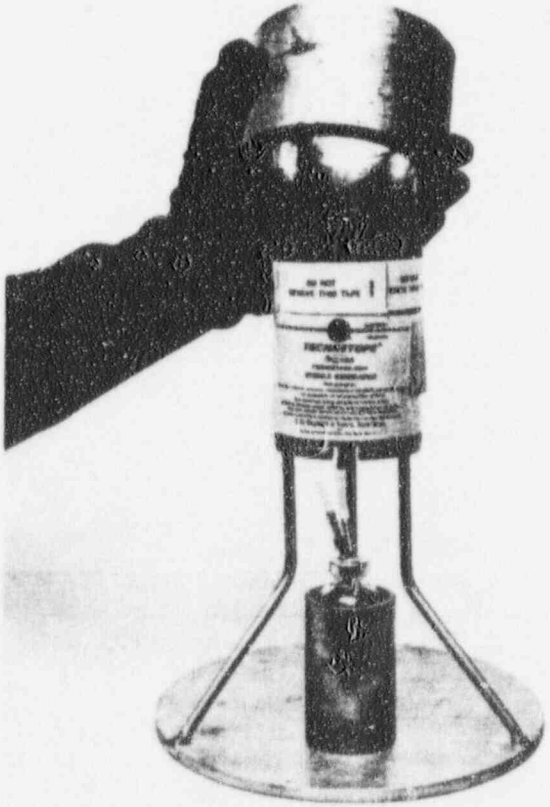


1. Set lead-shielded generator on metal stand and remove lead plugs in top and bottom of generator shield. **Do not remove top of lead shield. Do not take glass column out of lead shield.**

   Swab rubber closures in generator column with a suitable germicide, using a sterile cotton-tipped applicator.

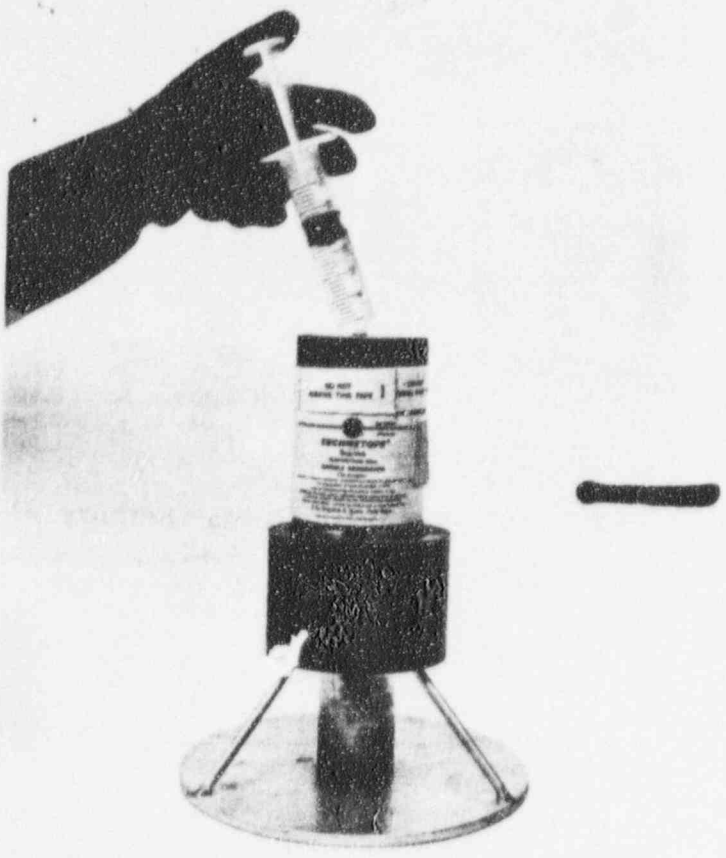
2. Swab top of collecting vial with germicide, and insert breather needle and one end of milking tube.

   Insert flanged end of milking tube into rubber closure in bottom of generator column.



3. Place collecting vial into lead container provided for it. Corrugated paper may be used to hold collecting vial firmly in place.

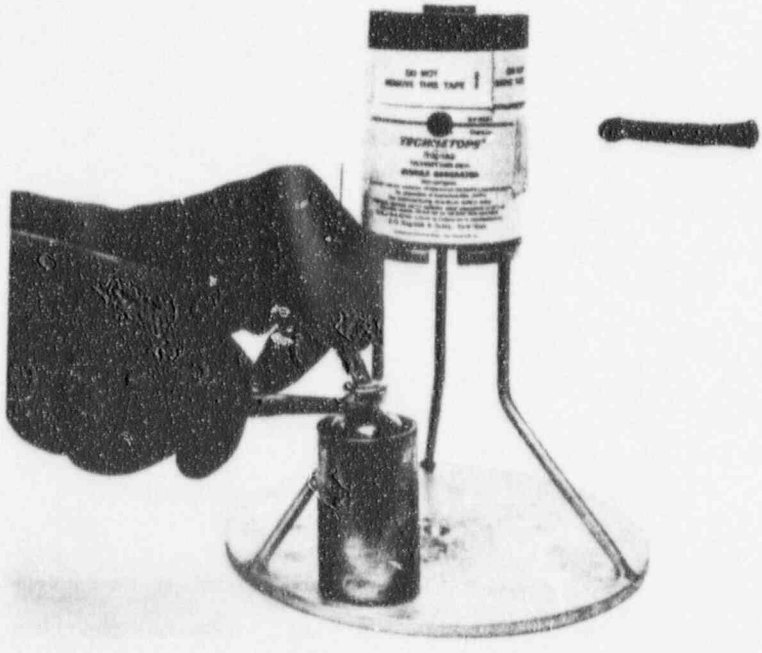
   Slide lead sleeve down over generator and into position on metal stand, so that it shields milking tube and top of collecting vial.

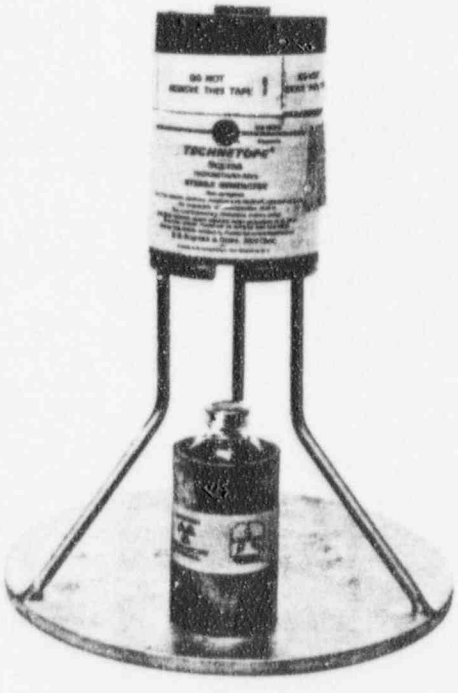


4. Swab top of eluent bottle with germicide and withdr 25 cc. of eluent into disposable syringe.

Inject eluent through rubber closure in top of gen ator column. Eluted Tc^{99m} should flow rapidly ir collecting vial.

NOTE: It is not necessary to exert excessive pressure on the syringe while injecting eluent. If solution does not pass freely through column on application of moderate pressure, the entire milking assembly (sterile syringe, eluent, milking tube, breather needle, and collecting vial) should be replaced.





5. As soon as elution is completed, remove milking tube from bottom of generator and replace top and bottom plugs in generator shield.

Remove breather needle and milking tube from collecting vial.

NOTE: A few drops of Tc^{99m} may remain in milking tube; use appropriate radiation safety precautions.

6. Discard all equipment used to elute the generator. For each subsequent elution, use a new bottle of eluent, and inject it with a fresh disposable syringe; use a new milking tube, breather needle, and vial to collect eluted Tc^{99m}.

If the metal stand for the generator is not available, the generator may be clamped to a standard laboratory ring stand with a sturdy 3-fingered clamp, and eluted as described above. The lead sleeve may be used to shield the milking tube by clamping it to the ring stand and sliding it into place before injecting the eluent into the generator column.

DIRECTIONS FOR ASSAYING Tc^{99m} ACTIVITY
Using the Conometry™ Unit and the Squibb Cobalt-57 Standard

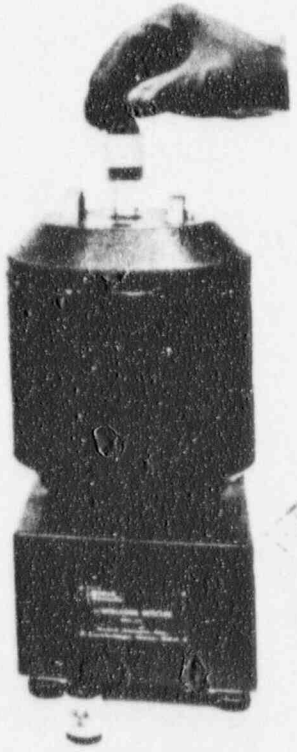
The Conometry Unit consists of a device which standardizes counting geometry when inserted into any standard well counter, and a lead absorber for obtaining a suitable counting rate. The Cobalt-57 Standard provides an appropriate amount of Cobaltous Chloride Co 57 Solution for comparison with an appropriately diluted 0.1 cc. aliquot of Tc^{99m}. Special bottles for assaying the Tc^{99m} are also provided.

1. Place the Conometry Unit in a well-type counter. See photo below.
2. Place the vial of Co^{57} Standard in the cup of the Conometry Unit and determine the activity in the 0.04—0.2 Mev range. Record net counts/minute.
3. Prepare a Tc^{99m} assay sample as follows:
   Put 5.0 cc. of tap water in one of the assay bottles.
   Aseptically withdraw 0.1 cc. from the vial of Tc^{99m} eluate and add this to the water in the assay bottle. (The lead collar may be fitted over the top of the collecting bottle for additional shielding during withdrawal).
   Swirl the assay bottle gently to assure uniform mixing of the Tc^{99m} assay sample.
4. Remove the Co^{57} Standard from the Conometry Unit and replace it with the Tc^{99m} sample. *Maintaining constant geometry* with the previous count, determine the activity in the 0.04—0.2 Mev range. Record net counts/minute.
5. Calculate Tc^{99m} activity using the following formula:

$$Tc^{99m}\ \text{activity (mc/cc.)} = \frac{A \times B \times 10 \times 0.91}{C}$$

Where:

A = net cpm of Tc^{99m} sample
B = activity (in millicuries) of Co^{57} Standard (taken from label and corrected for decay)
C = net cpm of Co^{57} Standard
10 = dilution factor for Tc^{99m}
0.91 = factor for converting Co^{57} activity to equivalent Tc^{99m} activity (corrections for difference in photon yield and attenuation of Co^{57} and Tc^{99m} photons are included)



Conometry Unit in well-type counter

COBALT-57 DECAY FACTORS

To obtain B in the formula at left, multiply the assay value stated on the label of the Cobalt-57 Standard by the appropriate factor in the following table:

Weeks	Factor	Weeks	Factor	Weeks	Factor	Weeks	Factor
1	0.980	14	0.776	27	0.614	40	0.486
2	0.962	15	0.762	28	0.603	41	0.477
3	0.945	16	0.748	29	0.592	42	0.469
4	0.928	17	0.735	30	0.582	43	0.461
5	0.911	18	0.722	31	0.571	44	0.452
6	0.895	19	0.709	32	0.561	45	0.444
7	0.880	20	0.696	33	0.551	46	0.436
8	0.864	21	0.684	34	0.541	47	0.429
9	0.848	22	0.672	35	0.532	48	0.421
10	0.833	23	0.660	36	0.522	49	0.414
11	0.819	24	0.648	37	0.513	50	0.406
12	0.804	25	0.636	38	0.504	51	0.399
13	0.790	26	0.625	39	0.495	52	0.392

DIRECTIONS FOR ASSAYING Mo^{99} ACTIVITY

1. Place the collecting vial containing the total Tc^{99m} eluate in a ¼-inch lead container and set this on the surface of a well-type scintillation detector or scintillation probe. (The lead container is provided on request with the Cesium-137 Standard mentioned below.)
2. Determine the activity in the 0.6—1.0 Mev range. Record net counts/minute.
3. Remove the vial of Tc^{99m} from the lead container and replace it with a Cesium-137 Standard. Determine the activity in the 0.6—1.0 Mev range, maintaining constant geometry with previous count. Record net counts/minute. (The Cesium-137 Standard is provided on request in a Technetope collecting vial with a total volume of 25 cc.)
4. Calculate Mo^{99} activity using the following formula:

$$Mo^{99}\ \text{Activity}\ (\mu c/cc.) = \frac{A \times B \times 4.5}{C}$$

Where:

A = net cpm of Tc^{99m} sample
B = activity (in microcuries per cc.) of Cs^{137} Standard
C = net cpm of Cs^{137} Standard
4.5 = factor for converting Cs^{137} activity to equivalent Mo^{99} activity

NOTE: It is not possible to completely shield out spurious Mo^{99} counts which are due to the presence of large amounts of Tc^{99m}. Hence, Tc^{99m} eluates that are totally free of Mo^{99}, when assayed in this manner, will appear to contain approximately 0.1 microcurie of Mo^{99} per millicurie of Tc^{99m}.

Tc^{99m} DECAY FACTORS

The activity of Tc^{99m} at the time of administration can be determined by multiplying the calculated activity by the appropriate factor in the following table:

Hours	Factor	Hours	Factor	Hours	Factor
½	0.944	4½	0.595	8½	0.375
1	0.891	5	0.561	9	0.354
1½	0.841	5½	0.530	9½	0.334
2	0.794	6	0.500	10	0.315
2½	0.749	6½	0.472	10½	0.297
3	0.707	7	0.445	11	0.281
3½	0.667	7½	0.420	11½	0.265
4	0.630	8	0.397	12	0.250

PHYSICAL PROPERTIES

Technetium-99m has a half-life of 6 hours. The scintillation spectrum of Tc^{99m} shows a photopeak at 0.14 Mev from its gamma emission; it does not emit a beta particle.

Molybdenum-99 has a half-life of 67 hours. Its two major photopeaks are at 0.74 Mev and 0.78 Mev, from two of its numerous gamma emissions; in addition, the isotope emits several beta particles.

The half-life of Cobalt-57 is 270 days. The scintillation spectrum of Co^{57} shows essentially only one photopeak at 0.123 Mev from its principal gamma emission. Co^{57} also emits an X-ray, but has no beta emission.

E·R·SQUIBB & SONS, NEW YORK
INC.
J2-422D
Printed in U.S.A.