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NRC Form 313 I (12-81) 10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*
   - a. NEW LICENSE
   - b. AMENDMENT TO: LICENSE NUMBER
   - c. RENEWAL OF: LICENSE NUMBER 06-10081-03

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
PHILIPS MEDICAL SYSTEMS, INC.
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(203) 926-7018

3. NAME AND TITLE OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
ROBERT F. AVRUTIK
TELEPHONE NUMBER: AREA CODE – NUMBER EXTENSION
(203) 926-7018

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)* *(Address to which NRC correspondence, notices, bulletins, etc., should be sent.)*
710 BRIDGEPORT AVENUE
SHELTON, CT 06484

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
710 BRIDGEPORT AVENUE
SHELTON, CT 06484

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

	FULL NAME	TITLE
a.	ROBERT F. AVRUTIK	DIRECTOR - REGULATORY DEPARTMENT
b.	WOLFGANG SCHOTT	ENGINEERING PROJECT MANAGER
c.	ANGELO VECA	Q.A. MANAGER

7. RADIATION PROTECTION OFFICER
ROBERT F. AVRUTIK RSO
WOLFGANG SCHOTT ARSO

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.
(CONTINUED ON SEPARATE SHEET)

8. LICENSED MATERIAL

LINE NO.	ELEMENT AND MASS NUMBER A	CHEMICAL AND/OR PHYSICAL FORM B	NAME OF MANUFACTURER AND MODEL NUMBER *(If Sealed Source)* C	MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME D
(1)	CESIUM 137	SEALED SOURCE	ATOMCHEM CORP. TYPE 2000, MOD. CS-2-10	ONE SOURCE 100 MILLICURIES
(2)	BARIUM 133	SEALED SOURCE	ISOTOPE PRODUCTS MODEL 233	NOT TO EXCEED 100 MICROCURIES PER SOURCE
(3)	AMERICIUM 241	SEALED SOURCE	AMERSHAM INTERNATIONAL PLC MODEL AMC-64	NOT TO EXCEED 10 MILLICURIES PER SOURCE
(4)				

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06-10081-03 PDR

LINE NO.	[USE O]F LICENSED MATERIAL E
(1)	FOR CALIBRATING INSTRUMENTS
(2)	FOR USE IN TESTING DETECTORS
(3)	FOR CALIBRATING INSTRUMENTS
(4)	

License Fee Infor[mati]on
on ~~Next Page~~ 10/16/84 cover letter
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9. STORAGE OF SEALED SOURCES

LINE NO.	CONTAINER AND/OR DEVICE IN WHICH EACH SEALED SOURCE WILL BE STORED OR USED. A.	NAME OF MANUFACTURER B.	MODEL NUMBER C.
(1)	HEAVY DUTY SEALED SOURCE HOUSING	EON CORP.	64-764
(2)	TYPE R	ISOTOPE PRODUCTS	233
(3)	HEAVY DUTY SEALED SOURCE HOUSING	PHILIPS	4522 161 52761
(4)			

10. RADIATION DETECTION INSTRUMENTS

LINE NO.	TYPE OF INSTRUMENT A	MANUFACTURER'S NAME B	MODEL NUMBER C	NUMBER AVAILABLE D	RADIATION DETECTED (alpha, beta, gamma, neutron) E	SENSITIVITY RANGE (milliroentgens/hour or counts/minute) F
(1)	SURVEY/ MEASURING	VICTOREEN	555*	1	SEE ATTACHED	DATA SHEETS
(2)	SURVEY	VICTOREEN	440	1	SEE ATTACHED	DATA SHEETS
(3)	SURVEY/ MEASURING	VICTOREEN	666	3	SEE ATTACHED	DATA SHEETS
(4)	SURVEY/ MEASURING	MDH	1015*	6	SEE ATTACHED	DATA SHEETS

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10

☒ a. CALIBRATED BY SERVICE COMPANY

NAME, ADDRESS, AND FREQUENCY

* OCCASIONALLY TO MFG. FOR CALIBRATION AND IN HOUSE (SEE (b))

☒ b. CALIBRATED BY APPLICANT

Attach a separate sheet describing method, frequency and standards used for calibrating instruments.

12. PERSONNEL MONITORING DEVICES

TYPE (Check and/or complete as appropriate.) A	SUPPLIER (Service Company) B	EXCHANGE FREQUENCY C
☒ (1) FILM BADGE ☒ (2) THERMOLUMINESCENCE DOSIMETER (TLD) ☐ (3) OTHER (Specify):	RADIATION DETECTION CO. P.O. BOX 1414 SUNNYVALE, CA 94086	☒ MONTHLY (1) ☐ QUARTERLY ☒ OTHER (Specify): (2) YEARLY

13. FACILITIES AND EQUIPMENT (Check were appropriate and attach annotated sketch(es) and description(s).

☐ a. LABORATORY FACILITIES, PLANT FACILITIES, FUME HOODS *(Include filtration, if any)*, ETC. N/A

☒ b. STORAGE FACILITIES, CONTAINERS, SPECIAL SHIELDING *(fixed and/or temporary)*, ETC.

☐ c. REMOTE HANDLING TOOLS OR EQUIPMENT, ETC. N/A

☐ d. RESPIRATORY PROTECTIVE EQUIPMENT, ETC. N/A

14. WASTE DISPOSAL

a. NAME OF COMMERCIAL WASTE DISPOSAL SERVICE EMPLOYED N/A

b. IF COMMERCIAL WASTE DISPOSAL SERVICE IS NOT EMPLOYED, SUBMIT A DETAILED DESCRIPTION OF METHODS WHICH WILL BE USED FOR DISPOSING OF RADIOACTIVE WASTES AND ESTIMATES OF THE TYPE AND AMOUNT OF ACTIVITY INVOLVED. IF THE APPLICATION IS FOR SEALED SOURCES AND DEVICES AND THEY WILL BE RETURNED TO THE MANUFACTURER, SO STATE.

IF WASTE DISPOSAL IS REQUIRED, THE SOURCE WILL BE RETURNED TO THE MANUFACTURER FOR DISPOSAL.

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit.

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation.

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, 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.

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.

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)* $110.00	b. CERTIFYING OFFICIAL *(Signature)* [signature]
	c. NAME *(Type or print)* FREDRIC J. FRIEDBERG
(1) LICENSE FEE CATEGORY: 170.31 – 3L RENEWAL	d. TITLE VICE PRESIDENT
(2) LICENSE FEE ENCLOSED: $ 110.00	e. DATE 9/27/84

6. CONTINUED

d.	HARTWIG BLUME	EXPERIMENTAL PHYSICIST
e.	DAVID C. BONAR	PHYSICIST
f.	CHARLES WORRILOW	MANAGER OF INSTALLATIONS

11b. Radiation Detection Instruments listed in Section 10 are calibrated at six month intervals using a Cesium 137 Gamma Source Standard, Model 64, s/n 198. Each detection instrument is calibrated against a Cs 137 Dose vs Distance plotted curve within a max. of 300mr/hr.

13b. No special facilities are required for the sources because the approximate reading on the outside surface of their containers is $\leq$ 5mr/hour. When not is use, under proper supervision, each source will be further contained in a lead lined box. The outside surface will read $\leq$ 1mr/hour.

15. The sources are kept in locked lead lined boxes. Only those persons authorized by this license to use the sources have access to them.

The attached copy of the Philips Medical Systems, Inc. Radiation Safety Manual is given to each monitored employee and explains our Radiation Safety Program. In addition, each monitored employee receives a 1½ hour lecture on Radiation Safety and Biological Effects of Ionizing Radiation from the Company Radiation Safety Officer.

The leak test will be carried out by one of the following methods:

1. Philips Medical Systems, Inc. employees, who have been properly instructed by Nuclear Radiation Consultants, will make a wipe as instructed and send it to Nuclear Radiation Consultants for analysis. The wipe will be analized on a single gamma ray spectrometer through the use of a sodium iodide crystal "well detector". Nuclear Radiation Consultants will use a standard Cs 137 source for comparison and quantification. Nuclear Radiation Consultants will then send a certification to Philips Medical Systems, Inc. showing the results.

2. The wipe will be performed by Stephen Balter, PhD. according to the following procedure:

WIPE TEST

Instruments

Victoreen Thyac III G.M. Counter

Victoreen 489-35 End Window G.M. Tube

N.E. Nuclear Co-60 Reference source

5.1 nanoCuries on 6/9/76

Frequency - Semi Annual

1. Turn on and warm up the G.M. Counter.

2. Record background on the most sensitive range (typical 50 cpm) (B).

3. Place the reference source within 2mm of the end window of the geiger tube. Record the reading (typical 650 cpm for 4 nC.).

4. Calculate the activity of the reference source.

5. The calibration of the G.M. Counter is Fc = Net Counts/Present Activity.

6. Using protective gloves obtain wipes of the instrument (with the source in the on position). Wipes are obtained by vigorous scrubbing using a dry cotton cloth.

7. Wipes should be obtained from the operating control rod.

8. Hold the center of the wipe cloth within two millimeters of the end window of the G.M. Tube. Record the gross sample count rate (Sg).

9. The activity in microCuries on the wipe is calculated from: A = Fc* (Sg - B)/1000.

10. If the wipe demonstrates activity above 25 nanoCuries (0.025 micro-Curies) the device under test will be immediately sealed in plastic. Decontamination/Disposal assistance will be obtained from the device manufacturer. The NRC will be notified as required by 10CFR.

11. If the wipe or the protective gloves demonstrate activity above 1 nanoCurie (approximately 2/x background gross count rate) said material will be disposed of as radioactive waste.

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ROBERT F. AVRUTIK

RESUME

Born March 23, 1924 - Yonkers, N. Y. - U. S. Citizen

Graduated - N. Y. U., 1949 - BEE Degree

1942 - 1945	U. S. Air Force - Radio repair airborne and fixed station equipment.
1948 - 1950	N. Y. U. Research Department (Secret Project - Radar Field).
1950 - 1955	General Precision Lab - Pleasantville, N.Y. Manufacturing and Production engineer on an airborne Doppler Radar Navigational System.
1955 - 1966	North American Philips Co., Instruments Div., Mount Vernon, New York.
(1955-60)	Project Engineer - Automatic X-ray Spectrograph and other X-ray units.
(1960-66)	Quality Control Manager - Testing all spectrographic and diffractometer X-ray systems and components. Assistant Company Radiation Safety Officer.
1966 - 1970	Philips Medical Systems, Inc. - National Service Manager and Company Radiation Safety Officer.
1970 - 1978	Philips Medical Systems, Inc. - Manager Quality Control and Quality Assurance, Company Radiation Safety Officer, Company Safety Officer. Responsible for all testing of medical X-ray equipment manufactured and imported.
1978 - present	Philips Medical Systems, Inc., Manager, Radiation Safety and Standards, Company Radiation Safety Officer. Responsible for company wide Radiation Safety program and training of all persons involved in X-ray use, testing and use of by-product material. Responsible for investigation of all radiation incidents involving Philips Medical Systems, Inc. equipment and/or personnel and reporting same to company management and government regulatory agencies involved.

Hold F.C.C. licenses.

	Since:
1st class, Radio-Telephone -	1949
2nd class, Radio-Telegraph -	1949
Extra class, Amateur Radio -	1942

Received approximately 25 hours of formal X-ray safety and biological health training.

Approximately 18 years practical on the job training in safety and measurement techniques.

Taught 1½ hour Radiation Safety and Biological Effects course to at least 500 employees and dealer representatives.

W. SCHOTT

RESUME

1959	B.A. Physics, Hunter College, N.Y.C.
1965	M.S. Physics, University of Pennsylvania, Philadelphia, Pa.
1960 - 1962	General Electric Company, Semi-conductor Products Department, Advanced Process Development Engineer
1962 - 1966	General Electric Company, Missile & Space Division, Project Engineer Electro-Optical Devices
1966 - 1968	Adcole Corporation, Project Engineer Sun Sensors
1968 - Present	Philips Medical Systems, Inc., Instrumentation Engineer, Project Engineer, Advanced Development, Supervisor, Systems Engineering

Working on design, development, modification and basic engineering of medical x-ray equipment for the past six years. Much involvement during this time with radiation leakage measurements, radiation detection measurements, and background measurements. Have used and am familiar with all Victoreen measuring instruments listed on application.

Received approximately ten hours of formalized radiation safety training in addition to courses in college on Quantum Physics.

SUMMARY OF RADIATION EXPERIENCE AND TRAINING

Angelo C. Veca - BSEE, MSES
PMSI Quality Assurance Manager, and Department Radiation Safety Officer

Has over (4) four years of experience working with radiation equipment. Designing equipment and test methods for systems and components, such as X-ray tubes for use by normal test personnel. Had to build in safety features and provide safe operating methods to prevent any accidental radiation accidents.

Has received the required PMSI Radiation Safety Training. Formal training was gained by undergraduate curriculum in Modern Physics and Classical Physics and laboratory studies, including practical use of various source materials.

Informal training has been gained by reading in subjects such as Biological Effects of Radiation on Living Organisms, Medical X-ray Technique, and by conducting radiation measurements with a Certified Radiation Physicist.

SUMMARY OF RADIATION EXPERIENCE AND TRAINING

D. Hartwig Blume
E perimental Physicist

P ofessional E ucation:	BS, Physics, Univ. of Munich, W. Germany, 1958. MS, Physics, Univ. of Freiburg, W. Germany, 1962 PhD., Physics, Univ. of Freiburg, W. Germany, 1967.
O cupations:	Research Associate, Dept. of Physics, Univ. of Freiburg, 1963-1967. Research Associate, Dept. of Physics, Lehigh Univ., Bethlehem, Pa., 1967-1969. Sr. Physicist, Carson Laboratories, Bristol, Ct., 1969-1973. Sr. Physicist, Dept. of Optics, National Bureau of Standards, Braunschweig, W. Germany, 1973-1975. Experimental Physicist, Philips Medical Systems, Inc., Shelton, Ct. since 1975.

Ex perience with Ionizing Radiation: From 1959 to 1969, research ac ivities were closely related to understanding the interaction of ionizing radiation with solids. Understandably radio-active sources and X-ray tubes were very frequently used tools. Research Associate duties at the Univ. of Freiburg included teaching laboratory courses which covered handling and uses of radio-active sources. Involved in the development of the Philips CT Scanner. Improved the X-ray optics such that the patient would be subjected to a minimum dose and that the most efficient use of the transmitted radiation was achieved. These activities have helped to develop alertness and responsibility and create sufficient knowledge of the hazards in the use of ionizing radiation.

Publications: Twelve (12) publications and five (5) papers presented at meetings of physical societies.

SUMMARY OF RADIATION EXPERIENCE AND TRAINING

Da'id C. Bonar
Ph'sicist

Ed.cation: BA, Physics, 1954, Rice Univ., Houston, Texas
MS, Physics, 1958, Yale Univ., New Haven, Conn.
PhD., Physics, 1962, Yale Univ., New Haven, Conn.

1:58-1969. Worked at Yale Univ. first as graduate student, then a: Research Associate, in polarized-ion-source development and e:periments, which involved using techniques of atomic physics t(advance nuclear physics accelerator technology.

A sembled and operated deuteron accelerators which caused pro-d:ction of fast neutrons and other particles.

- -Personally handled and installed 10-Curie (beta emitting) tritiated titanium unsealed targets.
- -Designed and assembled fast neutron counters with plastic scintillators.
- -Used cesium (gamma emitting) test source.
- -Used americium test source.
- -Installed and used surface barrier detectors for proton detection.
- -Used multichannel analyzer to obtain energy spectra of ionizing radiation.
- -Used Geiger and proportional survey meters.

1)72-1973 (one year). Worked at Brookhaven National Laboratory, Upton, N. Y., as Research Intern. The work involved a project to do groundwork towards developing a facility for irradiating patients with a beam of pions for therapeutic purposes.

Collaborated on an experiment which measured the yield of negative pions produced when a high energy proton beam strikes various targets.

- -Worked with Cerenkov counters and scintillation counters to detect various ionizing particles.
- -By study and participation in meetings and conferences, gained familiarity with the effects of high Linear Energy Transfer radiation on living tissue.
- -Was awarded a grant to attend a conference on particle radio-therapy in Los Alamos, New Mexico.

1977-present (over one year). Worked at Philips Medical Systems, Inc., Shelton, Conn., in physics lab.

-Operated computed-tomography diagnostic x-ray scanner for experimental evaluation of image quality.

-Worked with details of interactions of x-rays with matter; calculated x-ray absorptions in various plastics.

-Presently involved in a committee working to formulate recommendations to tighten radiation safety in the Engineering Department

RESUME OF CHARLES S. WORRILOW

EDUCATIONAL BACKGROUND: High School
Trade School (Toolmaker)
Service School (Electronics)
Bliss Electrical College
Evening College (Business Management)
Penn State University

MILITARY BACKGROUND: World War II, U.S.N.R., Honorable Discharge with rate of A.E.T.M. 1/C

EMPLOYMENT RECORD:

September 1972 to Present	Philips Medical Systems, Inc.
September 1972 to July 1975	District Manager of Philadelphia District
July 1975 to July 1977	Deputy National Service Manager with additional responsibilities for: 1. Service Spare Parts Department 2. Service Documentation 3. Radiation Safety Officer for National Service Department
July 1977 to Present	Manager of Installations responsible for: 1. Assuring compliance with legal requirements of "The Radiation Control for Health and Safety Act of 1968". 2. Establishing safe procedures to be observed during the installation phase of Diagnostic and Theraputic X-ray facilities. 3. Development of specialized equipment to facilitate safe handling of delicate yet heavy X-ray apparatus. 4. Served as company representative on the NEMA subcommittee for Installation Quality Assurance.

5. Continued as Radiation Safety Officer for the National Service Department.

6. As of January 1, 1984, assumed the role of Company Radiation Safety Officer.

December 1968 to August 1972

Picker X-Ray Corporation
Technical Sales Consultant

Assisting Sales Department in specification and marketing of highly specialized X-ray installations.

January 1967 to December 1968

Richard Chamberlain, M.D. Associates
(Hospital of the University of Pennsylvania)
Advisor to the Director of Radiology

1. Supervision of Mechanical Plant.
2. Specification writing for equipment.
3. Development of specialized equipment.
4. Selection of new equipment.
5. Development of routine testing procedures for diagnostic rooms.
6. Assisting the Physics Department in maintenance of Varian 6 MEV Lin Ac and Van DeGraff generator.
7. Room design and work flow study.
8. Assisting in the training of residents and students in X-ray Physics and Radiation Safety.

April 1965 to January 1967

Picker X-Ray Corporation
District Manager

1. Complete responsibility for equipping and staffing a new district office, including the procuring and training of an office staff.
2. Complete responsibility for all phases of a district operating from three locations: consisting of (3) Service Managers, (2) Service Supervisors, (2) Dispatchers, (30) Service Engineers, (3) Clerks, (1) Solution Service Coordinator, (4) Processor and Solution Servicemen.

3. Established a chemical mixing plant, including silver reclaiming by both the mechanical and precipitate methods.

4. Complete responsiblity for the following:

   a. Budget preparation and maintenance.

   b. Personnel management and training.

   c. Establishment of pricing and discounts on processing chemicals, used equipment labor and service contracts.

   d. Purchasing of supplies for resale.

   e. Inventory maintenance.

5. Serving as a regular member of the seven member "Product Improvement Committee" meeting quarterly at the factory and charged with:

   a. Improvement of production equipment through evaluation of field experience.

   b. Testing and evaluation of proto-type products.

   c. Determination of effectiveness of plant quality control

October 1962 to April 1965

Picker X-Ray Corporation
Regional Service Manager

Duties consisted of coordination, training and overall responsibility for the operation of two district service departments. Total number of employees under my control ranged from 24 to 34. This position in many respects was a staff position because the District Sales Manager was responsibile for the operation of the respecti service departments.

September 1958 to October 1962

Picker X-Ray Corporation
Service Manager

Duties consisted of day-to-day operation of a service department reporting directly to the District Sales Manager.

April 1955 to September 1958	Picker X-Ray Corporation Service Supervisor Acting Service Manager from September 1955 to September 1958 Duties were the same as that of Service Manager. There was no Service Manager during this period.
September 1951 to April 1955	Picker X-Ray Corporation Sales Engineer Covered 21 counties in Northeastern Pennsylvania with sales and service.
September 1947 to September 1951	Picker X-Ray Corporation Service Engineer Worked in the Philadelphia area and in the Cleveland area for six months.
1947	Picker X-Ray Corporation X-Ray Service Trainee
1946	Textile Machine Works; Reading, Pennsylvania Trainee Erector for knitting machines. Left to get employment in the electronics field.
1943 to 1946	World War II Active duty in U.S.N.R.
	Prior to February 1943, I was a student with summer employment.

CLUBS: Member and Past Commander of the Main Line Power Squadron, a unit of the United States Power Squadrons. Member of the Coast Guard Auxiliary.

HOBBIES: Boating, Golf, and bridge.

STEPHEN BALTER

CURRICULUM VITAE

Date of Birth:	November 13, 1940, New York City
Home Address:	420 East 72nd Street New York, New York 10021 (212) 249-5061
Office Address:	Philips Medical Systems, Inc. 710 Bridgeport Avenue Shelton, Connecticut 06484 (203) 929-7311
Boards:	American Board of Radiology, Certificate in Radiological Physics - 1973 Certification Commission: Clinical Engineering - 1976
Education:	B.S. - Polytechnic Institute of Brooklyn - 1961 M.S. - Columbia University - 1963 Ph.D. - Polytechnic Institute of Brooklyn - 1971 (Absorption in Simultaneous Borrmann Diffraction)
Honors:	Society of the Sigmi Xi
Societies:	American College of Radiology American Association of Physicists in Medicine Radiological Society of North America Radiological and Medical Physics Society of New York Institute of Electrical and Electronic Engineers New England Radiological Physics Organization American Association of Physics Teachers Society for Radiological Engineering
Appointments:	Memorial Hospital for Cancer and Allied Diseases, New York City 6/63 - 6/71 Consultant in Physics, Memorial Hospital for Cancer, New York City 6/71 - Present Assistant Attending Physicist, The New York Hospital, 10/69 - 6/71 Instructor in Radiology, Cornell University Medical College, 1/68 - 12/72 Chief Physicist, St. Vincent Hospital, Worcester, Mass. 7/71 - 9/75 Assistant Professor of Radiology, University of Mass. Medical School, 9/71 - Present Co-Chairman Committee on Physics of Diagnostic Radiology, AAPM, 12/67 - 7/71 Executive Committee, NERPO 6/73 - 6/75 Diagnostic Committee, AAPM 7/74 - Present Staff Physicist, Philips Medical Systems, Inc. 9/75 - Present

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Societies:	American College of Radiology American Association of Physicists in Medicine Radiological Society of North America Radiological and Medical Physics Society of New York Institute of Electrical and Electronic Engineers New England Radiological Physics Organization American Association of Physics Teachers Society for Radiological Engineering
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Appointments:	Memorial Hospital for Cancer and Allied Diseases, New York City 6/63 - 6/71 Consultant in Physics, Memorial Hospital for Cancer, New York City 6/71 - Present Assistant Attending Physicist, The New York Hospital, 10/69 - 6/71 Instructor in Radiology, Cornell University Medical College, 1/68 - 12/72 Chief Physicist, St. Vincent Hospital, Worcester, Mass. 7/71 - 9/75 Assistant Professor of Radiology, University of Mass. Medical School, 9/71 - Present Co-Chairman Committee on Physics of Diagnostic Radiology, AAPM, 12/67 - 7/71 Executive Committee, NERPO 6/73 - 6/75 Diagnostic Committee, AAPM 7/74 - Present Staff Physicist, Philips Medical Systems, Inc. 9/75 - Present

TECHNICAL DATA

9

THE VICTOREEN INSTRUMENT DIVISION
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104
A Division of VLN Corporation

VICTOREEN

GAMMA SURVEY INSTRUMENT CALIBRATOR

Model 64-764

- **For use in radiation fields from 2 mR to 1 R/hr.**
- **Non-removable Cesium-137 source; long half-life.**
- **Automatic timer limits exposure periods.**
- **Container meets requirements of the A.E.C. and Agreement States.**

Model 64–764
In Stored Position

This safe, sturdy, easy-to-use device permits the fast and accurate calibration of instruments used for surveying gamma radiation. It enables users of dosage-measuring equipment to perform routine checks at will or as necessary to meet the regulations of the A.E.C. and Agreement States. This simple, fool-proof system is a time and money saver . . . it does away with the expense, inconvenience and work-time lost when sending such instruments to an outside calibration service.

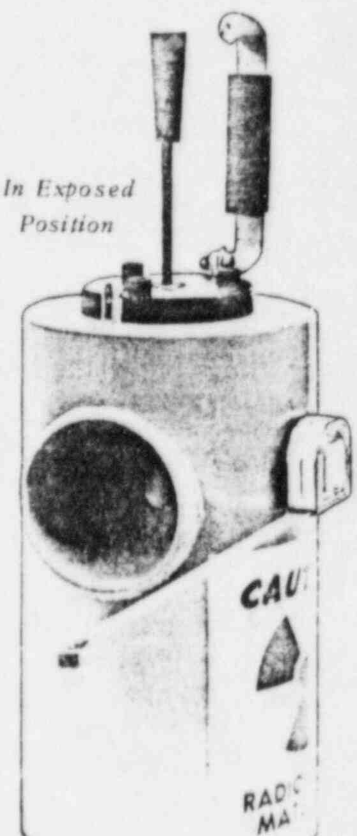
Consists of a heavy-duty container that holds 100 mc of Cesium-137 encapsulated at one end of a control rod. Since Cs-137 has a long half-life of 29 years, there is no need to calculate a correction factor for at least 1 or 2 years after the instrument has been received in the laboratory.

The source is kept in either of 2 positions: stored or exposed. In the fully-shielded "stored" position, radiation at the container's surface is less than 60 mr/hr; at 6" away it is less than 15 mr/hr. In the "exposed" position, the source faces a 45° port at the side of the shield, and the field can vary from 2 mr to 1 R/hr. The source is moved from "stored" to "exposed" merely by raising the control rod. For safety, the Cs-137 source cannot be removed from its shield except by the manufacturer.

For safety, the Calibrator includes a preset timer which limits the source's exposure period (1 to 60 minutes). At the expiration of the selected period, the source automatically drops to its safe storage position. Therefore, the source cannot remain exposed accidentally after an instrument has been calibrated.

Includes a built-in tape measure which helps accurately determine the distance from the Cs-137 source to the instrument being calibrated. A key-lock prevents any unauthorized use of the equipment. Convenient carrying handle. Measures 13" high x 7" D. Weighs 75 lbs.

In Exposed Position



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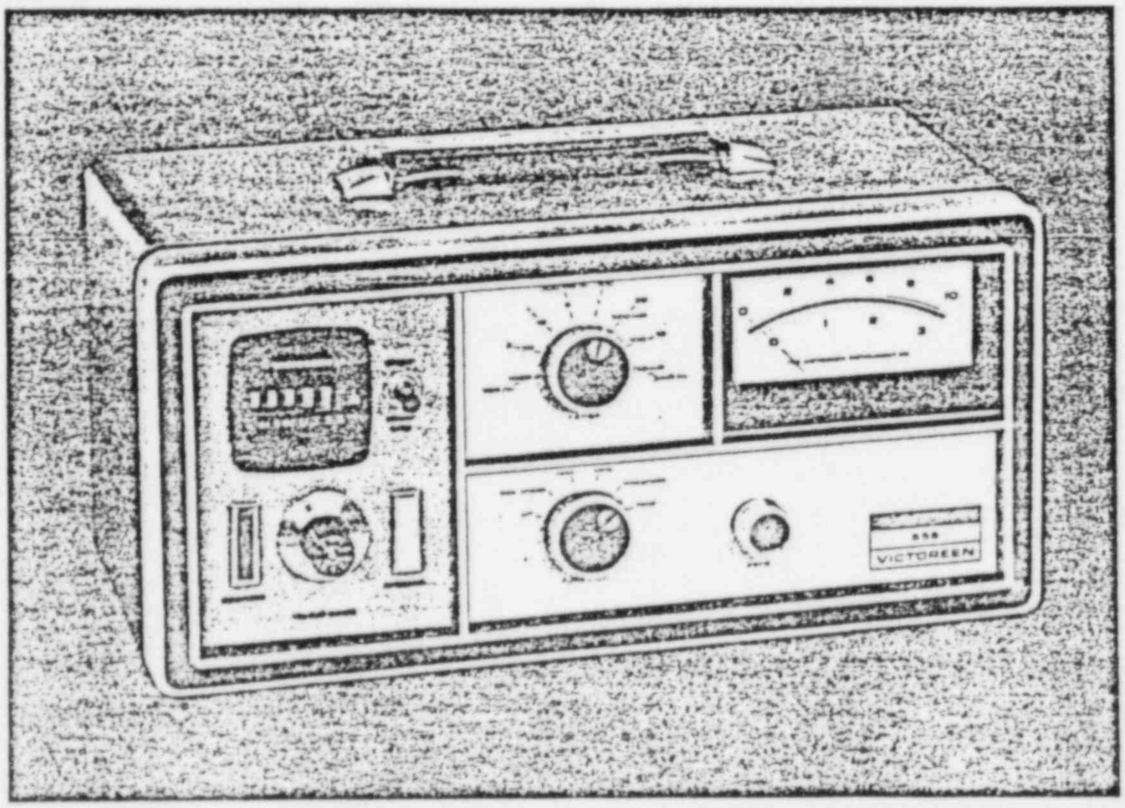
Litho in USA

INTEGRATING RATEMETER
MODEL 555 / RADOCON II



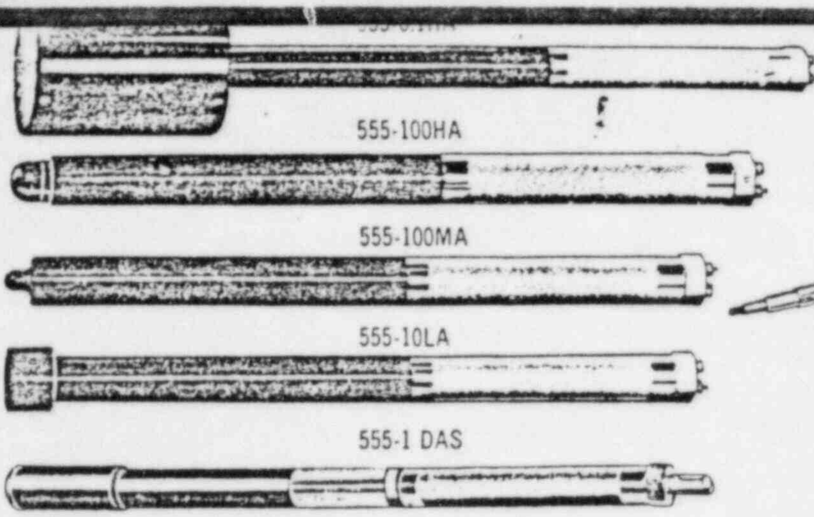
- Measures Exposure Rate and Total Exposure Over Wide Dynamic Range to Cover Diagnostic and Therapeutic Procedures.
- Wide Probe Selection for Direct Beam or Scatter Measurements.
- Diagnostic Probes That Help User Fulfill F.D.A. Requirements.
- Intra-Cavity Probes Permit Exact Positioning of Applicator in Radium Implant Studies.
- Guarded Electrode Ion Chambers Offer Essentially Zero Stem Effect.
- Optional Timer-Trip Plug-In Module for Automatic Control of Total Exposure.

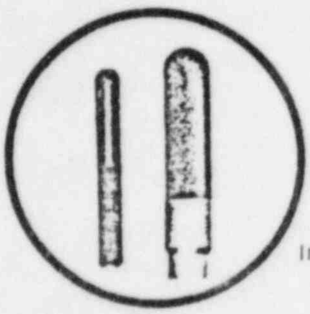
Measures Accurately, Precisely and Reliably, Beam Characteristics and Exposure Levels in Wide Range of Therapeutic and Diagnostic Procedures...Several Ion Chamber Probes Available for Almost Any Application... Plug-In Module for Timer-Trip Control of Total Integrated Exposure.

Model 555 Radocon II has been designed specifically for radiation beam measurement and control, particularly for applications involving diagnostic and therapeutic procedures. As an integrating ratemeter, the 555 is ideal in many laboratory and field applications — including flux mapping, installation surveys, entrance or exit measurements and phantom measurements.

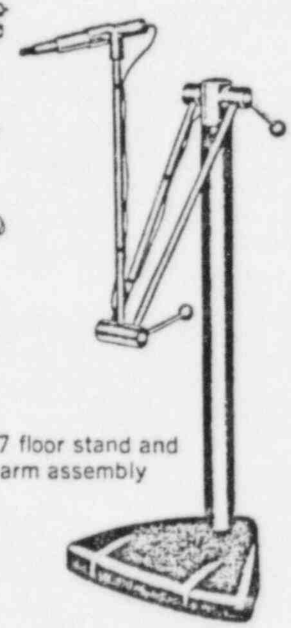
Victoreen's diagnostic probes can help assure the use of minimum exposure to make a higher quality diagnostic radiograph. The microminiature 1000 IC probe can be used with catheter in the urethra or in sinus cavities. The 100 IC probe can be positioned in the esophagus, or can be inserted in the rectum for double-checking source position in conjunction with the Ernst applicator. Both probes can be used with a phantom.

Several probes may be used in water phantoms, beam flatness phantoms or even with build-up equilibrium caps for high energy accelerator applications. Calibration of Victoreen's Model 555 Radocon II is directly traceable to the NBS. The Radocon II, when used with Victoreen special probes, gives a unique degree of patient radiation protection and assurance in diagnostic or therapeutic procedures.





Intra-cavity probes (actual size)



Model 381-157 floor stand and adjustable arm assembly

APPLICATIO
^{60}Co Therapy, Accelerators, Betatrons, High Energy Machines, Isodose Plots, Depth Dose
Orthovoltage and Deep Therapy Machines, Beam Flatness Phantoms
Grenz Rays, Superficial Therapy
Beam Flatness and Water Phantoms
Diagnostic—Helps Hospital to Meet New F.D.A. Std's. for Diagnostic Procedures
Intra-cavity Entrance and Exit Dose, In Esophagus, Rectum, Sinus Cavities, Urethra or Bladder

Radiation Measured: Beta, Gamma and X-ray.

Ranges: Range indications on front panel of console are multiplied by appropriate scale multiplication factor applying to probe assembly being used.

Rate Ranges - 3, 10, 30, 100, 300 mR/min. and 1, 3, 10 R/min. fullscale.

Integrate Ranges - 30, 100, 300 mR and 1, 3, 10, 30, 100 R fullscale.

Accuracy: Overall system accuracy within ± 5% fullscale indication excluding energy response.
Calibration accuracy is generally better than ± 5% excluding bone equivalent and intra-cavity probes.

Precision: Better than ± 1% on both integrate and rate functions.

Response Time: During Rate Function (calculated at 0 to 90% fullscale): 10, 3, 1 R/min. and 300, 100 mR/min. ranges - 3.3 seconds; 30, 10 and 3 mR/min. ranges - 6.2 seconds.

Operating Temperature Range: 0° to 50°C (32°F to 122°F).

Operating Humidity Range: 0 to 80% relative humidity.

Detectors: Thimble chamber type probes. 10 ft. coaxial cable connects probe to preamplifier unit. (8 ft. for intra-cavity probes); 50 ft. cable connects preamplifier to readout console.

(See Probe Selection Chart for individual probe specifications)

Circuitry: Vibrating reed and solid state.

Zero Stability: Drift less than ± 0.2% of fullscale on most sensitive range after 30 minutes warm-up in 24 hours of constant temperature, non-cumulative.

Meter: 4 in. (10.16 cm) panel mounted, 1% accuracy fullscale.

Recorder Output: 0 - 10 mV

DVM Output: 0 - 30 V.

Power Requirements: Approximately 10 watts for 115 volts a.c. or 230 volts a.c., ± 15%, 47 to 63 Hz; 12 volts at 200 ma output from external battery, if used. Instrument automatically switches in event of line failure, if connected to auxiliary battery power.

Overall Dimensions:

Readout Console - 8-1/2 in. (21.6 cm) high, 15-1/2 in. (39.4 cm) wide, 9 in. (22.9 cm) deep.

Remote Head Preamplifier - 3-1/2 in. (8.9 cm) high, 9-1/2 in. (24.1 cm) wide, 7 in. (17.8 cm) deep.

Carrying Case - 17 in. (43.2 cm) high, 18-1/2 in. (47 cm) wide, 11-1/2 in. (29.2 cm) deep.

Standard Probes - 5/8 in. (1.6 cm) diameter stem (excluding thimble chamber), 10-1/2 to 14-3/4 in. (26.7 - 37.5 cm) long, depending on chamber utilized.

Intra-cavity Probes - 0.23 in. max. (0.58 cm) diameter, 13/16 in. (2.1 cm) long, detector for Model 555-100 IC. 0.115 in. max. (0.29 cm) diameter, 1/2 in. (1.27 cm) long, detector for Model 555-1000 IC. Both probes are furnished with 8 ft. (244 cm) integral cable plus six catheters. A separate carrying case is supplied with the 100 IC probe.

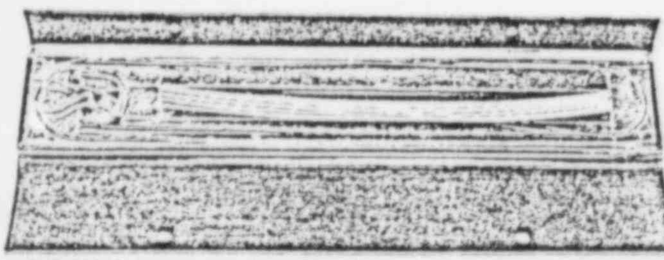
Net Weight: 44.2 pounds (20 Kg), including console, preamplifier, cable and carrying case.

Shipping Weight and Volume: 50 pounds (22.7 Kg), 2.5 cu. ft. (.07 m^3)

ACCESSORIES

Model 555-50 Timer-Trip Module: Provides both timing and trip control functions. Timing range covered is from 0 to 999.99 min in increments of .01 min. The % Full Scale selector allows user to select from 10 to 100% of any chosen integrate range. Instrument automatically trips when preselected percentage has been reached. Connection can be made to On-Off controls of X-ray unit or shutter mechanism of other radiation sources for automatic control of total exposure. (Illustration shows timer-trip module plugged into Model 555). In addition, instrument can be switched to Hold which will also stop timer and trip. The X-ray unit can then be restarted by switching back to Integrate which then continues exposure without loss in previous exposure or time of exposure to within ± 1% of fullscale.

Model	Energy Response		Sensitivity Range (Rate)	Integrate Range (Exposure)	Thimble Parameters				Intensity Limit (Integrate Mode)	Beta Cut-Off	Multiply Scale Reading By
	Tolerance %	keV Eff.	Full Scale mR/m R/m	Full Scale mR-R	Type	Wall Material	Thickness mg/cm²	Volume cc	R/Min.	MeV	
555-0.1HA	± 5	200-1300	0.3-1	3-10	Air Equiv.	Phenolic	643	97.4	8	1.45	x.1
555-1HA	± 5	200-1300	3-10	30-100	Air Equiv.	Delrin	569	9.74	135	1.31	x1
555-10HA	± 5	200-1300	30-100	300-1000	Air Equiv.	Delrin	575	0.974	30,000	1.32	x10
555-100HA	± 5	200-1300	300-1000	3000-10,000	Air Equiv.	Delrin	533	0.0974	450,000	1.25	x100
555-0.1 MA	±10	35-660	0.3-1	3-10	Air Equiv.	Phenolic	212	97.4	8	.62	x.1
555-1 MA	±10	35-660	3-10	30-100	Air Equiv.	Delrin	252	9.74	135	.71	x1
555-10 MA	±10	35-660	30-100	300-1000	Air Equiv.	Delrin	144	0.974	30,000	.47	x10
555-100 MA	±10	40-300	300-1000	3000-10,000	Air Equiv.	Delrin	144	0.9740	450,000	.47	x100
555-10 LA	± 7	6.5-42	30-100	300-1000	Air Equiv.	Mylar	6.6	0.974	6,000	.066	x10
555-100 LA	± 3	6.5-42	300-1000	3000-10,000	Air Equiv.	Mylar	6.6	0.0974	100,000	.066	x100
555-10 MB	±15	40-660	30-100	300-1000	Bone Equiv.	Magnesium	177	0.974	30,000	.54	x10
555-100 MB	±15	40-660	300-1000	3000-10,000	Bone Equiv.	Magnesium	177	0.0974	450,000	.54	x100
555-0.1 DAS	±10	10-400	0.3-1	3-10	Air Equiv.	Flexible	46	97.4	8	.20	x.1
555-1 DAS	±10	35-400	3-10	30-100	Air Equiv.	Propionate	46	9.74	135	.20	x1
555-100 IC	±15	30-Up	300-1000	3000-10,000	Intra-cavity	Delrin	151	0.0974	2000	.50	x100
555-1000 IC	±20	60-Up	3000-10,000	N/A	Intra-cavity	Fansteel	220	0.0048	N/A	.66	x1000

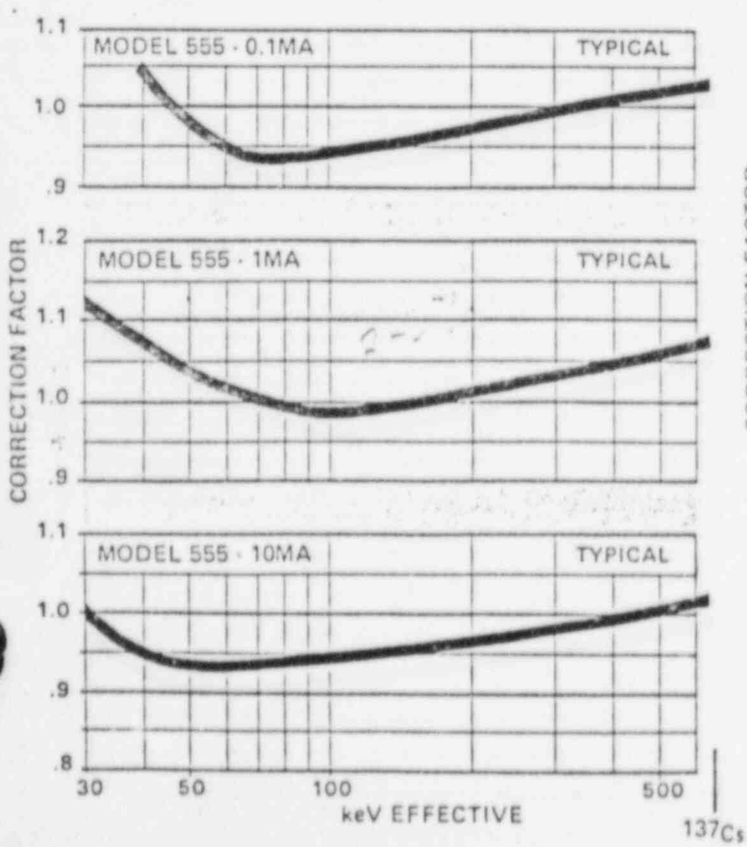


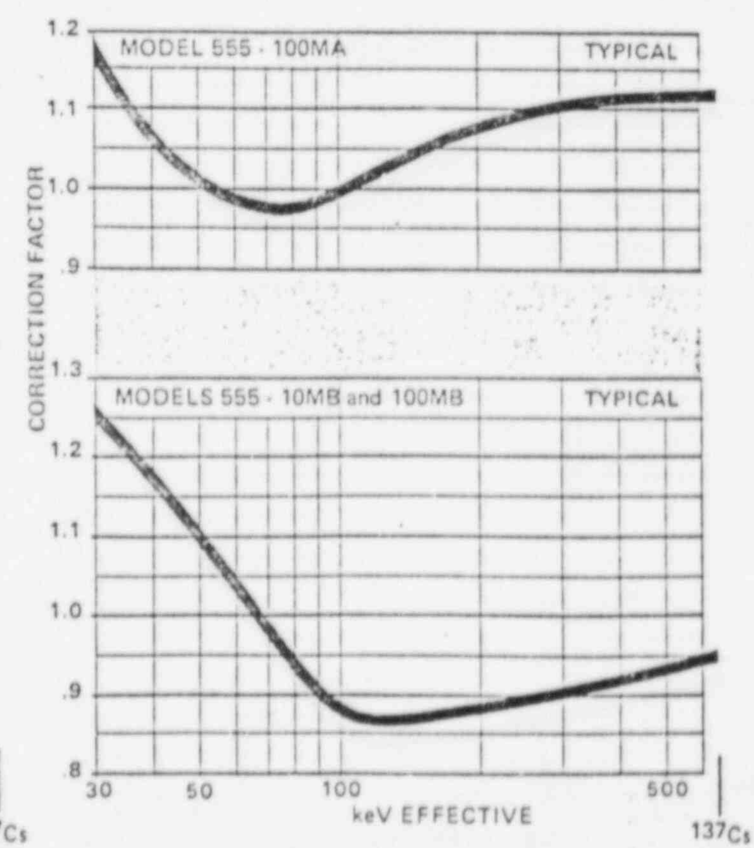
555-100IC intra-cavity probe with catheters and carrying case.

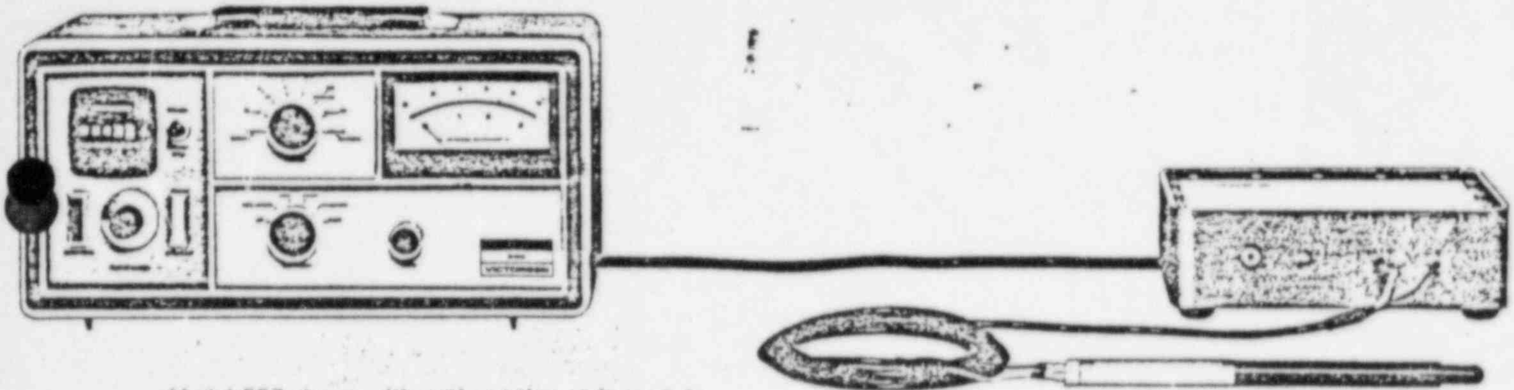
CATHETERS FOR INTRA-CAVITY PROBES

Probe Model No.	Catheter Model No.	O.D. CM	I.D. CM	Material	Qty. Per Pkg.
555-100 IC	555-298	0.90	0.635	Latex	6
	555-305	0.60	0.585		10
555-1000 IC	555-279	0.355	0.305		6
	555-280	0.585			6

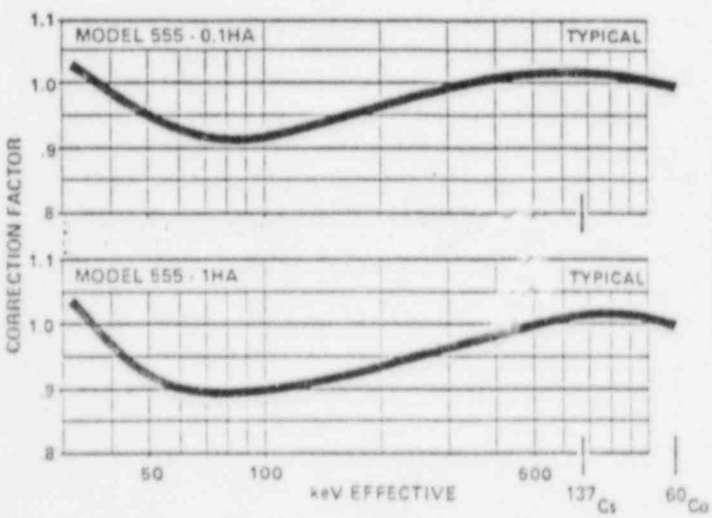
RESPONSE CURVES

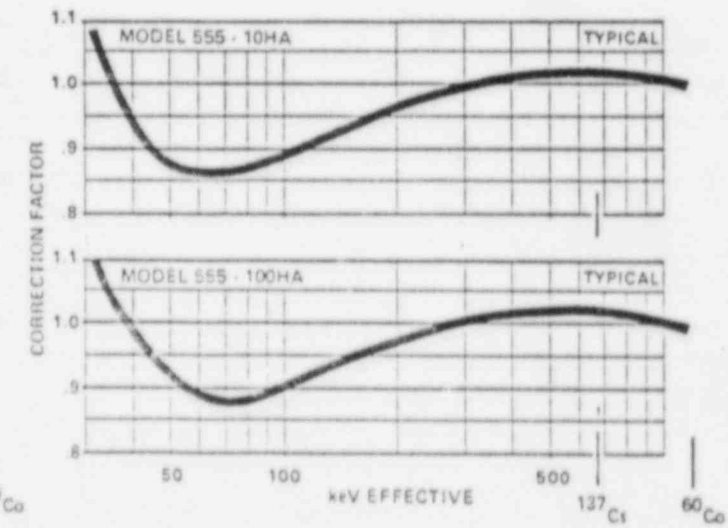


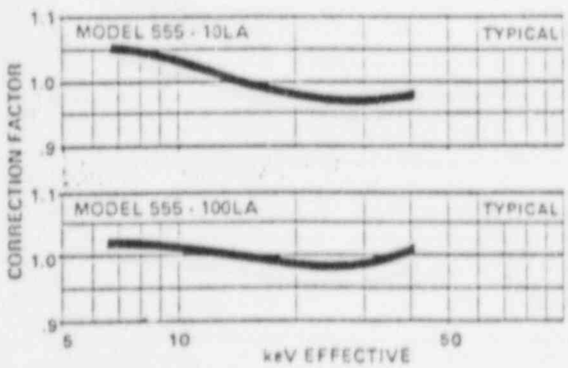


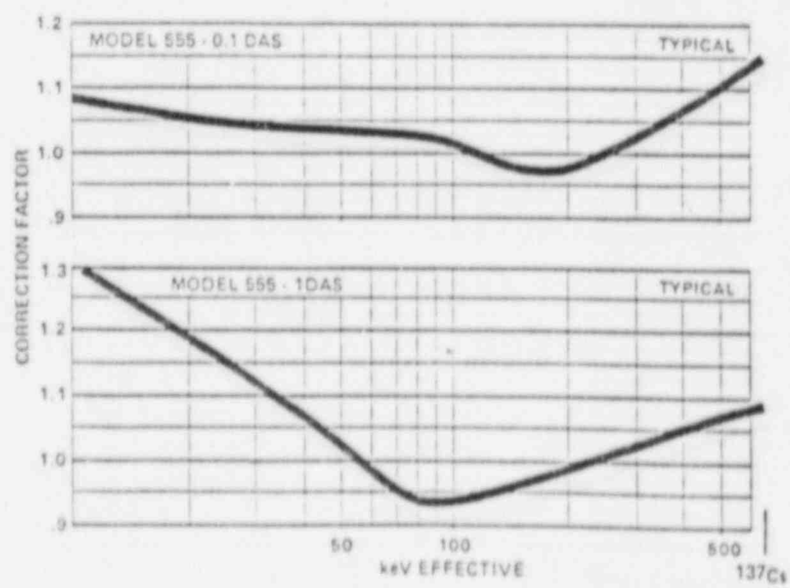


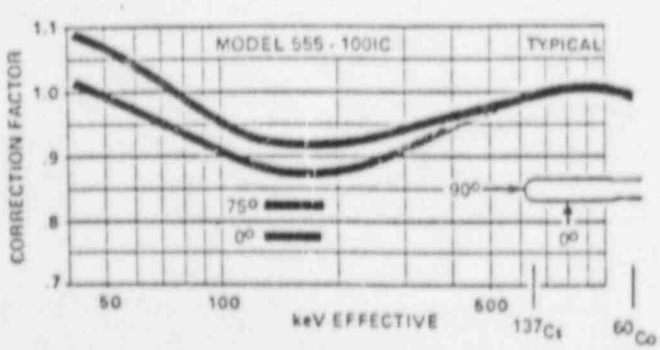
Model 555 shown with optional timer-trip module

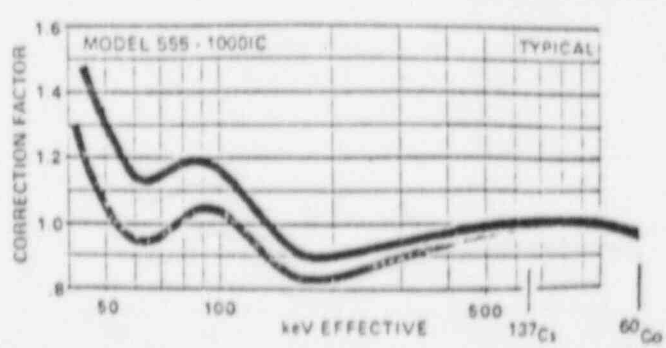






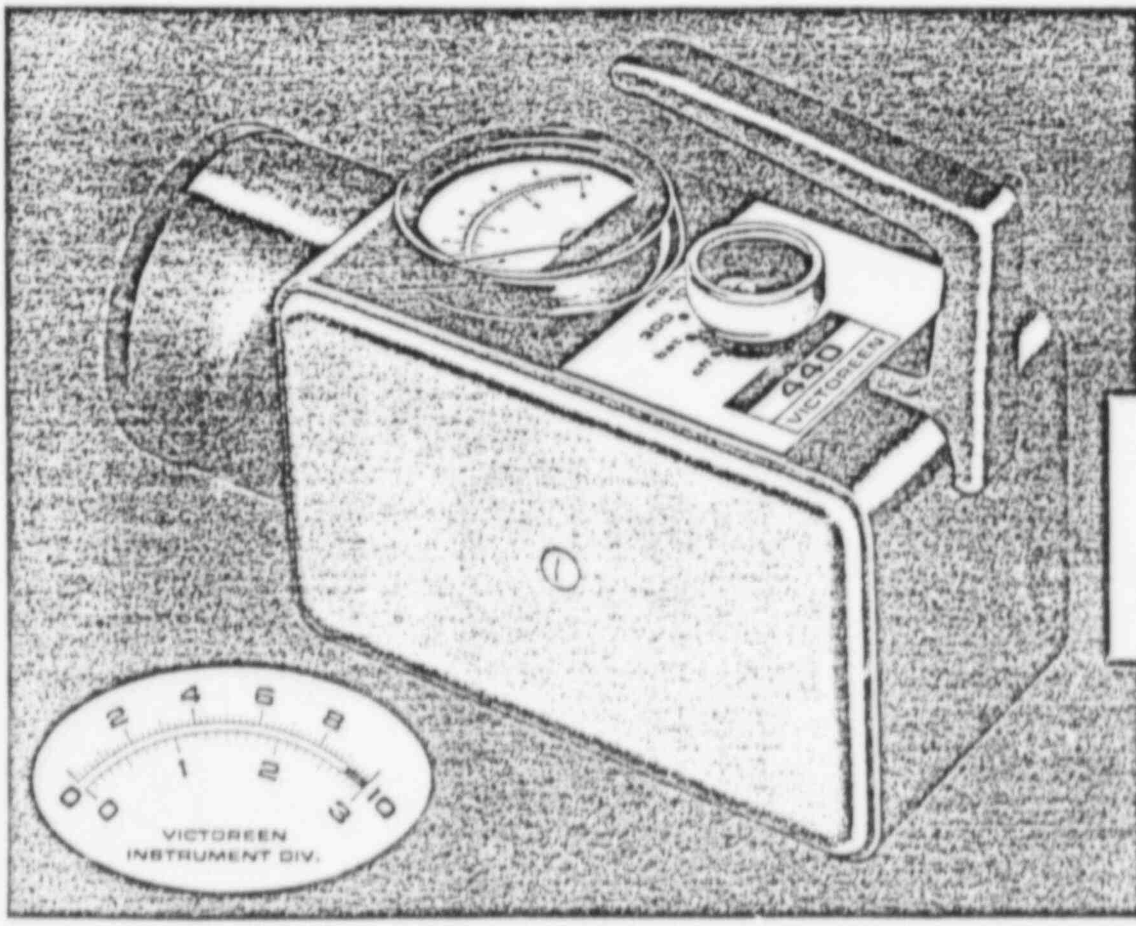






LOW ENERGY

MODEL 440 / SURVEY METER



A Highly Sensitive and Accurate Ion Chamber Survey Meter...the Non-Sealed Air Chamber Uses Extremely Thin Aluminized Mylar Window Material for Superior Low Energy Response... Equilibrium Wall Thickness Is Maintained for High Energy Surveys Through the Use of an Aluminum End Cap Which Also Provides Beta Discrimination.

- Accurate Measurement of Alpha, Beta and a Broad Energy Range of X and Gamma Radiation.
- Extreme Sensitivity Over a Broad Energy Range from 7 keV to 1.3 MeV Gammas in Five Overlapping Linear Ranges from 0 - 3 mR/Hr to 0 - 300 mR/Hr Fullscale.
- Dynamic Capacitor Design and Solid-State Circuitry for Reliable, Ultra-Stable Field Operation with Minimal Battery Drain.
- Simple to Operate and Easy to Use.

Model 440 has long been the world's accepted instrument for the solution of a difficult problem - measurement of extremely low energy X and gamma radiation mixed with high energy photons. In applications concerning low energy X-ray fluorescence, the 440 exhibits response characteristics ideal for routine radiation survey. Vibrating reed design provides a hard zero with sensitivity and accuracy characteristics unequaled by conventional survey meters. Alpha and beta radiation can readily be detected while X and gamma are measured with fine precision.

MODEL 440

Radiation Detected: Alpha above 4 MeV, beta above 100 keV, gamma and X-ray above 7 keV.

Operating Range: Exposure rate in five overlapping linear ranges; 0-3, 10, 30, 100 and 300 mR/hr.

Accuracy: Within ±10% of fullscale indication exclusive of energy dependence.

Precision: Within ±4% on readings over 30% of fullscale on any range.

Detector: Air ionization chamber with 3-1/2 in. (8.90 cm) diameter, 3.0 mg/cm^2 mylar end-window. 1/16 in. (0.16 cm) thick bakelite wall and protective aluminum end cap for alpha and beta discrimination. Chamber depth 2 in. (5.1 cm), 19.2 cu. in. (314 cc) volume.

Energy Dependence: Within ±10% from 30 keV to 1.3 MeV with end cap, ±15% from 7 keV to 1.3 MeV without end cap.

Warmup Time: Approximately 3 minutes when used at ambient room temperature. Up to 1/2 hour when exposed to 20°F or larger temperature change from ambient conditions.

Response Time: 20 seconds on 0-3 mR/hr range, 12.5 seconds on all other ranges.

Switching Transients: Negligible after warmup.

Drift: Negligible drift over 24 hour period.

Zero Adjust: Vibrating reed provides a "hard" zero even on the most sensitive range. No zero adjust required.

Environmental Effects:

Temperature Operating Range: -40° to +120°F (-40° to +50°C) except for batteries.

Temperature Dependence: Within ±10% from 32° to +120°F (0° to +50°C). Use alkaline batteries below 32°F.

Pressure Dependence: Unsealed ion chamber, uses standard air density correction factors.

Humidity Range: Less than ±5% from 0-95%.

Power Requirements:

Battery Complement and Life: Four (4) "D" size cells, NEDA type 13. Battery life is approximately 100 hours at four (4) hours per day.

Controls: Single rotary switch for Power and Range switching marked; Off, Battery Check, X300, X100, X30, X10 and X3.

Readout: Meter, 3-1/2 in. (6.4 cm) scale marked 0-3 and 0-10 in units of mR/hr.

Geotropism: Approximately ±2% of fullscale determined by rotating instrument through 360° in each of two planes normal to each other and perpendicular to the ground.

Case Construction: Splash-proof, 3/32 in. aluminum wrap-around with sheet metal sides; printed aluminum operating control panel; special mar-resistant matte finish.

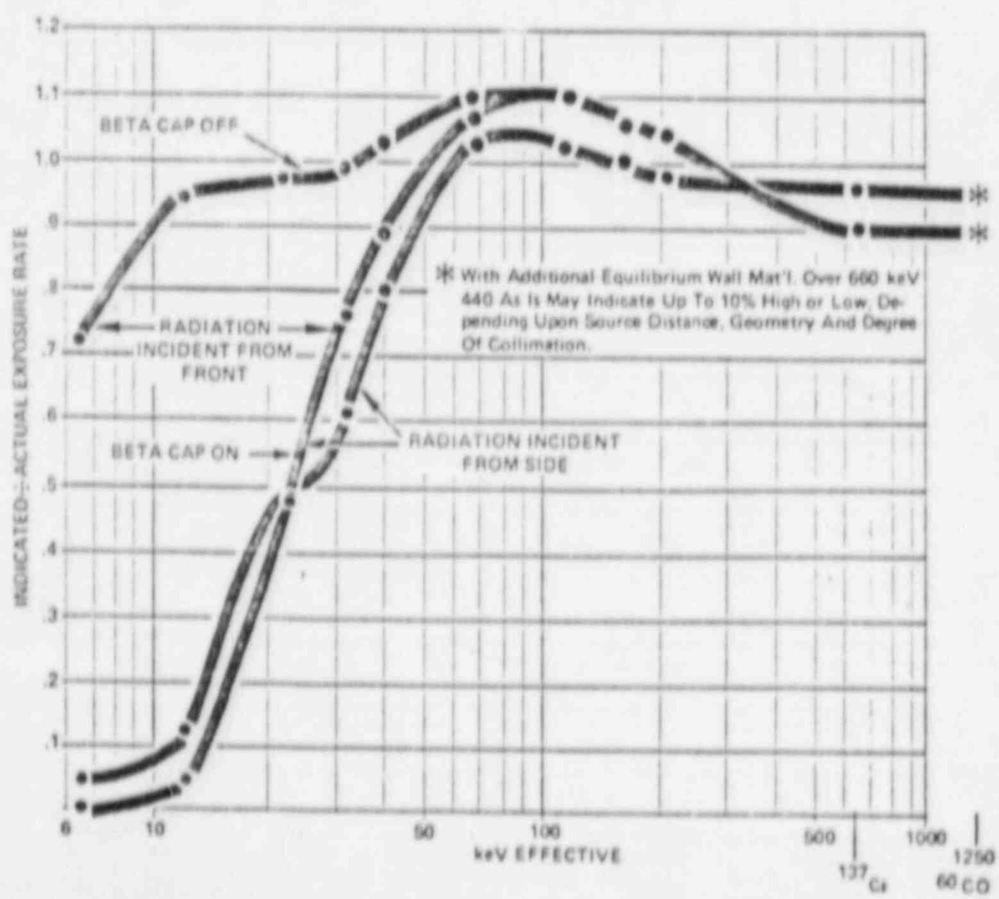
Overall Dimensions:

10 in. (25.4 cm) long
4 in. (10.2 cm) wide
7-1/2 in. (19.0 cm) high

Net Weight: 5 pounds (2.26 Kg).

Shipping Weight and Volume: 10 pounds (4.55 Kg), 2.5 cu. ft. (0.071 m^3).

RESPONSE CURVES

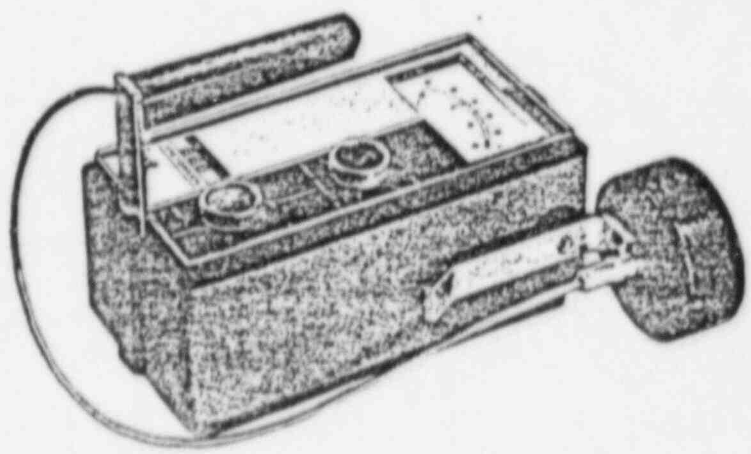


TECHNICAL DATA

VICTOREEN
THE VICTOREEN INSTRUMENT DIVISION
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104
A Division of VLN Corporation

Model 666 . . . Fluoroscopic Survey Meter

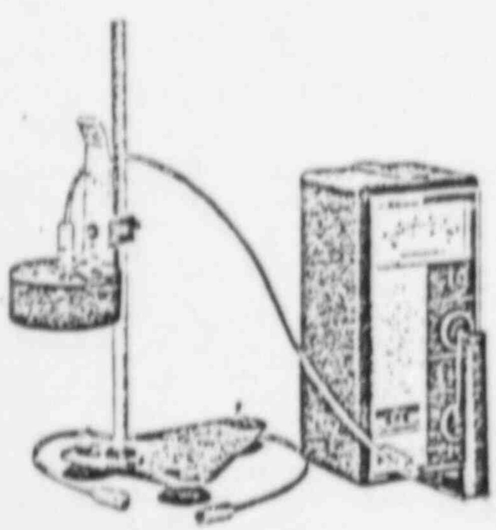
Model 666 is designed to check the requirements set forth in Handbook 76 for monitoring fluoroscopic, dental and other x-ray installations. An extremely desirable combination of features and instrument capability further enhance the use of this instrument for general survey and dosimetry applications.



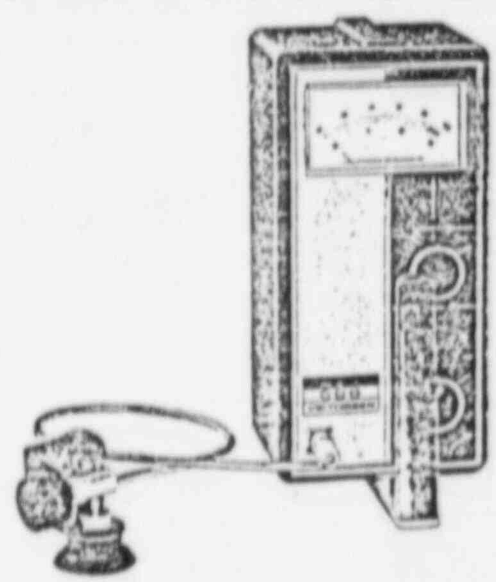
Model 666 with Background Probe.

FEATURES

- Accurate Stray Radiation Measurement on 0-0.3 mR integrate range.
- Accurate Direct Beam Measurement on 0-3 R integrate range.
- Interchangeable Probes for local or remote operation.
- Wide Exposure Rate Range from 3 mR/hr. to 30,000 R/hr. fullscale.
- Broad Energy Response from 20 Kev to 1.2 Mev.
- "Drift-Free" Vibrating Reed Stability.



Model 666 with Background Probe, Holder Attachment and Stand.



Model 666 with Diagnostic Probe and Holder Attachment.

Specifications on Reverse Side

SPECIFICATIONS

Radiation Detected: X-ray and gamma.

Exposure Rate Range: Scale reads from 3 mR/hr. to 300 R/hr. fullscale in ten linear ranges. Read scale directly with background probe. Multiply scale reading by 100 with diagnostic probe.

Integrate Range: Scale reads from 3 mR to 300 mR fullscale in five linear ranges. Multiply scale reading by 0.1 with background probe and 10 with diagnostic (small) probe.

Accuracy: Maximum instrument inaccuracy, exclusive of energy dependence, is less than ±10% of fullscale indication.

X and Gamma Energy Response: ±10% from 20 Kev to 1.2 Mev with background probe; ±20% with diagnostic probe.

Time Constant: 5 seconds with 2 foot cable assembly; 10 seconds with 20 foot cable assembly.

Drift: None — Vibrating Reed Stability results in "Hard Zero".

Detectors:

Background Probe — Air Ionization Chamber, 4" (10.1 cm) diameter x 1¼" (3.2 cm) high. Volume 237 cc. Wall material ¼" phenolic (220 mg/cm²).

Diagnostic Probe — Air Ionization Chamber, 1¼" (3.2 cm) diameter x ⅝" (1.4 cm) high. Volume 2.37 cc. Wall material ¼" phenolic (220 mg/cm²).

Circuitry: All solid state.

Temperature Range: Within accuracy limits from −20°F (−29°C) to 125°F (51°C), excluding batteries, when instrument is allowed to reach thermal equilibrium. Alkaline batteries are recommended at temperatures below 32°F (0°C).

Humidity Range: No effect from 0 to 90% RH.

Battery Complement: Four "D" size flashlight cells, NEDA Type 13.

Battery Life: Approximately 100 hours at 4 hours per day.

Items Furnished With Instrument: Background and diagnostic probes; 2 feet and 20 feet probe cable assemblies; stand and holder; 0.5 mm, 1 mm and 2.5 mm A1 filters and fluorescent screen; fitted carrying case to accommodate instrument and all accessories and operation manual.

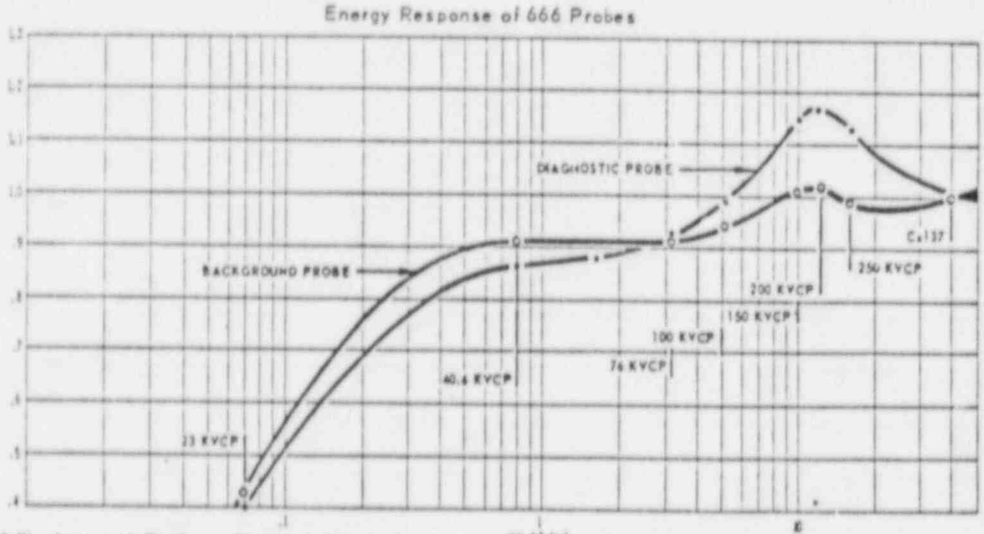
Dimensions: Instrument, 11¾" (29.8 cm) long x 5¾" (14.6 cm) wide x 8¾" (22.2 cm) high. Probe Stand, 17¾" (44 cm) high, 30⅝" (77.7 cm) with extension fixture.

Net Weight: Instrument only — 9 pounds.

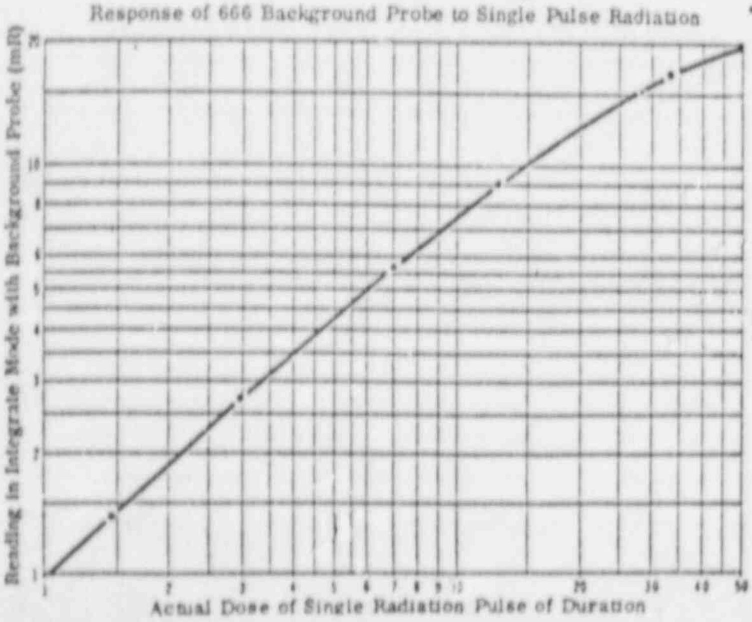
Gross Weight: 19 pounds. Includes instrument, probes and accessories in fitted carrying case.

Shipping Weight and Volume: 35 pounds; 16 Kg; 2.5 cubic feet.

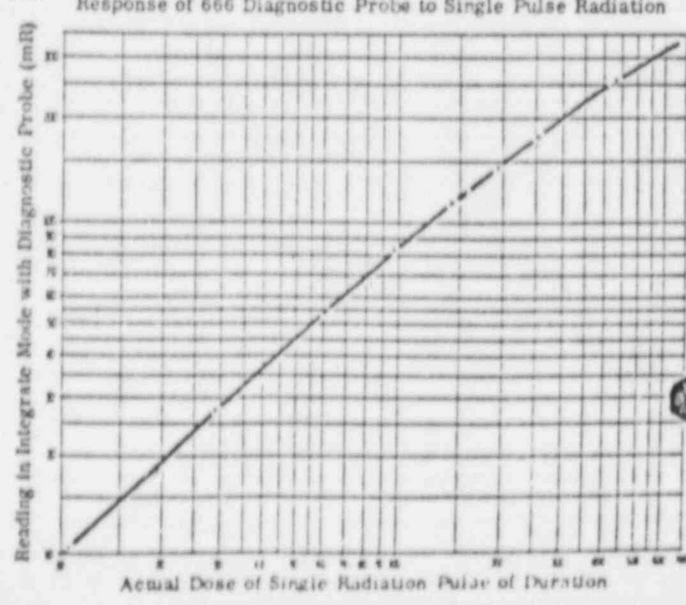
Energy Response of 666 Probes



Response of 666 Background Probe to Single Pulse Radiation



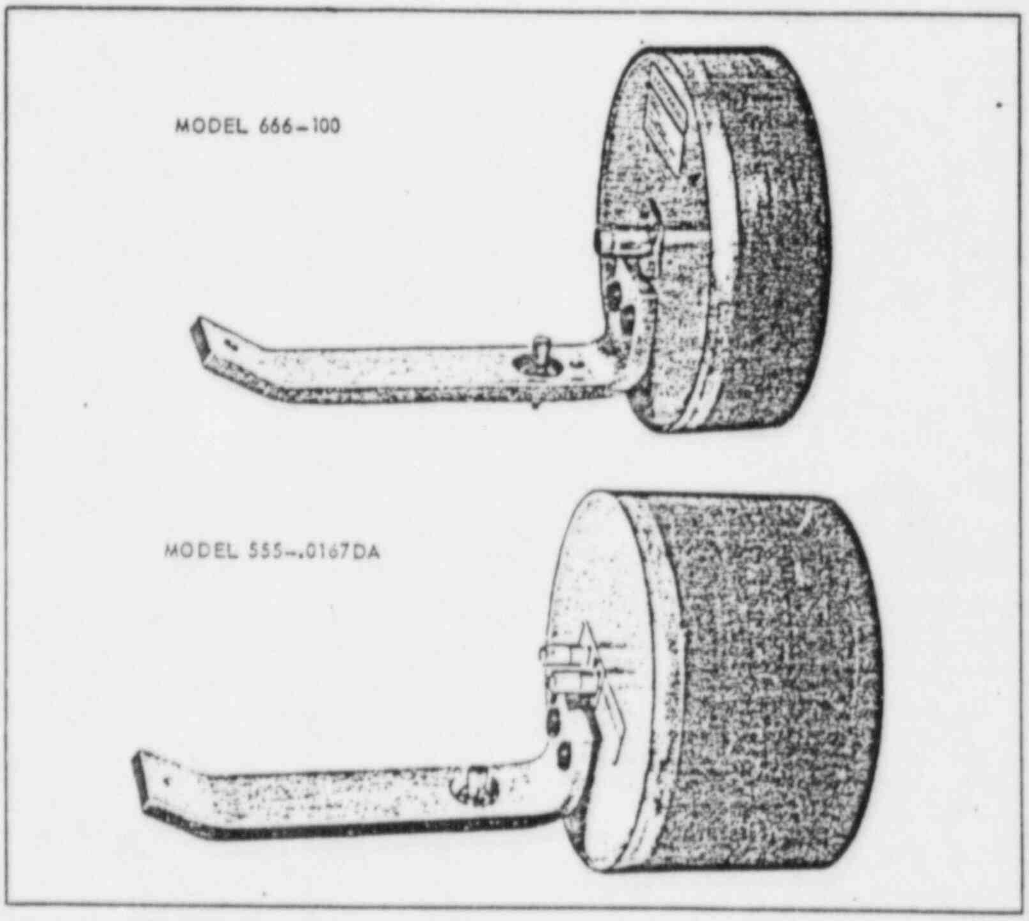
Response of 666 Diagnostic Probe to Single Pulse Radiation



VICTOREEN INSTRUMENT DIV. of VLN
10101 WOODLAND AVE · CLEVELAND OHIO 44104 · TEL. 216/795-8200

TECHNICAL DATA

MODEL 666-100 BACKGROUND PROBE
AND
MODEL 555-0.0167 DA DIAGNOSTIC CHAMBER



APPLICATIONS

Diagnostic X-Ray Systems

Radiographic Equipment

Cold-Cathode Gas Discharge Tubes

Fluoroscopic Equipment

Features

- Corrected Energy Response From 20 keV to 1.2 MeV For Greater Measurement Accuracy.
- Ionization Chambers Designed to Meet Requirements of 21 CFR, Part 278.
- Integral Mounting Bracket Simplifies Chamber Positioning.
- Detector Cross-Sectional Area 100 cm^2 for Both 555 and 666 Versions.

The Department of Health, Education and Welfare has set forth regulations covering performance standards for electronic products as a consequence of the Radiation Control for Health and Safety Act of 1968. The regulations, designated in 21 CFR, Part 278, apply to electronic products which emit radiation throughout the electromagnetic spectrum. Instruments described herein deal solely with ionizing radiation. The Model 666-100 and 555-.0167DA Ionization Chambers and their associated readouts provided by Victoreen can help the user to fulfill requirements as specified in the Federal Regulations as summarized in Table I.

(SEE SPECIFICATIONS REVERSE SIDE)

TABLE 1

Type Electronic Product	Exposure Rate Limit	Cross-Sectional Area of Detector Surface	Distance From Product Surface*
Cold-Cathode Gas Discharge Tubes	10 mr/hr	100 cm^2	30 cm
Diagnostic X-Ray Systems			
Diagnostic Source Assembly	100 mR/hr	100 cm^2	1 meter
Components Other Than Diagnostic Source Ass'y.	2 mR/hr	100 cm^2	5 cm
Radiographic Equipment	2 mR/hr	100 cm^2	5 cm*
Fluoroscopic Equipment	2 mR/hr	100 cm^2	10 cm**
Entrance Exposure — Automatic Exposure Rate Control	10 R/Min.	100 cm^2	See***
Entrance Exposure — Without Automatic Exposure Rate Control	5 R/Min.	100 cm^2	See****
Cabinet X-Ray Systems	5 mR/hr	10 cm^2	5 cm
Color TV	.5 mR/hr	10 cm^2	5 cm

*Radiographic Equipment; Response time no less than 3 seconds or greater than 3 seconds or greater than 20 seconds.

**Fluoroscopic Equipment; As measured at 10 cm from any accessible surface of the imaging system beyond the plane of the image receptor for each R/min. of entrance exposure rate.

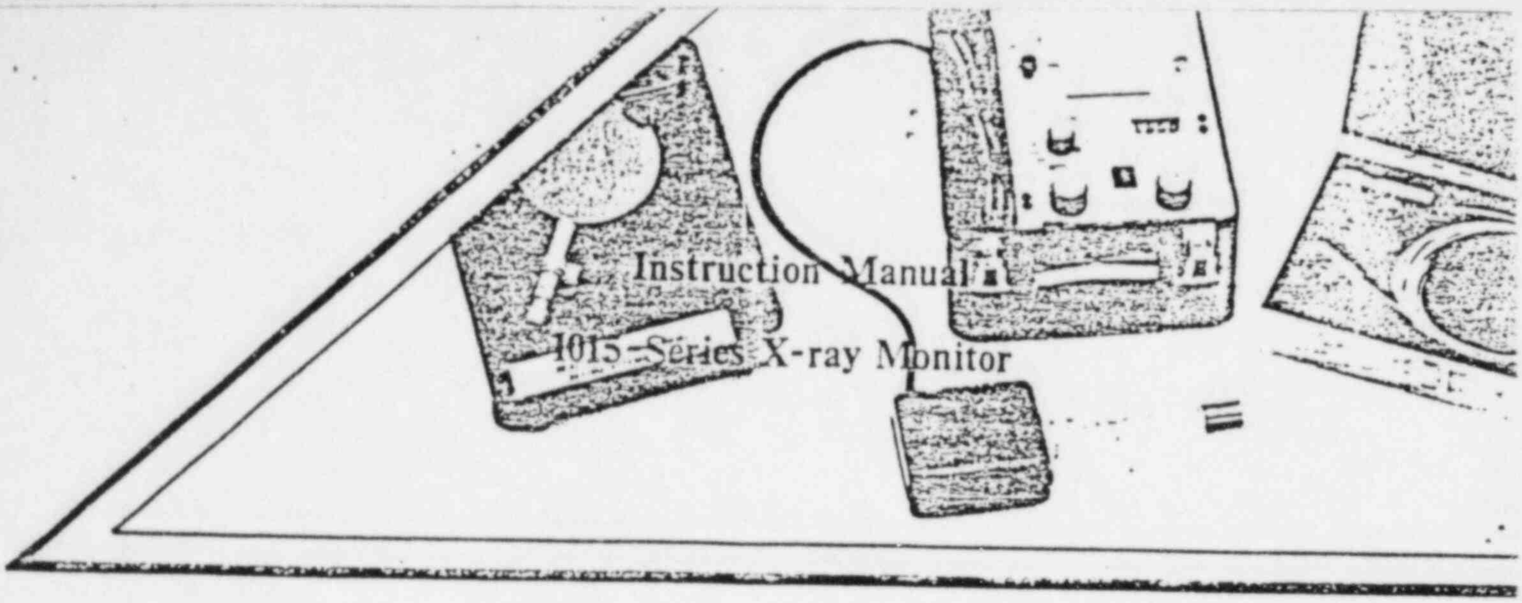
*** Automatic Exposure Rate Control; Entrance exposure rate limit 10 R/min. at point where center of useful beam enters patient except (1) during recording of fluoroscopic images (2) when high level control is provided and then limited to 5 R/hr unless control is activated.

****Without Automatic Exposure Rate Control; Entrance rate limited to 5 R/min. at point where center of useful beam enters patient.

SPECIFICATIONS

Model No.	666-100	555-.0167DA
Energy Response Tol. % / keV Eff.	±15 40-1250	±10 20-1250
Sensitivity Range (Rate) Fullscale	3 mR/hr - 300 R/hr	.05 mR/m-1.67 mR/m or 3 mR/hr-10 R/hr
Integrate Range (Exposure) Fullscale	3 - 300 mR	0.5 - 1670 mR
Type	Air Equiv.	Air Equiv.
Chamber Parameters Wall Material / Thickness mg/cm^2	Acrylic 94	Acrylic 94
Volume cc	240	583
Intensity Limit (Integrate Mode) R/Min.	3	12
Beta Cut-Off (MeV)	.33	.33
Multiply Scale Reading By	1	.0167

VICTOREEN



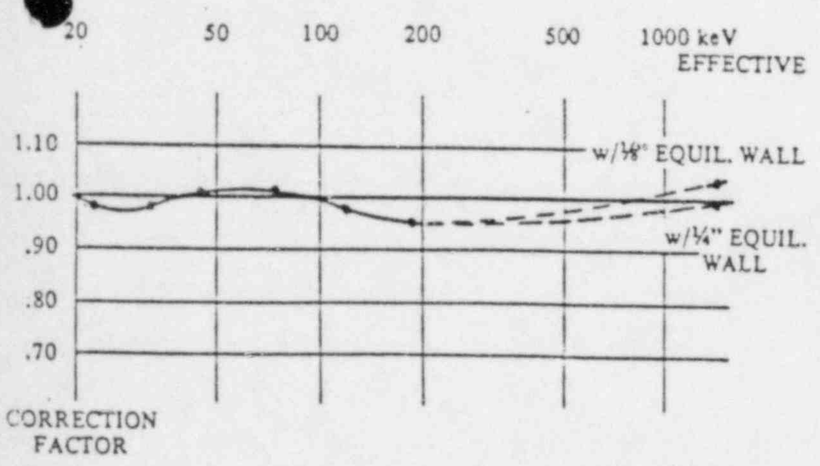
mdh industries, inc.

SPECIFICATIONS FOR MODEL 1015C X-RAY MONITOR WHEN USED WITH MODEL 10X5-180 ION CHAMBERS

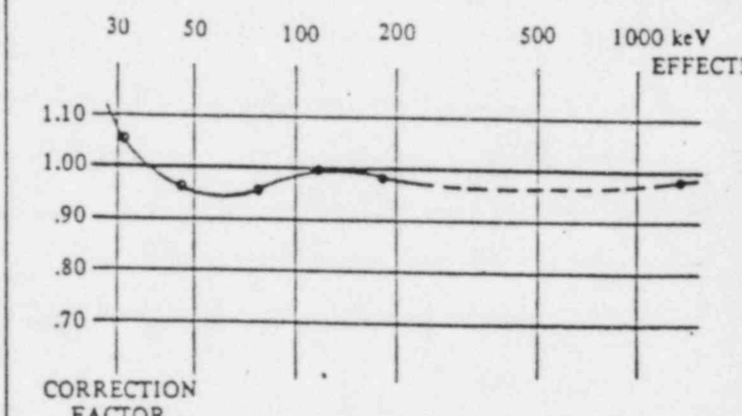
• RANGES	
– Exposure Rate:	1 mR/hr to 650 R/hr
– Exposure:	0.002 mR to 9.99 R
– Pulse Exposure:	1 mR to 0.433 R
– Pulse Duration:	1 ms to 99.9 s
• ACCURACY	
– Energy Dependence:	±10%, 30 keV to 1.33 MeV (with buildup cap)
– Exposure-Rate Dependence:	±5%, 20 mR/hr to 2000 R/h
– Noise Level:	0.002 mR to 1 mR/hr rms
– Resolution:	1% or 0.002 mR for exposure, 1 mR/hr for exposure rate
– Exposure and Exposure-Rate Calibration Accuracy:	±5% using Cobalt-60 and buildup cap with proper setting of barometric pressure (internally compensated for temperature)
– Uncertainty in Pulse-Amplitude Discrimination Level:	5%, rms
– Pulse-Duration Accuracy:	0.02% of measured pulse duration ±5 ms for rectangular pulse of 200 mR/s measured at 50% of the peak exposure rate
• OPERATING ENVIRONMENT	
– Temperature:	5°C to 45°C
– Humidity:	Up to 95% RH, without condensation
– Barometric Pressure:	600 to 1050 millibars
• MISCELLANEOUS SPECIFICATIONS	
– Measurement Interval:	2.4 seconds
– Pulse Exposure Measurement Internal Threshold:	1/3 mR/s
– Digitizing Resolution:	2/3 μR
– Electronic Response Time:	10 to 30 ms

SPECIFICATIONS FOR MODEL 1015C X-RAY MONITOR
WHEN USED WITH MODEL 10X5-6 ION CHAMBERS

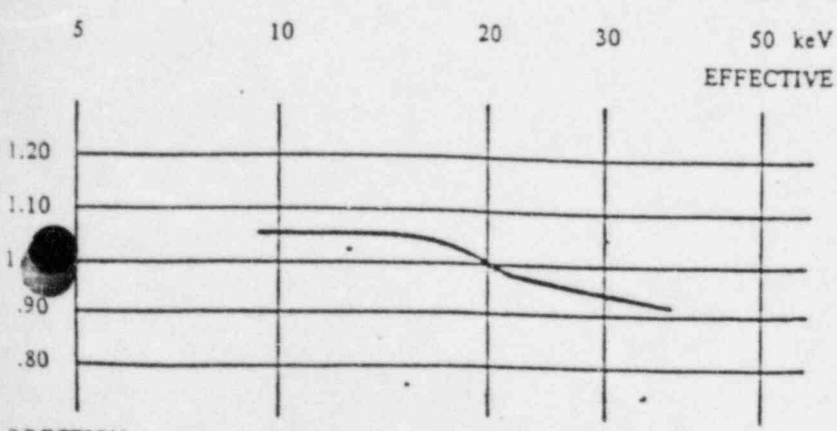
- **RANGES**
  - Exposure Rate — 1 mR/min to 650 R/min
  - Exposure: — 0.02 mR to 99.9 R
  - Pulse Exposure: — 1 mR to 13 R
  - Pulse Duration: — 1 ms to 99.9 s
- **ACCURACY**
  - Energy Dependence: — ±10%, 20 keV to 1.33 Mev (with build-up cap)
  - Exposure-Rate Dependence: — ±5%, 0.4 mR/s to 80 R/s average and up to 500 R/s for 50-μs pulses
  - Noise Level: — 0.02 mR or 1 mR/min
  - Resolution: — 1% or 0.02 mR for exposure, 1 mR/min for exposure rate, and 0.1 ms for pulse duration
  - Exposure and Exposure-Rate Calibration Accuracy: — ±5% using Cobalt-60 and buildup cap with proper setting of barometric pressure (internally compensated for temperature)
  - Uncertainty in Pulse-Amplitude Discrimination Level: — 5%, rms
  - Pulse-Duration Accuracy: (subsequent to first pulse) — 0.02% of measured pulse duration ±0.5 ms for rectangular pulse of 200 mR/s measured at 50% of the peak exposure rate
- **OPERATING ENVIRONMENT**
  - Temperature: — 5°C to 45°C
  - Humidity: — Up to 95% RH, without condensation
- **MISCELLANEOUS SPECIFICATIONS**
  - Measurement Interval: — 1.2 seconds
  - Pulse Exposure Measurement Internal Threshold: — 10 mR/s
  - Digitizing Resolution: — 0.02 mR/pulse



CALIBRATION DATA (TYPICAL)
MODEL 10X5-6 ION CHAMBER



CALIBRATION DATA (TYPICAL)
MODEL 10X5-180 ION CHAMBER



CALIBRATION DATA (TYPICAL)