TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 *(Use supplemental 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 Attached		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments	Details of		Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity	Training in		Yes No	Yes No
d. Biological effects of radiation	All Phases		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 Attached		

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 Attached					

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

See Attached

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

See Attached

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 Attached

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 Attached

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 Attached

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.

The Ohmart Corporation
Applicant named in item 1

Date 4-21-85

By: George A. Kelly
George A. Kelly
Radiation Safety Officer
Title of certifying official

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 : 1984 O—765-581

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 Commisson 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.)

The Ohmart Corporation
4241 Allendorf Drive
Cincinnati, Ohio 45209

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

See Attachment 6b

2 DEPARTMENT TO USE BYPRODUCT MATERIAL

See Attachment (2)

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

34-00639-01
See Attachment (3)

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.)

See Attachment

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.)

George A. Kelly
Radiation Safety Officer
Andrew J. Livingston
Associate Radiation Safety Officer

6 (a) BYPRODUCT MATERIAL. (Elements and mass number of each.)

See Attached

(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.)

See Attached

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.)

See Attachment

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(Continued on reverse side)

ITEMS 1 - 7

LICENSE APPLICATION - Form 313 SUPPLEMENTARY INFORMATION

Item 1a The Ohmart Corporation
4241 Allendorf Drive
Cincinnati, Ohio 45209

Item 1b In addition to the address in Item 1a, to be used for demonstration and testing purposes anywhere else where the USNRC has jurisdiction including reciprocal Agreement States.

Item 2 To be used in manufacturing department for construction of devices for sale, by Research and Development department for testing in plant and at other locations within USNRC jurisdiction and by sales department for demonstration of devices and measurement. This includes Agreement States.

Item 3 Amendment in entirety to License #34-00639-01 and change expiration date to 6-30-82.

Item 4 Byproduct Material will be used by, or under the supervision of individual designated by the Ohmart Isotopes Committee, George A. Kelly, Radiation Safety Officer, Chairman.

Item 5 George A. Kelly - Radiation Safety Officer
Andrew J. Livingston - Associate R.S.O.

ITEM 6

6A Byproduct Material		Chemical and/or Physical Form	6B Maximum Activity at Any One Time
A	Cesium 137	A Sealed Sources	A 300 Curies
B	Strontium 90	B " "	B 100 Curies
C	Cobalt 60	C " "	C 50 Curies
D	Krypton 85	D " "	D 50 Curies
E	Promethium 147	E " "	E 100 Curies
F	Americium 241	F " "	F 50 Curies
G	Thallium 204	G " "	G 1 Curies
H	Cerium 144	H " "	H 1 Curies
I	Polonium 210	I " "	I .010 Curies
J	Carbon 14	J " "	J .010 Curies
K	Ruthenium 106 Rhodium 106	K " " " "	K 1 Curies
L	Iron 55	L " "	L 1 Curies
M	Cadmium 109	M " "	M 1 Curies
N	Nickel 63	N " "	N 1 Curies

ITEM 7

Items A through N

To be used in development, testing of new devices. Redistribution to authorized recipients. Installation, testing and servicing of Ohmart gaging equipment.

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ITEM 8

The following is an outline of experience and training of those who use or supervise the use of radioisotope in the Ohmart plant and in the field.

I. H. L. Cook, Jr., Vice President, Engineering

8a	Mound Laboratory Miamisburg, OH	1946 - 1950
	Ohmart Corporation, Cincinnati, OH	1951 - present
8b	Mound Laboratory, Miamisburg, OH	1946 - 1950
	Ohmart Corporation, Cincinnati, OH	1951 - present
	Argonne National Laboratory	1950 - 1951
8c	Nuclear Radiation Physics, University of Cincinnati - Formal Course	1950
	Ohmart Corporation, Cincinnati, OH	1950 - present
8d	Ohmart Corporation with exception of UC course - on job informal	1950 - present

II G. A. Kelly, Radiation Safety Officer

8a, 8d - National Lead of Ohio Fernold Plant	1954 - 1957
8a, 8b, 8d - Industrial Nucleonics, Columbus, OH	1957 - 1960
8a, 8b, 8c, 8d - The Ohmart Corporation, Cincinnati, OH	1960 - present
All above informal or indoctrination on-job training.	

III. J. H. King, Manager Manufacturing

8a, 8b, 8c, 8d, - 3 day Formal Class at Ohmart	1966
Personal study and on-job training	1966 - present

IV R. Vayo, Assistant Field Service Manager

8a, 8b, 8c, 8d - N A S, Livermore, CA 1 week	1967
Ohmart Corporation 3 day formal	

V Andrew J. Livingston, Associate Radiation Safety Cfficer

8a, 8b, 8c, 8d - U.S. Air Force Formal Course 6 weeks	1968
Ohmart Corporation 3 day formal course	1973
Ohmart Corporation 3 - 5 years on job	1973 - present

VI E. Smith, Source Room Supervisor

8a, 8b, 8c, 8d - Ohmart Corporation Class for Source Handlers
4 - 5 years experience

Item 9

All those listed in Item 9 have had experience in loading and unloading sealed sources and working with sealed sources in devices for the time periods listed in Item 8 at the Ohmart plant. Ces 137 - 10 ci, Co 60 - 100 mCi, Kr 85 - 1.2 ci, Sr 90 - 1 ci, Fc 55 - 1 ci, Am 241 - 2 ci, Pu/Li neutron sources - 10 ci, Am/Be neutron sources, 3 ci.

With the exception of Mr, King and Mr. Smith, all those listed in Item 8 have considerable field experience in installing sealed sources and have conducted formal classes for Ohmart customers and representatives at the Ohmart plant.

Item 10

Radiation detection instruments are listed on the attached graph. Attached also are fax copies of manufacturers data sheets describing the instruments.

Item 11

Radiation detection instruments are spot checked in the range of use before use. If found in error they are rechecked at two points in each range (up to 50 mr/hr Gamma) and recalibrated. If error cannot be corrected they are returned to the manufacturer for repair and certified calibration. In case of any damage to detectors they are returned to the manufacturer for rework and recertification of accuracy. Each meter receives a calibration check (complete) every 6 months and if there is any doubt, they are returned to the manufacturer for this calibration.

Item 12

Film badges TLD ring badges, dosimeters and whole body counts and bioassays are provided as required as outlined in Item 14 supplement.

Item 13

Facilities and Equipment - A variety of handling equipment is maintained including specially modified tongs and tweezers to maintain the maximum practicable distance between the user (including hands and feet) and the unshielded source(s) with the minimum permissible distance being 20 inches. Lead shielded, primary and intermediate containers, plastic gloves and eye shields are provided. Source shipping containers are handled by lift truck.

See Exhibit SH-2 for outline of sealed source storage area. Ohmart has facilities for evaluation of wipe test samples for leakage and makes this service available to its customers as well as using it for testing for leakage of sources used by Ohmart. See Exhibit LT

Item 10

Radiation Detection Instruments Including Dosimeters

Type of Instrument Make & Model # of Each	Number Available	Radiation Detected	Sensitivity Range mr/hr	Window Thickness mg/cm^2	Use Monitoring, Surveying Measuring
Jordan AGB -50-1	1	Gamma	0-50 mr/hr 0-50 R/hr	Approx 500	Survey of Cs 137 - CO 60 devices and shipments
Jordan AGB -500	2	Gamma	0-500 mr/hr 0-500 R/hr	Approx 500	Survey of Cs 137 - CO 60 devices and shipments
Victoreen Model 2035 Radector III	1	Gamma Beta	0.1-100 mr/hr 0.1-100 R/hr 0.1-1 KR/hr	Approx 500	Radiation Surveys CS 137 - CO 60
Victoreen 440	2	Gamma > 7KEV Beta > 100KEV Alpha above 4MEV	0-3 0-10 0-30 0-100 0-300	3	Survey of all low energy sources and all beta sources in devices
Victoreen Thyac III with 489-9 probe	2	Beta Gamma	0-0.2 mr/hr 0-2 mr/hr 0-20 mr/hr 0-200 mr/hr	30	General Field surveying
Eberline Model PNR-4 Neutron Rem Meter	1	Fast Neutron	0-5 0-50 0-500 0-500 REM	9" Cadmium Loaded Poly-ethylene ball	Neutron Surveys
Bendix Dosimeters 019-200	3	Gamma	0-200 mrem	280 approx	Monitoring
019-500	2	Gamma	0-500 mrem		
Victoreen Model 581 Dosimeter	4	Gamma	0-200	280	Monitoring
Reactor Experiments Inc. Digirate	11	Gamma Beta	0-100 mr/hr		Field Surveys

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Item 14

Source Control and Radiation Protection Program

GENERAL

The Ohmart Corporation receives and distributes sealed sources only. With few exceptions, among them Krypton 85 and Plutonium 238 gamma sources, all sources are certified to meet the requirements for Special Form as outlined in 10 CFR part 71 and the regulations of the U.S. Department of Transportation. Furthermore all sources are certified by the manufacturer to meet the standards for sealed sources in devices as prepared by the American National Standards Institute (ANSI).

The only sources which Ohmart will accept other than the above are sources returned for disposal which have been tested and found leak free before being shipped to Ohmart. Some of these sources are quite old and may not meet the standards. If any source received for disposal cannot be identified as meeting the standards the source and its container or source holder are disposed of without removing the source from the holder or inner container.

RECEIVING PROCEDURE

Source shipping containers are accepted at the receiving department from carriers Monday through Friday, excluding holidays, between the hours of 8 AM and 5 PM. Containers are received on Saturday only by special arrangement with the carrier.

On receipt the container is taken immediately to the source storage room area, monitored for radiation level at the surface and at 3 feet from the surface. If the radiation level at the surface exceeds 200 mr per hour and/or exceeds 10 mr per hour at 3 feet from the surface, the Regional Office of Inspection and Enforcement is notified by telephone and mailgram. The container is then placed in the source room and tested for leakage, by wipe testing the seams of the closed container and 100 square centimeters of the surface. If more than 0.01 microcuries of removable contamination is found the final delivery carrier is notified by telephone and the Regional Office of Inspection and Enforcement is notified by telephone and mailgram. If the test reveals an excess of .005 uci arrangements are made for safe disposal of the shipment. If all tests are passed, the shipment is handled in normal procedures.

All incoming shipments are treated as coming by common carrier, and, as in excess of type A limits in accordance with 20.205.

STORAGE OF SOURCES

Source shipping containers and storage containers and the contained sources are controlled by the source room supervisor(s) from the time the sources reach the source room area.

On receipt of a shipment of sources, a receiving form is prepared and together with a copy of the packing list given to the source room supervisor who signs the receiving form acknowledging receipt of the sources. One copy of the

Item 14 continued

receiving form goes to Purchasing, one to Data Processing and one to the person initiating the purchase requisition. A permanent Source Record card is prepared for each source from the packing list and serves as a permanent record of each time the source is removed from the source room, when leak tested and the purpose of the removal whether for testing purposes, to fill a customer order, or to return to the manufacturer.

All sources received in reusable containers which must be returned to the manufacturer are unloaded within 10 days into source room storage containers. Point sources are received resting on discs of snythetic sponge either directly in holes in lead bricks or within plastic vials (uncapped) containing the sponges which are in the lead bricks. When being unloaded from the shipping containers each source is leak tested as follows: The sources, not more than 10 at one time, are transferred to an intermediate container consisting of holes drilled in lead bricks. The plastic sponges on which the sources have been resting in transit are then tested for removed contamination. If less than 0.00125 microcuries of removed contamination is found, the sources are considered leak free. If more than 0.00125 microcuries but less than 0.005 microcuries is found the source is returned to the manufacturer for cleaning or repair and recertification of being leak free. Sources found to have more than 0.005 microcuries of removed contamination are reported to the Regional Office of Inspection and Enforcement and arrangements made for safe disposal. The results of the test are recorded on the Source Record Cards.

As sources are determined by Ohmart to be leak free they are transferred to source room storage containers until needed. The source serial number and activity is verified at this time, and making any corrections that may be necessary on the Source Record Cards.

Sources in strip form are tested for leakage on receipt. Since the sources are in the form of a seamless stainless steel tube only the welds at each end are wiped and the sources are transferred directly to plastic tubes in a concrete underground container with lead cover. Should evaluation of the wipes for leakage indicate the source may be leaking, or contamination in excess of 0.005 microcuries be found, arrangement for safe disposal is made and, if required, the Regional Office of Inspection and Enforcement notified as outlined under point sources.

Some sources are recieved in non-returnable shipping containers and as such are not removed from the shipping container until required for use. The Source Record Cards for these sources are prepared on receipt but serial number, activity and leak free condition are not verified until the sources are removed from the containers for use in devices.

Sources are transferred to devices for use as follows: The Source Record Card is marked with the type of device, the date the order number or project to which the source is assigned and the card initialed by the person receiving the source for use. A cardboard tag is prepared containing the Isotope, activity, serial number, adhesive location tag from the source room, and order number or project to which the source is assigned. Loading of sources into devices is performed in the designated source loading areas. The cardboard tag which is yellow and bears the conventional radiation symbol is fastened to the device and remains attached until the permanent stainless steel label is affixed, whereupon the tag is removed and made part of the permanent record of the order or project.

Item 14 continued

Each source when removed from storage for use is identified by the serial number. If it has not been leak tested within the previous six months a wipe test is performed to determine that it remains leak free. The intermediate lead brick shields are used, as before, in leak testing outgoing sources.

Sources which are used for testing and comparison purposes are subject to the same controls as those transferred to customers and are leak tested at not greater than six months intervals.

Charts showing the location, serial number, model number, Isotope and activity of each source in storage are maintained.

Devices are transferred only to specifically or generally licensed persons under the conditions of 10 CFR 30.41 and 32.82 except Ohmart does not use the provision for oral certification contained in 30.41 (d) (d) since there is no way to enforce written certification within ten days.

Records are kept and reports made in accordance with the regulations contained in parts 19, 20, 30, 31-36.

STORAGE FACILITIES

Strip sources may be stored either:

1. Vertically in plastic tubes in concrete underground containers with lead lids or

2. Horizontally in lead shielded tubes with lead caps.

Point sources are stored in plastic vials in lead blocks on shelves in a lead lined safe. This method of storage is planned to be replaced approximately July, 1977 by lead lined boxes with lead lids stored in racks and suitable for movement by lift truck. The new method is expected to be more convenient and to substantially reduce exposure of personnel associated with handling un-shielded sources.

Special sources received in non-returnable containers are stored in the containers on shelves against the outside walls of the source room. See exhibit SH-2 for drawing of source room area.

SECURITY

The source room door is kept locked at all times except when sources are being moved in or out and the key remains in the possession of the Source Room Supervisor. A red light placed at the aisle nearest the source room door flashes continuously whenever the source room door is open. This alerts employees that unshielded sources may be present and that the door is open. The supervisor will only permit those who are appropriately trained to perform work in the source room and any transfer of sources in or out is the responsibility of that supervisor.

Item 14 continued

The source room, 9' 5" x 18' 10" inside dimension, is of essentially fireproof construction - constructed of concrete block eight inches thick and lined with another wall of unmortared solid concrete block twelve inches thick. The source room is entirely outside the main building sharing one wall twelve inches thick. The walls exterior to the main building are further protected by chain link fence. The entire plant is further protected by automatic sprinkler alarms in case of fire and by intrusion alarms which usually bring police and/or firemen within five minutes. The intrusion alarms are in service whenever plant personnel are not in control such as at night and on weekends. Two city of Cincinnati fire stations are located about one half mile away. All entrances to the factory area are marked with "Restricted Area" signs prohibiting deviation from marked aisles unless escorted. Visitors are conducted at all times. The aisles are checked monthly by the Radiation Safety Officer to assure that the radiation levels in the aisles are below 0.8 mr/hr.

A monthly inspection is also made of the unrestricted area outside the building to assure that radiation levels 18 inches from any outside wall do not exceed 0.5 mr/hr.

CONTAMINATION CONTROL

Since Ohmart uses only sealed sources, contamination is unlikely. However, contamination from leaking sources is a possibility, however remote. Therefore, incoming sources are leak tested in the source room area only, and, if found leaking, arrangements are made for safe disposal. All wipe test samples, whether from Ohmart internal tests, or from customers, are taken to the evaluation area immediately and checked for removed contamination. Transport is in vials from customers and envelopes for wipes taken within the plant. The sample is transferred directly from container to planchet, evaluated for leakage and sample and container placed in a plastic bag for disposal as radioactive material although no activity may have been indicated. In case a sample shows removable contamination the sample, planchet and plastic coated paper table cover used are all placed in the plastic bag for disposal.

Contamination from ruptured sources is extremely rare. However, employees are trained carefully not to spread contamination and if contamination is suspected to call for help immediately and if the radiation level is unacceptable to remove affected clothing and standby for assistance and to keep others away until help arrives. See exhibit SH-1A for training outline.

PERSONNEL MONITORING

All employees who regularly visit the manufacturing area in the performance of their duties are provided with personnel monitoring devices. This includes, in addition to those who regularly work in the factory area, sales, engineering and field service employees.

Film badges, thermoluminescent dosimeter ring badges and direct reading pocket dosimeters are provided as required. Film and ring badges are obtained from R. S. Landauer Division of Technical Operations, Inc. Pocket dosimeters are obtained from Bendix Corporation and Victoreen Instrument Company.

Personnel who are only casually exposed to radiation and those who work only with sources in devices emitting gamma or beta radiation are issued Landauer Type G badges to be worn on shirt pocket or belt. These badges are exchanged monthly.

Personnel who must work with neutron emitting sources, also, are issued Landauer Type P badges which are sensitive to gamma, beta and fast neutron radiation. These badges are exchanged every two weeks.

Those trained persons who handle unshielded sources are required to wear the Type P body badge and in addition when handling unshielded sources must wear Type P wrist badges, Thermoluminescent dosimeter (TLD) ring badges and pocket dosimeters. The body badges are exchanged bi-weekly and the wrist and TLD badges weekly. The pocket dosimeter readings are observed periodically during use to avoid complete discharge of the dosimeter. Should the reading be past 75% of scale the reading is logged and the dosimeter recharged or exchanged for a charged dosimeter. All dosimeter readings are kept in a continuously totalled log for each individual on a quarterly basis, maintained by the Source room supervisor and used as an aid in reducing exposure. Dosimeter accuracy is measured by placing in a measured 50 mr/hr field for two hours and observing the reading. Dosimeters with an error of more than -15% are retested and if still in error are replaced.

In addition to the above, although Ohmart handles only sealed sources, all personnel who routinely work with unshielded sources are required to receive an annual whole body count at the Radioisotopes Laboratory of the University of Cincinnati. Other employees may elect to have the count made. The Company does not limit this to source handlers only.

Exposure reports are received and reviewed by the Radiation Safety Officer, the Plant Manufacturing Manager and the Vice President, Manufacturing. Reports requiring no action are filed by calendar date. Dosages exceeding 25% of the allowable quarterly maximum are subject to review to determine how that does rate might be reduced in the future. Dosages in excess of the quarterly maximum for the part affected are reported in writing to the Regional Office of Inspection and Enforcement and to the employee, involved. The source room supervisor's log is inspected and by consultation with the employee and his supervisor an attempt is made to determine if a breakdown in procedures has caused the overexposure and, if standard procedures appear to be at fault, these procedures are adjusted or changed to preclude recurrence.

Ohmart is committed to the principle that exposure to radiation should be as low as reasonably achievable and continues implementing programs with this goal.

Item 15 - WASTE DISPOSAL

Waste in the form of old sealed point sources, sources that cannot be identified and point sources which have outlived their useful life to Ohmart, or returned by customers, and not reusable, are packaged in containers and shipped to the disposal area at Moorehead (Maxi Flats) Kentucky to Nuclear Engineering Company for burial. Activities of Am 241 are disposed of to Nuclear Engineering in

Item 15 continued

Washington as they will not accept it in Kentucky. Other authorized disposal agencies may be used.

Strip sources are returned to the manufacturer for disposal since disposal containers used will not accommodate sources as much as five feet long and manufacturer's returnable shipping containers can be used in returning the sources to them for disposal.

An average of approximately 30 curies per year are disposed of in this manner with the major isotope being cesium 137. Minor activities of other isotopes such as Co 60, Sr 90, Kr 85 and other isotopes covered by our possession license as listed in item 6a make up the balance.

SUPPLEMENTARY EXHIBITS

LT	Ohmart Leak Test Service
L-L10	Source Loading Procedures
SH-1	Training of Source Handling Employees
SH-1A	Ohmart Training Program for Persons Who Handle Sealed Soruces
SH-2	Drawing of Source Room Area
FS-1	Field Service Department Training
FS-2	Installation and Training Procedures for Installation of Ohmart Devices by Field Service Personnel
FS-3	Field Service Monitoring Equipment

Density Gage Safety Instructions Example

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EXHIBIT LT

OHMART LEAK TEST SERVICE

The Ohmart Model LT leak test service is made available to all who desire to use it.

The Ohmart Model LT Wipe test kit consists of a cotton swab "Q-Tip" in a capped plastic vial supplied in a mailing canister with return label and report form.

On return the wipes are evaluated for leakage in a Nuclear Measurement Corp. Model US-1 detector and DS-1B scalar.

Standard sources are used in calibrating the detector and we are in the process of obtaining from New England Nuclear Corp. new standards which are traceable to U. S. Bureau of Standards sources.

Results of the leak test if found leak free are returned to the customer by mail. In case removable contamination is found less than 0.005 mCi but significantly above background a new kit is sent for a rewipe. If contamination is evident on the second wipe although less than 0.005 mci the customer is advised to dispose of the source although it technically may not be leaking.

If greater than 0.005 mci of removable contamination is measured the customer is advised by telephone and mailgram to remove the source or device from service and notify the proper Agreement State agency or the Regional Office of Inspection and Enforcement USNRC as appropriate.

EXHIBIT L

SOURCE HANDLING PREPARATIONS

1) Both Supervisor and Source Handler have ring and wrist badges on proper hand and wrist, and are wearing their film badge and dosimeter.

2) All parts of source holder to be loaded have been checked to insure parts will fit together properly.

3) Source handling procedure for the job to be done has been read by both supervisor and source handler.

4) Area around source storage and where work is to be done must be clear with plenty of room to work.

5) Source to be loaded is located from source storage records. Refer to procedures.

EXHIBIT L-1

Shipping Container Unloading and Transfer of Sources to Storage

1) Prepare envelopes for wipe test; load plastic tubes in intermediate lead storage block.

2) Unbolt lid of vendors container.

3) Remove lid of vendors container using a boom crane.

4) Using 4 foot tool and vendor location chart, remove source capsule from vendors container and place in plastic tube in intermediate lead storage block.

5) Using 4 foot tool remove source wipe from hole that contained the source just removed, and put in envelope.

6) When a maximum of 10 sources are in the intermediate lead storage block, put lid back on vendors container, lock source room door and take wipes to reading area.

7) Read wipes. If any are in doubt notify supervisor.

8) If all wipes are acceptable return to source room, open safe and insert each source holding tube in appropriate hole in safe using 4 foot tool.

9) Repeat steps 3 through 8 until vendors container is empty.

EXHIBIT L-2

Source Capsule Loading Procedure Model SR-1 & SR-2

1) Mount rotor and handle assy. to SR-1.

2) Make sure source bushing and spacer fit properly in source tube, and ream source bushing to 0.505.

3) With rotor in position 1, insert shakeproof washer, lead, and source bushing in source tube.

4) Remove source from safe with 4 foot tool, dump out of plastic tube in pan. Check serial number and from source record card determine that the source has been wiped within the previous 6 months. If not perform wipe test and evaluation before proceding further.

5) Drop in retaining washer and spacer.

6) Using angled tru-arc pliers, insert tru-arc ring in groove, pushing down on spacer. Double check that tru-arc ring is seated properly in groove by pushing down with angled pliers.

7) Turn source holder to closed position.

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EXHIBIT L-3

Source Capsule Loading Procedure
Rotary Type Source Holders (SHRM-PA, SHRM series, SHRD series)

1) Turn source holder to closed position.

2) Drop in bottom piece of lead and tamp down.

* a) Drop in source bushing.

3) Remove source from safe with 4 foot tool, dump out of plastic tube in pan. Check serial number and from source record card determine that the source has been wiped within the previous 6 months. If not, perform wipe test and evaluation before proceding further. Pick up source and drop in source tube, hot end down.

* a) Locate source in bushing with 4 foot rod, check source position with Insp. mirror.

4) Drop in top piece of lead and tamp down.

5) Install lid.

* These steps used only when source bushing is used, check assy.

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EXHIBIT L-4

Source Capsule Loading Procedure
Models SHLG-1,2,3

1) Collect all parts.

2) Insert bottom lead piece in stainless steel source tube.

3) Insert aluminum slug on top of lead in stainless steel source tube.

4) Insert leaf clamp in source tube and push down on top of aluminum slug, fingers up.

5) Insert source tube in source holder leaving pin holes just exposed. Clamp vise grip.

6) Remove source from safe, dump out of plastic source tube in pan. Check serial number and from source record card determine that the source has been wiped within the previous 6 months. If not, perform wipe test and evaluation before proceding further. Pick source up and insert in source tube hot end down. All work done using 4 foot tool.

7) Insert top lead piece.

8) Insert spring.

9) Insert top stainless steel shaft with sealer on end and pin.

10) Install detent block with sealer on bottom and place pin punch in remaining hole to prevent dropping.

11) Remove vise grip and secure detent block.

EXHIBIT L-5

PROCEDURE FOR LOADING BETA SOURCE HOLDERS

1. Be certain all parts fit together properly.

2. Turn source block assembly upside down in source holder housing.

3. Locate source on storage charts, take source out of storage with 12" tongs and load into blocks hot side down. With 12" screw holding screw driver fasten source to block with 2 screws. Slip lead block back of source and install steel mounting plate onto source block assembly.

4. Turn assembly over using mounting plate and Ledex Solenoid and mount in housing using tweezer to install lock washers and nuts on the bolts and a long handle nut driver to tighten. Use extreme care to avoid being over the shutter or being in contact with the shutter surface. Know where the radiation field is! Check with survey meter!

5. Install filier piece in place with tweezers. Install steel collimating plate, align and tighten. Use care to avoid collimating hole.

6. Install top plate.

EXHIBIT L-6

LOADING SOURCE IN E.S. GAGE

Have all the proper tools available before starting. This includes electrometer and power supply so you can check amp output.

Make sure that the source tube will accept source before putting source in. Then proceed to load source by removing it from storage with 4 foot tool and sticking it into source tube which should already be sticking in gage frame. You should then shove source all the way into tube with a rod approximately 4 foot long. Then insert ½" O.D. lead rod about 12" long into tube up against the source. You should then measure the radiation field right up against source tube. If field is 40 mr/hr or less, then you should ease source tube out of gage until your electrometer reads the amperes you want. While doing this make sure ½" O.D. rod is firmly against source. When you finally get the amperes you want then check radiation field coming from large leg. This field should be less than 90 mr/hr and hopefully a lot less.

When achieving both these goals we should then mark source tube at flange with a scribe. After doing this we should remove lead rod and then remove source tube with a 4 foot tool and dump source into a safe staging area. We then cut tube to size and affix flange permanently. Again we should make sure source will fit back into source tube before actually loading it. We then cut lead rod to proper size which is 1¼" less than inside length of source tube. Put source tube back into gage and mount permanently. Load source back into gage by using all procedures as mentioned previously, with the exception of the lead being shorter. Then again check radiation field before inserting spring and mounting back plate. You should then check to see if you have desired output from detector and proper radiation field from long leg.

EXHIBIT L-7

LOADING STRIP SOURCES

1. Make sure you have all your tools for loading strip sources.

2. Source holder is to be in closed position w/source tag attached and bottom lead in place and leaf clamp approximately 3 to 4" inside hole.

3. Locate source needed and load into source holder by following steps:

   A. Screw threaded 4 foot handling rod into end of strip source. Keep hands at end of 4 foot handling rod when doing this.

   B. Pull source up until you expose approximately 2" of it. At this point we should read the serial number.

   C. We should then grab the 2" of exposed source with another tool and hold on until first man unscrews his 4 foot threaded rod and leaves the room.

   D. We then raise source up out of hole and then grab with another tool approximately 4 foot long and insert source into holder.

   E. We then put on cap and screws to hold it down.

NOTE: WHEN LOADING BELT SCALE SOURCE HOLDER THERE IS A SECOND LEAF CLAMP WHICH GOES ON TOP OF SOURCE WHICH SHOULD BE PUT ON BY MEANS OF INSERTING IT THROUGH A TUBE.

1. Have drawing of source holder and review assembly.

2. Make certain all parts fit properly (rods pinned, lead, etc.)

3. Locate and position special SHLM source loading fixture.

4. Put bottom lead in bottom source tube check for proper depth.

5. Locate bottom source tube in fixture.

6. Locate source on storage charts.

7. Using 4 foot tool remove source from storage, dump out of plastic tube in pan, read serial, load source into source tube. Install oversized piece of lead. Holding far end of long source rod insert in source tube, aligning holes of both rod and tube by tapping rod down on the lead.

8. Lift SHLM body, with CBG fitting removed, over and slide down over the rod and sit on top of fixture. Pull rod up until source is up in the body of the SHLM. Install CBG fitting. Install top handle.

EXHIBIT L-9

REMOVING SOURCE FROM SR-1 AND SR-2

1. Make sure source is clean by taking a wipe test.

2. Remove tru-arc by using bent pliers.

3. Remove spacer tube by means of a tool approximately 2 foot long bent at 90^{o} which we insert inside of spacer tube, press against inner walls and remove.

4. We should then tilt source holder over far enough to dump washer and source into flanged container.

5. Serial number should then be read and source should be picked up with approximately a 4 foot tool and put into storage.

EXHIBIT L-10

UNLOADING HM-8

1. a) Plastic gloves, read source tag for serial number.

   b) Keep lead shield on while unbolting FP bracket.

2. Remove FP bracket, put shield back over source, remove ring, turn rotor to ON position using extreme caution and 4 foot tool with Q-Tip wipe source, turn rotor OFF, put shield back in place, read wipe.

3. Remove rotor, remove tru arc, dump holder source to floor, pick source up with 4 foot tool put on roller read serial number, put in storage.

TRAINING OF SOURCE HANDLING EMPLOYEES

In accordance with 10CFR 19.12, employees are trained and instructed in the safe handling of radioactive materials. The training program is outlined in Exhibit I.

To assure that present personnel understand the principles and procedures of the safe handling of sealed sources, they have been subjected to a verbal examination by P. E. Sieck, Vice President Manufacturing and H. L. Cook, Vice President Engineering.

Actual observation of the procedure and performance of the procedure, as shown in the Training Program outline, will be controlled by the source room supervisor.

New employees are not allowed to handle sealed sources until they have completed the Training Program outlined in Exhibit SH-1A and been subjected to a verbal examination.

Records are mainted concerning the Training Program for both present and new employees. These records show: the name of the person trained; the instructors; dates of training; names of examiners. These procedures are audited quarterly by P. E. Sieck, Vice President Manufacturing to assure that the procedures established are being followed. Records are kept for this auditing procedure showing satisfactory operation and problems that may occur.

As the final measure of proper proceudres, all personnel handling sealed sources are required to use a ring TLD monitor, a wrist film badge, a body film badge and a direct reading ion chamber dosimeter worn in the breast pocket. Ring TLD's and wrist film badges are read weekly. Body film badges are read every two weeks. Body ion chamber dosimeters are read after the completion of each set of loadings. Records are kept of the number of sources handled and the activity of each source. All records are monitored by P. E. Sieck, Vice President Manufacturing.

Source handling proceudres, as detailed in Section V of the Training Program are posted on a special bulletin board located in the source handling area.

To reduce the dose to a value as low as reasonably achievable, we plan to design and build a handling facility where direct exposure to the unshielded source will not occur.

As now envisioned, this facility will consist of a work area shielded by at least one inch of lead. The work area will be equipped with an overhead slanted mirror.

Manipulation of the source will be accomplished with elongated tools shaped to fit the configuration of the shielded work area. Source storage containers will be re-designed and the source storage area will be revised to handle the new storage containers.

The source handling facility will be designed to receive the shipping container, the storage container and source holders to be loaded.

By use of this facility, it is estimated that the dose will average less than 200 mrem per calendar quarter to the hands and less than 75 mrem per calendar quarter to the whole body. Details of this facility will be supplied as soon as completed. Target date is July 15, 1977.

OHMART TRAINING PROGRAM

FOR PERSONS WHO HANDLE SEALED SOURCES

I. Theory of Nuclear Radiation

1. What it is

a. Particles - alpha, beta, neutron
b. Electromagnetic

2. Where it comes from

a. Background
i) Solar
ii) Residual - earth, building materials
b. Byproduct Materials
c. Irradiated Materials
d. Neutron Reaction

II. Potential Hazards

1. Ingestion

a. Hazard
b. Use of Sealed Sources

2. Radiation Field Exposure

a. Hazard
b. Reduce Exposure By
i) Minimum exposure time
ii) Maximum distance between source and body
iii) Use of maximum practical shielding

III. Measurement of Radiation

1. Wipe Test

a. How Perform
b. How Measure

2. Radiation Field Measurement

a. Dosimeters
i) Theory
ii) Use
iii) Calibration
b. Film Badges
i) Theory
ii) Use
iii) Read by Vendor

c. Survey Meters
i) How to measure Beta
ii) How to measure Gamma
iii) How to measure Neutrons
iv) Calibration

IV. Safety Regulations

1. Wipe Test for External Contamination

a. Legal Requirement
b. Ohmart Standard

2. Exposure

a. Whole Body Dose
b. Extremities Dose
c. Skin Dose
d. Dose as low as reasonably achievable

3. Transport Regulations

a. Label Classification

V. Ohmart Procedures

1. Shipping container unloading and transfer sources to storage.

a. Discussion
i) Wipe Test
ii) Dosimeters
iii) Badges - whole body and wrist and ring
b. Observation
c. Perform While Supervised.

2. Source Holder Loading

a. Discussion
i) Assembly Drawings
ii) Dosimeters
iii) Badges - whole body and wrist and ring
b. Observation
c. Perform While Supervised

3. Wipe Test

a. Discussion of Written Procedures
i) Incoming Sources
ii) Completed Gages
iii) Shipping Container
iv) Stored Sources (6 months)

b. Counting Equipment
i) How Handle Wipes
ii) Counter Theory
iii) Calibration

4. Radiation Survey

a. Source Holders
i) NRC Standards (Customer standards)
ii) Demonstration
iii) Perform While Supervised
b. Complete Gages
i) NRC Standards
ii) Demonstration
iii) Perform While Supervised
c. Shipping Container
i) Transport Standards
ii) Demonstration
iii) Perform While Supervised
d. Aisle-ways and outside of building
i) Requirements

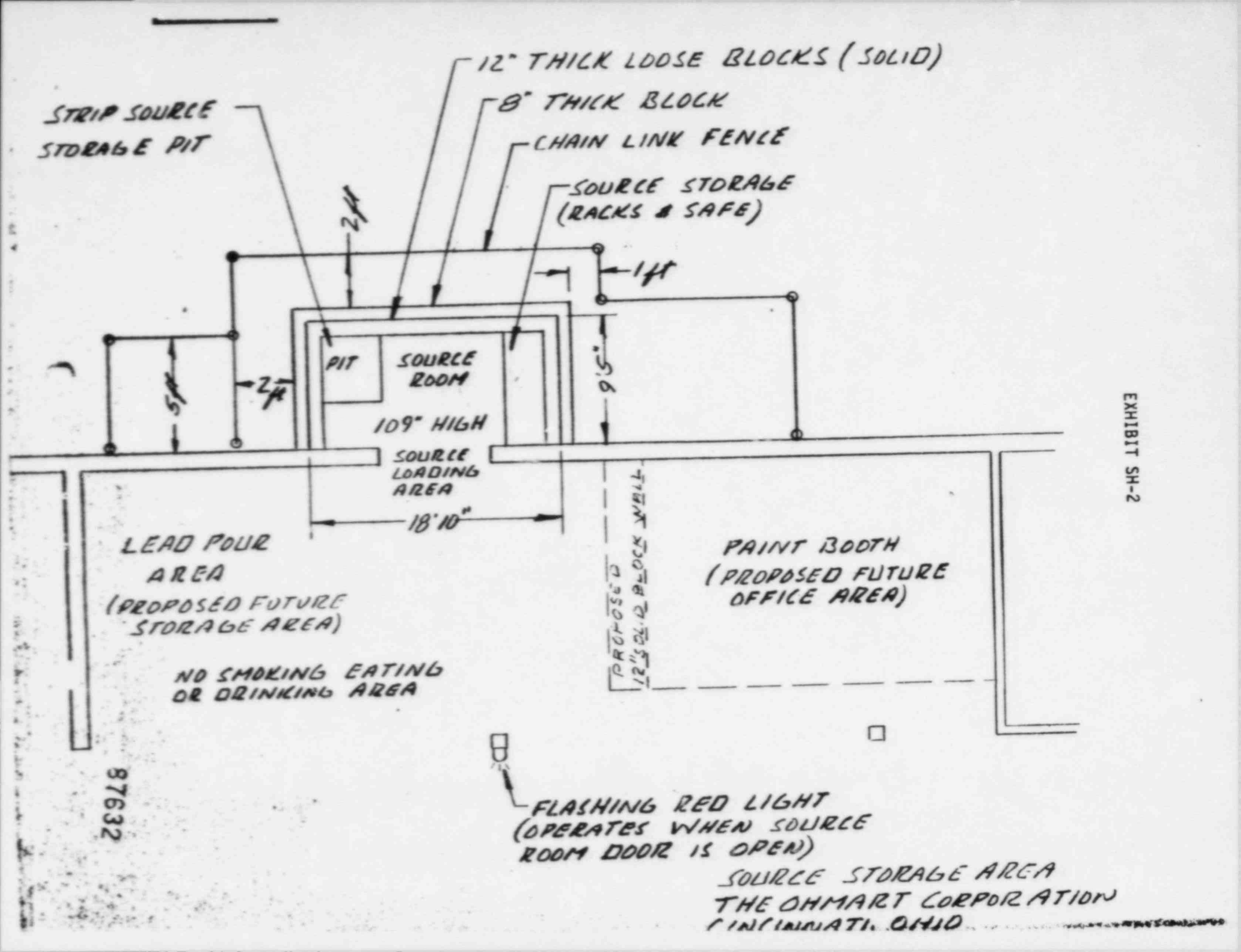
VI. Emergency Procedures

1. Leaking or Contaminated Source Capsule

a. Do not spread contamination
b. Call for help from supervisor, VP Manufacturing and Radiation Safety Officer

2. Failure of any source handling procedure which causes excessive radiation field

a. Get out of area
b. Barricade area
c. Call for help from supervisor, and Radiation Safety Officer


12" THICK LOOSE BLOCKS (SOLID)
8" THICK BLOCK
CHAIN LINK FENCE
SOURCE STORAGE (RACKS & SAFE)
STRIP SOURCE STORAGE PIT
2ft
1ft
5ft
2ft
PIT
SOURCE ROOM
109" HIGH
9'5"
SOURCE LOADING AREA
18'10"
LEAD POUR AREA (PROPOSED FUTURE STORAGE AREA)
NO SMOKING EATING OR DRINKING AREA
PROPOSED 12" SOLID BLOCK WALL
PAINT BOOTH (PROPOSED FUTURE OFFICE AREA)
FLASHING RED LIGHT (OPERATES WHEN SOURCE ROOM DOOR IS OPEN)
87632
SOURCE STORAGE AREA
THE OHMART CORPORATION
CINCINNATI, OHIO
EXHIBIT SH-2

FIELD SERVICE DEPARTMENT

I. TRAINING

A. All Field Service Personnel are required to attend the Ohmart factory school of Radiation Safety.

1. Included are source and source holder identification and handling.

2. Proper Radiation survey instruction and leak test performance instruction.

3. Dosage calculations.

4. Requirements for shipment of radioactive material.

5. uirements identified by Title 10CFR Parts 19, 20, 30 and 31.

6. Nuclear physics relative to Ohmart's equipment - types of radiation REM, RAD, RBE, Half-Life, dose limits relative to injury in perspective with normal limits around Ohmart's equipment, hazards of internal and external natures.

B. No Field Service Person may go into the field alone to do any job without first accompanying a qualified Field Service Person on no less than three (3) training trips.

II. PROCEDURES FOR CHANGING SOURCES IN THE FIELD

A. Sources in Source Wells

1. Complete job preparation by the service man before dispatch will include:

a) All drawings pertinent to the specific customer's application will be reviewed.

b) Appropriate source handling equipment will be obtained.

c) Appropriate monitoring equipment will be obtained.

d) A minimum of four (4) dosimeters will be obtained - two (2) for service man plus two (2) for an assistant who may be assigned by the customer.

e) Ring badges and wrist badges to be obtained also.

f) A dosimeter charger will be obtained for use with (d) above.

2. On-sight preparation to include:

   a) Proper layout of tools and equipment for ready access during physical change out.

   b) Proper location of sources to be installed for speed and ease of change out.

   c) Proper receptacle present for removal of old sources.

   d) Proper instruction given to person assisting (if any) preceded by brief radiation safety lecture.

   e) Dry (practice) run to be performed to insure proper placement of a, b, and c above to insure a minimum of exposure time.

   f) Change over to be performed methodically using smooth, steady movements according to plan established under (e) above.

B. Sources in Source Holders

   1. The policy of changing sources in source holders in the field is not to do it.

      a) This is a very hazardous operation to attempt in a customer's plant under less than ideal conditions.

      b) The recommended procedure is to supervise proper packaging of the source holder intact for return to the factory.

      c) In cases of emergencies involving a fire where the source holder's shielding may have been melted out or the source holder itself is physically damaged, proper shielding material will be obtained to decrease field intensity to a suitable level for return to the factory for disposal or repair.

      d) In all cases of emergencies, a Field Service Man will be dispatched with proper monitoring equipment, tools necessary if applicable, and dosimetry of proper configurations (ring badges, etc.).

C. Special Level Systems, e.g. MDDG, MDL

   1. Basic preparations to be made will be as outlined under sources in source wells.

   2. Appropriate on-sight inspections and dry runs are definitely a must in all operations of this type.

   3. Unnecessary personnel at jobsite will be advised to keep safe distances - in this and all previous cases.

INSTALLATION AND TRAINING PROCEDURES

INSTALLATION AND TRAINING PROCEDURES FOR INSTALLATION OF OHMART DEVICES BY OHMART FIELD SERVICE REPRESENTATIVES.

I. GENERAL

Ohmart maintains a force of trained Field Service Personnel qualified to install, maintain, and instruct customer personnel in the safe use and operation of devices containing radioactive material. These personnel are required to do extensive study in the realm of Radiological Safety, attend two day formal classes in Safety and the Regulations of the USNRC and pass an examination in the subjects covered. These subjects are:

A. Principles and Practices of Radiation Protection.
B. Monitoring Techniques and Instruments.
C. Radioactivity Measurement.
D. Basic Mathematics and Calculations.
E. Biological Effects of Radiation.
F. Waste Disposal and Emergency Procedures.
G. Regulations of USNRC.
H. License Interpretation.

New personnel are, also, trained by experienced personnel on actual jobs in the field before being allowed to do service alone.

II. DEVICE INSTALLATION PROCEDURE

A. Inspection of device for shipping damage.

B. Check source holder to assure that it is in the OFF position. Use survey meter to verify.

1. Demonstrate ON and OFF positions to personnel and explain indicators.

2. Explain construction of source holder and any precaution necessary in handling, or working with it.

3. Check caution label content and explain meaning of entries.

4. Check wipe test certificate (must be present). If date is more than 6 months prior make new wipe test. Point out required wipe test interval from license or label on gage.

5. If source holder is to be mounted on a vessel which personnel can enter, a "lockout" procedure must be prepared so that the source holder is in OFF position whenever personnel enter the vessel. This procedure must be in writing and must be followed for personnel protection.

6. Install device on pipe or vessel with source holder in OFF POSITION.

7. Make radiation survey with the level of material in the pipe or vessel below the primary radiation beam and with the source holder in the ON position. Make a similar survey with the source in the OFF position. Use standard survey forms where applicable, otherwise make sketch of installation. When making survey be sure to search for highest radiation levels and "hot spots". Explain and demonstrate procedure to personnel.

8. Evaluate occupancy and discuss means of reducing the amount of time personnel may be exposed to radiation. Post "Caution Radiation Area" signs wherever radiation level exceeds 5 mr/hr at 12 inches from the surface of the device. No 100 mr/hr field should exist external to a vessel or 2 inches from the surface of a device. Shielding, or a change in source activity may be used to reduce the field. If the field is necessary for measurement a cage or other form of access control to prevent personnel working regularly in the area must be instituted. Personnel monitoring equipment must be worn in such areas.

9. Demonstrate and perform wipe test for leakage of radioactive material. Emphasize difference between leakage of Radiation and leakage of Radioactive Material.

   Check license to determine if licensee is authorized to take wipe test sample. If not, advise that an amendment should be obtained to allow the licensee to take the sample based on training given.

III. FORMAL LECTURE (PRESENTED TO NEW LICENSEES BY OHMART SERVICE PERSONNEL)

A. Radioactivity in General

1. Alpha, Beta, Gamma, Bremsstrahlung, X-Ray, Neutron

B. Measurement Terms

1. Curie - Activity

2. Roentgen - Ionizing capability in air

3. Rem - Estimated biological effectiveness relative to 1 roentgen of X-Rays

4. Rad - Unit of absorbed dose (100 ergs per gram of tissue)

5. Half-Value Layer (HVL) - Cuts radiation level in half. Demonstrate

6. Half Life - Time to decay to 1/2 former value in Curies of milliCuries.

C. Radiation Detection - Ionization

1. Scintillator - Liken to luminous dial watch

2. GM Tube (Geiger Counter) - Energy sensitive

3. Ion Chamber - Widest capabilities

4. Neutron Detector - Used on moisture gages

5. Demonstrate radiation survey meter appropriate to installation

6. Calibration of survey meter - interval and method.

D. Radiation Safety

1. Hazards of Radiation - Ionization of tissue from internal or external source. Internal hazard prevented by use of sealed sources. External hazard reduced by short-time exposure, use of shielding material and remaining as far from the source as possible. Demonstrate application of inverse square law and calculations.

2. Effects of Radiation - 24 Hour Period

   a) 1000 Rem - In short period (24 hours) statistically all those receiving it would die.

   b) 500-600 Rem - Statistically a lethal dose to 50% of a group (LD50).

   c) 200-250 Rem - 1st death.

   d) 100-200 Rem - Nausea, fatigue, low blood count.

   e) 50 Rem - Slight temporary blood change.

   f) 25 Rem - No detectable effect.

3. "Normal" natural exposures to cosmic radiation and naturally occurring isotopes.

   a) Sea Level - 0.01 mrem/hr, 1.68 mrem/week

   b) Denver 0.02 mrem/hr, 3.36 mrem/week due to high altitude

   c) Round trip jet flight New York - Los Angeles - 5 mrem dose, due, like Denver, to altitude.

4. Normal Medical Exposures

   a) Chest X-Ray - 1.25 rem

   b) Fluoroscope - 7.5 rem/minute

   c) Medical Therapy - up to several hundred rems.

5. Compare to range of exposure to sun where extreme exposure results in death or severe illness, small doses result in tanning which fades if not repeated continuously, and brief exposures which have no detectable lasting effect.

6. Pipe, process material or body does not become radioactive. Compare to chest X-Ray, radio antenna. Neutron energy levels such as found in reactors or "Atom Smashers" required to make anything radioactive.

E. Regulations

1. Licensee may only use the device unless content of license specifically authorizes other action. Usually licensee may not install, remove or work on the source holder of the device. Wipe testing authorization must be spelled out. Most such work must be performed by persons specifically authorized to perform this service.

2. Explanation of regulatory limits to exposure - to General Licensees and to public - to Specific Licensee personnel. Define requirements for monitoring and by consultation with regard to occupancy factors calculate probable exposure to individuals working in area of gage. If it appears likely an individual might average more than 23 mrem/week suggest temporary (6 months) use of film badges to determine whether badges are legally necessary. Records of the test must be kept as part of permanent license records on form NRC-5 or equivalent.

3. Leak Test Procedure. Review leak test purpose and method of performance. Device having 0.005 microcuries of removable contamination considered to be leaking. Explain evaluation procedure and interval.

4. Review of Safe Installation and Removal Procedures - Checking with survey meter to assure source holder actually in OFF position.

5. Storage - Sources and source holders being stored must be secured against theft, properly labeled, and stored in a place dedicated to storage and in an area not normally frequented by personnel. Must be leak tested before reuse if has not been tested within previous 6 months.

6. EMERGENCY PROCEDURES

a) FIRE OR EXPLOSION - Barricade area around device until inspected for high radiation levels and/or leakage of material. Notify appropriate regulatory agency, State or Federal, by telephone and telegraph at once. Obtain help from agency and persons specifically licensed to deal with emergencies.

b) LOSS OR THEFT - Report at once by telephone or telegraph to appropriate regulatory agency and to local health authorities and take action to find device. Contact Ohmart for advice. Allow no scrap to leave plant site until found or it can be proven the source is no longer on the plant site. Periodic physical inspections of source holders for corrosion or other damage should be made at least once per year to prevent loss. Theft will usually be prevented by maintaining "Caution Radioactive Material" labels properly legible and stored sources properly locked up.

7. TRANSFERRING AND SHIPPING

a) May only be transferred to persons specifically licensed to receive it (30.41).

b) Shipping and preparation for shipment must be in accordance with regulations of NRC (Part 71) and USDOT. Contact Ohmart for information on specification packaging and transportation regulations. Refer to Item E1.

8. LICENSEE

a) May only perform such functions as are specifically authorized in license. License may refer to content of application which in effect makes the application part of the license and binds the licensee to act according to procedures set forth in license application together with content of license itself. If there is conflict, the license wording applies.

b) Clauses in license state who may make leak tests, radiation surveys, install or remove devices, etc. Just because Individual User(s) are mentioned on license does not necessarily authorize them to do other than just use the gage.

c) Go over license and answer any questions of interpretation.

d) Records - Keep all records together, license application, license, all correspondence, Radiation Surveys, Wipe Test records, exposure records, source replacement, transfer and disposal.

Waste Disposal - Radioactive waste in the form of decayed sources, leaking sources and sources no longer needed may be returned to Ohmart who will, for a nominal fee to cover cost of handling, dispose of used and no longer needed sources. Radioactive material, in whatever form, may only be disposed of to persons specifically licensed to receive it. Preparation for shipment and transfer must be in accordance with content of license, the regulations of the USNRC and the U. S. Department of Transportation (USDOT). The USNRC must be notified of the disposal and the packaging must meet USDOT requirements. Instructions and applicable excerpts from regulations are supplied by Ohmart on request.

e) Review Section 8 of instruction manual including pointing out in parts 19, 20 and 30 the definitions and regulations pertinent. Review exposure calculations. Point out necessity for posting signs (NRC-3, etc.) as required. Show, read and explain regulations about restricted areas, unrestricted areas, radiation areas, high radiation areas. Show 10 CFR20, Appendix D for appropriate Regional Office.

IV. QUESTION AND ANSWER PERIOD

A. Oral Examination. Use outline in III above.

FIELD SERVICE DEPARTMENT

I. RADIATION MONITORING EQUIPMENT

A. Survey Meters

1. We have eleven (11) units manufactured by Reactor Experiments, Inc. of San Carlos, California.

   a) The model is the Digi-Rate

   b) The sensitivity is 0.1 mr/hr at 99.9 mr/hr with ± 15% accuracy.

   c) Usage is for gamma and beta measurement

   d) Calibration is done utilizing a 5 millicurie radium 226 test source at levels from one (1) to fifty (50) mr/hr.

2. We have two (2) units manufactured by Victoreen Instruments of Cleveland, Ohio.

   a) The model is 490, Thyac III, with 489-4 gamma/beta probes.

   b) Sensitivities are 10% of full scale on ranges of 0 to .2 mr/hr, 0-2 mr/hr, 0-20 mr/hr and 0-200 mr/hr with an overall accuracy of ± 10%.

   c) Usage is for gamma and beta measurement.

3. Specified calibration intervals of above instruments are six (6) months (2 times per year)

   a) Calibration checks are also made prior to new gage start-ups as often as needed.

B. Dosimeters

1. We have four (4) units manufactured by Victoreen Instruments of Cleveland, Ohio.

   a) They are model 541/F pocket dosimeters with a 0-200 mr range.

   b) They are charged with a Victoreen model 2000A dosimeter charger.

   c) They are checked prior to each use with the 5 millicurie radium 226 calibration source.

d) They are issued in pairs to Field Service Personnel who are dispatched to do source work in the field, e.g., changing sources in source well systems or installing motor driven density gages.

e) Model 541/F dosimeters are direct read by holding them up to the light and looking through the barrel, or using the 2000A charger.

f) Records of dosages received on source work in the field are part of the field service reports. Total dosages are recorded by film badges issued under the plant-wide service.

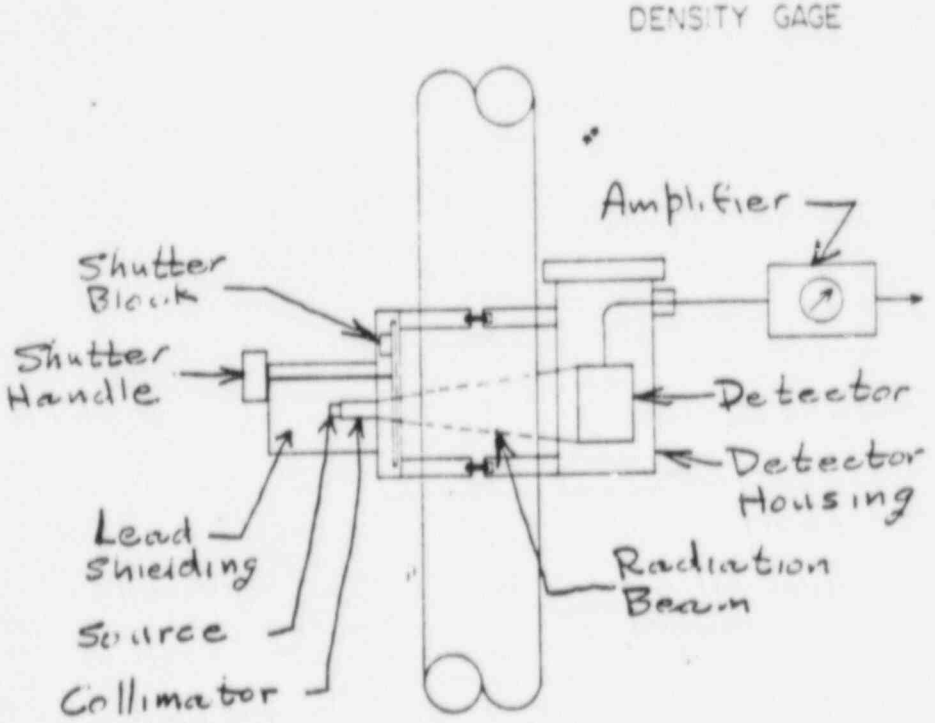
RADIATION SAFETY INSTRUCTIONS

Ohmart DensART ™ Series 3000 Density Gage with Model SR-1 or SR-2 Source Holder for gages distributed to General Licensees.

Gage Configuration

The Ohmart Density Gage measures the density of a process material flowing in a pipe by passing a beam of gamma radiation through the material. The gamma radiation is partially absorbed by the process material and the part which is not absorbed is measured by the Ohmart radiation detector.

This arrangement is shown in simplified form in the drawing below.



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The gamma radiation is obtained from radioactive material which is doubly encased in a stainless steel source capsule. The capsule is mounted in a source holder which is constructed of a steel shell filled with lead. The lead provides radiation shielding and a collimator so that the radiation beam is directed through the process material toward the detector. Lead shielding reduces the radiation field intensity to a safe value on the back and sides of the source holder.

The source holder has a lead shielding block, or shutter, which can be rotated into position so that the collimated beam directed toward the detector can be turned OFF. The shutter is controlled by a handle on the back-side of the source holder. There are two other positions of this handle - ON and STANDARDIZE. The shutter can be locked in the OFF position but is held in place by a screw in the ON and STANDARDIZE positions.

US NUCLEAR REGULATORY COMMISSION REGULATIONS

The use of this density gage is controlled by the regulations of the US Nuclear Regulatory Commission (USNRC) or the equivalent agency of a State. These regulations are numbered 10CFR 31.5; 10CFR 30.34 and 30.51 through 30.63; 10CFR 20.402, 20.403, Appendix D. A copy of these regulations is included at the end of this section of the manual. This copy of the regulations are those that were in effect at the time of writing this material (approx. June 1977). Contact The Ohmart Corporation if questions arise about changes in the regulations.

RADIATION SAFETY LABEL FOR GENERAL LICENSEES

In order to comply with the USNRC regulations, a metal label has been attached to the gage which states the responsibilities of the General Licensee.

In the following paragraphs, the actual wording of the label is shown with an explanation.

RECEIPT, POSSESSION, USE AND TRANSFER OF THIS DEVICE ARE SUBJECT TO A GENERAL LICENSE OR EQUIVALENT AND REGULATIONS OF THE U.S. NRC OR AN AGREEMENT STATE.

This refers to the USNRC regulations in 10CFR 31.5.

ABANDONMENT OR DISPOSAL PROHIBITED UNLESS TRANSFERRED TO PERSONS SPECIFICALLY LICENSED BY THE NRC OR AN AGREEMENT STATE.

This means that the gage cannot be abandoned, sold for scrap, or placed in the trash bin. If the gage is no longer needed, it must be shipped to a person or company specifically licensed by the USNRC or an Agreement State to receive the gage.

Note in the fourth paragraph that the General Licensee may not dismantle the gage. Again, this must be done by a person specifically licensed by the USNRC or an Agreement State.

OPERATION PROHIBITED IF THERE IS INDICATION OF FAILURE OF OR DAMAGE TO SHIELDING, OR SOURCE CONTAINMENT.

If there is any damage to the gage, or failure of the shutter mechanism, telephone the Field Service Manager at The Ohmart Corporation - (513) 272-0131.

ANY PERSON MAY MOUNT THIS DEVICE IN PLACE INITIALLY, PROVIDED THE ON-OFF MECHANISM IS LOCKED IN THE OFF POSITION. ALL OTHER DEVICE INSTALLATION, DISMANTLING, RELOCATION, REPAIR AND TESTING INVOLVING THE RADIOACTIVE MATERIAL, ITS SHIELDING AND CONTAINMENT SHALL BE PERFORMED BY PERSONS SPECIFICALLY LICENSED BY THE NRC OR AN AGREEMENT STATE.

Anyone may mount the density gage in position on the process pipe, do the electrical wiring, and turn the electrical power switch ON -- if the source holder shutter is locked in the OFF position.

This applies only to gages which contain a source activity of less than 2000 mCi. Gages which contain a source activity of more than 2000 mCi must be mounted in position by a person specifically licensed by the NRC or an Agreement State. There is a label on the source holder which states the activity of the source in mCi (millicuries).

After these preliminary services are performed, a person specifically licensed by the NRC or an Agreement State must do the start-up of the gage. This involves: unlocking the shutter and turning ON; testing for proper operation of the shutter and the shutter position indicator; making the initial radiation field intensity survey; initial testing for leakage of radioactive material.

The gage is shipped from the Ohmart factory with the source holder shutter locked OFF with a padlock. Lock combinations or keys are not shipped with the gage and will be given only to the specifically licensed person performing the start-up and placing the gage in service. Usually, this person is the service representative from the Ohmart Field Service Department.

A tag is attached to the lock with the following wording:

> THIS DEVICE MAY BE MOUNTED IN PLACE INITIALLY BY ANY PERSON PROVIDED THE SHUTTER REMAINS LOCKED IN THE OFF POSITION. ONLY A SPECIFICALLY LICENSED PERSON MAY PLACE THE DEVICE IN SERVICE BY INITIALLY OPENING THE SHUTTER AND MAKING THE REQUIRED LEAK TEST, TESTING FOR PROPER OPERATION OF THE ON-OFF MECHANISM AND INDICATOR AND MAKING THE RADIATION SURVEY.

DEVICE SHALL BE TESTED FOR RADIOACTIVE LEAKAGE AND PROPER FUNCTIONING OF ON-OFF MECHANISM AND INDICATOR, AT INSTALLATION, AT SOURCE REPLACEMENT AND THEREAFTER AT NO LONGER THAN 3 YEAR INTERVALS.

OFF-ON Mechanism

After initial testing of the shutter and shutter indicator by a specifically licensed person at the time of start-up, testing at three year intervals can be done by the General Licensee.

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With the gage electronics turned ON, and operating properly, turn the shutter to the OFF position. The gage reading on the indicating meter (or recorder) should be above 100% of full scale. This above 100% reading is a result of the lead shielding block being inserted into the radiation beam - which is the equivalent of a very high gravity process material. If the gage does not indicate above 100% of full scale, the gage must be serviced by a specifically licensed person.

If the electronic circuit is not operating properly, this electrical test is not valid and the shutter mechanism must be tested by a specifically licensed person.

OFF-ON Indicator

Testing of the OFF-ON indicator means that the shutter indicator must indicate ON and OFF properly. This can be observed when testing the shutter as described above.

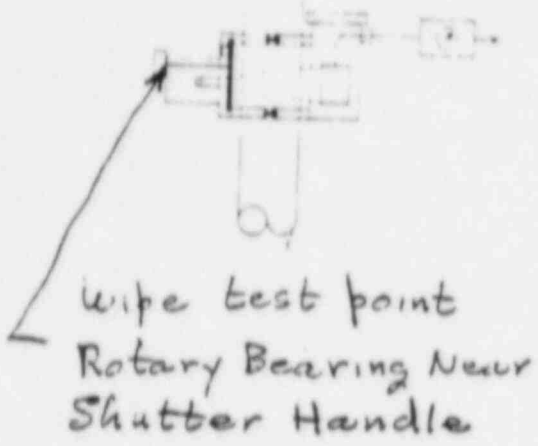
Radioactive Material Leakage Test

This test involves wiping the external surfaces of the source holder with the cotton end of a "Q-Tip" and then analyzing the cotton end for the presence of radioactive material.

The General Licensee may perform the wiping procedure but only a person, or company, specifically licensed by the NRC or an Agreement State may do the analysis for radioactive material.

The Ohmart Corporation, and other companies, supply a Leak Test Kit to make this test for radioactive material leakage. The Ohmart Corporation supplies a "Q-Tip" in a plastic vial contained in a small cardboard mailing tube. To use the Ohmart Leak Test Kit, follow this procedure:

1. Take the cardboard mailing tube containing the Q-Tip to the source holder to be tested. Remove the top from the mailing tube. Remove the cap from the vial which holds the Q-Tip. Tilt the vial and grasp the Q-Tip by the wooden end.
2. Wipe the external surface of the source holder with the cotton tipped end. Wipe all seams and around the rotor shaft as shown in the sketch below. These areas are most likely to be contaminated if the source leaks. Do not touch the cotton tipped end or allow it to touch other objects as this would spread contamination if the source leaks.
3. After making the wipe test, replace the Q-Tip in the vial with the cotton tipped end at the bottom. Replace the cap on the vial and the top on the mailing tube.
4. Attach an address label reading "The OHMART Corporation" 4241 Allendorf Drive, Cincinnati, Ohio 45209".
5. Upon receipt of the wipe, The Ohmart Corporation will perform a very sensitive test to determine the presence of radioactive material. If the wipe is free from contamination a notice will be sent, via mail, that the source is leak-free. If the wipe has a significant amount of radioactive material, an emergency notification will be sent, via telegram or telephone, advising that the source holder must be taken out of service and returned for repair. Arrangements can be made with The Ohmart Corporation, or other specifically licensed person, to take the gage out of service.



LOSS, THEFT OR TRANSFER OF THIS DEVICE AND FAILURE OF OR DAMAGE TO THE SHIELDING, OR THE SOURCE CONTAINMENT, MUST BE REPORTED TO THE NRC OR AN AGREEMENT STATE.

In addition to notifying the USNRC or the Agreement State agency, The Ohmart Corporation should also be notified so that proper help can be provided.

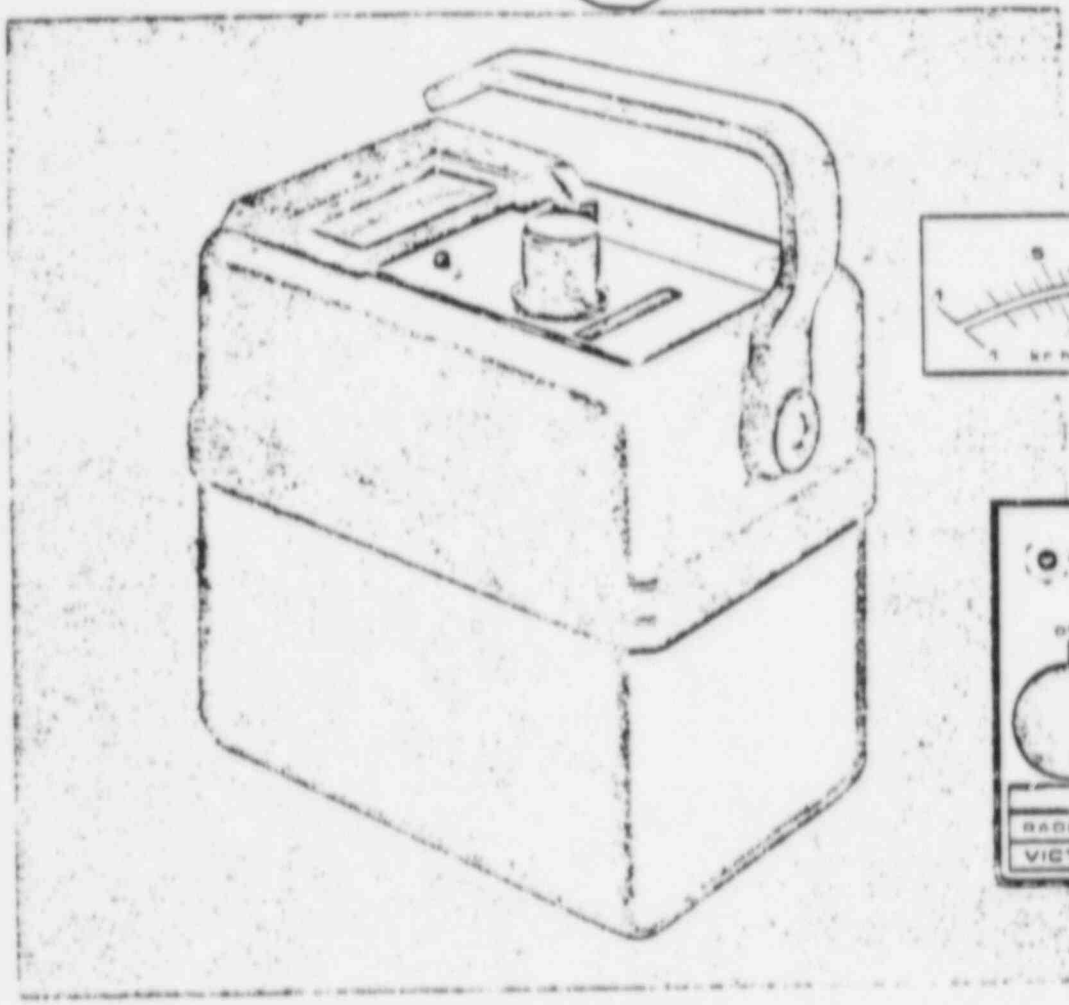
If the gage is involved in a fire or explosion, the area around the gage should be barricaded or roped-off until the situation can be evaluated by a specifically licensed person. Telephone The Ohmart Corporation (513) 272-0131 for help.

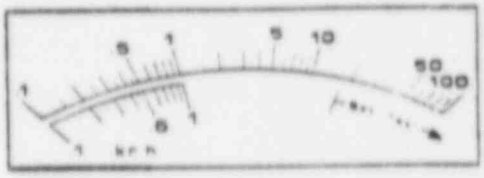
REMOVAL OF THIS LABEL IS PROHIBITED.

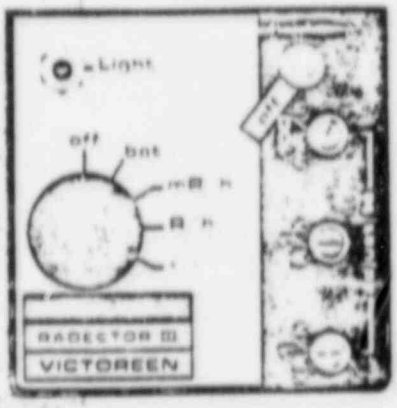
The label may not be removed from the gage and it must be kept clean and legible.

LOGARITHMIC SURVEY METER

MODEL 2035, 2036 / RADECTOR III







- Patented Neher-White Ion Chamber for Wide Range Logarithmic Response from 0.1 mR/Hr. to 1000 R/Hr.
- Ruggedized Meter and Pushbutton Scale Illumination for Fast, Reliable Readings.
- Built-In Check Source and Shutter Control for Precise Standardization of All Ranges.
- Remote Monitoring Capability with Optional External Probe and Cable Assembly.

Radector III, third generation of Radectors, offers the rugged dependability of its predecessors with greater range and precision. Available in two models, the compact 2035 and 2036, with remoted detector assembly. Radector III provides wide-range monitoring of beta and gamma radiation where intensities may vary from background through disaster levels. This unique instrument meets A.E.C. requirements for "uncontrolled" areas.

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VICTOREEN INSTRUMENT DIV. of VLN
[illegible] HARVARD AVENUE . . . CLEVELAND OHIO 44104

MODEL 2035, 2036

Radiation Detected:

Model 2035: Beta above 200 keV, X-ray and gamma above 80 keV.

Model 2036: Gamma only, with external probe and cable assembly; X-ray and gamma above 80 keV.

Operating Range: 7-decade logarithmic response in three range segments as follows: 0.1 to 100 mR/hr., 0.1 to 100 R/hr and 0.1 to 1 kR/hr.

Accuracy: Exclusive of energy dependence, is within ±20% of indication.

Detector: Patented Neher-White stainless steel ionization chamber, 2-1/4 in. (5.7 cm) diameter by 2-7/8 in. (7.3 cm) long with four 7/16 in. (1.1 cm) diameter beta windows, 1 mil (20 mg/cm^2) stainless steel and 2 mil (13.7 mg/cm^2) aluminum. Argon filled at 10 atmospheres. Shutter for beta discrimination on Model 2035.

Energy Dependence: Within ±20% for gamma from 80 keV to 1.2 MeV.

Warmup Time: Approximately 1/2 hour, but almost immediate use is possible using adjustment control associated with each range.

Response Time: 5 seconds on mR/hr range, 5 seconds on R/hr range and 3 seconds on kR/hr range.

Switching Transients: Approximately 15 seconds when switching from Off to Range position.

Drift: Less than 5%/3 hours, 10%/24 hours of fullscale.

Zero Adjust: Uses check source to set ends of scale. Logarithmic response makes zero meaningless.

Environmental Effects:

Temperature Operating Range: -20° to +130°F (-30° to +55°C) except for batteries.

Temperature Dependence: Less than ±10% over the above temperature range.

Pressure Dependence: Negligible due to use of hermetically sealed ion chamber. Usable to 50,000 feet.

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

Power Requirements:

Battery Complement and Life: Four (4) "D" type flashlight cells, NEDA Type 13. Life, approximately 500 hours continuous use.

Check Source and Calibration Check Switch:

Spring-loaded switch, 10 microcuries ^{85}Kr operational check source.

Controls:

Rotary range switch marked, Off, Battery, mR/hr, R/hr and kR/hr.

Calibration adjust control; three adjustments, one for each range.

Scale illumination pushbutton switch.

Readout: Meter, 3 in. (7.3 cm) logarithmic scale marked 0.1, 1, 10 and 100 mR/hr., 0.1, 1, 10 R/hr and 0.1 to 1 kR/hr.

Geotropism: Within ± 2% of linear fullscale.

Construction: Fiberglas case with mar-resistant matte finish.

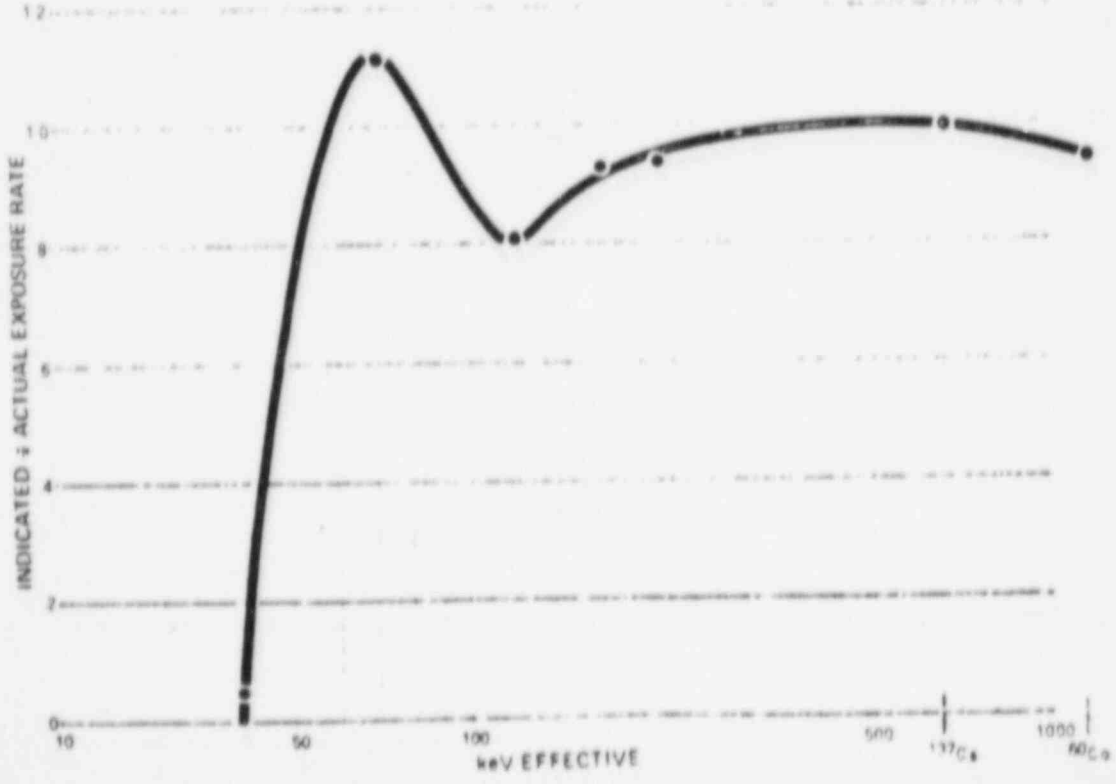
Overall Dimensions:

6 in. (15.3 cm) long
4 in. (10.2 cm) wide
5-1/2 in. (14.0 cm) high

Net Weight: 4 pounds (1.82 Kg).

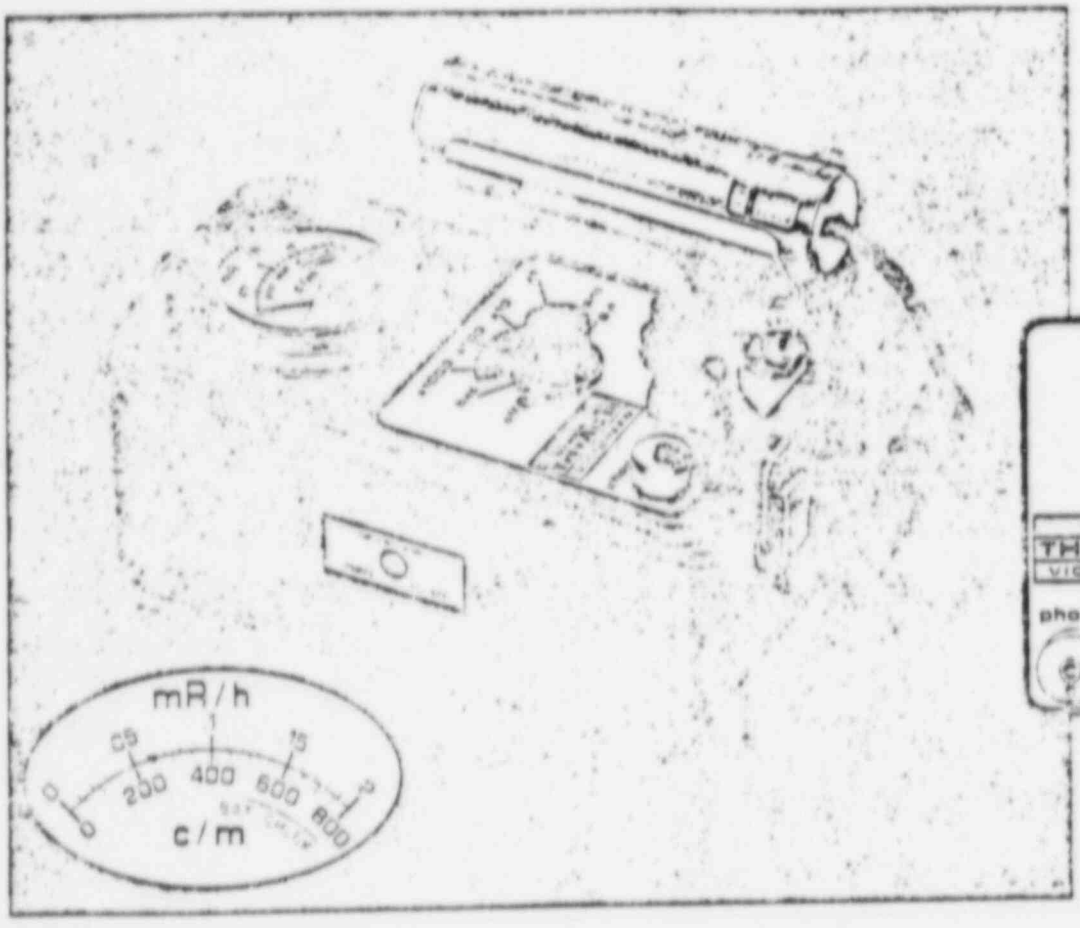
Shipping Weight and Volume: 8 pounds (3.64 Kg) 2.5 cu. ft. (0.071 m^3).

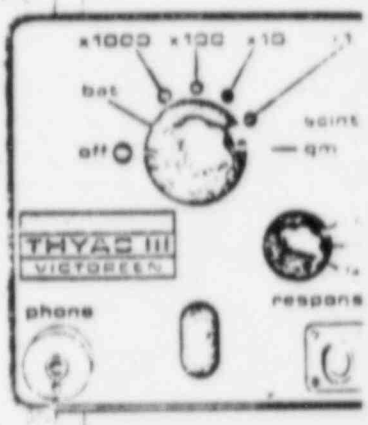
RESPONSE CURVE



GM...SCINTILLATION SURVEY METER

MODEL 490 / THYAC III





Field-Proven, Model 490 Thyac III Gives Unsurpassed Performance, Reliability, Ruggedness and Versatility in G-M Survey Instrumentation ... Ideal for Field or Lab Radiation Surveys. Thyac III Detects Alpha, Beta, Gamma and X-Ray Radiation with Either G-M or Scintillation Probes ... Choice of Response Time ... Loudspeaker ...

- G-M and Scintillation Operation Without the Necessity of Switching High Voltage.
- Slow, Medium and Fast Response Time to Reduce Statistical Fluctuations at Low Counting Rates and Improved Response Time at High Counting Rates.
- Four Fullscale Ranges from 0 – 800 to 0 – 800,000 cpm – Plus External Speaker Output.
- Completely Interchangeable G-M and Scintillation Probes for Maximum Survey Flexibility and Greater Range of Sensitivities.

Thyac III, in the tradition of all Thyac Series instrumentation since 1949, offers unequaled performance and versatility for all types of radiation surveys. Model 490 has been tested and proven even more rugged and reliable than its predecessors, Thyac I and Thyac II. Increased sensitivity and flexibility have been carefully considered and designed into the 490. Highly sensitive circuitry ensures counting even the extremely low level Geiger tube pulses encountered at high count rates. Thyac III accepts a wide selection of detector probes.

VICTOREEN INSTRUMENT DIV. of VLN

CLEVELAND, OHIO 44104

MODEL 49

Radiation Detected: Capable of measuring alpha, beta and gamma as a function of probe selection.

Operating Range: Four linear overlapping ranges. G-M detectors utilize the first three ranges (0-800, 0-8,000 and 0 – 80,000 cpm). Scintillation detectors utilize the entire four ranges (0-800, 0-8,000, 0-80,000 and 0-800,000 cpm). Intensity ranges for use only with 489-4 and 489-35 probes in high energy gamma radiation fields. To be used only as approximate measure of radiation intensity (0-0.2, 0-2 and 0-20 mR/hr).

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

Detectors: Accepts the following standard Victoreen detectors: 489-4, 489-35, 491-40, 489-50, 491-30, 489-55, 489-60 and 702.

Warmup Time: Negligible.

Response Time: 15 seconds, 5 seconds and 1.5 seconds.

Environmental Effects:

Temperature Operating Range: Will operate within accuracy limits of instrument from -20° to +120°F (-30° to +50°C) excluding batteries except for Model 489-4 probe which uses an organic quenched G-M tube.

Temperature Dependence: Less than 20% of fullscale from -20° to +120°F (-30° to +50°C). Use alkaline batteries below 32°F.

Humidity Range: Less than ±5% change in reading over 24 hours at 90%.

Power Requirements:

Battery Complement and Life: Two (2) "D" size flashlight cells, NEDA type 13. Minimum life of 100 hours continuous service.

Check Source: Depleted uranium on side of case.

Controls: Rotary Range and Function switch marked: Off, Battery, X1000, X100, X10 and X1 in counts per minute and 0-.2, 2 and 20 mR/hr. Rotary Response Time switch marked: Slow (15 seconds), Medium (5 seconds) and Fast (1.5 seconds).

Connectors: External MHV connector for detector hook-up. Special microphone type mounted on case top for loudspeaker or earphones.

Readout: Meter; 3 in (7.7 cm) scale marked 0-0.2 mR/hr and 0-800 cpm.

Geotropism: Approximately ±2% of fullscale.

Construction: Sturdy, splash-resistant, cast aluminum top fitted on drawn aluminum case bottom, printed aluminum control panel, probes fit conveniently onto handle, special mar-resistant matte finish.

Overall Dimensions: (Basic instrument less probes):

8-3/4 in. (22.2 cm) long
4-1/2 in. (11.4 cm) wide
7 in. (17.8 cm) high

Net Weight: 4 pounds (1.82 Kg).

Shipping Weight and Volume: 8 pounds (3.64 Kg), 1.5 cu. ft. (0.042 m^3).

Accessories Supplied: Vinyl carrying strap and low-level beta emitting check source.

RESPONSE CURVES ... See "GM, Scintillation Probes and Accessories" Catalog Sheet ... Form 3230-2-72

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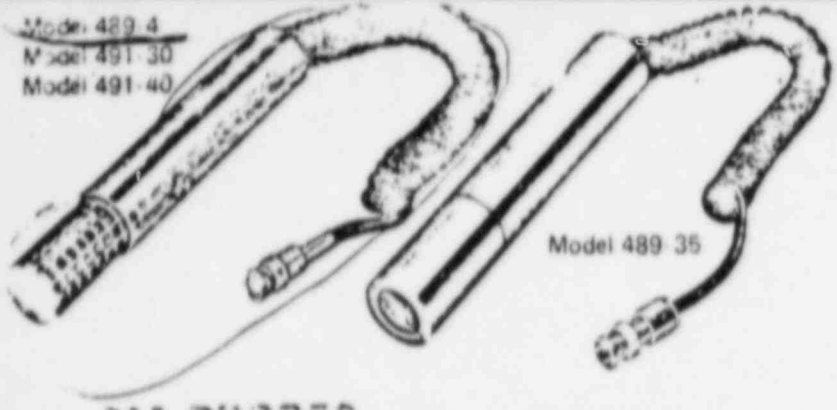


GM PROBES

Victoreen Geiger-Mueller detectors fulfill a wide variety of radiation measurement needs. Probes are available for detection of alpha, beta and gamma radiation. By using the sliding 360° shield, the user can discriminate between different type radiation in mixed fields.

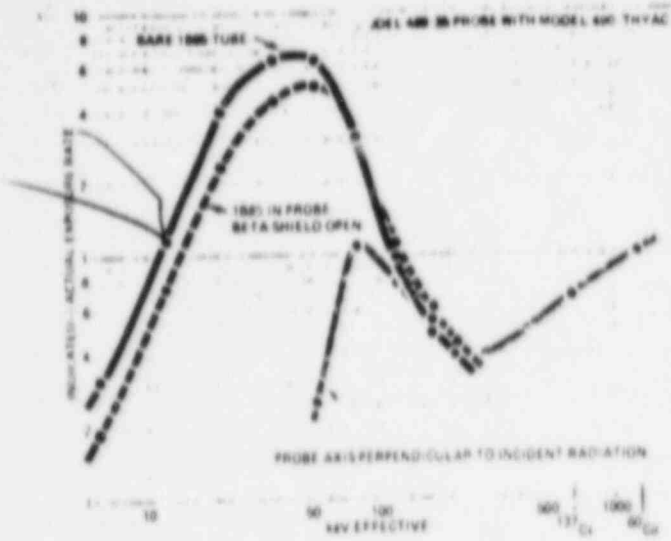
Reliability and ruggedness are inherent to these detectors. Uniformity of construction and field proven design assure dependable performance with all Victoreen G-M survey instruments. Standard MHV type connectors readily allow interchange of all Victoreen detector probes. The G-M tubes are fastened by a simple mounting clip for quick replacement of expended counter tubes. The life expectancy of the counter tubes range from 10^8 to essentially an infinite number of counts depending on type quench gas utilized. Enhanced sensitivity to low level gamma and beta radiation is achieved when using the unique Victoreen 1885 G-M tube in the Model 489-4 probe.

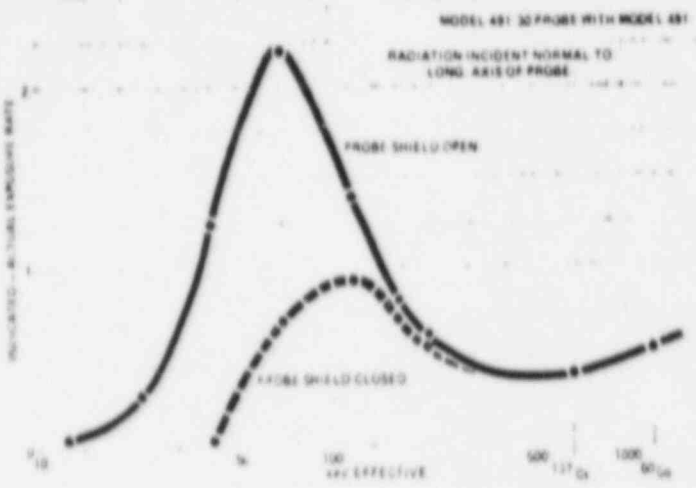
Victoreen G-M probes are the first choice for use in portable survey instruments, area monitoring systems, and precision laboratory measuring equipment. These probes are also ideally suited for multiple tube counters or for coincidence and anti-coincidence circuits.

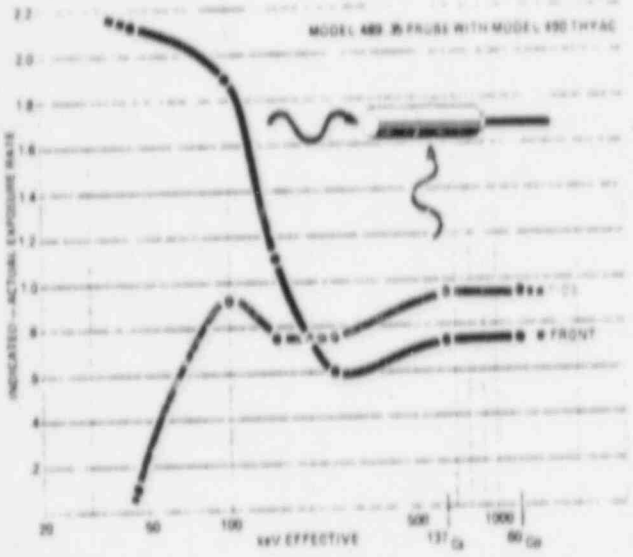
Model No.		489-4	491-30	491-40	489-35
Type		Beta - gamma G-M probe with sliding 360° metal shield for beta discrimination			Alpha, beta, gamma G-M probe with thin end window
Radiation Detected		Gamma above 6 keV Beta above 200 keV	Gamma above 12 keV Beta above 200 keV		Alpha above 4 MeV Beta above 70 keV Gamma above 6 keV
Energy Dependence		See response curves			
Exposure Rate Limitations (Typical)		Recovery time approximately 100 μ sec. Unsaturated* at 2000 R/hr with Model 490			
		Saturates above: 1.6 R/hr with Model 491 3 R/hr with Model 493 6 R/hr with Model 495	Saturates above: 4 R/hr with Model 491 10 R/hr with Model 493 20 R/hr with Model 495	Saturates above: 7 R/hr with Model 491 18 R/hr with Model 493 40 R/hr with Model 495	Saturates above: 4.7 R/hr with Model 491 11.6 R/hr with Model 493 25 R/hr with Model 495
Temperature Range		-20°F to +165°F (-30°C to +75°C)	-65°F to +195°F (-55°C to +85°C)		
Pressure Range		To 5 psig	To 15 psig		To 5 psig
Humidity Range		0 - 95% relative humidity			
Voltage Operating		900V on all probes			
Detector Construction	Wall Material	Aluminum	Stainless steel		Stainless steel with mica end window
	Wall Thickness	30 mg/cm²			1.4 mg/cm² end window; 30 mg/cm² wall
	Active Length	2 3/4 in. (7 cm)	2 3/8 in. (6 cm)	2 1/4 in. (5.7 cm)	4 in. nominal (10.2 cm)
	Quench	Organic	Halogen		
Probe Connector		Standard MHV type female			
Overall Probe Dimensions (Excluding Cable)	Dia.	1 3/16 in. (3.2 cm)			1 5/16 in. (3.34 cm)
	Length	5 3/8 in. (13.6 cm)			7 1/2 in. (19.1 cm)
Cable Length		40 in. (125 cm)			
Weight		Approximately 1 pound (0.45 Kg)			

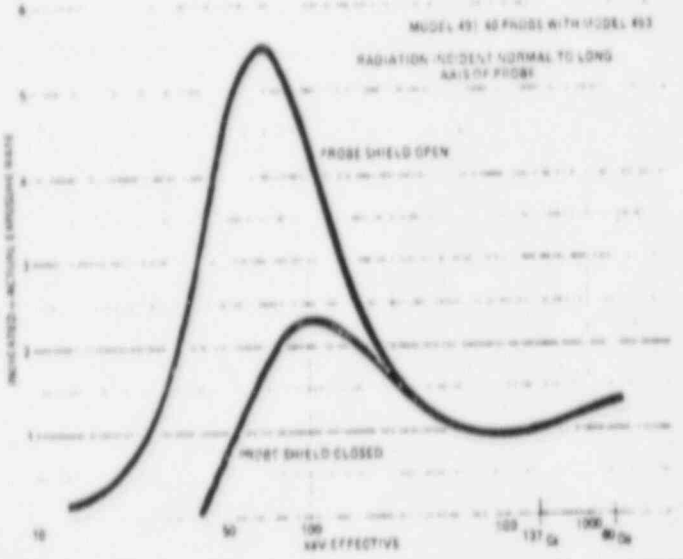
* Saturation is interpreted as a decrease in meter (or scale) indication with increasing radiation intensity.

RESPONSE CUR ES









When using the probe/survey meter combination shown on the response curves the meter is read directly in mR/hr. Calibration point is indicated as either ^{137}Cs or ^{60}Co. When other combinations are utilized, divide the meter reading by the appropriate factor.

Survey Meter	Probe				Calibration Source
	489-4	489-35	491-30	491-40	
490	Read Directly	95	.45	2	^{60}Co
491	2.3	2.2	Read Directly	.45	^{137}Cs
493	5.3	5.1	2.3	Read Directly	^{137}Cs

MODEL 490-50 SPEAKER ACCESSORY

A loudspeaker accessory is also available, that sounds the presence of radiation in distinctly audible tones discernable in typical background noise. The 490-50 speaker can replace earphones and requires no modification to be utilized with any of VICTOREEN's G-M type survey meters that provide a phone jack connector. Simply screw the 490-50 on to the survey meter for the speaker to become operational. The 490-50 has an independent battery supply to assure long life and dependable performance.

SPECIFICATIONS

Range: Operable above 1,000,000 cpm.

Battery Complement: One 15 volt Eveready photoflash battery, type 504 or equivalent (NEDA 220).

Circuitry: Simple pulse shaper and output stage utilizing 4 silicon transistors.

Connector: Female microphone type, mates with Amphenol No. 75-PC1M (chassis mount) or No. 75-MC1F (cable connector).

Construction: Black plastic cylinder and base with aluminum cap and speaker grill screen.

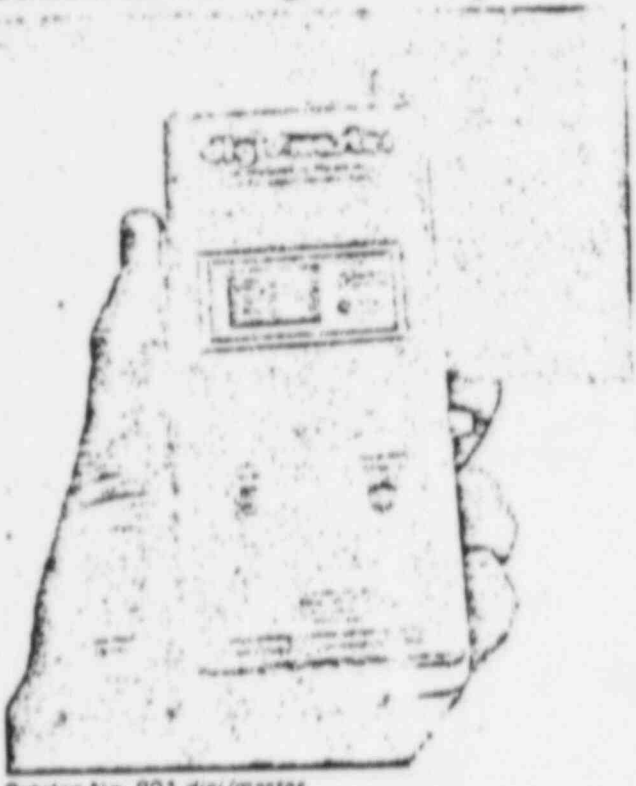
Audio: One 2-inch (5.1 cm) PM speaker.

Size: 2 inches diameter x 2-3/16 inches high (5.1 cm x 5.5 cm).

Weight: Approximately 4 ounces (.11 Kg).

Shipping Weight: 1 pound (.45 Kg).

digi/master
Subminiature Digital Survey Meter



Catalog No. 801 *digi/master*

■ Digital Readout ■ Automatic Range Switching
■ Integrated Circuitry □ Small, Light, Rugged
■ Wide Range

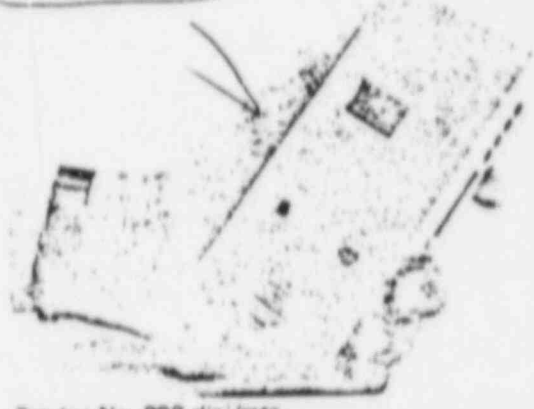
This pocket-size beta/gamma survey meter is not just another redesign of existing types. It is the first completely new approach to survey meters in many years. The *digi/master* has a remarkably wide range—from 0.1 mR/h to 100,000 mR/h (100 R/h). Range switching, as required in ordinary survey meters, is not necessary since the correct range is automatically selected. The CMOS digital logic converts the radiation pulses to digital output in mR/h or R/h. The instrument weighs only 11 ounces (0.3kg), and will fit readily in a lab coat or a back pocket. It is competitively priced, and its exceptional ruggedness makes it ideal for field or laboratory use.

The only controls on the *digi/master* are an on-off switch, and a display-on-command button. When the button is pressed, the display zeros in on the dose rate in 1 to 2 seconds. The use of the push button for display minimizes battery use and helps provide the long battery life of over 150 hours using only small penlite cells. There's no error due to misread meters or scale factors, and no problems with fluctuating meter pointers. Even inexperienced personnel can obtain accurate, unambiguous readings the first time. The 3-digit LED display provides a readily visible readout both in daylight or dark areas.

The *digi/master* uses two halogen-quenched, filtered GM tubes. The lower range tube has a sliding shield which permits either beta-gamma or gamma-only readings. The higher range tube measures gamma radiation only. The LED's read .1 to 99.9, and range indicator lights show whether the reading is in units of mR/h or R/h. The display cycles continuously in fields over 100 R/h. An earphone signal is available continuously when the instrument is switched on—it is not necessary to press the display button in order to obtain the audio signal. This is especially useful for contamination surveys.

The Catalog No. 801 *digi/master* is a truly unique survey meter that does considerably more than any currently available instrument—and does it better, and at a lower price.

digi/rate
Subminiature Digital Survey Meter



Catalog No. 802 *digi/rate*

■ Digital Readout ■ Automatic Range Switching
■ Integrated Circuitry ■ Small, Light, Rugged
■ Low Cost

The economical *digi/rate* digital survey meter is identical to the *digi/master* survey meter except that it has a shorter range: 0.1 mR/h to 100 mR/h—it should be noted that even this range is still somewhat beyond that encountered in most laboratory type survey meters.

The *digi/rate* has an accurate, unambiguous digital readout utilizing an LED display. The unit has automatic range switching over the 3 decades that it covers as well as overrange indication at dose rates greater than 100 mR/h. The CMOS digital logic contributes to the light weight and small size of the device, in addition to providing to its high reliability and exceptional ruggedness. The simple controls involve only an on-off switch and a press-to-display button. There is a sliding beta/gamma window. The instrument operates for over 150 hours on one set of Penlite cells. There is also a continuous earphone signal when the instrument is on.

The Catalog No. 802 *digi/rate* is designed to provide a simple, reliable, low cost instrument for measuring radiation levels that do not require the wide-range capability of the *digi/master*.

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Digi/Master and Digi/Rate are all solid-state beta-gamma survey instruments with a three-digit light emitting diode (LED) display. Low power MOS digital logic is used to provide high reliability and long battery life. The detector used is a thin wall, halogen quenched Geiger-Mueller tube, filtered to provide essentially flat energy dependence about the tubes axis of symmetry. The instrument is housed in a rugged, all-metal package small enough to be conveniently used in one hand.

This booklet includes technical specifications, the principles of operation, use of the instrument, calibration, maintenance, warranty data and a parts list.

TECHNICAL SPECIFICATIONS

Radiation Detected	Beta, X-ray and Gamma Radiation
Range	Digi/Master: 0.1 mR/h to 99.9 R/h
	Digi/Rate: 0.1 mR/h to 99.9 mR/h
Detector	Halogen quenched G-M tube (two in Digi/Master)
Accuracy	±15% of fullscale indication exclusive of energy dependence when calibrated with Cs 137.
Energy Dependence	±5% of true doserate from 90 keV to 1.3 meV. Minimum detectable beta energy is 0.25 meV.
Display	Three digit LED
Output	Earphone jack (earphone included)
Response Time	Digi/Master: Nominal one or two seconds depending on rate.
	Digi/Rate: Nominal one second regardless of rate.
Controls	On-off switch
	Press-to-read
	Beta window slide
Battery Complement	Four AA size "Penlite" cells (batteries included)
Battery Life	Greater than 140 hrs. with NEDA Type 15.
Circuitry	Low power, all solid state digital logic
Operating Temp	0 to 40°C
Overall Dimensions	3 3/4" x 2" x 1 1/2"
Net Weight	12 oz. including batteries.

Doserate is determined in Digi/Rate by gating the pulses from the GM tube into a 3-decade counter for a time set by the instrument's main time base (see figure 1). Data in the counter are transferred to temporary storage and serialized by decade. A read-only memory is programmed to provide the proper output code to drive each 7-segment LED display in sequence. Thus, only one digit in the display is illuminated at any one time but the scanning is performed at a high rate so that the observer's eye integrates the display, and all digits appear "on" simultaneously. Battery power is conserved by this technique. A doserate higher than 99.9 mR/h results in an overflow signal which resets the time base and places the circuitry in a recycling mode which persists until the doserate falls within the measurement range. High voltage for the G-M tube is provided by an electronically-regulated, blocking oscillator supply. Primary power is provided by four AA size cells.

The operation of Digi/Master is essentially the same except that auto-ranging circuitry, LED range indicators, and an additional G-M tube are used increasing the range to 99.9 R/h. Continuous recycling, as in Digi/Rate, occurs at levels above 99.9 R/h.

OPERATION OF THE INSTRUMENT

Because of the simplicity of operation, obtaining reliable data is straightforward. The only controls are an ON/OFF switch, a push-to-read button, and a beta window slide. For aural monitoring, the sub-miniature headphone is plugged into the phone jack.

One major advantage of the "Digi's" is that their compact size permits one-hand operation leaving the other hand free. With the instrument held in the hand, the display button can be conveniently operated with a thumb or finger.

To operate the instrument, move the power switch to the ON position and wait several seconds to permit the high voltage supply to reach its proper operating point.

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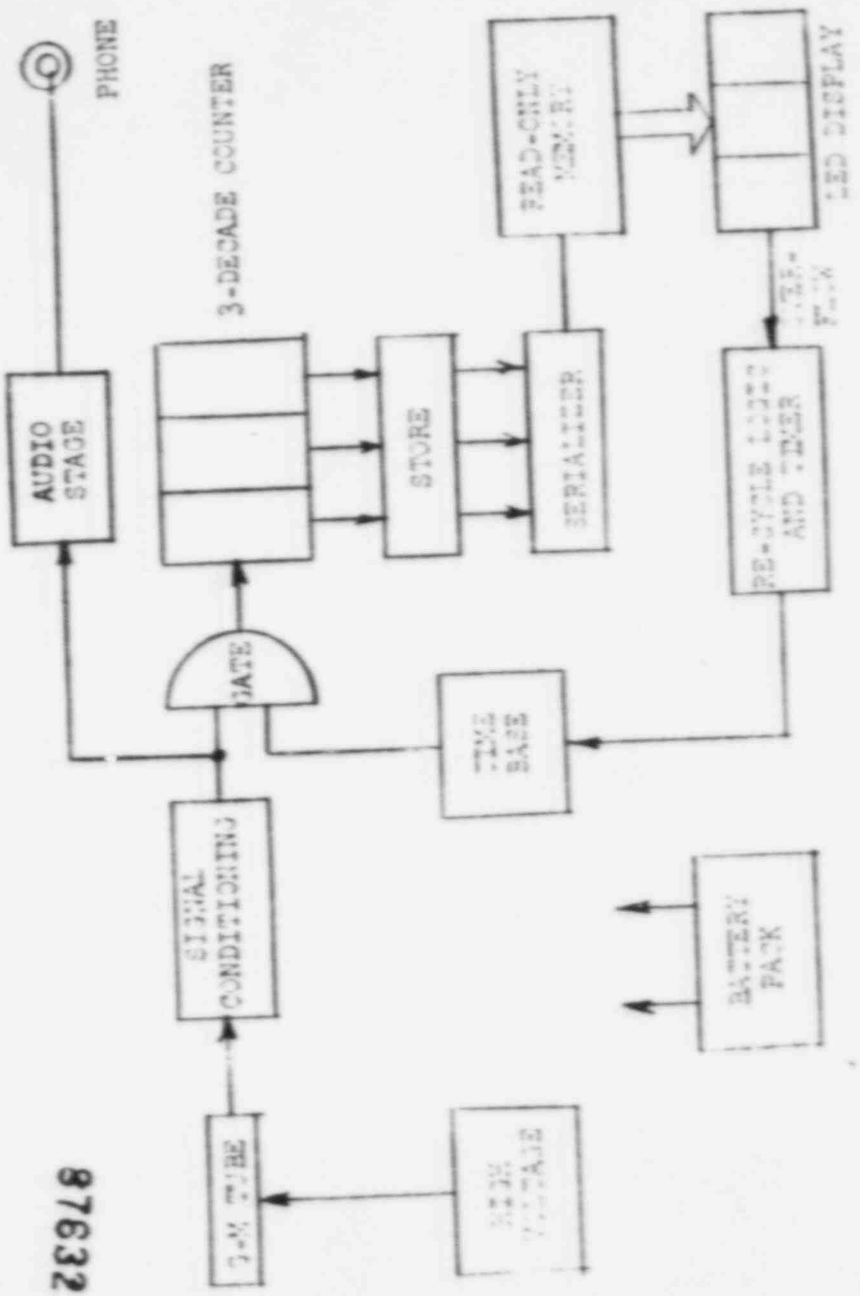

FIGURE . DIGI/RATE BLOCK DIAGRAM

Then, to make a measurement, the push-button at the left side of the instrument is depressed and held in until the LED display shows a constant number (this takes about one second in Digi/Rate and up to two seconds in Digi/Master depending on the doserate). Care should be exercised to avoid making repeat measurements too rapidly (less than 3 to 5 sec.) or pushing the button impulsively otherwise spurious readings may be obtained. During the counting interval the number displayed by the readout will continue to advance until the actual doserate is displayed. To conserve battery life, the button should not be depressed longer than the time necessary to note the final reading. However, reasonable use of the display command will have little effect on battery life. For example, if the display command is activated as often as every two minutes for three seconds, the additional average current drain is about four milliamps. While use of the display command button to obtain a reading may be an unfamiliar procedure, the user should experience no difficulty in quickly adapting to it. Pushing the button to obtain a display takes less time than interpreting the meter position on an analog device and the possibility of error is significantly less.

The headphone circuit operates continuously when the instrument is ON. The display command button need <u>not</u> be depressed to activate this function. This feature is quite useful in certain types of free field and contamination measurements as discussed below.

To obtain accurate measurements with Digi/Rate and Digi/Master specific procedures should be followed. Procedures for two types of measurements --- free field and contamination --- are discussed below.

Free Field Measurements

The principal considerations in free field gamma measurements are the relative positions of the source and the operator and the geometry of the counter tube. Energy dependence in the GM tube is controlled by a filter wrapped about its axis of symmetry. Thus, measurements are best made with the radiation beam perpendicular to this axis which is parallel to the long dimension of the instrument.

The radiation beam should intersect the long axis of the GM tube at its midpoint and should pass through the energy dependence filter. Shielding should be arranged so that the tube is exposed to the radiation but the operator has access to the pushbutton without exposing himself. A mirror can be used so that only the operators hand need be shielded. With the set-up complete, expose the source and depress the push-button noting the reading on the display. If the rate displayed is correct within the statistical deviation expected (see section on Accuracy of Measurement) and the specified accuracy of the device, no adjustment is required. If the rate is low, increase the timed period by rotating the potentiometer (part #[illegible]) clockwise only a few degrees. Retest and readjust as necessary. If the displayed rate is too high initially, reverse the potentimeter adjustment.

Digi/Master

For the mR/h range the procedure is the same as that used for Digi/Rate. Both of the R/h ranges are set by a single setting of the high range potentimeter (part [illegible]). For this adjustment, the unit should be set-up on a cesium or cobalt range at a doserate between 1.00 and 5.00 R/h. (At these rates, arrangements to permit remote activation of the button are recommended). After completing this adjustments confirming check should be made at a doserate between 20 and 50 R/h. If the proper reading is not obtained, the unit is malfunctioning. Assuming proper operation, a final check should be made at a rate in excess of 100 R/h to verify proper recycling action. During the Digi/Master recalibration procedure, it is also important to observe the operation of the LED range indicators for malfunction.

NOTE It is recommended that the Digi's be calibrated at [illegible] of the true doserate on cesium and cobalt so that response over the full energy range (50 keV - 1.3 meV) will be within ± 15% of the true doserate.

PARTS LIST

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
04	Transformer	47	10M
06	GMT Asbly.	64	Earphone
07	GMT Asbly.	66	Phone Jack
09	100M, ±5%	69	3.3M, ±5%
11	PB Swt.Asbly.	77	270
12	Diode	78	Transistor
19	Transistor	80	4.7K
20	Transistor	81	22K
21	IC	83	Battery (390,1015 or Equivalent)
22	IC		
23	IC	86	Bat.Strap
24	IC	87	IC
25	IC	100	Switch
26	LED Display	101	Transistor
29	0.047,12V	102	Zener Diode
31	0.01,500V	103	LED
32	0.001,1000V	104	0.1,100V
33	50,10V	105	36, ±5%
36	1.0,35V	106	6.2M, ±5%
37	100	107	2.5M,Potentiometer
39	1K	113	Battery Holder
40	10K	116	0.01,100V
41	33K	117	0.05,50V
42	100K	118	3.3K
45	220K	119	1K,Potentiometer
		125	22M
		126	56K
		127	2.7M
		128	7.5M, ±5%

NOTE:

All resistors ¼W. ±10% unless specified otherwise.
All capacitors in mf.

REACTOR EXPERIMENTS, INC.
963 TERMINAL WAY SAN CARLOS CALIFORNIA 94070
Phone (415) 592-3355 Cable Address: REACTEX

ADDENDA

DIGI/MASTER - DIGI/RATE INSTRUCTION MANUAL

Operation

These survey meters are especially designed to permit one-hand operation thus freeing the other hand for additional functions. Users generally find the most convenient manner of operation is to held the instrument in the left hand and press the "display" button with the thumb.

Beta-ray Measurement

The digi/rate will measure beta radiation when the beta window slide is in the open position and the instrument is oriented so that the detector tube "sees" the beta radiation through the window.

The digi/master will also detect beta radiation in a similar manner, as long as the radiation level is below 100 mr/h. Above this level the digi/master automatically switches to its high level detector which is only sensitive to gamma rays. Thus measurement of beta rays will not be correct at levels over 100 mr/h. Gamma rays, however, will be accurately measured over the entire instrument range.

Special Considerations in Calibration (digi/master only)

The digi/master cannot be calibrated with a beta source because, as described above under "Beta-ray Measurement", the high range detector will detect only gammas.

Another consideration to be kept in mind when calibrating the digi/master is that low and high level G-M tubes are slightly separated, physically. Therefore when the instrument is exposed to a gamma beam, it must be ascertained that both tubes are exposed to essentially the same beam. This is because the low range tube cycles up through the 100 mr/h level and then signals the high range tube to take over. Thus, if the two tubes are exposed to significantly different radiation levels, the reading will be incorrect.

Battery Failure Modes

One should be aware of the probable manner in which low battery level may manifest itself. After relatively short experience with the instruments, the user will find that he will readily spot the indications of low battery voltage. The following list gives the failure modes in order of their most likely occurence.

1) The overall display will become extremely dim.
2) The cycling period will lengthen erratically beyond the usual 1 to 2 second length.
3) The display will go blank.

ADDENDA
(Continued)

Changing Batteries

In order to insure that inadverdent reverse polarity does not occur during battery hookup, the following practice is recommended:

> Initially orient the snap connector at 90° to the connectors on the battery box. After making up one connection; swing the snap connector around to permit making up the other connection.

Speed of Operation

When the instruments are first turned on, the user must wait only two seconds before taking the first reading. If the press-to-read button is used before this, the resulting reading may be incorrect. While the reading is being taken, the button should be held in for two seconds to permit the device to complete its cycling to the final reading. This is especially important at low levels, where the numbers are not changing rapidly. Between readings, the button should be released for one second. If this time is not allowed, transients may be introduced, thus resulting in incorrect readings.

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PORTABLE NEUTRON REM COUNTER
MODEL PNR-4

* MEASURES NEUTRON DOSE RATE FROM THERMAL THROUGH FAST
* BF_3 TUBE GIVES HIGH GAMMA REJECTION
* DETACHABLE DETECTOR
* FOUR DECADES DISPLAYED WITHOUT SCALE SWITCHING
* UTILIZES ANY STANDARD D-SIZE BATTERIES
* BATTERY CONDITION CHECK