

DOW INDUSTRIAL HYGIENE CALIBRATION PROCEDURE FOR RADIATION SURVEY INSTRUMENTS

Survey instruments are calibrated using the Eberline Model No. 1000 gamma calibrator. The Model 1000 calibrator is designed to provide a beam of ionizing radiation internal to a self-contained source shield. The calibrator (Serial No. 112) contains eight individual sources totalling 143.0998 Ci of Cs-137. The source quantity breakdown is as follows.

<u>Position Number</u>	<u>Source Serial Number</u>	<u>Test Date</u>	<u>Isotope</u>	<u>Curies Quantity</u>
1	422	12/12/74	Cs-137	88 μ Ci
2	407	12/12/74	Cs-137	8.2 mCi
3	393	12/12/74	Cs-137	322 mCi
4	254	12/12/74	Cs-137	7.5 Ci
5	410	12/12/74	Cs-137	3.5 mCi
6	399	12/12/74	Cs-137	166 mCi
7	386	12/12/74	Cs-137	3.1 Ci
8	253	12/12/74	Cs-137	132 Ci
TOTAL				143.0998 Ci

The exposure rate (mr/hr) for each source versus height (in.) in the calibration chamber is given in Table 1. The actual calibration curves for each source and positions may be found in the back portion of the technical manual for the Model 1000 (Serial No. 112) provided by Industrial Reactor Laboratories, Incorporated, of Plainsboro, New Jersey, the manufacturer. A description of the initial calibration procedure performed by Industrial Reactor Laboratories may also be found in the technical manual.

During calibration the instrument is placed in a jig in the calibration chamber with the center of the detector at the desired exposure height. The jigs consist of 1/8-inch aluminum sheeting. A hole is cut in the aluminum sheet in the area above the source exposure well such that the instrument detector is supported above the well at a known height. The aluminum hole is large enough so there is no additional shielding effects due to the aluminum sheet. On a semi-annual basis the exposure rates for the various sources at a set height (as given in Table 1) will be checked using the Victoreen condenser r-meter Model 570 (Serial No. 259); a secondary standard, as part of the quality control for the calibration program. The r-meter will be used in conjunction with the Model 621 chamber which has a range of 0-100 r, with $\pm 5\%$ accuracy for energies 400-1300 KeV (eff.). The results

of all quality control checks and meter calibrations will be kept on file at the Industrial Hygiene Laboratory in 1803 Building, Midland, Michigan.

The calibrations will be performed by the following health physics staff personnel: L. G. (Larry) Silverstein, Gordon W. Engdahl, Richard A. Olson or Jonathan A. Jacoby (see enclosures for individual resumes).

The calculations pertinent to the calibration procedure are very limited because Table 1 gives appropriate exposure rates at known detector heights. The semi-annual quality control check will include generating updated versions of Table 1 to compensate for source decay.

The calibration procedure for the radiographers' meter is enclosed as Appendix I. The results are recorded on the Industrial Hygiene Radiation Instrument Calibration Sheet and filed. The calibration sheet includes checks for batteries and identification of instrument model number, serial number, date of calibration and person performing the calibration.

If during calibration any meter cannot be adjusted to measure within $\pm 10\%$ of the actual exposure rate on one or more scales the meter will be taken out of service and replaced. Faulty instruments will be returned to the manufacturer for repair or discarded depending on the situation.

GWEngdahl
6/20/75

PROCEDURE FOR CALIBRATING RADIOGRAPHERS METER VICTOREEN 592B
USING THE EBERLINE MODEL 1000 MULTIPLE SOURCE GAMMA CALIBRATOR,
Cs-137.

1. Meter should be warmed up for one-half hour. Check batteries and replace if necessary.
2. Zero Instrument
3. Set instrument in the calibrator so the middle of ionization chamber is at the 7 inch level (using the appropriate jig)
4. Adjust mirror and light so the meter is visible.
5. Record all readings on calibration sheet.
6. Turn the instrument to the X1 scale and lock door
 - pull out source #1 - meter should read 3.3 mR/hr* $\pm 10\%$
 - replace source #1 and pull out source #5 - meter should read 7.3 mR/hr* $\pm 10\%$
 - replace source #5 and unlock door

Turn the instrument to the X10 scale and lock door

- pull out source #2 - meter should read 27 mR/hr* $\pm 10\%$
- replace source #2 and unlock door

Turn the instrument to the X100 scale and lock door

- pull out source #6 - meter should read 240 mR/hr $\pm 10\%$
- replace source #6 and pull out source #3 - meter should read 830 mR/hr $\pm 10\%$
- replace source #3 and unlock door

Place instrument flush on floor of chamber with ionization chamber over the source opening

- set instrument on X10 scale and lock door
- pull out source #2 - meter should read 60* mR/hr $\pm 10\%$
- replace source #2

* If the reading is more than $\pm 10\%$ adjust the calibration controls so the meter reads correctly.

Place the calibration data in the calibration file and tag the instrument with the date of calibration and your initials.

INSTRUMENT _____ DEPT. _____
MODEL NUMBER _____ MAN RESPONSIBLE _____
SERIAL NUMBER _____

COMMENTS _____

EBERLINE MODEL 1000 MULTIPLE GAMMA SOURCE CALIBRATOR Cs-137

SOURCE # MR/HR

<u>INCHES</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
1	13.5	105	2,400	55,000	19	650	12,000	480,000
2	10.	78	1,900	44,000	16	530	9,800	400,000
3	8	60	1,600	36,000	13.5	440	8,300	340,000
4	6.5	47	1,300	30,000	11.5	380	7,000	290,000
5	5.0	38	1,150	25,000	10	325	5,900	240,000
6	4.1	32	950	21,000	8.4	280	5,100	210,000
7	3.3	27	830	18,000	7.3	240	4,500	180,500
8	2.8	22	720	16,000	6.5	210	4,000	160,500
9	2.3	19	630	14,000	5.8	190	3,500	140,500
10	2.0	17	550	13,000	5.1	170	3,200	130,000
11	1.8	15	490	11,500	4.6	150	2,900	115,000
12	1.6	14	440	10,000	4.3	135	2,600	105,000
13	1.5	13	400	9,400	3.8	130	2,400	98,000
14		12	360	8,700	3.5	120	2,200	90,000
15		11	330	8,000	3.3	110	2,000	84,000
16		10	310	7,500	3.1	100	1,900	78,000

TABLE 1

GORDON WAYNE ENGBAHL

PERSONAL

Birthdate: _____

Sex: Male

Social Security Number: _____

Marital Status: _____

EDUCATION

B.A., Chemistry, Cum Laude, June, 1972
Augustana College
Sioux Falls, South Dakota

M.S., Environmental Health, Radiological Health
& Industrial Hygiene, August, 1973
University of Minnesota
Minneapolis, Minnesota

EXPERIENCE

October, 1974-Present
Industrial Hygienist
Industrial Hygiene Laboratory
The Dow Chemical Company
Midland, Michigan

June, 1973-August, 1973
National Radiation Laboratory
Lawrence Livermore Laboratory
University of California
Livermore, California

June, 1972-June, 1973
School of Public Health
University of Minnesota
Minneapolis, Minnesota

September, 1969-June, 1972
Augustana College
Sioux Falls, South Dakota

JONATHAN ARNOLD JACOBY

Birthday:

Birthplace:

Marital Status:

Social Security:

Education:

Unionville High School
Unionville, Michigan
1968-1971

Central Michigan University
Mt. Pleasant, Michigan
B.S. Biology-Chemistry
1971-1974

Membership:

Student Affiliates Chemical Society
1972-1974

Employment:


The Dow Chemical Company
1973

Chemical Biology Research Laboratory
Pharmacokinetics Section
1973-1975


Health and Environmental Research
Industrial Hygiene Laboratory
1975-

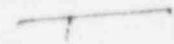
RICHARD ANTHONY OLSON

PERSONAL

Birthdate: 

Sex: Male

Social Security Number: 

Marital Status: 

EDUCATION

B.A., Chemistry, Cum Laude, June, 1973
Augustana College
Sioux Falls, South Dakota

M.S., Environmental Health, Radiological Health
& Industrial Hygiene, August, 1974
University of Minnesota
Minneapolis, Minnesota

EXPERIENCE

August, 1974-Present Industrial Hygienist
Industrial Hygiene Laboratory
The Dow Chemical Company
Midland, Michigan

June, 1974-August, 1974 Field Experience in Health Physics,
Brookhaven National Laboratory
Health Physics & Safety Division
Upton L.I., New York

July, 1973-June, 1974 Student
University of Minnesota
Minneapolis, Minnesota

July, 1972-July, 1973 Laboratory Technician
Sioux Falls City Health Department
Sioux Falls, South Dakota

June, 1972-December, 1972 Laboratory Assistant
Chemistry Department, Augustana College
Sioux Falls, South Dakota

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LAWRENCE GORDON SILVERSTEIN

Birthdate:

Birthplace:

Marital Status:

Children:

Education: North High School, Binghamton, N.Y., 1943-46
Harpur College of the State University of N.Y.
Binghamton, New York 1948-50, 1952-54
A.B. degree in Chemistry (Magna cum Laude)

Graduate Work - The Univ. of Rochester
Rochester, New York, 1954-55
M.S. degree in Radiation Biology
(Thesis - Radioactive Waste Disposal)

Memberships: Health Physics Society - Charter Member
1955 to present.

American Industrial Hygiene Association
1960 to present

Certifications: Certified in Health Physics by the
American Board of Health Physics, 1963

Certified in Comprehensive Practice of Industrial
Hygiene by the American Board of Industrial
Hygiene, Incorporated, 1971

Certified Safety Professional by the Board of
Certified Safety Professionals of the Americas,
Incorporated, 1972

Employment: The Dow Chemical Company 1955 -

1955-60 - Biochemical Research Laboratory
Industrial Hygiene Section as Industrial
Hygienist

1960-62 - Texas Division Industrial Medical
Department as Chief Industrial Hygienist
Texas Division

LCSilverstein

Employment: Continued

1962-70 - Biochemical Research Laboratory as
Industrial Hygienist and Senior Research
Environmental Health Engineer (1967)

1970-71 - Manager of Safety and Industrial
Hygiene, Midland Division

1971- Chemical Biology Research,
Industrial Hygiene Section as Senior Research
Industrial Hygiene Specialist.

Committees: ASTM - D26 Committee on Halogenated Solvents
(Chairman of Subcommittee 5, Industrial Hygiene)
1969-70

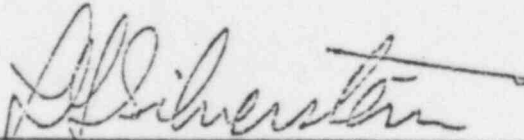
Michigan State Health Commissioner's Radiation
Advisory Committee, 1955-60; 1962-72

Publications: "Industrial Health Experience with Magnesium-
Thorium Alloys" - published in Magnesium Today
(1958) and by The Dow Chemical Company (1958)

"Safe Handling of Epoxy Resin Systems"- Chapter
in Epoxy Resin Technology, Wiley (1968)

"Summary of Safe Handling of Tetrachlorodibenzo-
p-dioxin (TCBD) in the Laboratory" - published by
The Dow Chemical Company for the U.S. Government,
Academic and Industrial Laboratories with an
interest in an extremely toxic compound.

"Hazards from Chlorinated Hydrocarbon Decomposition
During Welding" - L. C. Rinzema and L. G. Silverstein
American Industrial Hygiene Association Journal
Vol. 33, No. 1 pp. 35-40 (Jan. 1972)



L. G. Silverstein

November 30, 1972