X. APPENDIX III - MATERIAL SAFETY DATA SHEET

The following items of information which are applicable to a specific product or material shall be provided in the appropriate block of the Material Safety Data Sheet (MSDS).

The product designation is inserted in the block in the upper left corner of the first page to facilitate filing and retrieval. Print in upper case letters in as large type size as possible. It should be printed to read upright with the sheet turned sideways. The product designation is that name or code designation which appears on the label, or by which the product is sold or known by employees. The relative numerical hazard ratings and key statements are those determined by the rules in Chapter V, Part B, of the NIOSH publication, An Identification System for Occupationally Hazardous Materials. The company identification may be printed in the upper right corner if desired.

(a) Section I. Product Identification

The manufacturer's name, address, and regular and emergency telephone numbers (including area code) are inserted in the appropriate blocks of Section I. The company listed should be a source of detailed backup information on the hazards of the material(s) covered by the MSDS. The listing of suppliers or wholesale distributors is discouraged. The trade name should be the product designation or common name associated with the material. The synonyms are those commonly used for the product, especially formal chemical nomenclature. Every known chemical designation or competitor's trade name need not be listed.

(b) Section II. Hazardous Ingredients

The "materials" listed in Section II shall be those substances which are part of the hazardous product covered by the MSDS and individually meet any of the criteria defining a hazardous material. Thus, one component of a multicomponent product might be listed because of its toxicity, another component because of its flammability, while a third component could be included both for its toxicity and its reactivity. Note that a MSDS for a single component product must have the name of the material repeated in this section to avoid giving the impression that there are no hazardous ingredients.

Chemical substances should be listed according to their complete name derived from a recognized system of nomenclature. Where possible, avoid using common names and general class names such as "aromatic amine," "safety solvent," or "aliphatic hydrocarbon" when the specific name is known.

The "%" may be the approximate percentage by weight or volume (indicate basis) which each hazardous ingredient of the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, "10-40% vol" or "10% max wt" to avoid disclosure of trade secrets.

Toxic hazard data shall be stated in terms of concentration, mode of exposure or test, and animal used, eg, "scu-rbt LDLo:243 mg/kg" or "permissible exposure from 29 CFR 1910.1000," or if not available, from other sources of publications such as the American Conference of Governmental Industrial Hygienists or the American National Standards Institute Inc. Flammable or reactive data could be flash point, shock sensitivity, or other brief data indicating nature of the hazard.

(c) Section III. Physical Data

The data in Section III should be for the total mixture and should include the boiling point and melting point in degrees Fahrenheit (Celsius in parentheses); vapor pressure, in conventional millimeters of mercury (mmHg); vapor density of gas or vapor relative to the density of air; solubility in water, in parts/hundred parts of water by weight; specific gravity (water = 1); percent volatiles (indicated whether by weight or by volume) at 70 degrees Fahrenheit (21.1 degrees Celsius); evaporation rate for liquids or sublimable solids, relative to the evaporation rate of butyl acetate; and appearance and odor. These data are useful for the control of toxic substances. Boiling point, vapor density, percent volatiles, vapor pressure, and evaporation rate are useful for designing proper ventilation equipment. This information is also useful for design and deployment of adequate fire and spill containment equipment. The appearance and odor may facilitate the identification of substances stored in improperly marked containers, or when spilled.

(d) Section IV. Fire and Explosion Data

Section IV should contain complete fire and explosion data for the product, including flash point and autoignition temperature in degrees Fahrenheit (Celsius in parentheses); flammable limits, in percent by volume in air; suitable extinguishing media or materials; special firefighting procedures; and unusual fire and explosion hazard information. If the product presents no fire hazard, insert "NO FIRE HAZARD" on the line labeled "Extinguishing Media."

(e) Section V. Health Hazard Information

The "Health Hazard Data" should be a combined estimate of the hazard of the total product. This can be expressed as a TWA concentration, as a permissible exposure, or by some other indication of an acceptable standard. Other data are acceptable, such as lowest LD50 if multiple components are involved.

Under "Routes of Exposure," comments in each category should reflect the potential hazard from absorption by the route in question. Comments should indicate the severity of the effect and the basis for the statement if possible. The basis might be animal studies, analogy with similar products, or human experiences. Comments such as "yes" or "possible" are not helpful. Typical comments might be:

> Skin Contact--single short contact, no adverse effects likely; prolonged or repeated contact, mild irritation and possibly some blistering.
>
> Eye Contact--some pain and mild transient irritation; no corneal scarring.

"Emergency and First Aid Procedures" should be written in lay language and should primarily represent first aid treatment that could be provided by paramedical personnel or individuals trained in first aid.

Information in the "Notes to Physician" section should include any special medical information which would be of assistance to an attending physician including required or recommended preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed workers.

(f) Section VI. Reactivity Data

The comments in Section VI relate to safe storage and handling of

hazardous, unstable substances. It is particularly important to highlight instability or incompatibility to common substances or circumstances such as water, direct sunlight, steel or copper piping, acids, alkalies, etc. "Hazardous Decomposition Products" shall include those products released under fire conditions. It must also include dangerous products produced by aging, such as peroxides in the case of some ethers. Where applicable, shelf life should also be indicated.

(g) Section VII. Spill or Leak Procedures

Detailed procedures for cleanup and disposal should be listed with emphasis on precautions to be taken to protect workers assigned to cleanup detail. Specific neutralizing chemicals or procedures should be described in detail. Disposal methods should be explicit including proper labeling of containers holding residues and ultimate disposal methods such as "sanitary landfill," or "incineration." Warnings such as "comply with local, state, and federal anti-pollution ordinances" are proper but not sufficient. Specific procedures shall be identified.

(h) Section VIII. Special Protection Information

Section VIII requires specific information. Statements such as "Yes," "No," or "If Necessary" are not informative. Ventilation requirements should be specific as to type and preferred methods. Respirators shall be specified as to type and NIOSH or US Bureau of Mines approval class, ie, "Supplied air," "Organic vapor canister," "Suitable for dusts not more toxic than lead," etc. Protective equipment must be specified as to type and materials of construction.

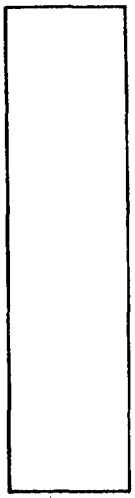
(i) Section IX. Special Precautions

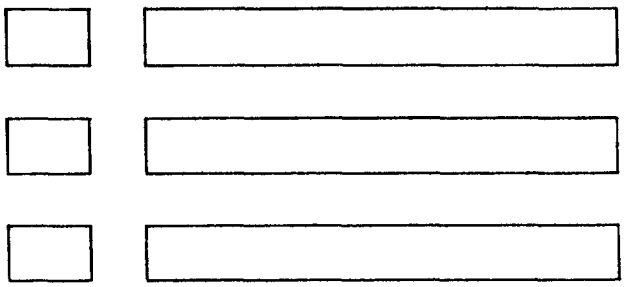
"Precautionary Statements" shall consist of the label statements selected for use on the container or placard. Additional information on any aspect of safety or health not covered in other sections should be inserted in Section IX. The lower block can contain references to published guides or in-house procedures for handling and storage. Department of Transportation markings and classifications and other freight, handling, or storage requirements and environmental controls can be noted.

(j) Signature and Filing

Finally, the name and address of the responsible person who completed the MSDS and the date of completion are entered. This will facilitate correction of errors and identify a source of additional information.

The MSDS shall be filed in a location readily accessible to workers potentially exposed to the hazardous material. The MSDS can be used as a training aid and basis for discussion during safety meetings and training of new employees. It should assist management by directing attention to the need for specific control engineering, work practices, and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff in planning a safe and healthful work environment and suggesting appropriate emergency procedures and sources of help in the event of harmful exposure of employees.





MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION	
MANUFACTURER'S NAME	REGULAR TELEPHONE NO. EMERGENCY TELEPHONE NO.
ADDRESS	
TRADE NAME	
SYNONYMS	

II HAZARDOUS INGREDIENTS		
MATERIAL OR COMPONENT	%	HAZARD DATA

III PHYSICAL DATA		
BOILING POINT, 760 MM HG		MELTING POINT
SPECIFIC GRAVITY (H_2O=1)		VAPOR PRESSURE
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H_2O, % BY WT
% VOLATILES BY VOL.		EVAPORATION RATE (BUTYL ACETATE=1)
APPEARANCE AND ODOR		

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)		AUTOIGNITION TEMPERATURE	
FLAMMABLE LIMITS IN AIR, % BY VOL.	LOWER		UPPER
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARD			

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA

ROUTES OF EXPOSURE

INHALATION

SKIN CONTACT

SKIN ABSORPTION

EYE CONTACT

INGESTION

EFFECTS OF OVEREXPOSURE

ACUTE OVEREXPOSURE

CHRONIC OVEREXPOSURE

EMERGENCY AND FIRST AID PROCEDURES

EYES

SKIN:

INHALATION:

INGESTION

NOTES TO PHYSICIAN

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

INCOMPATIBILITY

HAZARDOUS DECOMPOSITION PRODUCTS

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NEUTRALIZING CHEMICALS

WASTE DISPOSAL METHOD

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL)

EYE

GLOVES

OTHER CLOTHING AND EQUIPMENT

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

OTHER HANDLING AND STORAGE REQUIREMENTS

PREPARED BY

ADDRESS:

DATE

XI. TABLES AND FIGURE

TABLE XI-1

US CONSUMPTION OF CHROMITE BY INDUSTRY OF USAGE
THOUSAND SHORT TONS

Year	Metallurgical*	Refractory**	Chemical
1952	677	340	147
1953	743	441	152
1954	502	278	133
1955	994	431	159
1956	1212	475	160
1957	1177	435	148
1958	778	312	131
1959	796	379	162
1960	665	391	164
1961	662	375	163
1962	590	365	176
1963	632	368	187
1964	832	430	189
1965	907	460	217
1966	828	439	194
1967	866	310	179
1968	804	311	202

* Some part of the total, usually between 10,000 and 20,000 tons was added directly to steel. The balance was used to make ferroalloys and Cr metal.

** A small quantity, usually between 5,000 and 10,000 tons, was used in direct furnace repairs; the balance was used in making brick and other refractory products.

Derived from reference 185

TABLE XI-2

FORECAST GROWTH IN CHROMITE AND CHROMIUM CONSUMPTION IN THE US
THOUSAND SHORT TONS

	Chromite After Allowance for Scrap		% Change
	1968	1973	
Stainless steel	525	659	+26
Alloy steel	125	157	+26
Tool steel (1) (all types)	16	19	+19
High-temp & nonferrous alloys	61	87	+43
Foundries-metallurgical	61	84	+38
Miscellaneous metallurgical applications (2)	6	10	+67
Subtotal, metallurgical	794 (4)	1016	+28
Foundries-facing sand	26	65	+150
Refractories	310	250	-19
Chemicals (3)	226	254	+12
GRAND TOTAL	1356	1585	+17

(1) Based on production of 96,000 tons of tool steel with an average Cr content of 6%.
(2) Includes cutting and wear-resistant materials, welding and hard facing rods and use in other steels.
(3) Consumption in chemicals market in 1968 was estimated at 149,000 tons of sodium dichromate equivalent. One ton of $Na_2Cr_2O_7.2H_2O$ requires 1.4 tons of ore based upon an 80-85% recovery.
(4) This is calculated as 50% ore, but small quantities of chemical grade ore (44-45% Cr) and refractory grade ore (34-37% Cr) are used.

The projection includes allowance for losses during use of the ferroalloys in metallurgical processing and an additional 10% loss for processing chromite into ferroalloys. The average assay of ore for metallurgical uses is 50% Cr_2O_3; the average assay of ore for refractory use is 35% Cr_2O_3 and no processing loss is assumed; average assay of ore for chemicals and facing sand uses is 45% Cr_2O_3.
Derived from reference 185

TABLE XI-3

POTENTIAL OCCUPATIONAL EXPOSURES

Abrasive makers
Acetylene purifiers
Adhesive workers
Airplane sprayers
Alizarin makers
Alloy makers
Aluminum anodizers
Aniline black makers
Anodizers
Battery makers, dry
Biologists
Blueprint makers
Boiler scalers
Candle makers, colored
Cement workers
Ceramic workers
Chromate workers
Chrome alloy workers
Chrome alum workers
Chromium platers
Chromium workers
Color makers
Copper etchers
Copper plate strippers
Corrosion inhibitor workers
Crayon makers, colored
Diesel locomotive repairmen
Drug makers
Dry color makers
Dye makers
Dyers
Electroplaters
Enameler workers
Explosive makers
Fat purifiers
Fireworks makers
Flypaper makers
Furniture polishers
Fur processors
Glass fiber makers
Glass frosters
Glass makers
Glass makers, colored
Glue makers
Histology technicians
Ink makers
Jewelers
Laboratory workers, chemical
Leather finishers
Linoleum workers
Lithographers
Magnesium treaters
Match makers
Metal cleaners
Metal cutters
Metal etchers
Metal treaters
Milk preservers
Mordanters
Oil drillers
Oil purifiers
Organic chemical synthesizers
Painters
Paint makers
Palm oil bleachers
Paper dyers
Paper waterproofers
Pencil makers, colored
Perfume makers
Photoengravers
Photographers
Photographic chemical workers
Pigment makers
Platinum polishers
Porcelain decorators
Potter frosters
Pottery glaze makers
Pottery glazers
Printers
Printing ink workers
Process engravers
Pyrotechnic workers
Railroad engineers
Refractory brick makers

TABLE XI-3 (CONTINUED)

POTENTIAL OCCUPATIONAL EXPOSURES

Rubber makers	Textile mordanters
Rust inhibitor workers	Textile printers
Shingle makers	Textile waterproofers
Silk screen makers	Wallpaper printers
Smokeless powder makers	Wax bleachers
Soap makers	Wax ornament workers
Sponge bleachers	Welders
Stainless steel workers	Wood preservative workers
Tanners	Wood stainers
Textile dyers	Wood stain makers

Derived from reference 14

TABLE XI-4

CHEMICAL AND PHYSICAL PROPERTIES OF SELECTED HEXAVALENT CHROMIUM COMPOUNDS

Compound	Molecular Formula	Formula Weight	Boiling Point, C	Melting Point, C	Density	Solubility: g/100 cc	
						Cold Water	Other
Ammonium chromate	(NH4)2CrO4	152.08	...	Decomposes 180	1.91	40.5 (30 C)	Insoluble in alcohol; slightly soluble in NH3, acetone
Ammonium dichromate	(NH4)2Cr2O7	252.06	...	Decomposes 170	2.15	30.8 (15 C)	Soluble in alcohol; insoluble in acetone
Ammonium magnesium chromate	(NH4)2CrO4 MgCrO4 6H2O	400.51	...	Decomposes	1.84	Very soluble	...
Barium chromate	BaCrO4	253.33	...	...	4.498	0.00034 (160 C)	Soluble in mineral acid
Barium dichromate	BaCr2O7	353.33	...	...	...	Slightly soluble	Soluble in hot concentrated H2SO4
Barium dichromate, hydrate	BaCr2O7, 2H2O	389.36	...	-2H2O. 120	...	Decomposes	Soluble in concentrated CrO3 solution
Bismuth dichromate, basic	(BiO)2 Cr2O7	665.94	...	...	...	Insoluble	Soluble in acid; insoluble in alkali
Calcium chromate	CaCrO4 2H2O	192.09	...	-2H2O, 200	...	16.3 (20 C)	Soluble in acid, alcohol
Cesium chromate	Cs2CrO4	381.80	...	...	4.237	71.4 (13 C)9	...
Chromium(VI) oxide	CrO3	99.99	Decomposes	196	2.70	67.45 (100 C)	Soluble in alcohol, ether, sulfuric acid, nitric acid
Chromium oxychloride	CrO2Cl2	154.90	117	-96.5	1.911	Decomposes	Decomposes in alcohol; soluble in ether, acetic acid
Dysprosium chromate	Dy2(CrO4)3 10H2O	853.13	Decomposes	-3 1/2 H2O, 150	...	1.002 (25 C)	...
Iron(III) dichromate	Fe2(Cr2O7)3	759.66	...	...	...	Soluble	Soluble in acid
Lead chromate	Nat. crocoite, chromate yellow, PbCrO4	323.18	Decomposes	844	6.12	0.0000058 (25 C)	Soluble in acid, alkali; insoluble in acetic acid, NH3
Lead chromate basic	Chrome red PbCrO4.PbO	546.37	...	...	6.63	Insoluble	Soluble in acid, alkali
Lead chromate, basic	Pb2(OH)2 CrO4	564.39	...	920	6.63	Insoluble	Soluble in KOH
Lead dichromate	PbCr2O7	423.18	...	...	...	Decomposes	Soluble in acid, alkali
Lithium chromate	Li2CrO4 .2H2O	165.90		-2H2O 130	...	52 (20 C)	...
Lithium dichromate, dihydrate	Li2Cr2O7 .2H2O	265.90	-2H2O (110 C)	187 Decomposes	2.34	187 (30 C) 56 (30 C)	Soluble in, reacts with alcohol

TABLE XI-4 (CONTINUED)

CHEMICAL AND PHYSICAL PROPERTIES OF SELECTED HEXAVALENT CHROMIUM COMPOUNDS

Compound	Molecular Formula	Formula Weight	Boiling Point, C	Melting Point, C	Density	Solubility: g/100 cc	
						Cold Water	Other
Lithium dichromate	Li2Cr2O7. .2H2O	265.90	Decomposes	-2H2O 130	...	151 (30 C)	...
Magnesium chromate	MgCrO4 .7H2O	266.41	211.5 (30)	-3H2O, 120	1.695	Very soluble	...
Mercury(I) chromate	Hg2CrO4	517.17	...	Decomposes	...	Very slightly soluble	Soluble in HCl, HCN, HNO3; insoluble in alcohol, acetic acid
Mercury(II) chromate	HgCrO4	316.58	...	Decomposes	...	Slightly soluble, decomposes	Soluble in NH4Cl; decomposes in acid; insoluble in acetone
Neodymium chromate	Nd2(CrO4)3 .8H2O	780.58			...	0.027	...
Potassium chromate	K2CrO4 Nat. tarapacaite	194.20	...	968.3 975	2.732	62.9 (20 C) 36 (20 C)	Insoluble in alcohol
Potassium dichromate	K2Cr2O7	294.19	Decomposes 500	Triclinic becomes monoclinic 241.6 melting point 398	2.676	4.9 (0 C) 102 (100 C)	Insoluble in alcohol
Potassium chromium chromate, basic	K2CrO4 .[Cr(OH) .CrO4]	564.19	...	300	2.28	Insoluble	Insoluble in alcohol, acetone, acid
Potassium magnesium chromate	K2CrO4 MgCrO4 2H2O	370.53	...	...	2.59	...	...
Potassium peroxo chromate	K3CrO8	297.30	Decomposes 170			Slightly soluble	
Potassium zinc chromate	K2O.4ZnO .4CrO3 .3H2O	873.71			...	Slightly insoluble, decomposes	
Rubidium chromate	Rb2CrO4	286.93	...	...	3.518	62 (0 C)	...
Rubidium dichromate	Rb2Cr2O7	386.93		...	Triclinic 3.125 monoclinic 3.02	4.96 (18 C) 5.42	...
Samarium chromate	Sm2(CrO4)3 .8H2O	792.80	...	...	...	0.043 (25 C)	...
Silver chromate	Ag2CrO4	331.73	...	...	5.625	0.0014	Soluble in NH4OH, KCN
Silver dichromate	Ag2Cr2O7	413.73	...	Decomposes	4.770	.0014 (0 C)	Soluble in MeOH, NH4OH, KCN;
Sodium chromate	Na2CrO4	161.97	...	...	2.710-2.736	87.3 (30 C)	Slightly soluble in alcohol; soluble in MeOH
Sodium chromate decahydrate	Na2CrO4 .10H2O	342.13	...	19.92	1.483	50 (10 C) 126 (100 C)	Slightly soluble in alcohol; insoluble in acetic acid
Sodium bichromate dihydrate	Na2Cr2O7 .2H2O	298.00	Decomposes 400 (anhydr)	-2H2O, 100 356.7 (anhydr)	2.52	238 (0 C) (anhydr) 180 (20 C)	Insoluble in alcohol

TABLE XI-4 (CONTINUED)

CHEMICAL AND PHYSICAL PROPERTIES
OF SELECTED HEXAVALENT CHROMIUM COMPOUNDS

Compound	Molecular Formula	Formula Weight	Boiling Point, C	Melting Point, C	Density	Solubility: g/100 cc	
						Cold Water	Other
Strontium chromate	SrCrO4	203.61	...	...	3.895	0.12 (15 C)	Soluble in HCl, HNO3, acetic acid, NH4 salts
Thallium chromate	Tl2CrO4	524.73	...	...	...	0.03 (60 C)	Slightly soluble in acid, alkali; insoluble in acetic acid
Thallium dichromate	Tl2Cr2O7	624.73	...	...	...	Insoluble	Decomposes in acid
Tin(IV) chromate	Sn(CrO4)2	350.68	...	Decomposes	...	Soluble	...
Zinc dichromate	ZnCr2O7 .3H2O	335.40	...	...	...	Very soluble	Insoluble in alcohol, ether; soluble in acid
Zinc chromate	ZnCrO4	181.36	...	...	3.40	Insoluble	Soluble in acid, liquid NH3; insoluble in acetone

Adapted from reference 15

TABLE XI-5

TABULATION OF DEATHS CAUSED BY LUNG CANCER IN CHROMATE WORKERS

Subject	First Exposure Date	Death Date	Years of Exposure	Latent Period in Years	Time-weighted Exposure mg CrO3/cu m*		
					Water Insoluble	Water Soluble	Total
CB	5-33	8-43	9.0	10.0	0.37	0.17	0.54
TG	1-32	3-50	14.5	14.3**	0.37	0.08	0.45
FJ	5-36	12-44	12.5	12.5	0.19	0.02	0.21
JK	5-36	6-45	7.5	9.0	0.92	0.29	1.21
EL	1-34	1-48	9.25	14.0	1.12	0.15	1.25
ESM	10-41	12-48	2.0	7.2	0.19	0.02	0.21
WDS	8-31	12-38	7.25	7.25	1.12	0.15	1.27

* Based upon samples taken during the first half of 1949 by Bourne and Yee [3]

** Pneumonectomy, 1946

Derived from reference 90

TABLE XI-6

TABULATION OF SIGNIFICANT EFFECTS OF CHROMIUM

Airborne Chromium Concentration				Effects*					
Cr (Total) mg/cu m	Cr(VI) mg/cu m	Cr(III) mg/cu m		Nasal Septum Perforation		Chronic Rhinitis		Chronic Pharyngitis	
0.00-0.25	0.00 -0.125	0.00 -0.125	GROUP I	2/4	50.0%	4/4	100.0%	3/4	75.0%
0.26-0.51	0.26 -0.255	0.00 -0.255		3/7	42.9%	6/7	85.7%	4/7	57.1%
0.52-1.00	0.26 -0.5	0.00 -0.5		4/8	50.0%	7/8	87.5%	3/8	37.5%
0.00-0.25	0.00 -0.119	0.00 -0.208	GROUP II	7/9	77.8%	8/9	88.9%	4/9	44.4%
0.26-0.51	0.044-0.124	0.136-0.424		20/32	62.5%	28/32	87.5%	14/32	43.8%
0.52-1.00	0.09 -0.48	0.272-0.83		11/15	73.3%	15/15	100.0%	7/15	46.7%
0.00-0.25	0.00 -0.042	0.00 -0.245	GROUP III	2/7	28.6%	4/7	57.1%	2/7	28.6%
0.25-0.51	0.005-0.085	0.217-0.500		1/2	50.0%	0/2	0.0%	0/2	0.0%
0.52-1.00	0.01 -0.167	0.433-0.981		11/13	84.6%	12/13	92.3%	4/13	30.8%

* Effects data are expressed both as a ratio: No. with effect/No. examined and as a percentage.

Derived from reference 41

TABLE XI-7

PERTINENT INFORMATION ON TEN CASES OF CANCER IN CHROMATE WORKERS

Case Number	Age in Years	Years of Exposure	Time-Weighted Average Exposure*	Number of Cigarettes**
1	43	21	0.04-0.7	10
2	45	18	0.15-1.1	"
3	62	39	0.48-1.5	0
4	62	25	0.12-1.4	20
5	53	14	0.50-1.5	40
6	63	22	0.04-0.7	14
7	62	27	0.04-0.8	15
8	53	21	0.50-1.5	10
9	48	8	0.71-1.0	"
10	54	33	0.04-0.54	1

* Very crude estimates from atmospheric concentration data collected at time of study and from patient's work history, but excessive previous exposure likely in all cases.

** Based on case histories

Derived from reference 5

TABLE XI-8

STANDARDS FOR CHROMIUM

Country or State	Substance	Concentration, mg/cu m
Bulgaria	Chromic acid, chromates, bichromates (as Cr_2O_3)	0.1
Czechoslovakia	Chromium and chromates TWA Ceiling	0.05 0.10
Finland	Chromic acid and chromates, as chromium(VI) oxide	0.1
Hungary	Chromic acid and chromates, irritant	"
Japan	Chromium, as chromium(VI) oxide	"
Poland	Chromates and bichromates	"
Rumania	Chromium (chromic acid, chromates, bichromates as chromium(VI) oxide (also absorbed by the skin	"
United Arab Republic	Chromic acid	10.0
Syrian Arab Republic	"	"
Florida	Chromic acid and chromates as chromium(VI) oxide	0.1
Hawaii	Chromic acid	"
Massachusetts	"	"
Mississippi	Chromic acid and chromates as chromium(VI) oxide, ceiling	"
Pennsylvania	Chromic acid and chromates as chromium(VI) oxide, TWA	"
South Carolina	Chromic acid and chromates as chromium(VI) oxide	"

TABLE XI-8 (CONTINUED)

STANDARDS FOR CHROMIUM

Country or State	Substance	Concentration, mg/cu m
Alaska	Chromic acid and chromates, as chromium(VI) oxide	Current TLV
California	"	"
Colorado	"	1967 TLV
Iowa	"	Current TLV
Michigan	"	"
New Hampshire	"	"
New Jersey	"	"
New York	"	1960 TLV
North Carolina	"	1967 TLV
Oregon	"	"
Texas	"	1966 TLV
Washington	"	1963 TLV
Wisconsin	"	Current TLV
USSR	Chromic anhydride, chromates, bichromates, as chromium(VI) oxide	0.1
Yugoslavia	Chromic acid and chromates as chromium(VI) oxide	"

TABLE XI-9

PRELIMINARY DATA FROM STUDY OF LUNG CANCER
IN JAPANESE CHROMATE-PRODUCING INDUSTRY WORKERS

INDIVIDUAL LUNG CANCER DATA

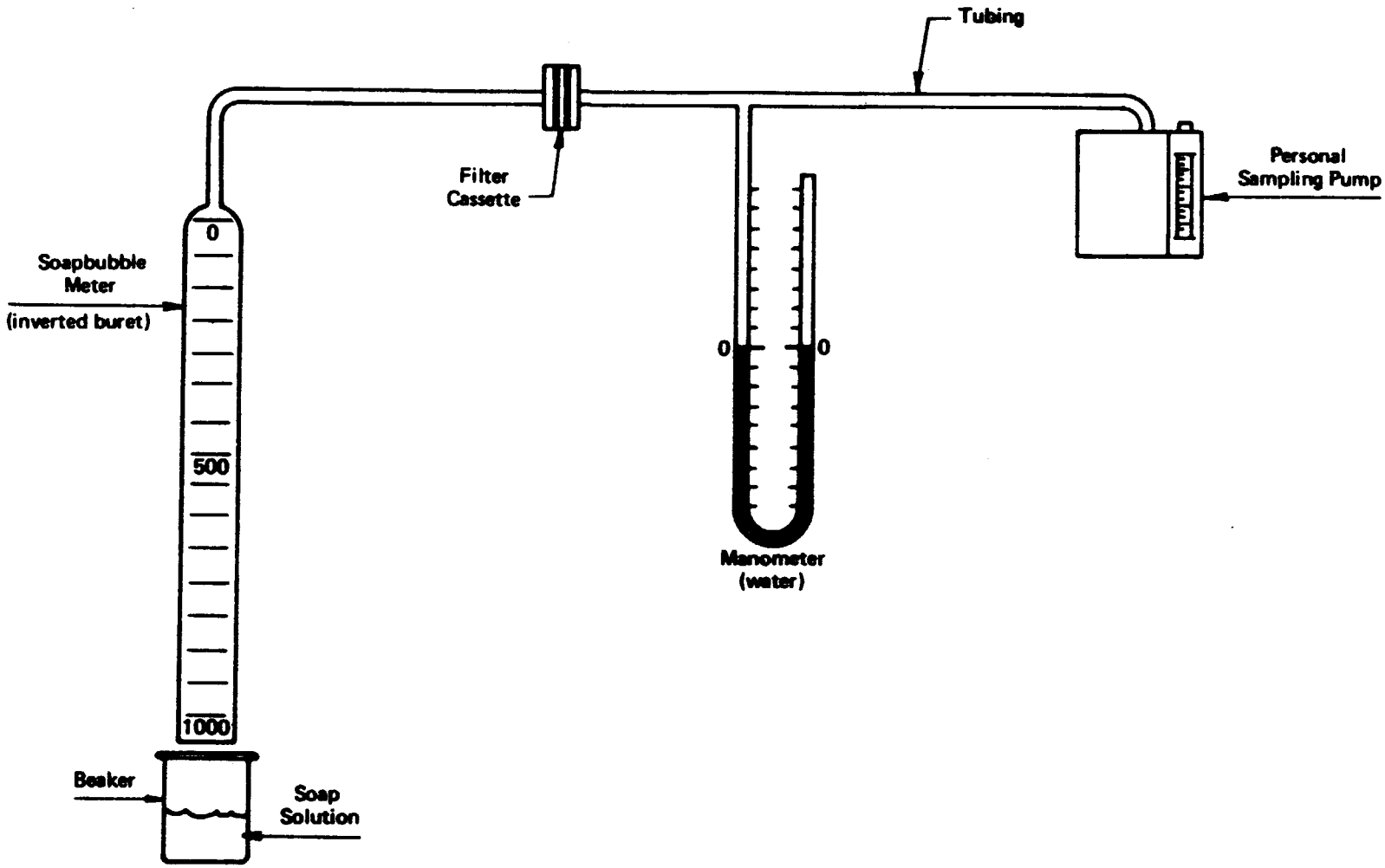
Case No.	Age	Duration of Exposure, Years	Smoking History, (Pieces/Day x Years)	Date of Death	Carcinoma Type
1	27	9	20x10	1/60	Small round cell
2	65	12	Pipe	8/66	--
3	56	31	"	11/69	--
4	40	25	--	12/70	--
5	56	30	--	10/71	Squamous cell
6	57	27	10x40	7/73	"
7	41	13	15x8	"	Small round cell
8	59	29	30x30	Alive	Squamous cell
9	49	25	25x30	"	"
10	56	36	20x35	"	"

LUNG CANCER MORTALITY DATA

Age Group	Chromate Workers		Deaths/ 100,000 Person-Years, General Population	Expected Number of Deaths, Chromate Workers
	Person-Years, Observed Population	Number of Deaths		
20-29	19	1	0.32	0.00
30-39	363	0	1.30	"
40-49	516	2	5.76	0.03
50-59	448	3	26.78	0.12
60-69	174	1	79.43	0.14
70-79	29	0	129.78	0.04
Total	1,549	7		0.33

Derived from reference 182

FIGURE XI - 1. CALIBRATION SETUP FOR PERSONAL SAMPLING PUMP WITH FILTER CASSETTE



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