XI. APPENDX III

MATERIAL SAFETY DATA SHEET

The following items of information, applicable to any product or material containing mercury shall be provided in the appropriate section of the Material Safety Data Sheet or approved form. If a specific item of information is inapplicable (ie, flash point), initials "n.a." (not applicable) should be inserted.

(a) The product designation in the upper left hand corner of both front and back to facilitate filing and retrieval. Print in upper case letters as large as possible.

(b) Section I. Source and Nomenclature.

(1) The name, address, and telephone number of the manufacturer or supplier of the product.

(2) The trade name and synonyms for a mixture of chemicals, a basic structural material, or for a process material; the trade name and synonyms, chemical name and synonyms, chemical family, and formula for a single chemical.

(c) Section II. Hazardous Ingredients.

(1) Chemical or widely recognized common name of all hazardous ingredients.

(2) 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 of maximum amount, ie, 10-20% V; 10% max. W.

(3) Basis for toxicity of each hazardous material (eg, established OSHA standard), in appropriate units and/or LD50, showing

amount and mode of exposure and species or LC50 showing concentration, duration, and species.

(d) Section III. Physical Data.

(1) Physical properties of the total product including boiling point and melting point in degrees Fahrenheit; vapor pressure, in millimeters of mercury, vapor density of gas or vapor (air = 1), solubility in water, in parts per hundred parts of water by weight; specific gravity (water = 1); percentage volatile (indicate if by weight or volume) at 70 Fahrenheit; evaporation rate for liquids (indicate whether butyl acetate or ether = 1); and appearance and odor.

(e) Section IV. Fire and Explosion Hazard Data.

(1) Fire and explosion hazard data about a single chemical or a mixture of chemicals, including flash point, in degrees Fahrenheit; flammable limits, in percent by volume in air; suitable extinguishing media or agents; special fire-fighting procedures; and unusual fire and explosion hazard information.

(f) Section V. Health Hazard Data.

(1) Toxic level for total compound or mixture, relevant symptoms of exposure, skin and eye irritation properties, principal routes of absorption, effects of chronic (long-term) exposure, and emergency and first-aid procedures.

(g) Section VI. Reactivity Data.

(1) Chemical stability, incompatibility, hazardous decomposition products, and hazardous polymerization.

(h) Section VII. Spill or Leak Procedures.

(1) Detailed procedures to be followed with emphasis on precautions to be taken in cleaning up and safe disposal of materials leaked or spilled. This includes proper labeling and disposal of containers with residues, contaminated absorbants, etc.

(i) Section VIII. Special Protection Information.

(1) Requirements for personal protective equipment, such as respirators, eye protection, protective clothing, and ventilation, such as local exhaust (at site of product use or application), general, or other special types.

(j) Section IX. Special Precautions.

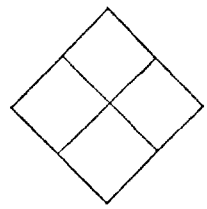
(1) Any other general precautionary information, such as personal protective equipment for exposure to the thermal decomposition products listed in Section VI, and to particulates formed by abrading a dry coating, such as by a power sanding disc.

(k) The signature of the responsible person filling out the data sheet, his address, and the data on which it is filled out.

PRODUCT DESIGNATION

MATERIAL SAFETY
DATA SHEET

Form Approved
Budget Bureau No.
Approval Expires
Form No. OSHA



SECTION I SOURCE AND NOMENCLATURE	
MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
ADDRESS (Number, Street, City, State, ZIP Code)	
TRADE NAME AND SYNONYMS	CHEMICAL FAMILY
CHEMICAL NAME AND SYNONYMS	FORMULA

SECTION II HAZARDOUS INGREDIENTS						
BASIC MATERIAL	APPROXIMATE OR MAXIMUM % WT. OR VOL.	ESTABLISHED OSHA STANDARD	LD 50		LC 50	
			ORAL	PERCUT.	SPECIES	CONC.

SECTION III PHYSICAL DATA			
BOILING POINT	°F.	VAPOR PRESSURE	mm Hg.
MELTING POINT	°F.	VAPOR DENSITY (Air=1)	
SPECIFIC GRAVITY (H_2O=1)		EVAPORATION RATE (_____=1)	
SOLUBILITY IN WATER	Pts/100 pts H_2O	VOLATILE % Vol.	% Wt.
APPEARANCE AND ODOR			

SECTION IV FIRE AND EXPLOSION HAZARD DATA		
FLASH POINT METHOD USED	FLAMMABLE (EXPLOSIVE) LIMITS	UPPER LOWER
EXTINGUISHING MEDIA		
SPECIAL FIRE FIGHTING PROCEDURES		
UNUSUAL FIRE AND EXPLOSION HAZARDS		

PRODUCT DESIGNATION

SECTION V HEALTH HAZARD DATA	
TOXIC LEVEL	CARCINOGENIC
PRINCIPAL ROUTES OF ABSORPTION	SKIN AND EYE IRRITATION
RELEVANT SYMPTOMS OF EXPOSURE	
EFFECTS OF CHRONIC EXPOSURE	
EMERGENCY AND FIRST AID PROCEDURES	

SECTION VI REACTIVITY DATA
CONDITIONS CONTRIBUTING TO INSTABILITY
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION
INCOMPATIBILITY (Materials to Avoid)
HAZARDOUS DECOMPOSITION PRODUCTS

SECTION VII SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
WASTE DISPOSAL METHOD

SECTION VIII SPECIAL PROTECTION INFORMATION	
VENTILATION REQUIREMENTS LOCAL EXHAUST	PROTECTIVE EQUIPMENT (Specify Types) EYE
MECHANICAL (General)	GLOVES
SPECIAL	RESPIRATOR
OTHER PROTECTIVE EQUIPMENT	

SECTION IX SPECIAL PRECAUTIONS
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE
OTHER PRECAUTIONS

Signature _____ Address

Date

Table XII-1

MERCURY PRODUCED IN THE UNITED STATES, BY STATES

	Producing mines	Flasks	Value (Thousands)* Dollars
1970			
California	51	18,593	$7,582
Idaho	1	1,038	423
Nevada	13	4,909	2,001
Oregon	5	274	112
Alaska, Arkansas, New York, Texas, Washington	9	2,482	1,012
Total	79	27,296	11,130
1971			
California	38	13,233	3,869
Idaho	1	1,057	309
Nevada	8	1,589	465
Alaska, Arkansas, New York, Oregon, Texas	8	1,748	511
Total	55	17,627	5,154

Adapted from reference [1]
*Values Calculated at Average New York Price
Flask =76 pounds

Table XII-2

Mercury Consumed in U.S. - 76 Pound Flask

USE	1967	1968	1969	1970	1971
Agriculture	3,732	3,430	2,689	1,811	1,477
Amalgamation	219	267	195	219	W
Catalysts	2,489	1,914	2,958	2,238	1,141
Dental Preparations	2,386	3,079	2,880	2,286	2,387
Elec. Apparatus	16,223	19,630	18,490	15,952	16,938
Elec. Preparation of Chlorine & Caustic Soda	14,306	17,453	20,720	15,011	12,262
Genl. Laboratory Use	1,940	1,989	1,936	1,806	1,809
Ind. & Control Instruments	7,459	7,978	6,655	4,832	4,871
Paint--Antifouling	152	392	244	198	414
--Mildew Proofing	7,026	10,174	9,486	10,149	8,191
Paper & Pulp Mfgr.	446	417	588	226	W
Pharmaceuticals	283	424	712	690	682
Redistilled (1)	-	-	-	-	-
Other (2)	12,856	8,275	9,134	5,858	2,300
Total Known Uses	69,517	75,422	76,657	61,276	52,472
Total Uses Unknown			715	227	3
GRAND TOTAL	69,517	75,422	77,372	61,503	52,475

Adapted from reference [1]

(1) "Redistilled" used in industrial instruments, dental preparations, and electrical apparatus and after 1967 reported in the category for which it was used.

(2) "Other" includes mercury used for installation of chlor-alkali plants for 1963 and later dates.

W = Withheld to avoid disclosing individual company confidential data; included order "Other"

Table XII-3

Contingency Forecasts of Demand for Mercury
by End Use, Year 2000
(76-pound flasks)

End Use	Demand 1968	U.S. Forecast Base 2000	Demand in Year 2000 United States Low	High
Alkalies and chlorine	17,000	60,000	40,000	60,000
Electrical (batteries, apparatus, and lamps)	20,000	33,000	25,000	40,000
Mechanical measuring devices	8,000	13,000	10,000	17,000
Plastic materials and resins	2,000	7,000	5,000	10,000
Paints and allied products	11,000	18,000	15,000	20,000
Agricultural chemicals, n.e.c.	3,000	5,000	3,000	5,000
Medicinals, botanicals and dental supplies and equipment	3,000	5,000	5,000	8,000
Other uses	11,000	18,000	17,000	20,000
Total	75,000	. . .	120,000	180,000
			(Median 150,000)	

Adapted from reference [2]

Table XII-4

Physical Properties of Mercury

Atomic Number	80
Atomic Symbol	Hg
Atomic Weight	200.61
Freezing Point	-38.87 C
Boiling Point	356.90 C
Density	13.546 g/ml (20 C)

Vapor Pressure at Various Temperatures

Temperature Degree		Vapor Pressure (mm of Hg)	Mercury Concentration
C	F		(µg Hg/cu m)
0	32.0	.000185	2,180
10	50.0	.000490	5,880
20	68.0	.001201	13,200
24	75.2	.001691	18,300
28	82.4	.002359	25,200
30	86.0	.002777	29,500
32	89.6	.003261	34,400
36	96.8	.004471	46,600
40	104.0	.006079	62,600

Adapted from reference [3]

Table XII-5

Occupations considered to frequently include exposures to mercury

amalgam makers	fur processors
bactericide makers	gold extractors
barometer makers	histology technicians
battery makers, mercury	ink makers
boiler makers	insecticide makers
bronzers	investment casting workers
calibration instrument makers	jewelers
cap loaders, percussion	laboratory workers, chemical
carbon brush makers	lampmakers, fluorescent
caustic soda makers	manometer makers
ceramic workers	mercury workers
chlorine makers	miners, mercury
dental amalgam makers	neon light makers
dentists	paint makers
direct current meter workers	paper makers
disinfectant makers	percussion cap makers
disinfectors	pesticide workers
drug makers	photographers
dye makers	pressure gage makers
electric apparatus makers	refiners, mercury
electroplaters	seed handlers
embalmers	silver extractors
explosive makers	switch makers, mercury
farmers	tannery workers
fingerprint detectors	taxidermists
fireworks makers	textile printers
fungicide makers	thermometer makers
fur preservers	wood preservative workers

Adapted from reference [4]

TABLE XII - 6

Incident of Medical Effects in Russian Workers
Exposed to Mercury

Group	I		II		III *	
Numbers of workers	376		130		68	
Airborne conservations mg Hg/cu m	0.01-0.05		0.01-0.04		$\leq$0.01	
Effects reported	No.	%	No.	%	No.	%
Enlarged thyroid	55	14.6	18	13.8	3	4.4
Chest pain or "Colic", palpitations	109	29	47	36	27	40
Vascular dystonia	124	33	40	31	19	28
Functional shifts in liver	60	16	35	27	14	21
Gastrointestinal - loss of appetite, substernal distress nausea, vomiting	41	11	33	25	-	-
Bleeding gums	39	10.3	27	21	11	16

* Control population

Derived from Reference [52]

TABLE XII - 7

Symptoms Observed in 58
Mercury Workers

Air Concentration mg Hg/cu m	0.01-0.06	0.05-0.23	0.3-0.6
Number of workers	26	15	17
Average age	39.6	42.1	40.0
Average exposure, years	9.1	16.7	7.4
Tremor	19%	20%	29%
Erethism	8%	33%	29%
Impaired memory	0%	13%	18%
Demographia	8%	27%	18%
Gingivitis	42%	40%	35%
Bad teeth or dentures	46%	67%	41%

From Reference [114]

Table XII- 8

Relationship of Mercury Exposure to Mercury Levels in Urine, Uncorrected for Specific Gravity*

TWA** Exposure level groups (mg/cu m)	Number of workers	Percentage of group within urine level range (mg/l)					
		<0.01	.01-.10	.11-.30	.31-.60	.61-1.0	1.00
Controls 0.00	142	35.2	62.7	2.1	0	0	0
< 0.01	29	6.9	86.2	6.9	0	0	0
0.01-0.05	188	6.9	66.0	24.5	2.7	0	0
0.06-0.10	91	0	62.6	30.8	6.6	0	0
0.11-0.14	60	3.3	18.3	31.7	16.7	23.3	6.7
0.24-0.27	27	0	14.8	29.6	44.5	7.4	3.7

*Expressed as percentage of each exposure level group within designated ranges of urine mercury levels

**Time-weighted averages

From reference [28]

Table XII-9

Relationship of Mercury Exposure to Blood Mercury Levels*

TWA exposure Level groups (mg/cu m)	Number of Workers	Percentage of group within blood level range (µg/100 ml)			
		<1	1-5	6-10	10
Controls 0.00	117	69.3	30.7	0.0	0.0
< 0.01	27	33.3	63.0	3.7	0.0
0.01-0.05	175	20.6	74.9	4.0	0.6
0.06-0.10	77	10.4	81.8	6.5	1.3
0.11-0.14	53	3.8	22.6	26.4	47.2
0.24-0.27	26	0.0	19.2	26.9	53.9

*Expressed as percentage of each exposure level group with designated ranges of blood mercury levels

Adapted from reference [28]

Table XII-10

Time-weighted Average Exposures
for Mercury Exposed Workers

Exposure Levels (mg/cu m)	Number of Workers	Percent of Exposed Workers
< 0.01	58	10.20
0.01-0.05	276	48.70
0.06-0.10	145	25.60
0.11-0.14	61	10.70
0.15-0.23	--	--
0.24-0.27	27	4.8

Adapted from reference [28]

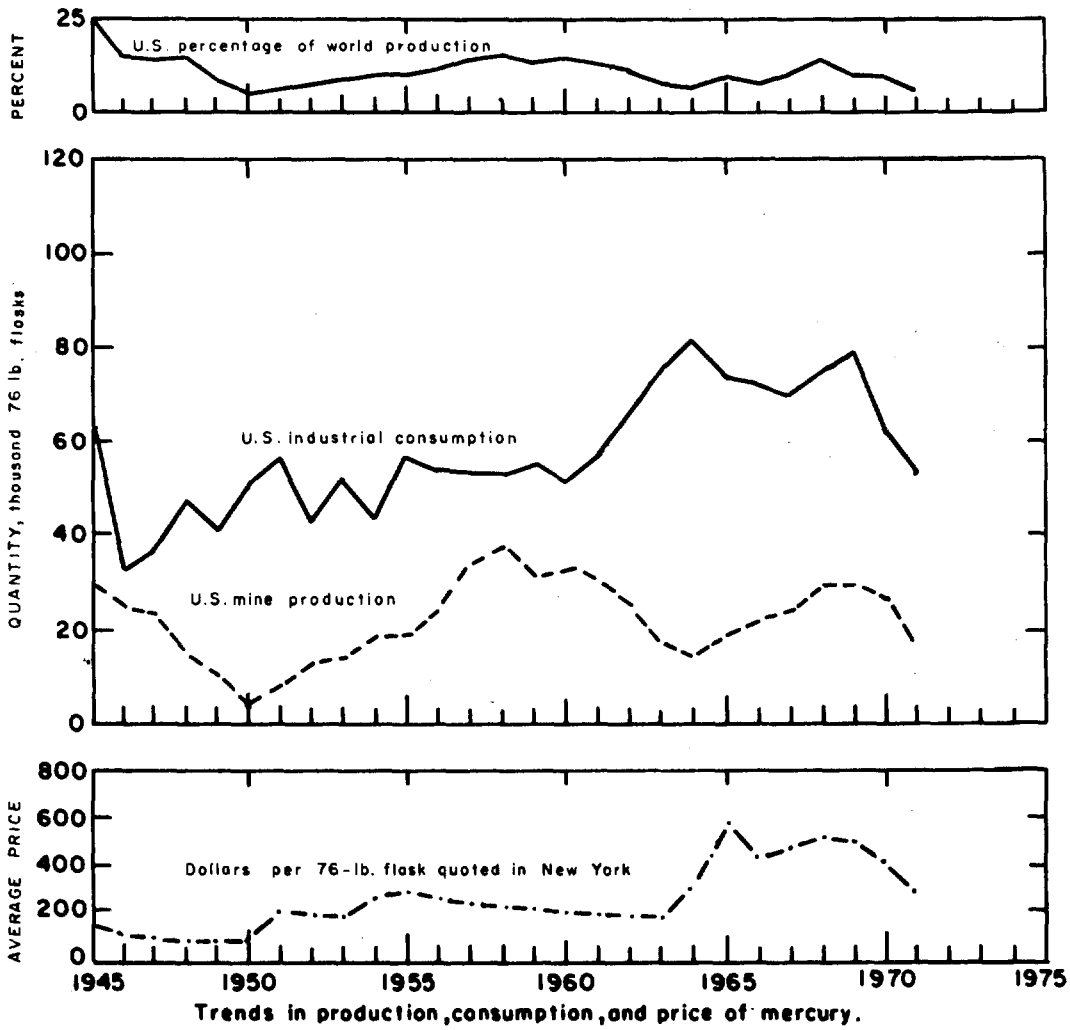


Figure XII-1

Trends in Production, Consumption and Price of Mercury

From Reference [1]

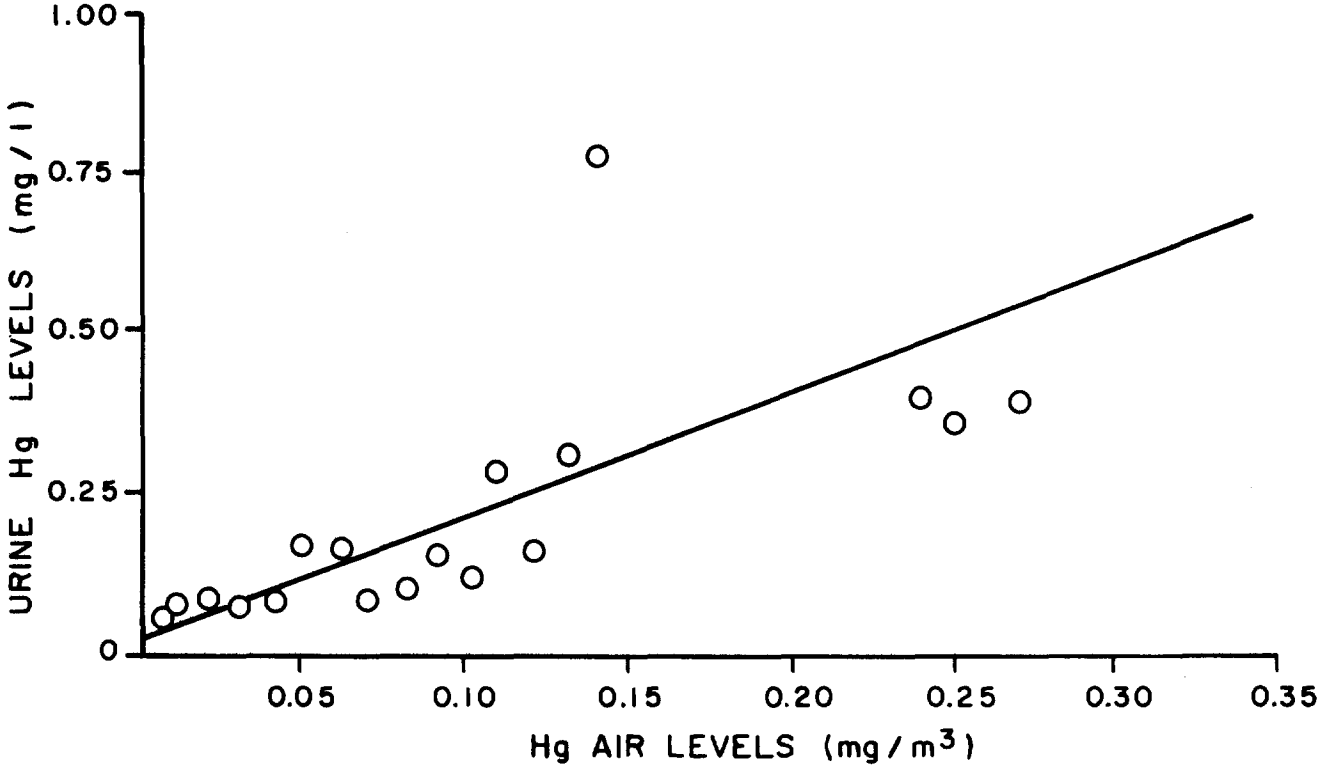


Figure XII-2

Concentrations of Mercury in Urine (uncorrected for specific gravity) in Relation to Time-Weighted Average Exposure Levels

From Reference [28]

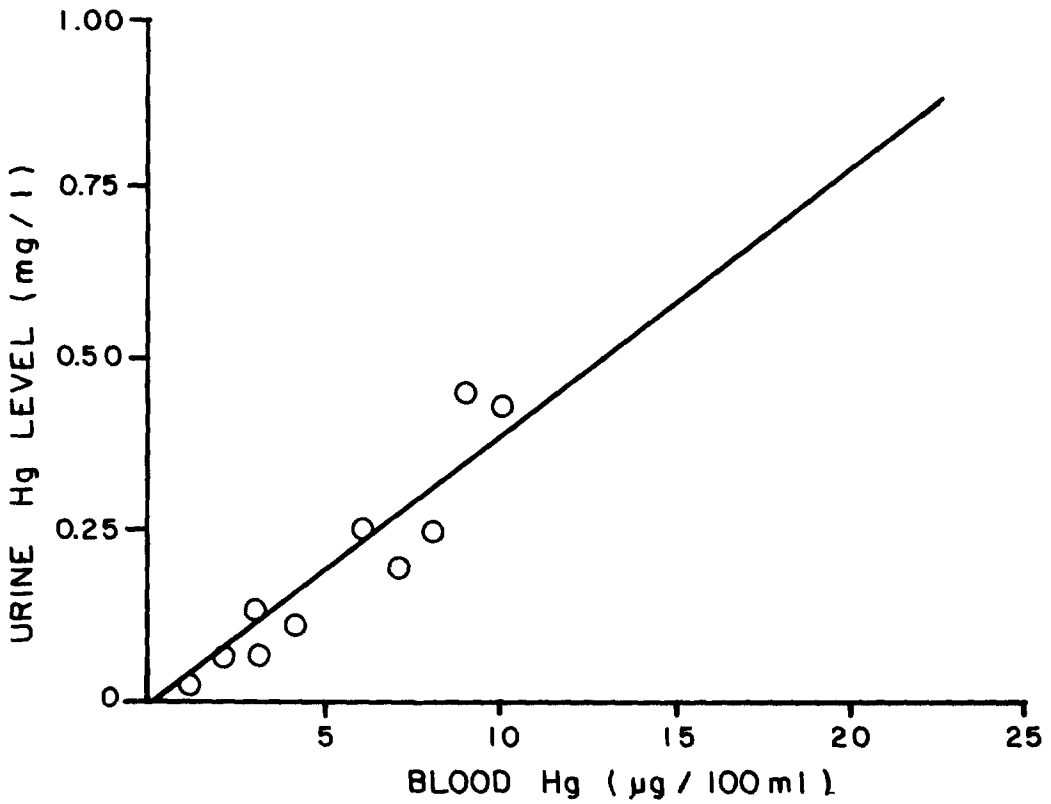


Figure XII-3

Relationship of Concentrations of Mercury in Blood and in Urine (uncorrected for specific gravity)

From reference [28]

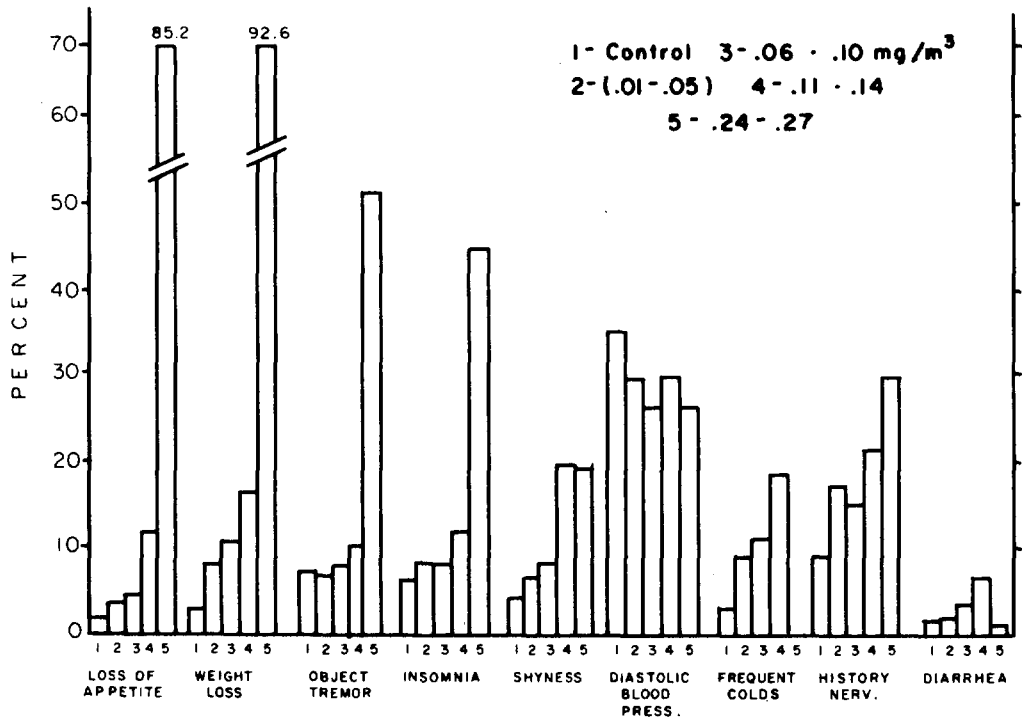


Figure XII-4

Percentage Prevalence of Certain Signs and Symptoms among Workers Exposed to Mercury in Relation to Degree of Exposure

From Reference [28]

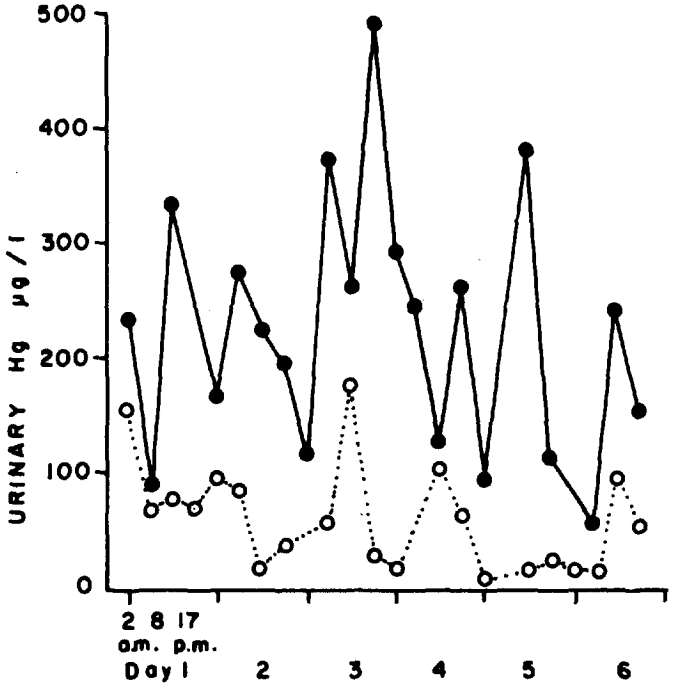


Figure XII- 5

Variations within the 24-hour Excretion of Mercury in Two Workmen with Mercury Poisoning

From reference [119]

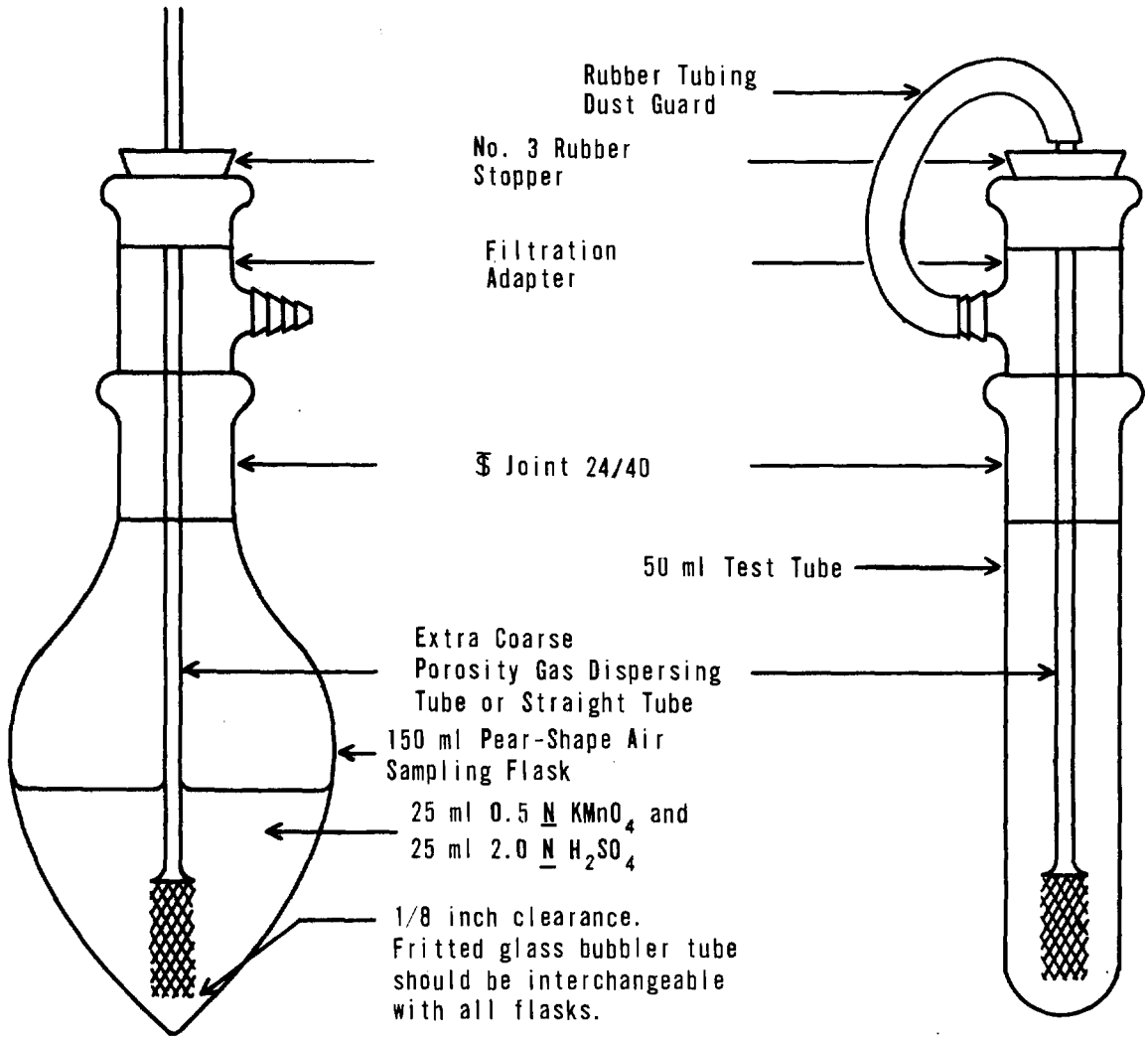


Figure XII-6

Collecting Bubbler for Particulates and Mercury Vapor [120]

A. Compressed air
B. Glass wool filter
C. Potassium iodide - activated charcoal filter
D. Flowmeter
E. 3-Way stopcock
F. Fritted glass bubbler flask and adapter
G. All-glass midget impinger
H. "Anhydrone" - glass wool filter
I. Optical gas cell
J. Mercury vapor detector or atomic absorption spectrophotometer
K. Strip chart recorder
L. Voltage regulator
M. Exhaust to hood or acid permanganate bubbler

Make all connections with "Tygon" tubing.
Keep connections as short as possible.

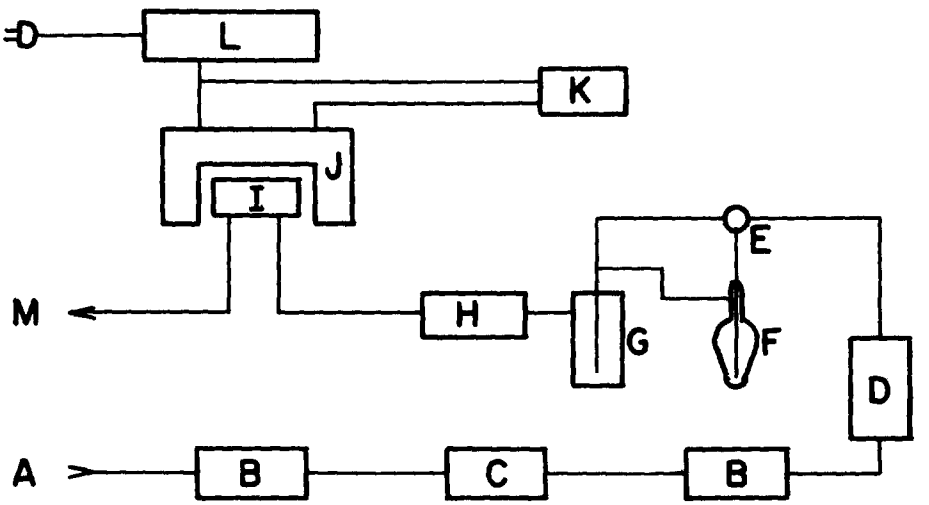


Figure XII-7

Desorption Train for Removing
Mercury from Collection Bubbler
[126]