

TABLE I\*  
PHYSICAL PROPERTIES OF BERYLLIUM

Property	Value
Atomic number	4
Atomic weight, chemical	9.013
Electron configuration	1s <sup>2</sup> 2s <sup>2</sup>
Thermal conductivity, cal/(sec)(cm <sup>2</sup> )(°C/cm)	0-100°C 0.349
Density, gm/cm <sup>3</sup>	25°C 1.8477 ± 0.0007
Melting point	1283°C, 2341°F
Boiling point	2970°C
Electrical Resistivity, μohm-cm	4.31
Optical properties	Steel-gray color, reflectivity 50-55%
Sound conductance, m/sec	12,600
ft/sec	41,300

\*See reference No. 1

TABLE II\*

INDUSTRIAL USES OF BERYLLIUM PRODUCTS

1. Nuclear Applications
  - Moderator reflectors
  - Weapons production
2. Guided Missiles and Space Vehicles
  - Inertial guidance
  - Radome and microwave windows
  - Fuels
3. Electrical Measuring Instruments
  - Alloy springs, connectors, contacts
4. Switchgear
  - Alloy electrical switches
  - Household appliances
5. Welding Apparatus
  - Alloy electrodes
  - Resistance welding equipment
6. Electronic Computer Equipment
  - Circuitry
7. Radio and Television Equipment
  - Circuitry
8. Other Uses
  - Molds for plastics
  - Chemical reagents
  - Alloy development

\*See reference Nos. 3,5,6

**TABLE III\***  
**INDUSTRIES PROCESSING AND MANUFACTURING**  
**BERYLLIUM PRODUCTS**

Aerospace equipment specialty products	Metallurgical operation
Alloy manufacturing	Mining and beneficiation of beryllium minerals
Beryllium alloy machining and fabrication	Non-ferrous foundry products
Beryllium ceramic products	Phosphor manufacturing
Electronic equipment manufacturing	Special chemicals
Extraction of beryllium	Tool and die manufacturing

\*See reference Nos. 3,5

TABLE IV\*  
EARLY LITERATURE ON BERYLLIUM POISONING

Author	Date	Be compounds and/or processes mentioned	Diagnoses
Weber and Engelhardt (Germany)	1933	Extraction of Be	Bronchitis; bronchiolitis
Fabroni (Italy)	1935	Be carbonate	Berylliosis; forms of pneumonia (guinea pigs)
Menesini (Italy)	1937	Be carbonate	Poisoning, by inhalation, of lungs and larger glands; acute accident pneu- mopathy (animals)
Gelman (Russia)	1936 & 1938	Be metal	Metal fume fever; nasopharyngitis; bronchitis and bronchioalveolitis; dermatitis; conjunctivitis ("neigh- borhood" cases)
Berkowitz and Israel (German-- writing from Russia)	1940	Be metal, fluoride	Fluorine beryllium poisoning; acute bronchiolitis
Meyer (Germany)	1942	Be silicate, hydroxide, sul- fate, chloride	Berylliosis; chronic large-celled pneu- monia; pulmonary sclerosis
Wurm and Ruger (Germany)	1942	Be silicate, hydroxide, sul- fate, chloride	Beryllium dust pneumonia (pathol- ogy of human cases; animal studies)
Van Ordstrand, Hughes and Carmody (USA)	1943	Extraction of Be; Be oxide, sulfate, chloride	Chemical pneumonia
Shilen, Galloway, and Mellor (USA)	1943	Extraction of Be; Be oxide, fluoride	Respiratory diseases
Kress and Crispell (USA)	1944	Fluorescent powder, Be car- bonate; Be, Mn silicate	Atypical pneumonitis
Van Ordstrand, DeNardi, and Carmody (USA)	1945	Be metal, oxide, sulfate, fluoride, oxyfluoride	Beryllium poisoning, contact dermatitis; contact conjunctivitis; chemical nasopharyngitis; chemical pneumonitis
Hardy and Tabershaw (USA)	1946	Fluorescent powder; Zn, Be, Mn silicate	Delayed chemical pneumonitis

TABLE IV  
(Continued)

Author	Date	Be compounds and/or processes mentioned	Diagnoses
Koelsch (Germany)	1947	Be silicate, sulfate, chloride, hydroxide	Bronchitis; atypical pneumonitis
Machle, Beyer, Gregorius and Tebrock (USA)	1948	Be oxide; Zn, Be, Mn silicate; Be halides	Berylliosis; acute pneumonitis; pulmonary granulomatosis
Agate (Gt. Britain)	1948	Fluorescent powder	Delayed pneumonitis (systemic disease)
Vigliani (Italy)	1948	Be extraction; fabrication Be alloys; Be fluoride, oxide, metal	Respiratory diseases; acute pneumonitis; chronic bronchitis; dermatitis; conjunctivitis

\*See reference No. 17

TABLE V

CONFIRMED CASES\* OF CHRONIC BERYLLIUM DISEASE FROM THE  
BERYLLIUM CASE REGISTRY OF WORKERS EXPOSED SINCE 1949

Sex	Year of Birth	Source of Exposure	Duration of Exposure	Dates of Diagnosis	Proximity to Source	Delay Between First Exposure & Symptoms	Environmental Levels, $\mu\text{g Be}/\text{m}^3$
M	1919	Machining & Polishing -- Fabrication work with Be-Cu	1 year	9/67	Handling or Breathing Zone	2 1/2 years	General Room Air <u>19.7</u> Polishing Operations <u>208.0, 346.0</u> Machining 0.08 to 1.6
M	1939	Machining-- Be Alloys	2 1/2 months	1/69	Handling or Breathing Zone	10 years	----
M	----	Machining-- Draftsman where Be pressed & fired	1 year	----	Under Same Roof	10 months	----
F	1924	Ceramics-- Be in porcelain	15 years	9/68	Handling or Breathing Zone	13 years	----
M	1932	Be powder	5 years	5/69	Handling or Breathing Zone	Less than 5 years	----
M	1917	Ceramics	6 weeks	1965	Handling or Breathing Zone	----	----
M	1927	Foundry-- Smelting Beryllium	3 years	1969	Handling or Breathing Zone	3 years	----

TABLE V  
 CONFIRMED CASES\* OF CHRONIC BERYLLIUM DISEASE FROM THE  
 BERYLLIUM CASE REGISTRY OF WORKERS EXPOSED SINCE 1949

(Continued)

Sex	Year of Birth	Source of Exposure	Duration of Exposure	Dates of Diagnosis	Proximity to Source	Delay Between First exposure & Symptoms	Environmental Levels <sub>3</sub> µg Be/m
M	1940	Grinding Shop-- Be-Ni Alloy	9 1/2 years	1961	Handling or Breathing Zone	3 years	----
M	1940	Ceramic Machine Shop--Technician & Maintenance	9 1/2 years	1971	Handling or Breathing Zone	8 1/2 years	Per Employer daily weighted averages- Low 0.7, High 5.9, Avg 2.0
-	1922	Smelting & Extraction	Greater than 2 years	1971	Handling or Breathing Zone	Less than 10 years	----

\*Ten representative case histories of approximately 20 examined.

TABLE VI

STATUS OF MALE BERYLLIUM STUDY COHORT AS OF JANUARY 1, 1968

<u>STATUS</u>	<u>NUMBER</u>
Known to be alive	3297
Known to be deceased	618
Known causes	595
Unknown causes	7
Overseas	16
Not known to be alive or deceased	<u>6</u>
TOTAL	3921



TABLE VII

EXPECTED AND OBSERVED DEATHS BY SELECTED CAUSES  
OCCURRING TO BERYLLIUM WORKERS, 1942-1967

CAUSE OF DEATH	LIST NO. (ICD)*	EXPECTED	OBSERVED
MALIGNANT NEOPLASMS	140-205	105.24	91
Digestive	150-159	37.65	30
Lung	160-164	25.41	25
Residual	140-149, 165-205	42.18	36
CEREB-VASC ACCIDENTS	330-334	56.81	40
HEART DISEASE	400-443	271.03	273
RESPIRATORY DISEASES	470-527	31.08	34
EXTERNAL CAUSES	800-999	78.24	65
ALL OTHER CAUSES		125.93	92
UNKNOWN			7
ALL CAUSES		668.33	602

\*ICD = International Classification of Diseases and Cause of Death

TABLE VIII

EXPECTED AND OBSERVED DEATHS BY CAUSE AND BY YEARS  
AFTER START OF BERYLLIUM WORK AT DIFFERING LEVELS OF EXPOSURE\*

CAUSE OF DEATH	<5 YRS. EXPOSURE				5-14 YRS. EXPOSURE				≥15 YRS. EXPOSURE			
	HIGH		LOW		HIGH		LOW		HIGH		LOW	
	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.
MALIGNANT NEOPLASMS	6.02	2	5.72	4	21.58	20	19.00	15	29.89	29	23.00	19
Digestive	2.49	1	2.42	1	7.96	7	7.10	5	9.97	9	7.70	6
Lung	1.10	0	1.03	0	4.80	6	4.13	6	8.16	9	6.17	5
Residual	2.43	1	2.27	3	8.82	8	7.77	4	11.76	11	9.13	8
CEREB-VASC ACCIDENTS	2.80	1	2.77	0	10.83	12	10.05	11	16.80	6	13.53	10
HEART DISEASE	14.71	11	14.09	10	54.24	51	48.47	56	78.07	73	61.28	71
RESPIRATORY DISEASE	2.23	3	1.99	1	5.34	7	4.74	5	9.38	12	7.39	6
EXTERNAL CAUSES	10.96	9	9.11	4	19.15	17	15.62	14	13.17	15	10.14	6
ALL OTHER CAUSES	12.85	3	11.44	5	26.80	15	23.17	15	28.86	27	22.65	26
UNKNOWN	0	1	0	0	0	1	0	1	0	3	0	1
ALL CAUSES	49.57	32	45.12	24	137.94	123	121.05	117	176.17	165	137.99	139

\*Based Upon Opinion of a Professional Industrial Hygienist

TABLE IX

EXPECTED AND OBSERVED DEATHS BY CAUSE AND BY YEARS  
AFTER START OF BERYLLIUM WORK BY TOTAL TIME IN JOB

CAUSE OF DEATH	<5 YRS. AFTER START OF WORK						5-14 YRS AFTER START OF WORK						≥15 YRS. AFTER START OF WORK					
	<6 MOS		6 MOS. TO <2-1/2 YRS.		≥2-1/2 YRS.		<6 MOS		6 MOS. TO <2-1/2 YRS.		≥2-1/2 YRS.		<6 MOS		6 MOS. TO <2-1/2 YRS.		≥2-1/2 YRS.	
	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.
MALIGNANT NEOPLASMS	5.85	4	4.35	3	1.49	0	18.76	21	10.75	3	11.08	12	25.63	26	14.87	10	12.41	12
Digestive	2.49	2	1.85	0	0.56	0	6.87	6	4.07	2	4.13	5	8.43	9	4.99	3	4.25	3
Lung	1.04	0	0.78	0	0.31	0	4.19	7	2.29	1	2.45	3	7.09	8	4.00	3	3.24	3
Residual	2.32	2	1.72	3	0.62	0	7.70	8	4.39	0	4.50	4	10.11	9	5.88	4	4.92	6
CEREB-VASC ACCIDENTS	2.80	1	2.13	0	0.62	0	9.51	10	5.73	7	5.64	6	14.20	8	8.79	4	7.35	4
HEART DISEASE	14.49	12	10.76	6	3.50	3	47.43	51	27.53	30	27.79	27	66.81	62	39.59	42	33.00	40
RESPIRATORY DISEASE	2.21	2	1.55	1	.45	1	4.67	6	2.65	4	2.76	2	8.12	10	4.80	4	3.85	4
EXTERNAL CAUSES	10.63	6	6.95	5	2.34	2	16.95	12	8.58	13	9.27	6	12.12	11	6.16	3	5.06	7
ALL OTHER CAUSES	12.87	7	8.79	2	2.56	0	23.18	11	13.18	12	13.66	7	25.09	23	14.43	11	12.00	20
UNKNOWN	.00	0	.00	1	.00	0	.00	1	.00	1	.00	0	.00	2	.00	2	.00	0
ALL CAUSES	48.85	32	34.53	18	10.96	6	120.50	112	68.42	70	70.20	60	151.97	142	88.64	75	73.67	87

TABLE X

EXPECTED AND OBSERVED DEATHS BY CAUSE AND BY YEARS  
AFTER START OF BERYLLIUM WORK BY PERIOD WHEN STARTED WORK

CAUSE OF DEATH	<5 YEARS						5-14 YEARS						≥15 YEARS					
	<1943		1943-47		>1947		<1943		1943-47		>1947		<1943		1943-47		>1947	
	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.	EXP.	OBS.
MALIGNANT NEOPLASMS	2.71	2	5.39	3	3.65	2	13.01	9	18.48	18	9.11	9	26.02	22	23.55	23	3.34	3
Digestive	1.35	1	2.57	1	1.00	0	5.19	5	7.28	6	2.60	2	8.74	5	7.98	9	0.95	1
Lung	0.45	0	0.86	0	.82	0	2.59	1	3.75	4	2.60	6	7.07	5	6.17	8	1.10	1
Residual	0.91	1	1.96	2	1.83	2	5.23	3	7.45	8	3.91	1	10.21	12	9.40	6	1.29	1
CEREB-VASC ACCIDENTS	1.42	1	2.96	0	1.21	0	6.86	7	11.03	12	2.98	4	14.35	8	14.88	7	1.10	1
HEART DISEASE	7.24	2	13.96	11	7.69	8	33.27	28	49.25	55	20.23	25	67.70	69	64.18	66	7.52	9
RESPIRATORY DISEASE	1.41	1	1.80	2	1.03	1	3.18	3	4.56	8	2.35	1	7.96	8	7.95	7	0.87	3
EXTERNAL CAUSES	5.14	2	5.60	1	9.37	10	11.00	10	11.20	9	12.59	12	11.65	11	9.20	8	2.50	2
ALL OTHER CAUSES	7.93	0	10.54	8	5.87	1	17.67	15	21.49	9	10.88	6	25.09	30	23.14	22	3.28	1
UNKNOWN		1						2				2		2				
ALL CAUSES	25.85	9	40.25	25	28.82	22	84.99	74	116.01	111	58.14	57	752.77	150	142.90	135	18.61	19

TABLE XI\*  
 REPRESENTATIVE ENVIRONMENTAL BERYLLIUM CONCENTRATIONS  
 (Prior to Controls)

Beryllium Operation	Concentration ( $\mu\text{g}/\text{m}^3$ )	
	Dust	Fumes
<b>Metal Furnace</b>		
Pouring	1430 to 4710	293
Coke removal	110 to 533	59 to 83
<b>Fluoride Furnace</b>		
3 feet away	59 to 70	
15 feet away	14	
<b>Ore Treatment (Rotary kiln dryer)</b>		
1-1/2 feet to far side of area	50 to 528	

\*See reference No. 105

TABLE XII\*

REPRESENTATIVE ENVIRONMENTAL EXPOSURE LEVELS IN A BERYLLIUM  
ALLOY PLANT PRIOR TO INSTITUTION OF CONTROL MEASURES

	$\mu\text{g Be/m}^3$			
	<u>11/47</u>	<u>12/47</u>	<u>1/48</u>	<u>2/48</u>
<b>Mix Operation:</b>				
General air	411			
Breathing zone	15,500	42,000		21,000 590 16,500
<b>Alloy Operation:</b>				
General air	2,840		2,400	
	1,330		7,060	
Breathing zone	43,300			4,700
<b>Stack Sampling:</b>			1,955 2,470	

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\*See reference No. 106

TABLE XIII\*

CHRONIC AND ACUTE-TO-CHRONIC CASES BY PROXIMITY TO SOURCE

Mode of Exposure	Number	Percent
Nonoccupational	6	1.8
Beryllium plant, different building**	15	4.5
Under same roof as source	44	13.2
Direct exposure	267	80.5

\*See reference No. 102 and 107

\*\*Building other than one in which beryllium materials are processed.

TABLE XIV\*

SAMPLE DISTRIBUTION BY CONCENTRATION FOR  
15 BERYLLIUM METALWORKING PLANTS

Stated Concentration $\mu\text{g Be}/\text{m}^3$	No. $\leq$ Stated Concentration	Percent $\leq$ Stated Concentration
0.05	84	42.06
0.10	148	63.52
0.20	170	72.96
0.50	198	84.97
1.00	216	92.70
2.00	223	95.70
5.00	225	96.56
10.00	228	97.85
20.00	230	98.71
50.00	232	99.57
100.00	233	100.00

\*See reference No. 112



TABLE XV\*

TIME-WEIGHTED AVERAGE EXPOSURE FOR PERSONNEL  
IN A BERYLLIUM ALLOY PLANT $\mu\text{g Be/m}^3$ 

## Master Alloy Production Crew

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	<u>6 &amp; 7/53</u>	<u>1 - 6/54</u>	<u>7 - 12/54</u>	<u>1 - 6/55</u>	<u>1 - 6/56</u>	<u>7 - 12/56</u>	<u>1 - 3/57</u>	<u>1 - 6/60</u>
Chief operator	4.5	7.9	17.0	10.3	7.0	11.2	8.8	23.1
Helper	9.5	7.9	16.3	10.0	7.7	18.5	11.8	34.0
Mixer	3.8	53.3	27.8	8.7	6.8	9.2	12.3	28.1
Charger	4.4	4.6	27.8	10.9	13.5	19.1	10.9	54.6

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\*See reference No. 106

TABLE XVI

 REPRESENTATIVE WORKER DAILY WEIGHTED AVERAGE  
 (DWA) EXPOSURES TO BERYLLIUM\*

## PLANT A

Survey Year	1953	1953	1954	1955	1956	1957	1957	
							All Employees	Production Employees Only
No. of Employees	213	152	66	61	164	198	132	44
Avg. DWA $\mu\text{g}/\text{m}^3$	1.0	0.6	1.1	2.4	2.6	1.4	-	-
Max. DWA $\mu\text{g}/\text{m}^3$	12.6	2.6	3.6	34.0	18.4	11.8	-	-
% Exposed 0-1.0 $\mu\text{g}/\text{m}^3$	56.3	88.8	60.6	71	-	-	70	16
% Exposed 0-2.0 $\mu\text{g}/\text{m}^3$	-	-	-	-	67.6	88	-	-
% Exposed 1.1-2.0 $\mu\text{g}/\text{m}^3$	30.5	7.2	28.8	18	-	-	11	27
% Exposed 2.1-4.0 $\mu\text{g}/\text{m}^3$	13.2	-	-	-	-	-	.7	50
% Exposed 2.1-5.0 $\mu\text{g}/\text{m}^3$	-	-	-	-	22	8.5	-	-
% Exposed > 2.0 $\mu\text{g}/\text{m}^3$	-	4.0	10.6	11.0	-	-	-	-
% Exposed > 4.0 $\mu\text{g}/\text{m}^3$	0.5	-	-	-	-	-	2	7
% Exposed > 5.0 $\mu\text{g}/\text{m}^3$	-	-	-	-	10.4	3.5	-	-

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

TABLE XVII

 REPRESENTATIVE WORKER DAILY WEIGHTED AVERAGE  
 (DWA) EXPOSURES TO BERYLLIUM\*

## PLANT B

Survey Year	1958	1957	1960		1961		1962	
			Production	Other	Production	Other	Production	Other
No. of Employees	116	200	155	58	77	77	37	44
Max. DWA $\mu\text{g}/\text{m}^3$	10	73	9.8	10.7	6.4	3.2	3.3	4.3
% Exposed 0-2.0 $\mu\text{g}/\text{m}^3$	82	4.0	25	62	93.5	62	24	43
% Exposed 2.1-5.0 $\mu\text{g}/\text{m}^3$	11	66.5	50	31	4.0	38	76	57
% Exposed > 5.0 $\mu\text{g}/\text{m}^3$	7	15.0	25	0	2.5	0	-	-
% Exposed > 10 $\mu\text{g}/\text{m}^3$	0	14.5	0	7	0	0	-	-
No. Exposed to Instantaneous Level > 25 $\mu\text{g}/\text{m}^3$	16**	14**	90	4	2	6	0	5
No. Exposed to Instantaneous Level > 100 $\mu\text{g}/\text{m}^3$	0	19**	2	0	0	0	6	0

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

\*\*In addition, these operators were also exposed to 29  $\mu\text{g}/\text{m}^3$  during 6 min. stay in the clothing change room.



TABLE XVIII  
 PLANT C  
 (Continued)

Survey Year					1959		1960		1961		1961	
	1957	1958	1958	1959	Production	Other	Production	Other	Production	Other	Production	Other
No. Exposed Instantaneous > 25 $\mu\text{g}/\text{m}^3$	19	22	23	10	25	-	12***	3	13	3	12	0
No. Exposed Instantaneous > 100 $\mu\text{g}/\text{m}^3$	15	15	18	5	13	-	6	0	18	0	0	0

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory

\*\*These personnel work in laundry.

\*\*\*In addition, every operator was exposed to 26.4  $\mu\text{g}/\text{m}^3$  during 10 min. stay in locker room

TABLE XIX

 REPRESENTATIVE WORKER DAILY WEIGHTED AVERAGE  
 (DWA) EXPOSURES TO BERYLLIUM\*

## PLANT D

Survey Year	1952	1953	1955	1956	1957	1958	1959	1960	
								Production	Other
No. of Employees	120	126	125	123	234	183	159	150	88
Avg. DWA $\mu\text{g}/\text{m}^3$	1.2	0.3	2.0	2.4	0.5	-	-	-	-
Max. DWA $\mu\text{g}/\text{m}^3$	6.2	1.0	98.0	14.8	3.0	11.2	5.2	1.3	2.2
% Exposed 0-1 $\mu\text{g}/\text{m}^3$	70.8	100	70	54	89	68	88	-	-
% Exposed 0-2.0 $\mu\text{g}/\text{m}^3$	78	-	80	-	-	-	-	100	95
% Exposed 1.1-2.0 $\mu\text{g}/\text{m}^3$	6.7	-	10	13	10	21	0	-	-
% Exposed 2.1-4.0 $\mu\text{g}/\text{m}^3$	16	-	14	-	1	7	-	-	-
% Exposed 2.1-5.0 $\mu\text{g}/\text{m}^3$	-	-	-	-	-	-	12	0	5
% Exposed 2.1-10.0 $\mu\text{g}/\text{m}^3$	-	-	19	30	-	-	-	-	-
% Exposed 4.1-10.0 $\mu\text{g}/\text{m}^3$	7	-	5	-	0	4	-	-	-
% Exposed > 2.0 $\mu\text{g}/\text{m}^3$	5.8	-	-	-	1	-	-	-	-
% Exposed > 10.0 $\mu\text{g}/\text{m}^3$	1	2	0	0	-	-	-	-	-
No. Exposed to Instantaneous Level > 25 $\mu\text{g}/\text{m}^3$	-	-	2	6	0	11	7	0	0

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory

TABLE XX

REPRESENTATIVE WORKER DAILY WEIGHTED AVERAGE  
(DWA) EXPOSURES TO BERYLLIUM\*

## PLANT E

	1961	
	Production	Other
No. of Employees	46	7
Max. DWA $\mu\text{g}/\text{m}^3$	73	4.0
% Exposed 0-2 $\mu\text{g}/\text{m}^3$	0	0
% Exposed 2-5 $\mu\text{g}/\text{m}^3$	4	100
% Exposed 5-10 $\mu\text{g}/\text{m}^3$	20	0
% Exposed >10 $\mu\text{g}/\text{m}^3$	76	0
No. Exposed to Instantaneous Level > 25 $\mu\text{g}/\text{m}^3$	16**	3**
No. Exposed to Instantaneous Level > 100 $\mu\text{g}/\text{m}^3$	21**	

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory

\*\*In addition, 29 workers were exposed to general air concentrations in the 25-100  $\mu\text{g}$  range.

TABLE XXI

 REPRESENTATIVE AVERAGE BREATHING ZONE CONCENTRATIONS  
 FOR VARIOUS PLANT OPERATIONS\*

 $\mu\text{g}/\text{m}^3$   
 PLANT A

Operation	1950	1950	1953	1953	1954	1955	1956	1956	1957	1957
Removing Plug from Beryl Furnace- Operating Tilt Controls during Pouring	5.5	1.3	--	--	14.6	--	--	5.5	7.42	--
Operating Controls While Elevating Frit Cage to Frit Shaker Platform	--	6.6	--	--	7.6	--	--	--	--	--
Opening Frit Cage for Drainage and Shoveling in Excess Frit	3.1	39.0	--	--	45	--	--	--	--	--
Placing Frit into Frit Shaker	2.8	8.5	--	--	22.6	--	--	--	--	--
Replacing Cover with Grate on Sulfate Mill	--	--	4.3	3.2	2.1	3.7	84.5	--	3.03	--
Taking Specific Gravity Reading at Sulfate Mill	--	--	6.5	6.3	14.4	7.4	--	--	--	--
Placing Cover on Sulfate Mill	--	--	5.0	29	0.8	--	--	--	--	--
Cleaning Burner End of Sulfate Mill	--	--	6.0	0.8	16.9	660	314	--	1.75	--
Lighting Burner End of Sulfate Mill	--	--	3.8	--	55.1	15000	278	11.1	5.28	--
Sampling Ground Ore Bin	--	--	12.5	28	3.3	20	--	--	--	--
Sampling at Sulfate Mill	--	--	6.4	--	29.7	--	--	--	--	--
Changing Hydroxide Drum	--	--	15	16	20.6	52	23.7	15.6	4.73	11
Sampling and Weighing Drums	--	--	--	--	--	--	30.2	6.5	3.71	--
Changing Discharge Drum	--	--	--	--	--	--	--	--	4.21	1.0
Washing Down Area	--	--	--	--	--	--	29.8	--	2.38	--
Discharging One Drum into Ball Mill	--	--	--	--	--	--	--	12.7	21.69	16
Weighing Up $\text{BeF}_2$ Charge	--	--	--	--	--	--	43.0	19.4	9.22	26
Charging Furnace	--	--	--	--	--	--	16.42	116.7	4.20	9
Vacuuuming Buggy, Removing to Cooling Area	--	--	--	--	--	--	156.2	11.3	2.15	--
Replacing Drum at Melts Crusher	--	--	--	--	--	--	16.2	65.9	25.3	--
Melts Buggy Operation	--	--	--	--	--	--	466.5	159.3	19.44	--



TABLE XXI  
PLANT A (continued)

Operation	1950	1950	1953	1953	1954	1955	1956	1956	1957	1957
Melts Crushing	--	--	--	--	--	--	705	80.0	503.19	--
<u>High Frequency Fluoride</u>										
Removing and Replacing Feed Drum	--	--	--	--	--	--	18.65	25.2	3.71	1.3
Removing and Displacing Discharge Drum	--	--	--	--	--	--	28.5	103.2	7.52	6.4
<u>Vacuum Cast Furnace Operator</u>										
Making Up Charge in Weigh Hood	--	--	--	--	--	--	21.4	12.7	66	44
Breaking Vacuum and Pouring	--	--	--	--	--	--	19.8	24.8	3.45	4
Scraping Dross into Mold	--	--	--	--	--	--	--	--	6.41	20
Extracting Mold from Furnace	--	--	--	--	--	--	49.4	8.9	6.01	6
Dumping Silent Butler	--	--	--	--	--	--	--	686	7.5	--
Extracting Billet from Mold	--	--	--	--	--	--	116.5	8.1	8.6	--
Place Billet in Transfer Can	--	--	--	--	--	--	--	12.3	31.7	--
<u>Sandblast Operator</u>										
Placing Billet in Sandblast Hood	--	--	--	--	--	--	437.3	--	10.25	19
Fill Billet Core, Sandblast and Clean Billet	--	--	--	--	--	--	51.56	--	2.15	1.3
Stamp Billet, Remove Billet	--	--	--	--	--	--	95.5	--	3.00	5
Composite Pebble Sample	--	--	--	--	--	--	--	--	20.47	--
Weighing Sampled Composite	--	--	--	--	--	--	--	--	25.35	--
<u>Sample Grinder</u>										
Vacuuming Grinding Hood	--	--	--	--	--	--	--	--	55	--
Riffling Ground Sample	--	--	--	--	--	--	27	--	7.67	--
<u>Sintering Technicians</u>										
Inverting Be Powder Drum, Dump and Clean Can	--	--	--	--	--	--	5.39	--	1.04	--

\*Data Supplied by U.S.A.E.C. Health and Safety Laboratory

TABLE XXII  
 REPRESENTATIVE AVERAGE BREATHING ZONE CONCENTRATIONS  
 FOR VARIOUS PLANT OPERATIONS\*  
 $\mu\text{g}/\text{m}^3$   
 PLANT B

Operation	1958	1958	1959	1960	1961	1962
<u>Beryl Furnace</u>						
Pour Beryl Furnace	15	2.2	30.7	3.3	0.9	--
Raise Frit Basket	--	--	4.7	0.2	1.8	--
<u>Sulfate Mill</u>						
Take Out Door, Put in Grate	11	24	--	12.5	4.1	1.6
Take Out Grate, Put in Door	--	--	15.9	28.1	--	--
<u>Thickener - Hydroxide</u>						
Change Discharge Drum	--	13	20.3	11.7	--	--
<u>Reduction Furnace</u>						
Charge Furnace	6.9	3.1	17.0	4.5	0.3	4.7
Change Drums in Charge Cart	23	--	106	8.1	1.6	10.8
Probe Melt	--	2.0	17.7	3.9	1.3	6.8
Pour Furnace	19	8.3	8.7	16.0	0.7	3.3
<u>Melts Crusher and Ball Mill</u>						
Put Steel Balls in Mill	--	2.7	3.1	2.3	1.6	--
Rotate Mill to Dump	--	--	4.9	2.1	1.8	--
<u>Pebble Inspection</u>						
Inspect Pebbles	--	--	11.3	3.0	0.5	--
Remove Discharge Drum	--	--	--	7.8	0.9	--
<u>Pebble Floatation</u>						
Rake Pebbles through Floatation	--	--	11.0	2.2	2.6	--
Remove Discharge Drum	--	--	--	15.7	7.5	--
<u>Vacuum Cast</u>						
Charge Furnace	--	6.0	7.5	5.0	2.7	22.4
Probe Melt	--	2.3	--	5.5	6.0	4.0
Pour Furnace	--	5.9	10.5	5.6	4.0	7.4
Remove Probe Rod Assembly	--	--	--	9.0	2.8	64.5
Remove Billet Mold, Install Dross Mold	--	--	7.3	7.8	--	--
Remove Dross Mold, Install Billet Mold	--	--	--	30.6	5.5	10.4

TABLE XXII  
PLANT B (continued)

Operation	1958	1958	1959	1960	1961	1962
<u>Sand Blast</u>						
Operate Sand Blast	--	4.0	8.6	11.3	1.8	3.8
Remove Billet from Sand Blast	--	8.0	24.7	27.5	--	--
<u>Chipping Lathe</u>						
Install Billet in Lathe	--	--	--	1.9	--	--
Change Chip Pick Up Drum	--	--	--	14.2	--	--
<u>Magnetic Chip Inspection</u>						
Vacuum Chips Out of Feed Drum	--	--	--	9.6	--	--
Inspect Chips	--	--	--	3.5	--	--
<u>Attrition Mill</u>						
Install Feed Drum	--	--	16.4	14.0	--	--
Change Discharge Drum	--	--	22.2	30.6	--	--
<u>Compact Load</u>						
Change Feed Drum on Transfer Unit	--	--	--	25.5	--	--
Change Receiving Drum on Transfer Unit	--	--	--	6.7	--	--
<u>Sinter Furnace</u>						
Load Die into Furnace	--	--	--	5.6	--	--
Put Lid on Furnace	--	--	--	2.1	--	--
<u>Degreaser And Dryer</u>						
Place Chips into Degreaser	--	--	--	5.5	--	--
<u>Chip Inspection</u>						
Inspect Chips	--	--	--	6.6	--	--
Remove Discharge Drum	--	--	--	13.5	--	--
<u>Magnetic Separator</u>						
Place Feed Drum into Dump Position	--	--	--	46.2	--	--
Remove Sample	--	--	--	33.5	--	--
Remove Discharge Drum	--	--	--	42.0	--	--
<u>Chip Crusher</u>						
Operate Crusher	--	--	--	21.3	--	--
<u>Laundry</u>						
Loading Dirty Outer Clothing into Washer	--	--	--	11.9	11.4	28.5
Loading Dirty Under Clothing into Washer	--	--	--	26.4	24.9	16.7

\*Data Supplied by U.S.A.E.C. Health and Safety Laboratory

TABLE XXIII  
 REPRESENTATIVE AVERAGE BREATHING ZONE CONCENTRATIONS  
 FOR VARIOUS PLANT OPERATIONS\*  
 $\mu\text{g}/\text{m}^3$

PLANT C

Operation	1957	1958	1958	1959	1959	1960	1961	1961
Holo-Flite Drum Change	4	79	13	Not Performed	80	5.2	-	-
Slurry Mixing	415	4000	22	7.5	15	9.5	8.4	2.2
Clean Sparkler Filter	1	22	13	10.6	6.3	3.1	5.4	-
Burwell Filter Press Breakdown	61	2600	29	17	12	28.3	3.1	14
Calciner Discharge	-	1500	155	Discontinued	-	-	-	-
Charge Ribbon Blender - Oxide	8.5	5800	14	Discontinued	-	-	-	-
Charge Blender - Bifluoride	-	-	13	-	-	-	-	-
Charge Slurry Tank - Bifluoride	-	-	-	5	23	5.1	0.8	-
Ribbon Blender Discharge	-	220	30	Discontinued	-	-	-	-
Fluoride Furnace Feed	7.3	4200	330	Automatic	-	-	-	-
Reduction Furnace Charge	40	1050	10	24	2.4	18.2	13	17
Reduction Furnace Pour	3.7	58	20	22	15	57.3	30	9.6
Reduction Furnace (Puddle Melt) Stir	3.6	-	9.3	18	16	-	-	-
Reduction Furnace Discharge Drum Change	125	180	38	48	27	12.3	45	-
Break Melt - Air Hammer	1	1550	8.5	11	5.7	15	8.8	-
Prepare Reduction Furnace Charge	930	-	1100	-	-	-	-	-
Patterson Mill Charge	2	1550	12	8	6.8	4.7	-	-
Prepare Patterson Mill Charge	-	-	27	110	103	3.4	-	-
Flotation Separation	-	12	5.9	1.2	2.3	3.7	1.3	14
Pebble Separation	11	58	1.8	28	31	2.4	23	11
Vacuum Furnace - Open and Clean	-	-	22	72	14	1.3	3.4	7.2
Remove Billet from Furnace	-	-	550	-	-	-	-	10
Remove Billet from Mold	-	-	4900	2900	78	84.8	160	-
Grinding Billet	-	-	6	-	-	-	-	-
Crucible Cleanout	-	-	22	-	9.5	-	-	-
Laundry - Dump Work Clothes	-	-	82	12	8.9	-	5.9	4.1

TABLE XXIV  
 REPRESENTATIVE AVERAGE BREATHING ZONE CONCENTRATIONS  
 FOR VARIOUS PLANT OPERATIONS\*  
 $\mu\text{g}/\text{m}^3$

PLANT D

Operation	1952	1953	1955	1956	1957	1958	1959	1960
Operating Do-All Saws	4.0	1.1	1.5	.9	0.4			1.4
Operating Lathes	2.3	.4	2.4	5.8	1.2			
Operating Surface Grinder	5.3	.6	2.0	.8	1.1			
Operating Milling Machines	3.8	.9	7.2	.5	0.8			1.2
Engraving Be Pieces			2.0	.5				
Operating Chipping Lathe				1.1	0.7	8.5		
Changing Chip Drum				10.1				
Transferring Chips from Drum to Bottles	57		1660.	21.3	10.1	6.1	1.6	
Changing Bottles on Attrition Mill		1.8	14.4	6.1	4.4	12	15	
Loading Blender	11.7		9.5	32.3	1.7	2.4	17	
Transferring Blender to Rollers	20	.4	1400	5.5	5.1			
Placing Blender on Compact Loading Hood		2.0	110.	10.2	8.0	100		
Filling Sintering Dies	10.8	.8	7.0	31.4	4.2	10		
Loading Vertical Furnace		.3		1.5				
Unloading Vertical Furnace		.5	1.8	2.5				
Stripping Die in Decontami- nation Room	63	.3	81.	128.				
Unloading 12" Vacuum Furnace				37.1	0.8			
Dismantling and Cleaning Mold from 12" Furnace				3.3				
Machine Tools					1.2	1.6	0.6	
Be Oxide Powder Furnace Loading					2.8	3.8	4.7	
Stripping Be Oxide Furnace						8.0	2.0	

\*Data Supplied by U.S.A.E.C. Health and Safety Laboratory

TABLE XXV  
 REPRESENTATIVE AVERAGE BREATHING ZONE CONCENTRATIONS  
 FOR VARIOUS PLANT OPERATIONS\*  
 $\mu\text{g}/\text{m}^3$

PLANT E

Operation	1961
<u>Ore Hauler</u>	
Cutting burlap bags and dumping ore into crusher	160
<u>Ore Mill Operator</u>	
Taking specific gravity reading at ore mill	15
Cleaning screen at ore mill	4.8
<u>Ore Weigher</u>	
Weighing barrel of ore from drum dryer and removing to storage area	27
<u>Weigh-Up Man</u>	
Weighing up mix	21
<u>Simpson Mixer Operator</u>	
Charging Simpson mixer	17
Discharging Simpson mixer	76
<u>Lancaster Mixer Operator</u>	
Charging Lancaster mixer	85
Discharging Lancaster mixer into wheelbarrow and trans- porting to extruder	45

TABLE XXV

## PLANT E (Continued)

Operation	1961 Average
<u>Extruder Operator</u>	
Hoeing down mix into extruder	10
<u>Extruder Helper</u>	
Removing bricks from extuder to cart	9.2
Transporting cart to storage area	8.6
<u>Sinter Furnace Operator</u>	
Loading sinter car with briquettes	6.0
Broom sweeping in loading area	21
Tranferring sintered briquettes into crusher	66
<u>Leach Operator Helper</u>	
Opening and discharging Shriver press	660
Closing Shriver press	1800
Drumming press discharge	330
<u>Laundry Man</u>	
Placing wet clothes into washer	2.4
Transferring clothes from tub to weigh up scale	2.1
Transferring dirty socks from basket to net bag, then to washer	31

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory

TABLE XXVI

REPRESENTATIVE AVERAGE GENERAL AIR  
CONCENTRATIONS FOR VARIOUS PLANT AREAS\* $\mu\text{g}/\text{m}^3$ 

## PLANT A

Survey Year	1952	1953	1954	1955	1956	1957	1957
<u>Area</u>							
Beryl Furnace	-	1.1	0.6	-	-	2.0	0.1
Sulfate Mill	1.4	0.5	0.2	5.9	2.3	0.4	-
Heat Treat and Grind	3.0	1.0	0.4	5.8	1.5	2.6	-
Hydroxide	2.9	1.1	3.6	1.5	4.2	1.6	2.7
Leach Shop	2.8	2.8	1.1	2.2	2.7	1.7	-
Boiler	1.4	0.6	0.2	0.7	-	-	-
Boiler Office	3.4	0.2	0.4	0.5	-	-	-
Wet Metal	1.5	1.0	0.5	0.5	2.5	1.0	0.2
Control Laboratory	1.1	0.4	0.6	0.4	-	-	0.5
Inplant Maintenance	-	0.1	0.4	0.5	-	-	0.2
Electrical Shop	0.8	0.5	0.5	0.1	-	-	0.2
Steelroom	0.2	0.2	0.3	0.6	-	-	-
Laundry	0.3	0.5	1.2	0.3	-	-	0.4
Fluoride Furnace	-	0.5	1.0	0.5	3.6	0.7	1.5
Production Superintendent's Office	-	0.3	1.2	0.3	-	-	0.3
Sewing Room	1.7	0.07	0.6	0.4	-	-	0.2
Lunch Room	0.8	0.2	0.3	0.9	0.6	0.8	0.3
Locker Room	0.8	0.2	0.4	1.0	2.2	0.7	1.6
Machine Shop	0.2	0.5	0.3	0.5	2.9	-	-
Garage	0.1	-	0.1	0.3	-	-	0.03
Guard House	0.05	0.03	0.2	0.2	-	-	0.03
Process Development	0.15	0.09	2.0	1.4	-	-	10.2
Air Laboratory	0.1	0.2	0.3	1.0	-	-	2.2
Air Laboratory Office	0.98	-	0.4	0.6	-	-	-
Office Building	0.07	0.1	0.1	0.2	-	-	0.02



TABLE XXVI  
 PLANT A  
 (Continued)

Survey Year	1952	1953	1954	1955	1956	1957	1957
<u>Area</u>							
Maintenance Office	1.5	1.1	1.5	0.6	-	-	0.2
Sintering Area	-	-	-	-	-	1.4	-
High Frequency - Reduction Furnace	-	-	-	-	1.8	.62	0.8
Furnace Rebuild	-	0.7	0.7	-	0.3	4.7	6.1
Vacuum Casting Area	-	-	-	-	6.2	0.6	0.5
Flotation	1.7	0.9	1.2	-	0.9	1.1	0.4
Sand Blasting	-	-	-	-	1.3	0.7	0.5

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

TABLE XXVII

REPRESENTATIVE AVERAGE GENERAL AIR  
CONCENTRATIONS FOR VARIOUS PLANT AREAS \*  
 $\mu\text{g}/\text{m}^3$

## PLANT B

Area	1958	1958	1959	1960	1961	1962
Ore Storage	10.4	0.6	2.4	-	-	
Beryl Furnace	6.9	1.8	13.6	0.9	1.6	
Heat Treater & Grind	3.8	1.8	3.3	1.4	0.8	1.6
Hardinge Mill	19	1.0	-	-	-	
Sulfate Mill	2.7	29	4.4	1.7	0.9	2.1
Leach and Thickening	1.8	1.9	3.6	2.3	0.9	2.6
Hydroxide Control Panel	0.65	-	-	-	-	-
Hydroxide Area	1.6	1.4	1.6	2.4		2.6
Wet Metal Area - ground floor	1.7	0.6	4.0	1.9	1.0	1.1
-platform	25	-	-			
Salt Evaporator Platform	18	0.8	3.2	2.3	1.5	0.6
Salt Centrifuge Area	26	1.8	3.2			
Fluoride Furnace Platform	14	1.2	-	-		
Fluoride Furnace - ground floor	24	0.8	5.3	1.3	1.0	2.0
Patterson Mill Platform	6.2	-	5.8			
Reduction Furnace Platform	2.7	1.1	-	-		
Reduction Furnace Area	5.5	1.4	5.4	3.3	0.5	2.5
Maintenance Area	2.9	1.1	1.8			0.6
Chemical Storage Area	1.3	0.2				
Boiler Area	5.5	0.7	3.7	2.8	0.3	4.1
Maintenance Office	3.7	0.2				
Control Laboratory	0.7	-		0.5	3.5	2.0

TABLE XXVII

PLANT B  
(continued)

Area	1958	1958	1959	1960	1961	1962
Superintendent's Office	1.7	0.4				
Lunch Room	1.9	0.6	4.4	0.9	1.0	2.2
Locker Room	1.0	29		2.3	1.2	1.0
Shoe Change Room	16	-	28.9	1.9	9.8	25.2
Oxide Furnace Area	3.7	-				
Pebble Sorting	7.8	-	4.2	2.5	0.5	1.1
Laundry	0.5	0.2		0.6	1.4	1.2
Magnetic Separation Platform	6.2	1.4				
Vacuum Casting Furnace Area	9.1	1.1	4.1	2.4	1.3	2.5
Dispensary	2.7	-	-	2.2		
Furnace Rebuild		1.5	18.2	2.7	0.8	2.7
Chemical Laboratory		0.4	2.3			
Sandblast and Sample Drill			34.4	4.4	1.3	3.1
Attrition Mill			10.9	8.8		
Sintering Furnace			3.8	3.8		
Chipping Lathe Room			5.5	1.8		

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

TABLE XXVIII

REPRESENTATIVE AVERAGE GENERAL AIR  
CONCENTRATIONS FOR VARIOUS PLANT AREAS\*  
 $\mu\text{g}/\text{m}^3$

## PLANT C

Location	1957	1958	1958	1959	1959	1961	1961
Chemical Storage	0.2	11	3.4	-	-	-	-
Precipitation Area	0.6	4.3	3.7	1.4	0.6	-	-
Burwell Platform-Hydroxide Purification	3.3	9.1	8.0	1.8	2.7	3.4	2.0
Burwell Room	9.1	800	260	-	-	-	-
Fluoride Furnace Area	14	27	2.0	2.5	1.2	2.0	5.2
Reduction Furnace Area	1.6	13	2.5	9.0	1.3	2.5	3.0
Patterson Mill Area	1.3	21	4.7	1.0	2.0	-	-
Vacuum Furnace Area	-	-	4.5	2.1	2.7	1.3	4.5
Furnace Repair	-	-	11	4.0	2.0	2.2	2.5
Analytical Laboratory	0.2	24	0.8	2.5	1.0	0.3	1.6
Sample Grind Laboratory	-	3.7	2.0	0.3	0.4	-	-
Spectrographic Laboratory	5.8	8.2	0.5	8.3	1.1	-	-
Maintenance Area	0.5	0.7	0.3	2.8	3.6	1.3	1.1
Laundry	0.4	3.2	0.7	0.6	1.4	0.5	0.5
Change Room-Work Dress	0.7	0.3	0.7	2.1	1.9	4.3	3.3
Lunch Room	1.0	0.7	0.8	2.0	2.5	3.6	3.5
Electricians Shop	-	-	0.4	4.0	-	-	-
Plant Corridors	-	-	3.1	0.7	-	-	-
Calcine Furnace Area	1.9	13	2.1	1.7	-	-	-
Motor Generator Room	1.7	2.2	6.6	0.3	0.5	0.5	-
Boiler Room	0.1	0.7	0.2	1.4	0.1	0.2	-
Warehouse	0.4	-	0.2	1.8	-	-	-
Spent Salt Area	0.6	-	7.8	1.9	2.0	2.4	2.1
Ore Handling thru Leaching	0.8	10	2.4	-	-	-	-

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

TABLE XXIX

 REPRESENTATIVE AVERAGE GENERAL AIR  
 CONCENTRATIONS FOR VARIOUS PLANT AREAS\*  
 $\mu\text{g}/\text{m}^3$ 

## PLANT D

Area	1952	1952	1953	1955	1956	1957	1958	1959	1960
Machine Shop	0.3	1.0	0.1	1.8	10.5	0.4	0.7	0.2	1.1
Jig Bore Room	-	-	-	-	-	0.2	-	-	-
Precision Parts Room	-	-	-	-	-	0.3	0.2	0.3	-
Chipping Lathe Room	-	-	-	-	-	0.7	3.8	-	-
Machine Shop Office	-	-	0.2	0.1	0.2	0.1	-	0.8	0.07
Guard Office	-	-	0.1	0.3	0.1	0.1	0.3	-	-
Shipping & Receiving	-	-	0.2	0.4	0.4	0.3	0.2	0.4	-
Inspection Room	-	-	-	0.6	0.5	0.1	0.2	0.3	0.1
Lunch Room	0.2	1.5	0.3	0.5	1.0	0.3	0.4	0.5	0.4
Locker Room	0.3	0.9	0.2	2.8	1.3	0.7	0.8	0.4	0.08
Attrition Mills	0.4	1.0	0.2	1.0	0.7	0.6	9.0	2.2	-
Vapor Blast Area	-	-	-	-	-	0.1	-	-	-
Powder Room Laboratory	-	-	-	0.7	0.8	0.1	2.0	4.5	-
Compact Filling Room	-	-	-	-	-	0.7	1.0	1.8	-
Sintering Furnace Area	0.3	0.3	0.2	0.3	0.3	0.4	2.1	1.1	-
Powder Blender	-	-	-	1.5	0.2	0.1	-	-	-
Chemistry Office	-	-	-	-	-	0.1	-	-	-
Chemistry Laboratory	-	-	0.1	0.1	0.1	0.2	0.2	0.3	0.06
Powder Laboratory	-	-	-	0.7	0.8	0.1	-	0.3	-
Metallurgical Laboratory	-	-	-	1.1	2.5	0.7	0.3	0.3	-
Administrative Offices	0.02	0.2	0.2	0.2	0.1	0.3	0.2	-	0.02
Ceramics Laboratory	-	-	-	0.2	0.4	0.9	2.6	0.4	0.8
Electrical Shop	-	-	0.1	0.1	0.0	0.2	-	-	-
Sintering Area Office	-	-	-	0.3	31.8	0.2	-	-	-
Alpine Classifier	-	-	-	-	-	31	-	-	-

\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

TABLE XXX

REPRESENTATIVE AVERAGE GENERAL AIR  
CONCENTRATIONS FOR VARIOUS PLANT AREAS\*  
 $\mu\text{g}/\text{m}^3$ 

## PLANT E

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Area	1961
Ore Mill Area	3.2
Wet Mill Area	14
Mixing Platform	7.3
Extruding Area	3.2
Sinter Furnace Area	14
Leach Platform	32
Precipitation Tank Area	10
Shriver Press Area	38
Laundry Room	1.8
Oxide Control Laboratory	3.7
Oxide Foreman's Office	10
Lunch Room	4.4
Locker Room Area	12

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\*Data supplied by U.S.A.E.C. Health and Safety Laboratory.

**FIGURE 1**  
**JOB ANALYSIS SHEET\***

OPERATOR Vacuum Furnace Operator      1 MEN/SHIFT: 3      SHIFTS/DAY: 3      MEN/DAY

Operation or Operating Area	Time Per Opera. (Min.)	Opera. Per Shift	Time Per Shift (Min) (T)	No. of Samples	Concentration $\mu\text{g}/\text{M}^3$ (C)			Avg. Conc'n.* Times Total Time (T X C)
					Low	High	Avg.	
BZ Cleaning and removing billet from furnace	13	3	39	4	7.6	22	15	590
BZ Weighing furnace charge	6	3	18	4	3.5	12	6	110
BZ Charging furnace	2	3	6	5	4	37	19	110
GA Vacuum furnace area			351	11	0.6	4.1	1.7	600
GA Spent salt area			45	9	0.3	2.2	0.9	41
GA Lunch room			30	4	0.2	0.5	0.4	12
GA Locker room, before shift			10	5	0.2	0.6	0.4	4
GA Locker room, after shift			15	5	1.5	4.8	2.7	41

\*Adjusted to two significant figures.

$$\frac{\Sigma(\text{T X C})}{\Sigma(\text{T})} = \underline{2.9}$$

$$\Sigma \text{T} \frac{510}{\mu\text{g}/\text{M}^3} =$$

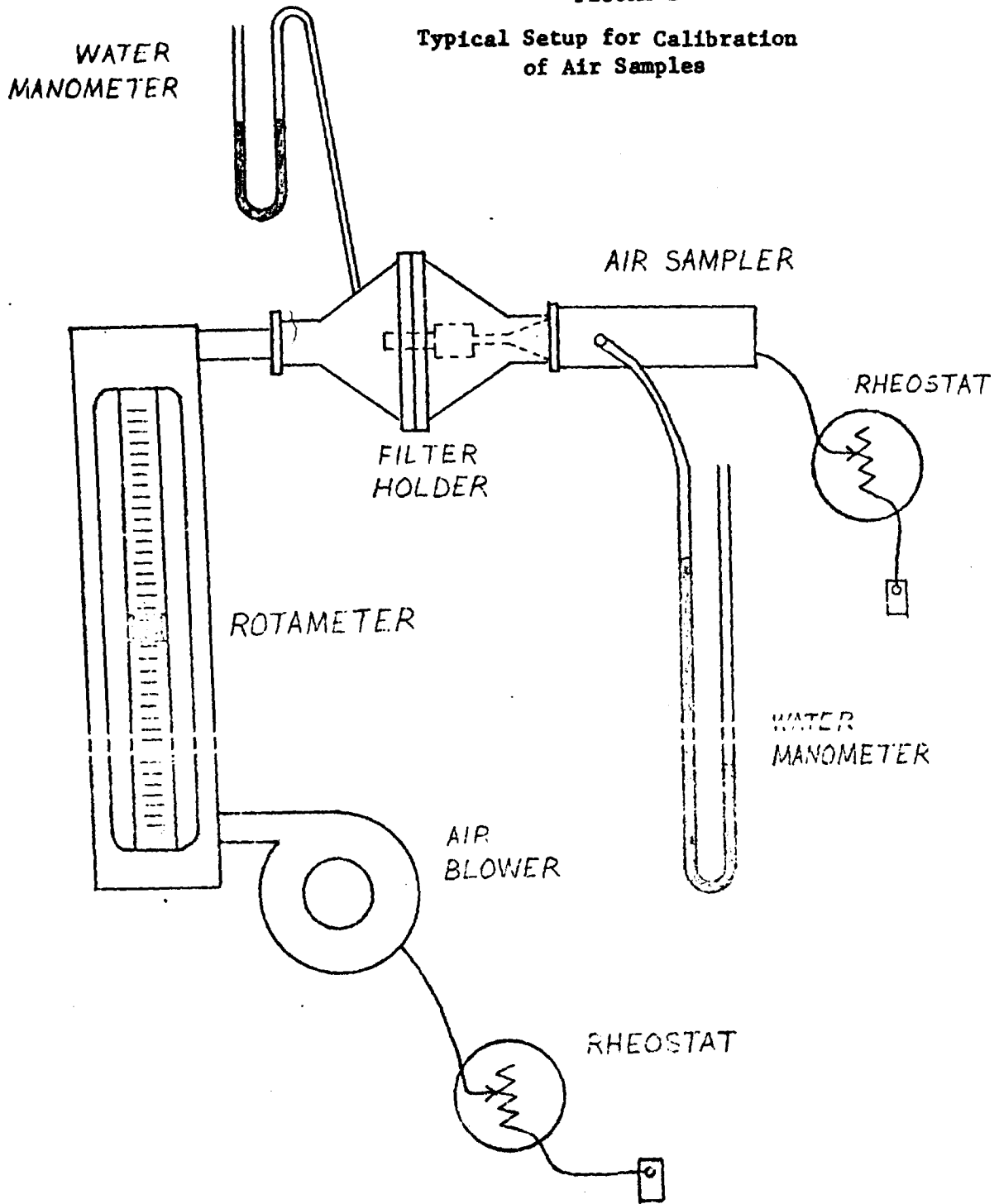
$$\Sigma(\text{T X C}) \frac{1500}{\text{Times the Maximum}}$$

Allowable Concentration

\*Courtesy U.S.A.E.C. Health and Safety Laboratory.

FIGURE 2

Typical Setup for Calibration  
of Air Samples





72-10268