U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 75-87-280

Kawecki Berylco Industries, Inc.
Reading, PA

APRIL 1976

File
75-87-280
(final report #280)
Thanks!
Zinc

I. TOXICITY DETERMINATION

It has been determined that employees in the Foundry, Arc, Scrap Remelt, Calcine, Detroit and R&D Atomizing areas are exposed to toxic concentrations of beryllium dust. This determination is based on the evaluation of the work place atmosphere by NIOSH industrial hygienists on August 19-22, 28-29, 1975, and October 30, 1975.

On October 7-9, 1975, NIOSH physicians visited the plant to examine the medical files of 153 randomly selected individuals.

The following table summarizes the results of the analysis of the medical records of this cohort plus the additional records analyzed.

Diagnostic Category	Number
Beryllium Dermatitis	1
Acute Beryllium Pneumonitis	1
Chronic Beryllium Pulmonary Disease	9

In view of the continued development and diagnosis of beryllium-induced disease which reflects past exposure to beryllium and the results of the current NIOSH industrial hygiene survey (Table I) which shows that in almost every location there were one or more samples which exceeded the recommended TWA of 2.0 ug/M^3 and several which exceeded the ceiling limit of 25 ug/M^3, cases of berylliosis can be expected to occur.

Based on the data of the medical and environmental investigations, it is concluded that a definite toxic exposure situation exists at the Reading Plant of Kawecki Berylco Industries.

Although physical agents are outside the scope of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, it is NIOSH policy that where health hazards are observed in workplaces under investigation, specific mention of such be incorporated and reported. Excessive noise levels were measured in the Detroit room. These levels could result in a noise-induced hearing loss among the work force. This determination is based on the measurement of sound levels in excess of the recommended OSHA standards designed to prevent hearing loss and those proposed in the NIOSH Criteria Document on Noise.

Tables of our findings and recommendations have been offered in the body of the report for control of environmental exposure of employees to the potentially toxic substances and for medical surveillance of exposed employees.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Copies have been sent to:

a) Kawecki Berylco Industries, Inc.
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region III
d) NIOSH - Region III
e) Dr. N. L. Sprince, Beryllium Case Registry, Massachusetts General Hospital

For purposes of informing the approximately 350 "affected employees," the employer will promptly "post" the Determination Report in a prominent place(s) near where affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S. Code 669(a)(6) authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found. The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees,

United Steel Workers of America, AFL-CIO, Local 2317. The Health Hazard Evaluation request form states that employees at the Reading Plant of Kawecki Berylco Industries, Inc. (hereafter to be referred to as KBI) are exposed to hazardous concentrations of beryllium in the workplace and that employees have developed beryllium lung disease.

IV. EVALUATION DESIGN

On June 24, 1975, Walter J. Chrostek, NIOSH Industrial Hygienist, conducted an initial walk-through survey of the plant and non-directed medical questionnaires were administered. The result of this visit indicated that a comprehensive environmental-medical evaluation was necessary. Environmental evaluation was carried out on August 19-22 and 28-29, 1975. At the request of KBI, following some engineering modifications, a re-evaluation of the Arc room operations was conducted on October 30, 1975.

On October 7-9, 1975, NIOSH physicians, Robert Rostand and Loren Hatch, visited the plant to examine the medical files of certain randomly selected individuals.

V. HEALTH HAZARD EVALUATION

a) Description of Process - Conditions of Use

The Reading Plant of KBI manufactures beryllium alloy tools, wire, rods, and strips. Beryllium hydroxide is purchased, calcined, alloyed at approximately 2300°F with other metals, mostly copper or aluminum, and cast into slugs or billets. These slugs are then used as needed to cast other alloys or sold as is. The alloys are then rolled or drawn to the proper size and thickness and tempered. Following this processing, the material is taken to the acid pickling room and the cleaning room.

There is a foundry on the premises. Here the alloys are cast into the desired configuration. From here the material goes to the machine shop for final processing.

Scrap alloy is bought from customers and reprocessed. In the Detroit furnace room, alloy metal is recovered from the dross.

b) Employee Profile

KBI employs at the Reading Plant 447 personnel. Approximately 350 employees are involved in production. A random sample

of 157 active employees reveals that the mean (± SD) length of employment with KBI is 13.22 ± 11.08 years with a range from 1 to 34 years. Almost two-thirds (65%) of this cohort have been employed for five or more years reflecting the rather stable employee population at this plant. Almost all production employees are males. Labor-management relations are judged by both sides as good. The plant operates three shifts per day with most personnel on the 8:00 a.m. to 4:00 p.m. work shift.

c) Health Capabilities

A small dispensary and clinic is located on the premises of the Reading Plant. A full-time nurse is on duty daily and a physician spends three days per week at the Reading Plant. A pre-placement history and physical examination are given each employee. Annual chest radiographs are offered to each employee. A special examination emphasizing weight, vital capacity, cough, sore throat, shortness of breath, and skin rash is given weekly to each new employee for two months, once a month for several months, and once yearly thereafter. A termination examination is offered to each employee. All supervisors are trained in first aid.

Local exhaust ventilation is supplied at all operations where dust and fumes are generated. The plating room has ceiling fans. The company has plans for altering the scrap reclaimation operation but no changes have been made to date. Personal respiratory protection is NIOSH certified and utilized by the employees. Goggles, face masks, safety glasses, and hearing protection are supplied to employees. Work clothes are provided to employees and showers and a clothing change are required before leaving the plant.

VI. EVALUATION METHODS

a) Environmental

Metals

Employee exposure to airborne metallic contaminants were evaluated using mixed cellulose ester filters and personal sampling pumps. The air sampling rate was approximately 1.5 liters per minute. General air samples were collected using the above filters at a rate of 9.0 liters per minute. These samples were subsequently analyzed for beryllium by atomic absorption as outlined in NIOSH (P&CAM 121) method.[1] An analysis for copper, nickel, and titanium also was made by the atomic absorption method.

Dust

Employee exposure to airborne quartz containing dust was assessed in the foundry area. Air samples were collected and subsequently analyzed gravimetrically for total dust and a bulk sample was analyzed by x-ray defraction for quartz content.

Noise

Area noise levels were measured utilizing a General Radio sound level meter, and one operator's exposure was evaluated utilizing a DuPont audio dosimeter.

b) Medical

The medical investigation at KBI's Reading Plant consisted of a thorough inspection of the plant and the various operations involved in the manufacture of beryllium alloys. In addition, an extensive review of a random sample of medical records containing the employee's pre-placement history, physical and pulmonary function tests, as well as subsequent yearly examinations, chest x-ray reports, and pulmonary function tests was conducted.

The random sample was derived from the most current union seniority list (May 1975) of active employees and the current list of retirees. Each person on these lists was assigned a number from 1001 to 1491. The numbers selected for this cohort were derived from the Table of Random Numbers contained in E. Vernon Lewis's Statistical Analysis, Princeton, NJ, D. VanNostrand, 1963.

VII. EVALUATION CRITERIA

a) Environmental

The occupational health standards relevant to substances of this evaluation as promulgated by the U.S. Department of Labor (Federal Register, Volume 39, June 27, 1974, pages 23541 and 23542) are:

Substance	8-Hour Time Weighted Average
Beryllium	.002 mg/M^3* or (2 ugM^3)
Copper Fume	0.1 mg/M^3
Copper Dust	1.0 mg/M^3
Silica (Quartz) Total Dust	$\frac{30 \text{ mg/M}^3}{\% \ S_1O_2+2}$
Titanium Dioxide	10 mg/M^3
Nickel	1 mg/M^3

*Approximate milligram of substance per cubic meter of air sampled.

Recently, the U.S. Department of Labor (Federal Register, Volume 40, No. 202, October 17, 1975) has proposed that limits should be lowered to 1.0 ug of beryllium per cubic meter of air, based upon a 40-hour working week and 5 micrograms of beryllium per cubic meter as a ceiling limit. The American Conference of Governmental Industrial Hygiene[3] has listed beryllium as an occupational substance suspect of oncogenic potential for exposed workers.

The American Conference of Governmental Industrial Hygienists has classified titanium dioxide as an inert dust with a permissible level of 10 milligrams per cubic meter of air.

Noise

The Occupational Health Standard relevant to this evaluation as promulgated by the U.S. Department of Labor (Federal Register, June 27, 1974, page 23597) is:

Table G-16, "Permissible Noise Exposures"

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

"When the daily noise exposure is composed of two or more periods of exposure to different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C1/T1+C2/T2+Cn/Tn exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure permitted at that level."

b) Medical

Beryllium is a rare element that was discovered in 1797. The principal source of beryllium is beryl ore which yields about 12% beryllium oxide and 4% of the metal.

Beryllium is a metal that is in demand because of its lightness and tensile strength. At the present time, its main uses are in nuclear physics, in the aerospace program, as a "window" in x-ray tubes, and in the production of sparkless tools.

Beryllium is highly toxic and leads to a lung condition known as berylliosis. The metal may be absorbed either through the lungs or the skin. The metal is not absorbed to any extent by the gastrointestinal tract. Once in the body, beryllium combines with proteins and is deposited in the liver, spleen, and lungs. A small residue remains in the lungs. Beryllium persists in the body long after it has been entirely excreted by the lungs.

1) Effects on Skin

The skin is often affected by beryllium. A variety of rashes may develop after an "incubation" period of about 10-14 days. Accidental implantation of a metal sliver in the skin may produce a "beryllium ulcer," which may be chronic. The more soluble salts are most likely to produce cutaneous sensitization if the skin is intact. Beryllium fluoride is the most potent beryllium containing skin sensitizing agent, followed by beryllium chloride and sulfate.

2) Acute Berylliosis

It has been postulated that exposure to concentrations of beryllium 25 ug/M^3 or more is sufficient to produce acute berylliosis. The acute syndrome affects the nasopharynx, trachea, bronchi, and lung tissue. The mucous membranes of the upper respiratory tract are swollen and hyperermic. Tracheitis and bronchitis may lead to a dry, nonproductive cough. If exposure to beryllium is severe and intense, an acute chemical pneumonia characterized by malaise, dyspnea, cough, cyanosis, rales, and rhonchi may develop. Most of the changes in acute beryllium pneumonitis resolve completely within one to four weeks, but in approximately 10% of affected subjects chronic beryllium disease develops.

3) Chronic Pulmonary Berylliosis

Chronic beryllium disease is a systemic granulomatous disease which notably affects the lung. The disease was first described in 1946. Most of the early reports involved workers engaged in the manufacture of flourescent

strip lightening. With varied uses of beryllium and several beryllium extracting plants in the United States, cases of berylliosis are still occurring and are likely to continue to do so. The disease has been reported to occur in individuals either living in close proximity to beryllium handling plants (generally within one mile) or having some direct contact, sometimes unknowingly, with beryllium, such as by inhaling beryllium dust from contaminated work clothes. In many instances there is a latent period of 10 to 15 years following exposure before the disease appears.

The clinical features of chronic beryllium disease include: shortness of breath, cough, weight loss, fatigue, generalized lymphadenopathy, hilar lymphadenopathy, granulomatous skin lesions, hepatosplemomegaly, salivary gland enlargement, renal stones. Many of the clinical findings of chronic beryllium disease are also found in sarcoidosis. However, certain features are more common in sarcoidosis: memingitis, peripheral neuropathy, myocardial involvement, and uveitis. Remission is also more common in sarcoidosis. As the disease progresses, the patient becomes increasingly dyspneic and cyanotic. Gradually cor pulmonale develops with right ventricular hypertrophy and heart failure. Progression of the disease is slow and a survival time of 15 to 20 years is relatively frequent.

The radiographic features and pulmonary function abnormalities of berylliosis are nonspecific. In some instances, the radiographic changes may precede the development of symptoms by several years. Both lung fields are commonly affected. Hilar adenopathy is a frequent finding and may be the only radiographic abnormality found. The pulmonary function abnormalities found in patients with chronic beryllium disease may be divided into three patterns: an interstitial, obstructive, and restrictive pattern. In general, the course of beryllium lung disease is more disabling in the patients with obstructive and restrictive defects. Pulmonary function tests are of value in identifying the type of physiologic impairment which is an important determinant of progress of the disease.[4,5]

A cutaneous patch test for berylliosis was first discovered in 1951 and is positive not invariably in chronic berylliosis. The test is negative in sarcoidosis. Tissue biopsy and spectrographic analysis of the biopsy specimens for beryllium are singularly unhelpful since most workers who have been exposed to beryllium for any appreciable time will be found to have beryllium present in their bodies. The

severity of chronic beryllium disease is unrelated to the beryllium content of the tissues. Also, a lung biopsy specimen may have a normal beryllium content when there is excellent circumstantial evidence to suggest the diagnosis of berylliosis.[6]

On the basis of many experiments, beryllium is a carcinogen capable of inducing osteogenic sarcomata and lung tumors in experimental animals.[7,8] Whether or not employees exposed to beryllium are at a greater risk than the average person for developing lung cancer, this question cannot at the present be definitely answered. It is NIOSH's current position (based on the consistent animal data) that beryllium is a human carcinogen.

VIII. RESULTS

a) Environmental

Sixty-six (66) personal and general air samples were collected and analyzed for beryllium and copper. Sampling time duration was approximately 400 minutes. The air concentrations for beryllium ranged from non-detected (N.D.) to 195.4 micrograms per cubic meter of air. (See Tables I and IIA.) The highest air concentrations were found in the Arc room.

It was not possible to differentiate between copper fume and dust at most of the operations. Air concentrations ranged from (N.D.) to 0.67 miligram per cubic meter of air sampled. (See Tables II and IIA.)

Nine (9) air samples were analyzed for nickel. All concentrations were less than the lower limit of detection which was 0.001 milligram per sample.

Four (4) air samples were collected and analyzed for titanium. Concentrations ranged from none detectable (N.D.) (lower limit of detection was 0.005 milligram per sample) to 0.393 milligram per cubic meter of air.

Two employee exposures to quartz-containing dust were evaluated. The quartz content of the two bulk samples of the sand averaged 17 percent. Utilizing the formula

$$\text{Quartz (total dust)} + \frac{30 \text{ mg}}{\% \text{ quartz} + 2},$$

the OSHA permissible dust level would be 1.58 milligrams per cubic meter of air sampled. The two samples collected were 0.52 and 0.89 milligrams per cubic meter of air samples. This is below the permissible limit.

Noise levels measured in the Detroit room at the furnace were 105-107 dBA. The OSHA permissible noise exposure time for noise of this intensity would be one hour duration per day. Exposure to noise was evaluated utilizing a personal dosimeter. A read-out of the memory cell showed that the employee would have been exposed to 137 percent exposure. This would be 37 percent over the permissible level. The company has an ear protection program in this area.

b) Medical

A total of 165 personal medical records were selected and, of these, 153 records were reviewed by the medical team. Nine persons currently retired are included in the cohort. In addition, but not included in the cohort, the records of those persons known to have chronic berylliosis - nine (9) in number - and the records of twenty-one (21) retirees randomly selected from the retiree list were also reviewed. All subjects studied were men and had worked on the average 13.6 years (range 1-35 years). From this cohort, one person had a documented episode of acute beryllium disease; one had a case of suspected beryllium dermatitis; and one person currently employed carries the diagnosis of chronic pulmonary beryllium disease. Two persons had equivocal medical records. Thus, there are nine persons who fulfill the criteria used by the Beryllium Case Registry for diagnosing beryllium disease.[3] Communication with the Case Registry reveals that only two of these nine persons are included in the Registry. A review of the 21 records from the list of retirees reveals no suspected cases of beryllium disease. However, due to the latency of onset of the disease, one cannot rule out that the disease will not appear.

IX. CONCLUSIONS

Based upon data obtained in the NIOSH environmental and medical investigations, it is concluded that a definite health hazard exists to workers exposed to beryllium at the Reading Plant of Kawecki Berylco. (See summary statement - Section I - Toxicity Determination.)

X. DISCUSSION AND RECOMMENDATIONS

In view of the known toxic effects of beryllium and NIOSH's position regarding beryllium as a carcinogen, it is of paramount importance that engineering controls and ventilation be implemented and/or improved so that the employee exposure to beryllium will be reduced to below the current TWA of 2.0 ug/M^3. All unnecessary beryllium exposure must be avoided. Dust control is of paramount importance so that the generation of fumes and dust is kept to a minimum. Respiratory protection equipment should be worn until the concentration of beryllium in the ambient air is below the OSHA standard. Periodic environmental sampling should be carried out until air concentrations are below the standard of 2.0 ug/M^3. Also, controls should consider the newly proposed OSHA standard of 1 ug/M^3.

During the environmental evaluation, there were some malfunctions in the Arc room requiring engineering changes. In other areas where engineering controls existed, they were inadequate, considering the toxicity of the contaminant.

In particular the following environmental recommendations in addition to those of general scope above should be addressed.

1. Re-evaluate all local exhaust systems to determine if they are operating at maximum efficiency. With the amount of ventilation present, tempered make-up air may be necessary in certain areas.

2. Install local exhaust ventilation on the scrap remelt furnace.

3. Continue the program of requiring the use of NIOSH approved personal respiratory protective equipment in areas where exposure is not controlled, e.g., Detroit room, scrap reclaimation area, etc.

4. Establish a periodic maintenance program for all local exhaust ventilation systems.

5. Utilize vacuum or wet methods when cleaning operations are performed.

6. When redesigning the Detroit furnace room, noise levels should be considered.

7. Continue the periodic atmospheric sampling program until the contaminant is reduced to acceptable levels.

XI. REFERENCES

1. NIOSH Manual of Analytical Methods.

2. Federal Register, Vol. 39, No. 125, Subpart G, June 27, 1974.

3. American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances in the Work Environment."

4. F. M. Hasan and H. Kazemi. Chronic Beryllium Disease: A Continuing Epidemiologic Hazard. Chest, 65:289 (1974).

5. J. A. Andrews, H. Kazemi, and H. L. Hardy. Patterns of Lung Dysfunction in Chronic Beryllium Disease, Am. Rev. Resp. Dis. 100,791 (1969).

6. W. K. C. Morgan and A. Seaton. Occupational Lung Disease. Philadelphia: W. B. Saunders Co., 1975, pp. 223-231.

7. L. B. Tepper, H. L. Hardy, and R. I. Chamberlin. Toxicity of Beryllium Compounds. New York: Elsevier Publishing Company, 1961, pp. 124-129.

8. P. F. Infante, J. K. Wagoner, and D. L. Bayliss. Evidence for the Carcinogenicity of Beryllium. Proceedings of the International Conference on Heavy Metals in the Environment, Toronto, Canada. October 30, 1975. In Press.

XII. AUTHORSHIP AND ACKNOWLEDGEMENT

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Table I
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Report No. 75-87
Beryllium Air Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration* ug/m^3	Remarks
Foundry Area			
Molder	6:47-13:25	N.D.	Oper. Exposure
Floor Man	6:50-13:22	1.00	Oper. Exposure
Finish Grinder	6:50-13:27	0.69	Oper. B. Z.
Crew Chief	6:55-13:27	5.46	Oper. B. Z. & Exposure
Furnace Operator	6:55-13:26	19.76	Oper. B. Z. & Exposure
Shaw Press	6:59-13:30	0.61	Oper. Exp.
Cut-Off, Swing Grinder	6:10-11:31	15.56	Oper. B. Z.
General Area Air	7:17-13:31	0.31	
Scrap Remelt Area			
Scrap Remelter	7:00-13:20	4.49	Oper. B. Z. & Exposure
Dross Grinder	7:01-13:29	6.95	Oper. B. Z. & Exposure
Grinding-Bagging	7:02-13:29	1.15	Oper. B. Z. & Exposure
General Area Air-Remelt	7:12-13:32	0.38	
Melt & Cast Area			
Furnace Operator	8:21-15:26	0.69	Oper. Exposure
Pan Man Helper	8:22-15:31	2.12	Oper. B. Z.
Crane Operator	8:24-15:28	0.93	Oper. Exposure
Saw Cutter	8:25-15:26	N.D.	Oper. Exposure
Furnace Repairman	8:26-15:32	N.D.	Oper. B. Z.
Crew Leader	8:28-15:31	0.52	Oper. Exposure
Heater-Weigher	8:31-15:39	N.D.	Oper. Exposure
Furnace Helper	8:35-15:32	0.79	Oper. Exposure
General Area Air	8:37-15:37	0.52	Oper. Exposure

Table I (Cont.)
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Beryllium Air Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration* ug/m^3	Remarks
Arc Room			
Mixer	8:07-15:27	30.37	Oper. B. Z.
Assistant Operator	8:08-15:31	28.29	Oper. B. Z.
Helper	8:10-15:30	40.80	Oper. B. Z.
Operator	8:12-15:30	195.40	Oper. B. Z.
General Area Air	8:20-15:28	4.08	
	Metal	5.6 mg/gram of sample	
Tap Hole Mix	Dust	4.9 mg/gram of sample	
Calcine Room			
Operator	8:14-15:25	6.84	Oper. B. Z.
Rod-Wire			
Grinder	8:24-15:18	1.78	Oper. B. Z.
Inspection	8:30-15:15	1.46	Oper, Exposure
Rolling Mill			
Conditioning	8:37-15:43	N.D.	Oper, Exposure
Operator	8:38-15:41	N.D.	Oper. Exposure
Assistant Operator	8:41-15:44	1.43	Oper, Exposure
Tool Grinder		N.D.	Oper, Exposure
Foundry (Be-Al heat and button casting)			
Operator	8:20-13:26	25.06	Oper, Exposure
Helper	8:18-13:27	3.33	Oper, Exposure
Rod & Wire			
V. Block	8:24-15:30	N.D.	Oper, Exposure
Tandem Mill	8:25-15:30	N.D.	Oper. Exposure
Cold Roll	8:42-15:25	N.D.	Oper. Exposure
Strand Annealing	8:39-15:32	N.D.	Oper. Exposure
Welder, Maintenance	8:31-15:33	3.82	Oper. Exposure
Slitter	8:40-15:27	N.D.	Oper. Exposure

Table I (Cont.)
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Job Description	Time	Concentration* ug/m^3	Remarks
Detroit Room			
Helper	8:09-14:55	6.57	Oper. B. Z.
Operator	8:11-14:54	13.69	Oper. B. Z.
Helper	8:13-14:55	36.56	Oper. B. Z.
Research & Development			
Powder Room	3:31-15:59	1.60	Oper. B. Z.
Powder Room	8:33-15:56	1.33	Oper. B. Z.
Furnace	8:36-15:58	1.37	Oper. Exposure
Genral Work	8:37-15:56	0.84	Oper. Exposure
Grinding	8:38-15:56	N.D.	Oper. Exposure
General Work	8:39-15:58	N.D.	Oper. Exposure
General Work	8:40-15:54	N.D.	Oper. Exposure
General Work	8:42-15:57	0.31	Oper. Exposure
Powder Room	8:43-15:55	1.98	Oper. Exposure
General Work	8:46-15:55	N.D.	Oper. Exposure
General Work	9:12-15:57	N.D.	Oper. Exposure
Specialty Machine Shop			
Sawing	8:00-13:40	1.37	Oper. Exposure
Lathing	8:02-13:41	1.08	Oper. Exposure
Laundry	8:05-14:05	N.D.	Oper. Exposure
Hydro Press Cleaner	8:10-14:00	N.D.	Oper. Exposure
Hydro Press Scrap	8:14-14:04	N.D.	Oper. Exposure
R & D Atomozing			
General Area Sample	8:50-13:53	N.D.	
Technician	8:54-13:52	11.36	Oper. Exposure

Table I (Cont.)
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Job Description	Time	Concentration* ug/m^3	Remarks
Detroit Room			
Helper	8:09-14:55	6.57	Oper. B. Z.
Operator	8:11-14:54	13.69	Oper. B. Z.
Helper	8:13-14:55	36.56	Oper. B. Z.
Research & Development			
Powder Room	3:31-15:59	1.60	Oper. B. Z.
Powder Room	8:33-15:56	1.33	Oper. B. Z.
Furnace	8:36-15:58	1.37	Oper. Exposure
Genral Work	8:37-15:56	0.84	Oper. Exposure
Grinding	8:38-15:56	N.D.	Oper. Exposure
General Work	8:39-15:58	N.D.	Oper. Exposure
General Work	8:40-15:54	N.D.	Oper. Exposure
General Work	8:42-15:57	0.31	Oper. Exposure
Powder Room	8:43-15:55	1.98	Oper. Exposure
General Work	8:46-15:55	N.D.	Oper. Exposure
General Work	9:12-15:57	N.D.	Oper. Exposure
Specialty Machine Shop			
Sawing	8:00-13:40	1.37	Oper. Exposure
Lathing	8:02-13:41	1.08	Oper. Exposure
Laundry	8:05-14:05	N.D.	Oper. Exposure
Hydro Press Cleaner	8:10-14:00	N.D.	Oper. Exposure
Hydro Press Scrap	8:14-14:04	N.D.	Oper. Exposure
R & D Atomozing			
General Area Sample	8:50-13:53	N.D.	
Technician	8:54-13:52	11.36	Oper. Exposure

Table I (Cont.)
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Beryllium Air Concentrations
August 19-22 and 28-29, 1975

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*ug/m^3 -denotes microgram of substance per cubic meter of air sampled.
**TWA -denotes Time Weighted Average based on an 8-hour working day.
Oper. Exposure -denotes operator's exposure
Oper. B. Z. -denotes operator's breathing zone
Where the term Oper. B. Z. and Exposure is used, the operator only wore the respirator when an operation was being performed, otherwise he wore no respirator while in the area.

Table IA
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Report No. 75-87
Beryllium Air Concentrations
October 30, 1975

Job Description	Time	Concentration ug/m^3	Remarks
Arc Room			
Mixer	11:50-15:37	5.28	Oper. B. Z.
Assistant Operator	8:15-15:36	15.41	Oper. B. Z.
Operator	8:11-15:37	144.51	Oper. B. Z.
Helper	8:13-15:36	43.72	Oper. B. Z.
General Area Air	8:19-15:33	1.54	Oper. Station
Calcine Operator	13:35-15:35	10.00	Oper. B. Z.

Table II
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Report No. 75-87
Copper Dust and Fumes Air Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration* mg /m^3	Remarks
Foundry Area			
Molder	6:47-13:25	.008	Oper. Exposure
Floor Man	6:50-13:26	.008	Oper. Exposure
Finish Grinder	6:50-13:27	.014	Oper. B. Z.
Crew Chief	6:55-13:27	.008	Oper. B. Z. & Exposure
Furnace Operator	6:55-13:26	.026	Oper. B. Z. & Exposure
Shaw Bress	6:59-13:30	.011	Oper. B. Z. & Exposure
Cut-off, Swing Grinder	6:10-11:31	.673	Oper. Exposure
General Area Air	7:17-13:31	.003	
Scrap Remelt Area			
Scrap Remelter	7:00-13:20	.014	Oper. B. Z. & Exposure
Dross Grinder	7:01-13:29	.017	Oper. B. Z. & Exposure
Grinding-Bagging	7:02-13:29	.005	Oper. B. Z. & Exposure
General Area Air-Remelt	7:12-13:32	.002	
Melt & Cast Area			
Furnace Operator	8:21-15:26	N.D.***	Oper. Exposure
Pan Man Helper	8:22-15:31	N.D.	Oper. B. Z.
Crane Operator	8:24-15:28	N.D.	Oper. Exposure
Saw Cutter	8:25-15:26	N.D.	Oper. Exposure
Furnace Repairman	8:26-15:32	N.D.	Oper. B. Z.
Crew Leader	8:28-15:31	N.D.	Oper. Exposure
Heater-Weigher	8:31-15:39	N.D.	Oper. Exposure
Furnace Helper	8:35-15:32	N.D.	Oper. Exposure
General Area Air	8:37-15:37	N.D.	Oper. Exposure

Table II (Cont.)
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Report No. 75-87
Copper Dust and Fumes Air Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration* mg/m^3	Remarks
Arc Room			
Mixer	8:07-15:27	.048	Oper. B. Z.
Assistant Operator	8:08-15:31	.091	Oper. B. Z.
Helper	8:10-15:30	.091	Oper. B. Z.
Operator	8:12-15:30	.441	Oper. B. Z.
General Area Air	8:20-15:28	N.D.	
Calcine Room			
Operator	8:14-15:25	.005	Oper. B. Z.
Rod-Wire			
Grinder	8:24-15:18	.073	Oper. B. Z.
Inspection	8:30-15:15	.023	Oper. Exposure
Rolling Mill			
Conditioning	8:37-15:43	.007	Oper. Exposure
Operator	8:38-15:41	.005	Oper. Exposure
Assistant Operator	8:41-15:44	.016	Oper. Exposure
Tool Grinder	8:44-15:42	.003	Oper. Exposure
Detroit Room			
Helper	8:09-14:55	.020	Oper. B. Z.
Operator	8:11-14:54	.038	Oper. B. Z.
Helper	8:13-14:55	.080	Oper. B. Z.
Foundry Area			
Molder	6:47-13:25	.008	Oper. Exposure
Floor Man	6:50-13:26	.008	Oper. Exposure
Finish Grinder	6:50-13:27	.014	Oper. B. Z.
Crew Chief	6:55-13:27	.009	Oper. B. Z. & Exposure
Furnace Operator	6:55-13:26	.026	Oper. B. Z. & Exposure
Shaw Press	6:59-13:30	.011	Oper. Exposure
Cut-off, Swing Grinder	6:10-11:31	.673	

Table II (Cont.)
Kawecki Berylco Industries, Inc.
Reading, Pennsylania
Report No. 75-87
Copper Dust and Air Fumes Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration mg/m^3	Remarks
Foundry Area (Cont.)			
General Area Air	7:17-13:31	.003	
Scrap Remelt Area			
Scrap Remelter	7:00-13:20	.014	Oper. B. Z. & Exposure
Dross Grinder	7:01-13:29	.017	Oper. B. Z. & Exposure
Grinding-Bagging	7:02-13:29	.005	Oper. B. Z. & Exposure
General Area Air-Remelt	7:12-13:32	.002	
Melt & Cast Area			
Furnace Operator	8:21-15:26	N.D.	Oper. Exposure
Specialty Machine Shop			
Hydro Press Cleaner	8:10-14:00	.003	Oper. Exposure
Hydro Press Scrap	8:14-14:02	.002	Oper. Exposure
R & D Atomizing			
Area Air Sample	8:50-13:53	N.D.	
Technician	8:54-13:52	N.D.	

*mg/m^3 - denotes milligram of substance per cubic meter of air sampled.
**N.D. - denotes detection limit for copper was .001 mg/sample.
Oper. Exposure - denotes operator's exposure.
Oper. B. Z. - denotes respirator was worn.
Where the term Oper. B. Z. & Exposure is used, the operator only wore the respirator when an operation was being performed, otherwise he wore no respirator while in the area.

Table IIA
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Report No. 75-87
Copper Air Concentrations
October 30, 1975

Job Description	Time	Concentration mg/m^3	Remarks
Arc Room			
Mixer	11:50-15:37	.005	Oper. B. Z.
Assitant Operator	8:15-15:36	.015	Oper. B. Z.
Operator	8:11-15:37	.114	Oper. B. Z.
Helper	8:13-15:36	.044	Oper. B. Z.
General Area Air	8:19-15:33	.002	Oper. Station
Calcine Operator	13:35-15:35	.010	Oper. B. Z.

Table III
Kawecki Berylco Industries, Inc.
Reading, Pennsylvania
Titanium Air Concentrations
August 19-22 and 28-29, 1975

Job Description	Time	Concentration ug/m^3	Remarks
Rolling Mill			
Operator	8:14-15:17	N.D.	Oper. Exposure
Assistant Operator	8:16-15:17	N.D.	Oper. Exposure
Conditioning	8:15-15:19	N.D.	Oper. B. Z.
Slab Grinding	8:35-13:27	.393	Oper. B. Z.

.*ug/m^3 - denotes microgram of substance per cubic meter of air sampled.
**N.D. - denotes detection limit for titanium was .005 mg/sample.
Oper. B. Z. - denotes respirator was worn.
Oper. Exposure - denotes operator's exposure.