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

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 79-118-733

PHILBRICK, BOOTH AND SPENCER
HARTFORD, CONNECTICUT

Revised-October 1980

I. SUMMARY

In June 1979, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of the Philbrick, Booth and Spencer foundry to determine if underlying lung disease was a possible risk factor involved in the occurrence of three cases of severe Acinetobacter pneumonia which resulted in the deaths of two workers over a three month period of time.

Environmental samples for total and respirable particulate, silica, nickel, chromium, iron oxide, copper, manganese, lead, methylene bisphenyl isocyanate (MDI), phenol, ammonia, acrolein and carbon monoxide were collected on July 2 and 3, 1979 to determine exposure levels at that time. The medical portion of the study included review of the 125 employee chest x-rays taken in May 1979, review of the hospital records of the three pneumonia cases, and examination of lung tissue from the two deceased employees.

The environmental results indicated that a number of workers were exposed to free silica in excess of the NIOSH recommended level of 0.05 mg/M^3. Samples collected on the cleaning room and pouring bay personnel indicated exposures in excess of NIOSH or ACGIH recommended levels for total particulate, iron oxide, nickel, chromium and copper fume. Concentrations of manganese, lead, carbon monoxide, acrolein, MDI, ammonia and phenol were all below permissible exposure levels.

The company x-rays revealed four cases of possible pneumoconiosis (Category 1 or greater X-ray changes), one of which had the involvement of the upper lung zones typically seen in silicosis. The non-fatal pneumonia case and one of the fatal cases had no X-ray evidence of pneumoconiosis. Both of the fatal cases, however, had histologic evidence of mixed dust pneumoconiosis, and one (who had X-ray evidence of pneumoconiosis) had a single silicotic nodule.

The data collected during this investigation indicate that employees at Philbrick, Booth and Spencer are exposed to potentially toxic concentrations of respirable and total particulate, free silica, iron oxide, nickel, chromium and copper fume. The medical data from this study are not sufficient to establish that pneumoconiosis is a risk factor for acquiring Acetinobacter pneumonia. However, the existence of three temporally clustered cases of an unusual disease, in the absence of any other identified risk factor, suggests that something in the work environment contributed to their occurrence. Recommendations for improving working conditions are presented on pages 11 and 12.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970*, NIOSH investigates the toxic effects of substances found in the workplace. The management at Philbrick, Booth and Spencer requested an evaluation to determine if underlying lung disease was a possible risk factor involved in the occurrence of three cases of severe Acinetobactor pneumonia which resulted in the deaths of two workers over a three month period of time. The three individuals were all employed as grinders and welders of finished steel castings.

III. BACKGROUND

Philbrick, Booth and Spencer is a ferrous foundry performing "job shop" operations. The foundry produces carbon steel, low alloy steel and stainless steel. The foundry has been in operation since 1916 and presently employs approximately 125 workers. The processes used are similar to most foundry operations and include core making, sand molding, melting and pouring, shakeout and chipping, grinding and welding procedures. A brief description of the process stages and associated potential health hazards follows.

A. Core Room

Cores are made by both oil bake and airset processes. The oven-bake cores employ a binder system which consists of oil, cereal binder and water. The coremakers shovel or hand scoop the sand mixture onto the patterns and compact the sand mixture to form the core. The cores are then placed in the baking oven (approximately 400°) for curing. The airset cores are prepared using a Lino-cure® binder system consisting of an oil-modified alkyd and a polymeric MDI-type isocyanate. The core muller, located just outside the core room, mixes the sand with the Lino-cure® binders which is then brought into the core room by means of a wheelbarrow to the coremakers. Approximately 12 employees work in the core room. The coremakers are exposed to silica inherent to general workroom activities. The oil bake coremakers are potentially exposed to thermal degradation products of the core oils and resins such as ammonia, acrolein and carbon monoxide. Such exposure, however, would be more likely to occur during pouring, as the core oven is vented to the outside of the building. The airset coremakers would be potentially exposed to MDI.

---

*Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health and Human Services, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

B. Mold Preparation

Several types of mold making operations are used, including squeeze molding, floor molding for large castings, and bench molding on a conveyor system for medium sized castings. Depending on the mold size, sand is manually shovelled into the mold forms or dropped from a conveyor system into the molds. New sand is packed in first to provide the facing against the mold pattern. This facing is backed up with recycled sand. Standard pneumatic compacting and manual finishing techniques are used. All molding operations are performed in the main molding and pouring bay of the plant. One employee is involved in squeeze molding, seven to eight employees work on the large molding operations, and approximately eight men are involved in the medium molding procedures. Because the molding and pouring are conducted in the same area, in addition to silica dust exposures, workers may be exposed to the thermal degradation products of the core oils and resins, including MDI as well as the airborne metal dusts and fumes that could result from the pouring operations. Carbon monoxide exposure would also be a potential problem.

C. Melting and Pouring

An electric arc furnace is used for most of the large melting for carbon and low alloy steel. The charge consists mainly of scrap from steel stamping operation. The materials, including alloys, are added manually to the furnace. There are generally four melts per shift. The electric arc furnace is provided with overhead local exhaust ventilation. In addition to the electric arc furnace there are three smaller induction furnaces which are used frequently and a large induction furnace which is used for stainless steel. Two of the smaller induction furnaces have overhead local exhaust systems. The melts are poured from the tilting furnaces into large ladles. The ladles are transported by overhead cranes to positions throughout the main bay of the building where the large and medium molds are poured. Small hand-held ladles are carried by two workers when pouring the squeeze molds. Melting and pouring are conducted on the day shift only. Approximately five individuals makeup the melting and/or pouring crew. The melting and pouring crew would potentially be exposed to airborne metal dusts and fumes, carbon monoxide and the decomposition products from the oils and resins in the sand.

D. Shakeout

After a cooling interval, the molds are carried to a stationary vibrating shakeout grate where the sand falls through the grate into the sand handling system. At times the sand is pushed into piles and returned to the sand handling system by means of a payloader. The shakeout area is provided with side-draft local exhaust ventilation. After shakeout, the hot casting is moved by crane and laid on the floor adjacent to the Wheel-a-brator* (a power-rotating metal drum in which castings are cleaned by tumbling them with an abrading material to free them of scale and adhering sand) and allowed to cool. Two or three individuals are involved in the shakeout operation. Crystalline silica dust is the principal exposure of the shakeout personnel. Due to the close proximity of the shakeout to the pouring, shakeout personnel may also be exposed to those substances listed for the melting and pouring crew.

E. Chipping, Grinding and Welding Operations

After the castings have been tumbled in the Wheel-a-brator they are taken to the Finishing Department. The Finishing Department is divided into three sections, large, medium and small castings. Cleaning operations in the department include burning, arc air, chipping, grinding and welding. Procedures in the various areas are very similar. Most of the workers are provided with separate enclosures or booths. Local exhaust ventilation is located in the arc air booths and the welding stations. The personnel in this department consisted of six chipper-grinders, six welders and two arc air in large castings; five chipper-grinders, two welders, two burners and two arc air in medium castings; and three chipper-grinders and two welders in small castings. All workers are potentially exposed to respirable silica as well as metals.

IV. EVALUATION DESIGN AND METHODS

An initial survey was conducted at Philbrick, Booth and Spencer on June 25-27, 1979. Participants in the initial survey included a NIOSH physician and industrial hygienist, representatives of the management at Philbrick, Booth and Spencer, a union representative, Connecticut Department of Health Services officials, and personnel from the Bureau of Epidemiology, Center for Disease Control (CDC). During the initial evaluation, a walk-through survey of the plant was conducted and process information was obtained. The NIOSH physician reviewed available company medical records. This review included the medical records of all current employees and the records of the three men who had contracted Acinetobacter pneumonia. The records included reports of the annual chest x-rays taken on the total workforce since 1975 and occasional pulmonary function studies (which were not part of a systematic medical monitoring program)

Mention of commercial name or product does not constitute endorsement by NIOSH.

The NIOSH medical investigator reviewed the hospital records of the three pneumonia cases. Blocks of lung tissue from the two fatal pneumonia cases were examined by a NIOSH pathologist.

The following chest X-rays were interpreted according to the UICC/Cincinnati system[1] by a NIOSH contract radiologist with special training and certification in that system (a "B" reader): (a) the 125 x-rays taken in 1979 as part of the company's medical monitoring program, and (b) the hospital admission X-rays of the three pneumonia cases.

A follow-up environmental survey was conducted on July 2 and 3, 1979. Personal breathing zone respirable silica samples were taken with Type G MSA* pumps using 10 mm cyclones at a sampling rate of 1.7 lpm. All samples were collected on preweighed FWSB filters to determine total respirable particulate. The samples were analyzed for quartz and cristobalite by x-ray diffraction according to NIOSH P&CAM method #109. In addition, bulk samples of the silica sand were sieved to determine size distribution and analyzed by x-ray diffraction to determine percent free silica.

In addition to gravimetric analysis, nickel, chromium, iron, lead, manganese, and copper analyses were performed by atomic absorption according to P&CAM method #173. MDI was sampled using MSA Model G pumps with a midget impinger. Samples were collected in 15 ml of a hydrochloric and glacial acetic acid absorbing solution at a sampling rate of 1.5 lpm. Analysis was accomplished by a colorimetric method according to P&CAM 141 and 142. Phenol was sampled using an impinger containing 15 ml of 0.1N NaOH. Analysis for phenol was by gas chromatography according to NIOSH method S 330. Ammonia samples were collected using a impinger containing 15 ml of 0.1N sulfuric acid and analyzed colorimetrically according to NIOSH method P&CAM 205. Samples for organic solvents were collected on charcoal tubes and analyzed by gas chromatography. Acrolein samples were collected on molecular sieve tubes and analyzed by a gas chromatographic method published in <u>Analytical Chemistry</u> 50:2839-1841 (1978). Samples for carbon monoxide were taken using Drager* long term detector tubes.

In addition to NIOSH's activities, the Connecticut Department of Health Services and the (CDC) Bureau of Epidemiology obtained blood specimens from (a) Philbrick, Booth and Spencer employees, (b) employees of another foundry, and (c) persons applying for marriage licenses in Connecticut. These were analyzed for antibody to <u>Acinetobacter</u>.

V. EVALUATION CRITERIA

A. Environmental Standards

Airborne exposure levels intended to protect the health of workers have been recommended or promulgated by several sources. These limits represent conditions under which it is believed that nearly all workers may be repeatedly exposed to a substance for an 8-hour to 10-hour workday, 40-hour per week basis without adverse effect. For this investigation, the criteria used to assess the degree of health hazards to workers were selected from three sources: (1) airborne exposure limits which NIOSH has recommended to OSHA for occupational health standards, (2) Threshold Limit Values (TLVs) for 1979 and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), and (3) Occupational Health Standards as promulgated by the U.S. Department of Labor.

The NIOSH Recommended Standards and the TLVs presented in the following tabulation are given prominence in this evaluation since they represent the most current health criteria. The OSHA Standards are provided only as a reference to determine the state of compliance or non-compliance with Federal Regulations. The federal standards are legal standards and enforcement is a responsibility of the U.S. Department of Labor, OSHA.

In the following tabulation of criteria, appropriate values are presented:

Substance	NIOSH Recommended Criteria	ACGIH TLV	OSHA Standard
Silica	0.05 mg/M^3	$\frac{10\ mg/M^3}{\%SiO_2+2}$*	$\frac{10\ mg/M^3}{\%SiO_2+2}$*
Respirable Particulate		5 mg/M^3	5 mg/M^3
Total Particulate		10 mg/M^3	15 mg/M^3
Iron Oxide		5 mg/M^3	10 mg/M^3
Nickel	0.015 mg/M^3	1 mg/M^3	1 mg/M^3
Total Chromium		0.5 mg/M^3	1 mg/M^3
Chromium (VI)	0.025 mg/M^3	0.05 mg/M^3	0.1 mg/M^3
Copper		0.2 mg/M^3	0.1 mg/M^3
Manganese		5 mg/M^3	5 mg/M^3
Lead	0.1 mg/M^3	0.15 mg/M^3	0.05 mg/M^3
Carbon Monoxide	35 ppm	50 ppm	50 ppm

*Cristobalite: Use 1/2 the value calculated from the formula for quartz.

B. Health Effects

1. Silica

Silicosis[2] is a lung disorder caused by the repeated inhalation of crystalline silica particles. Occupational activities in which silicosis has historically occurred include mining, quarrying, tunnelling, sandblasting, foundry work, pottery making, and refractory products manufacturing. The characteristic lesions of silicosis are fibrotic nodules in the lungs. Unless exposure is extremely intense, several years of exposure precede any evidence of the disease. In its early stages silicosis is manifested by the appearance on the chest X-ray of small rounded opacities, usually appearing first in the upper lung zones. It is not until the advance stages that substantially diminished lung capacity and shortness of breath occur, although a slight decrease in lung capacity has been demonstrated epidemiologically to occur earlier, even prior to x-ray changes.[3,4]

Mixed dust pneumonconiosis[5] refers to the lung disorder produced by exposure to a mixture of crystalline silica and non-fibrogenic dusts. Such a mixture occurs in foundries, the non-fibrogenic dust being iron oxides. Mixed dust pneumoconiosis is distinguished from silicosis by the infrequency of the characteristic silicotic nodules and the presence, instead, of irregular fibrotic lesions. The chest x-ray appearance in the early stages, and the lung function impairment and symptoms of more advanced stages, however, are similar to those of silicosis.

2. Iron Oxide

In addition to its role in producing mixed dust pneumoconiosis (described above), iron oxide deposits in the lung can cause a lung condition called siderosis. While siderosis[6] has an x-ray appearance similar to that of silicosis, it apparently does not cause any impairment of pulmonary function. The presence of siderosis, however, suggests the possibility of exposure to more harmful dusts.

3. Other Metals[7]

Nickel causes a hypersensitivity dermatitis called "nickel itch". Nickel fume is a respiratory irritant, and nickel dust has been associated with cancer of the lungs and paranasal sinuses. Hexavalent chromium compounds are the most hazardous chromium compounds. They can cause dermatitis, ulceration of mucous membranes and skin, performation of the nasal septum, erosion of the teeth, kidney damage, and lung cancer. Chronic manganese exposure can cause a neurologic disorder manifested by a variety of symptoms, including headache, sleep disturbances, emotional instability, hallucinations, confusion, excess salivation, masklike expression, muscle weakness and rigidity, tremor of the arms and head, and impaired gait. Copper dust and fume are mucous membrane irritants and can cause green discoloration of skin and hair. Copper and manganese fumes can cause metal fume fever, an illness lasting one or two days and characterized by chills, fever, muscle aches, dryness of the mouth and throat, and headache.

VI. RESULTS AND DISCUSSION

A. Environmental

The results of the personnel sampling for respirable quartz, respirable cristobalite and total respirable particulate are presented in Tables 1, 2 and 3. During the two days of sampling a total of 25 samples were collected on the molders and shakeout workers. Six of the samples exceeded the NIOSH recommended standard of 0.05 mg/M^3 for free silica (range 0.079 mg/M^3 - 0.142 mg/M^3). Twelve of the 25 samples exceeded the OSHA silica standard. Three of four samples for free silica collected on shakeout personnel exceeded the NIOSH recommended standard. As stated previously, side draft ventilation was present at the shakeout operation. However, inspection of the system revealed that it was clogged with sand and virtually inoperative.

The results indicated no detectable levels of free silica on samples collected on core room workers (Table 2). Total respirable particulate levels were also below permissible levels (range 0.2 mg/M^3 to 0.6 mg/M^3). The data presented in Table 3 shows the free silica concentration measured on two of the grinders exceeded the NIOSH recommended level of 0.05 mg/M^3. Both concentrations also exceeded the OSHA silica standard. Total respirable particulate on an arc air operator exceeded the ACGIH recommended exposure limit of 5 mg/M^3.

A bulk sample of the sand used at the foundry was collected during the initial survey and analyzed by x-ray diffraction. It was determined that the sample contained 86% quartz and <1% cristobalite. Based on the quartz content of the bulk, the concentration of quartz measured on each of the individual personnel samples appeared questionably low. As a result, three bulk samples of sand used at the foundry were obtained from the suppliers and a fourth sample was collected at the foundry. The bulk samples were submitted for analyses of silica by x-ray powder diffraction. In addition, the samples were dry-sieved so the percent respirable fraction could be calculated. The respirable (<10 um) fraction accounted for less than 0.3% of the sample. Quantitiative results of the <10 micron-fraction revealed a minimum of 90% quartz. When considering the small percentage (<0.3%) of the sand which was of respirable size, the free silica content of the individual personnel samples appear reasonable and acceptable. (A variety of metal fumes and other substances which were present in the location where the samples were collected apparently accounted for the total respirable particular levels measured.)

Tables 4-7 contain the results of samples collected for total particulate and metal divided according to job categories. The results in Table 4 show that the total particulate concentrations exceeded the OSHA standard of 15 mg/M^3 (15.2 mg/M^3 - 20.9 mg/M^3) on three grinders, and levels on three additional grinders exceeded the ACGIH recommended limit of 10 mg/M^3 (10.4 mg/M^3 - 11 .2 mg/M^3). Iron oxide levels on five of the six workers exceeded the ACGIH recommended limit of 5 mg/M^3 for iron oxide (5.8 mg/M^3 - 10.0 mg/M^3). Nickel concentrations ranged from 0.01 mg/M^3 to 0.17 mg/M^3 on the grinders. The NIOSH recommended standard for nickel is 0.015 mg/M^3. The current OSHA standard for nickel is 1 mg/M^3. Chromium levels on the grinders were found to range from 0.01 mg/M^3 to 0.30 mg/M^3. NIOSH recommends the chromium (VI) levels not exceed 0.025 mg/M^3. The OSHA standard for chromium (VI) is 0.1 mg/M^3. The OSHA standard for total chromium is 1 mg/M^3.

The sampling results for the welders and pouring bay personnel are presented in Tables 5 and 6. The concentration of total particulate measured on a burner exceeded the ACGIH recommended limit and the iron oxide concentration measured on another burner exceeded the ACGIH recommended limit for iron oxide. All other samples for total particulate, iron oxide, copper, manganese and lead were found to be below both the NIOSH recommended levels and the OSHA standards. Nickel concentrations ranged from 0.005 mg/M^3 to 0.07 mg/M^3. Of the thirty samples collected, seventeen exceeded the NIOSH recommended level of 0.015 mg/M^3. No levels were in excess of the OSHA standard. The chromium levels found were 0.006 mg/M^3 to 0.26 mg/M^3. Sixty percent (18 of 30) of the samples exceeded 0.025 mg/M^3 and 30% exceeded the OSHA standard of 0.1 mg/M^3.

The results of the seven samples collected on the arc air are shown in Table 7. All seven total particulate concentrations exceeded the ACGIH recommended limit of 5 mg/M^3 (range 12.8 mg/M^3 - 37.3 mg/M^3) and all but one exceeded the OSHA standard of 15 mg/M^3. All seven iron oxide levels also exceeded the NIOSH recommended standard of 5 mg/M^3, with four samples being in excess of the OSHA standard of 10 mg/M^3. Nickel concentrations (0.04 mg/M^3 - 0.71 mg/M^3) exceeded the 0.015 mg/M^3 level and chromium concentrations (0.07 mg/M^3 - 1.0 mg/M^3) exceeded the NIOSH level of 0.25 mg/M^3 and, on all but one sample, the OSHA standard of 0.1 mg/M^3. Copper concentrations ranged from 0.15 mg/M^3 to 0.32 mg/M^3. The ACGIH TLV for copper fume is 0.2 mg/M^3 and the OSHA standard is 0.1 mg/M^3. Manganese and lead levels were below NIOSH, ACGIH and OSHA permissible exposure limits.

Thirteen long term detector tube samples for carbon monoxide were collected on the pouring and molding crews. Concentrations of carbon monoxide ranged from 3 ppm to 19 ppm. NIOSH recommends that exposure to carbon monoxide not exceed 35 ppm on an 8-hour time weighted average (TWA).

Samples for organics, acrolein, ammonia, phenol and MDI were also collected in the core room and molding and pouring areas. No detectable levels of any of the substances were measured.

During the survey, deficiencies were noted in housekeeping, ventilation, work practices and respiratory usage and care. These areas will be addressed in detail in the recommendation section of this report.

B. Medical (NIOSH)

The company's policy concerning an employee with an abnormal chest X-ray is to refer him to a local pulmonary physician. The physician said that he was aware of only two cases of silicosis, one of which is in a retired employee. The other, which is complicated by tuberculosis (currently under treatment), is in a current employee. Since the company's X-rays were not interpreted according to the UICC/Cincinnati system, it is possible that X-rays with early changes of pneumoconiosis would not be interpreted as abnormal and would thus not come to the attention of the consulting physician.

The three pneumonia cases occurred between late April and mid June 1979. All were due to the bacterium Acinetobacter calcoceticus var. antitratus. Both fatal cases had histological evidence of mixed dust pneumoconiosis. One may have had early silicosis, as evidenced by a single lesion typical of the classical nodular form of silicosis. His 1977 chest X-ray showed no evidence of silicosis, but a 1979 X-ray taken during his illness showed q opacities, profusion 1/1, involving both upper and mid lung zones and the lower left zone. The other fatal case and the non-fatal case had no X-ray evidence of pneumoconiosis.

The NIOSH interpretations of the company X-rays taken May 16, 1979 are presented in Table 8. Of the 117 X-rays interpreted, 112 (96%) showed no evidence of pneumoconiosis. Two of the remaining five had q opacities, profusion 0/1, involving lower and mid lung zones. Another had q opacities, profusion 1/2, involving lower and mid zones. (The only other X-ray with Category 1 or greater changes was the one from the fatal pneumonia case described above.) There were two X-rays with profusion 2/1; one had q opacities (site not specified) and ill defined large (B) opacities. There were thus four (or six, depending on how profusion 0/1 is interpreted) possible cases of pneumoconiosis among the 117 chest x-rays interpreted, but only one had the involvement of the upper lung zones typically seen in silicosis.

C. Serologic Survey*

Fifteen percent of Philbrick, Booth and Spencer employees and 15% of the employees of the other foundry had antibodies to a pool of the strains of Acetinobacter that caused the three pneumonia cases, indicating previous infection (not necessarily associated with overt illness). In contrast, only about 1% of the marriage license applicants had antibody to these strains. This comparison is confounded by the younger age distribution of the latter group, but suggests that foundry employees may be at greater risk of Acetinobacter infection. Whether this is due to greater susceptibility (e.g., impaired lung function, or a more favorable physiologic environment for the bacterium) or to greater exposure (i.e., greater prevalence of Acetinobacter in foundries than in the general environment) was not determined. Furthermore, although specific risk factors for the three pneumonia cases were not identified, it was determined that their only likely common source of exposure was the foundry.

VII. RECOMMENDATIONS

1. The current medical surveillance program should be improved by (a) having X-rays interpreted according to the UICC/Cincinnati system, and (b) including pulmonary function testing routinely.

2. A respirator program should be implemented in accordance with OSHA regulations (29 CRF Part 1910.134).

3. There should be an increased emphasis on housekeeping.

4. The company should immediately provide for the engineering design and installation of proper local exhaust ventilation for the arc air, welders, grinders, chippers and burners. Until engineering controls are installed, the company should implement interim respiratory protection for toxic dusts.

5. The local exhaust ventilation for shakeout should be cleaned out, the effectiveness of the system should be determined, and a schedule should be set up for maintaining the system in proper working order. If necessary the effectiveness of the system should be improved.

6. The practice of using a payloader to return the excessive build-up of sand around the shakeout unit to the sand handling system should be discontinued as it generates unnecessary and excessive dust levels.

---

*Information concerning the findings of this survey was obtained from Lester G. Cordes, III, M.D., Special Pathogens Branch, Bacterial Disease Division, Bureau of Epidemiology, Center for Disease Control, Atlanta, Georgia; it has not yet been published.

7. The practice of using air pressure to blow loose sand out of the cores and molds should be discontinued. An alternate cleaning method should be found.

8. When ventilation deficiences are corrected, environmental monitoring should be repeated to determine adequacy of the controls.

9. A ventilation expert, familiar with foundries, should be consulted concerning all the ventilation, general and local, in the plant to determine adequacies of present systems and feasibility of proposed systems.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Dawn Gilles Tharr
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Mitchell Singal, M.D.
Medical Officer
Medical Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

ACKNOWLEDGEMENTS

Medical Investigator:

W. Elva Elesh, M.D.
Medical Officer
Medical Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Environmental Evaluation

Gary Verst
Co-Op Student
Gary White
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office: Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
Cincinnati, Ohio

Report Typed By: Linda Morris
Clerk-Typist
Industrial Hygiene Section

IX. REFERENCES

1. The UICC Committe: UICC/Cincinnati classification of the pneumoconioses. Chest 58:57-67, 1970.

2. Seaton A: Silicosis, in Morgan WKC, Seaton A (eds): Occupational Lung Diseases. Philadelphia, W.B. Saunders Company, 1975, pp. 80-111.

3. Theriault GP, Peters JM, Fine LJ: Pulmonary Function in Granite Shed Workers in Vermont. Arch Environ Health 28:18-22, 1974.

4. Theriault GP, Peters JM, Johnson WM: Pulmonary function and roentgenographic changes in granite dust exposure. Arch Environ Health 28:23-27, 1974

5. Parker WR: Occupational Lung Disorders. London, Butterworth and Company, 1974, pp. 194-197.

6. Morgan WKC: Other Pneumoconioses, in Morgan WKC, Seaton A (eds): Op. cit., pp. 235-240.

7. Proctor NH, Hughes JP: Chemical Hazards of the Workplace. Philadelphia, J.P. Lippinocott Company, 1978, pp. 370-371, 173-176, 319-320, 181-183.

X. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Publications Dissemination, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

a) Philbrick, Booth & Spencer
b) Allied Industrial Workers, Local 39
c) International Union Allied Industrial Workers of America
d) U.S. Department of Labor, Region I
e) NIOSH, Region I

For the purpose of informing the approximately 125 "affected employees," the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where exposed employees work.

Table 1

Personnel Sampling Concentration Data on Molders and Shakeout Workers
for
Respirable Quartz, Respirable Cristobalite and Total Respirable Particulate

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sample Volume (liters)	Quartz (mg/M3)	Cristobalite (mg/M3)	Total Free Silica (mg/M3)	Total Respirable Particulate (mg/M3)
			July 2, 1979				
4039	Large Molder (1)	6:14-15:03	899	N.D.	N.D.	—	0.9
4034	Large Molder (2)	6:44-15:30	894	N.D.	0.033	0.033	1.2
4040	Large Molder (3)	6:42-15:06	857	N.D.	N.D.	—	1.4
4038	Large Molder (4)	6:50-15:25	875	N.D.	0.034	0.034	1.0
4026	Medium Molder (1)	6:23-15:15	921	N.D.	0.032	0.032	1.1
4033	Medium Molder (2)	6:25-15:16	836	0.036	0.047	0.083	1.9
4041	Set-up Man	6:27-15:15	897	N.D.	0.033	0.033	1.4
4029	Sand Slinger	6:40-15:18	880	0.045	0.034	0.079	1.2
4032	Muller Operator (1)	8:15-14:20	578	N.D.	0.051	—	2.0
4030	Muller Operator (2)	6:57-15:21	857	N.D.	N.D.	—	1.2
4025	Squeeze Mold Operator	6:52-15:06	840	N.D.	N.D.	—	1.1
4027	Shakeout (1)	8:22-15:09	692	0.10	N.D.	0.10	2.2
4042	Shakeout (2)	7:20-13:12	658	0.10	N.D.	0.10	2.8
			July 3, 1979				
4232	Large Molder (2)	6:07-15:27	952	N.D.	N.D.	—	0.7
4236	Large Molder (5)	6:04-15:06	921	N.D.	N.D.	—	0.8
4238	Medium Molder (2)	6:15-15:20	926	N.D.	0.043	0.043	1.0
3976	Medium Molder (3)	7:15-15:25	833	N.D.	N.D.	—	0.6
4235	Set-up Man	6:12-13:15	719	N.D.	0.042	0.042	0.9
3979	Roll-over Machine Operator	7:40-15:22	785	N.D.	N.D.	—	0.8
3992	Mold-Closer	6:21-15:24	923	N.D.	0.032	0.032	0.8
3998	Muller Operator	6:18-9:25	317	N.D.	N.D.	—	0.9
3993	Mold Operator	6:10-15:25	943	N.D.	0.032	0.032	0.8
3991	Shakeout (2)	7:08-15:25	844	0.10	N.D.	0.10	4.3
3997	Shakeout (3)	8:05-15:30	785	N.D.	N.D.	—	1.2
3977	Shot Blast	7:20-12:48	557	0.071	0.071	0.142	1.2

Table 2

Personnel Sampling Concentration Data on Core Room Workers
for
Respirable Quartz, Respirable Cristobalite and Total Respirable Particulate

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sample Volume (liters)	Quartz (mg/M^3)	Cristobalite (mg/M^3)	Total Free Silica (mg/M^3)	Total Respirable Particulate (mg/M^3)
			July 2, 1979				
4044	Core Maker Helper	6:35-15:19	890				
4035	Core Maker 1	6:41-14:20	780	N.D.	N.D.	—	0.6
4047	Core Room Muller Operator	6:42-15:10	863	N.D	N.D	—	0.6
4046	Core Room Foreman	6:45-15:11	860	N.D.	N.D.	—	0.5
4043	Core Washer	6:47-15:11	790	N.D	N.D.	—	0.5
			July 3, 1979				
3988	Core Maker 1	6:05-15:00	909	N.D.	N.D.	—	0.4
3996	Core Maker 2	6:10-15:03	906	N.D.	N.D.	—	0.4
3990	Core Maker 3	6:07-15:00	906	N.D.	N.D.	—	0.3
4230	Core Maker 4	6:13-15:04	902	N.D.	N.D.	—	0.4
3995	Core Maker 5	6:17-15:06	899	N.D.	N.D.	—	0.2
3989	Core Maker 6	6:15-15:01	894	N.D.	N.D.	—	0.5
3994	Core Maker Helper	6:20-15:00	884	N.D.	N.D.	—	0.4
4237	Core Room Muller Operator	6:11-11:50	576	N.D.	N.D.	—	0.6

Table 3

Summary of Personnel Sampling Concentration Data on Welders and Grinders
for
Respirable Quartz, Respirable Cristobalite and Total Respirable Particulate

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sample Volume (liters)	Quartz (mg/M³)	Cristobalite (mg/M³)	Total Free Silica (mg/M³)	Total Respirable Particulate (mg/M³)
			July 2, 1979				
4024	Small Casting Welder	6:15-15:20	926	N.D.	N.D.	—	0.9
4031	Medium Grinder	7:05-15:22	844	0.047	N.D.	0.047	2.6
4037	Large Grinder (1)	5:30-14:46	843	0.059	0.047	0.106	2.3
4036	Large Grinder (2)	5:31-12:40	729	0.041	0.055	0.096	1.1
			July 3, 1979				
3984	Arc Air	5:53-14:06	768	N.D.	N.D.	—	10.1
3982	Small Grinder	6:05-15:04	916	N.D.	N.D.	—	1.6
3983	Medium Welder	6:11-15:10	916	N.D.	N.D.	—	1.4
3999	Castings Mover	7:36-15:15	780	N.D.	N.D.	—	1.0

Table 4

Personal Sampling Concentration Data on Chippers and Grinders
for
Total Particulate and Metallic Dusts

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sampling Volume (liters)	Total Particulate (mg/M^3)	Nickel (mg/M^3)	Chromium (mg/M^3)	Iron Oxide (mg/M^3)	Copper (mg/M^3)	Manganese (mg/M^3)	Lead (mg/M^3)
				July 2, 1979						
2641	Medium Casting Grinder 1	5:40-15:11	571	10.4	0.13	0.30	3.3	0.06	0.10	N.D.
2143	Medium Casting Grinder 2	5:43-15:11	568	15.2	0.17	0.21	7.7	0.007	0.15	N.D.
2623	Medium Casting Grinder 3	5:45-7:18	93	20.9	0.06	0.13	10.0	0.04	0.10	0.04
2634	Small Casting Grinder 1	5:35-14:52	557	2.7	0.03	0.07	1.3	0.01	0.02	N.D.
2640	Small Casting Grinder 2	5:39-15:02	563	9.2	0.06	0.11	5.8	0.02	0.04	N.D.
2635	Large Casting Chipper 1	7:41-15:14	679	4.4	0.07	0.12	1.3	0.02	0.04	N.D.
2620	Wheel-a-brator Operator	7:40-14:40	630	8.3	0.15	0.20	2.9	0.06	0.09	N.D.
2352	Area Foreman	8:05-15:03	418	5.0	0.10	0.14	2.7	0.04	0.07	N.D.
2345	Castings Mover	8:11-15:08	417	6.1	0.10	0.20	2.6	0.04	0.07	N.D.
				July 3, 1979						
2613	Large Casting Grinder 1	5:49-15:05	834	6.2	0.01	0.01	2.6	0.01	0.02	N.D.
2607	Large Casting Grinder 2	6:58-14:55	715	2.4	0.03	0.05	0.42	0.002	0.01	N.D.
2636	Large Casting Grinder 3	5:45-14:59	444	7.2	0.09	0.17	1.7	0.03	0.05	N.D.
2618	Large Casting Grinder 4	5:46-9:30	336	9.6	0.03	0.08	1.3	0.01	0.10	N.D.
2596	Medium Casting Grinder 1	6:36-14:30	711	6.4	0.06	0.10	4.0	0.03	0.06	N.D.
2639	Medium Casting Grinder 2	6:40-15:15	772	7.3	0.07	0.09	4.6	0.03	0.06	N.D.
2615	Medium Casting Grinder 3	6:50-15:19	763	16.5	0.11	0.08	6.9	0.04	0.07	N.D.
2622	Medium Casting Grinder 4	6:52-15:18	759	10.5	0.07	0.10	3.6	0.03	0.07	N.D.
2632	Small Casting Grinder 3	5:59-15:04	817	6.3	0.12	0.17	1.2	0.01	0.02	N.D.
2612	Large Casting Chipper 1	5:43-14:58	832	6.1	0.10	0.18	2.9	0.03	0.07	N.D.
2633	Medium Casting Chipper 1	6:18-15:23	817	11.2	0.09	0.13	7.4	0:03	0.07	N.D.

Table 5

Personal Sampling Concentration Data on Welders
for
Total Particulate and Metals

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sampling Volume (liters)	Total Particulate (mg/M^3)	Nickel (mg/M^3)	Chromium (mg/M^3)	Iron Oxide (mg/M^3)	Copper (mg/M^3)	Manganese (mg/M^3)	Lead (mg/M^3)
				July 2, 1979						
2605	Large Oasting Welder 1	5:58-15:06	548	1.8	0.02	0.20	0.5	0.04	0.04	N.D.
2630	Large Casting Welder 2	6:00-14:53	533	6.8	0.07	0.26	1.4	0.02	0.18	N.D.
2347	Large Casting Welder 3	6:28-11:54	326	6.8	0.06	0.19	2.0	0.02	0.12	N.D.
2340	Medium Casting Welder 1	6:40-14:32	472	9.7	0.07	0.14	4.2	0.04	0.10	0.008
2350	Medium Casting Welder 2	6:51-15:20	763	4.6	0.07	0.16	1.9	0.03	0.06	N.D.
2341	Small Casting Welder 1	6:23-14:49	506	3.1	0.03	0.08	1.2	0.01	0.04	N.D.
2359	Burner 1	8:07-15:38	676	8.6	0.05	0.09	5.8	0.06	0.09	N.D.
				July 3, 1979						
2601	Large Casting Welder 1	5:30-14:42	607	2.0	0.02	0.02	0.3	0.01	0.03	N.D.
2603	Large Casting Welder 2	5:48-14:52	816	5.9	0.04	0.11	1.2	0.02	0.17	N.D.
2142	Large Casting Welder 3	5:47-14:53	819	3.7	0.04	0.08	1.1	0.02	0.09	N.D.
2611	Medium Casting Welder 1	9:25-12:00	416	2.8	0.03	0.22	1.4	0.05	0.03	N.D.
2617	Small Casting Welder 1	5:55-14:54	943	1.4	0.01	0.04	0.3	0.01	0.02	N.D.
2610	Burner 1	8:10-15:20	553	6.7	0.05	0.08	3.6	0.03	0.05	N.D.
2614	Burner 2	7:30-15:11	276	12.1	0.07	0.10	4.5	0.04	0.06	N.D.

Table 6

Personal Sampling Concentration Data Pouring Bay Personnel
for
Total Particulate and Metals

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sampling Volume (liters)	Total Particulate (mg/M3)	Nickel (mg/M3)	Chromium (mg/M3)	Iron Oxide (mg/M3)	Copper (mg/M3)	Manganese (mg/M3)	Lead (mg/M3)
				July 2, 1979						
2357	Furnace Attendant	8:12-16:04	708	1.2	N.D.	0.008	0.28	0.002	0.02	N.D.
2353	Helper	8:55-10:30	97	4.0	N.D.	0.04	0.60	N.D.	0.03	N.D.
2356	Melting Foreman	6:10-15:17	820	3.7	N.D.	0.01	0.37	0.004	0.04	N.D.
2355	Furnace Helper	6:12-15:23	826	3.9	0.005	0.007	0.64	0.009	0.04	N.D.
2337	Pouring Foreman	6:10-15:15	804	2.4	0.01	0.02	0.63	0.01	0.02	N.D.
2343	Molder & Pouring Crane Op.	6:15-13:20	637	3.8	0.02	0.05	0.63	0.02	0.03	N.D.
2349	Molder & Pouring Crew	6:25-15:25	810	1.4	N.D.	0.008	0.26	0.005	0.01	N.D.
2625	Mold Closer 1	6:41-15:25	786	3.2	0.009	0.01	0.61	0.009	0.004	N.D.
2638	Roll-over Machine Op.	6:32-12:40	499	3.6	0.04	0.06	1.1	0.02	0.04	N.D.
2626	Mold Closer 2	6:31-12:20	523	4.0	0.03	0.05	1.1	0.02	0.04	N.D.
				July 3, 1979						
2609	Pouring Foreman	7:45-14:47	633	3.8	0.006	0.02	0.58	0.007	0.03	N.D.
2608	Supervisor (Molding/ Pour/Furnace)	7:50-15:08	657	2.9	0.006	0.02	0.33	0.06	0.004	0.011
2631	Furnace Helper	6:34-15:32	807	3.4	N.D.	0.006	0.37	0.003	0.04	N.D.
2624	Mold Closer	6:45-15:06	661	2.2	N.D.	0.01	0.56	0.006	0.04	0.04
2642	Large Casting Molder	7:20-15:23	724	2.8	0.01	0.01	0.73	0.008	0.02	N.D.
2606	Clean-up Man	8:35-14:20	517	3.8	0.07	0.16	1.5	0.029	0.05	N.D.

Table 7

Personal Sampling Concentration Data on Arc Air Operators
for
Total Particulate and Metallic Oxides

Philbrick, Booth & Spencer
Hartford, Connecticut

Sample Number	Job Classification	Sampling Period	Sampling Volume (liters)	Total Particulate (mg/M^3)	Nickel (mg/M^3)	Chromium (mg/M^3)	Iron Oxide (mg/M^3)	Copper (mg/M^3)	Manganese (mg/M^3)	Lead (mg/M^3)
				July 2, 1979						
2239	Arc Air 1	5:49-15:02	553	21.2	0.04	0.07	18.4	0.15	0.15	N.D.
2351	Arc Air 2	5:55-15:07	552	12.8	0.71	0.69	6.2	0.24	0.33	N.D.
2346	Arc Air 3	6:58-15:44	526	33.8	0.07	0.27	29.9	0.32	0.34	0.008
2338	Arc Air 4	10:57-11:55	230	17.7	0.61	1.0	7.4	0.29	0.43	N.D.
				July 1979						
2637	Arc Air 1	5:38-14:44	607	18.3	0.07	0.61	16.5	0.16	0.20	0.008
2628	Arc Air 2	5:25-14:40	522	34.7	0.52	0.66	5.3	0.23	0.29	0.009
2599	Arc Air 3	7:09-12:01	450	37.3	0.15	0.20	31.7	0.29	0.31	0.008

Table 8

NIOSH INTERPRETATION* OF MAY 1979 COMPANY CHEST X-RAYS

PHILBRICK, BOOTH AND SPENCER
HARTFORD, CONNECTICUT

Quality inadequate for interpretation		7		
Inadvertently not interpreted		1		
Interpreted				117
Category 0				114
Profusion 0/0			112	
No other findings		96		
Other findings present		16		
Pleural thickening	5			
Ill-defined diaphragm	1			
Tuberculosis (not obviously active)	2			
Abnormality of cardiac size or shape	4			
Enlargement of hilar shadows	2			
Granuloma in lungfield	1			
Unidentified density in lungfield	1			
Profusion $^{0}/1$ (q opacities)			2	
Category 1 (q $^{1}/2$)				1
Category 2				2
$^{2}/1$ (q)			1	
$^{2}/2$ (q; also ill-defined large (B) opacities and bullae)			1	

* UICC/Cincinnati system (reference 1).