U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-95-113

BANNER IRON WORKS
ST. LOUIS, MISSOURI
MARCH 1974

I. TOXICITY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 699(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any 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.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees to evaluate the potential hazards associated with the alleged exposure to dust which is produced from the cleaning of castings in the Cleaning Department at the Banner Iron Works, St. Louis, Missouri.

It has been determined on the basis of professional judgement and environmental evaluation that a potential health hazard exists from the exposure to free silica containing dust during this process. As a result of respirable dust samples which exceeded present OSHA Standards by factors of two and four, medical and environmental recommendations to improve working conditions are included in the report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) Banner Iron Works, St. Louis, Missouri
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region VII
d) NIOSH - Region VII

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

III. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The Banner Iron Works is a custom cast iron foundry. The Cleaning Department cleans the castings to remove molding sand and scrap iron as a result of the pouring. These operations are done by combinations of shot blasting, sandblasting, grinding, and chipping. There are a total of 30 workers employed in the department which operates two shifts per day five days per week.

Castings are received from the foundry shake-out area where residual amounts of molding sand and iron burrs from the pouring operation must be removed prior to shipment of the final product. These castings receive a primary cleaning in a Wheel-A-Brator unit and a shot blast machine (size permitting). Both of these machines include exhaust ventilation systems. The larger castings and those with excess scrap from the pouring are cleaned by workers using portable grinders and chippers.

The sandblasting operation is carried out in a poorly constructed booth at the east end of the shop and is only operated during the evening shift. Although the operation was not observed during the survey, there were indications that dust laden air escapes from the booth to the surrounding area during the sandblasting operation. The operator is provided with an air supplied hood.

There is relatively little ventilation control for the dust with the exception of some of the stationary grinding machines and the shot blast machines. However, prior to the time of the survey a make-shift ventilation system was installed on a swing grinder with resulting questionable effectiveness. The company also started wetting the floors which are covered with sand and dust in order to suppress the recirculation of airborne dust. Therefore, it could be assumed that conditions at the time of the survey were better than those which had prevailed in the past.

B. Evaluation Methods and Results

Six personal samples were collected in the breathing zone of workers to determine their exposure to respirable dust in various jobs around

the department. See Table for results. The concentrations of respirable dust ranged from slightly over 1 to almost 3 mg/M^3 of air by volume. The respirable dust samples were combined after total dust weight was obtained on each filter and submitted to the laboratory for determination of percentage of free silica in the respirable dust range. Samples 1, 2, and 3 yielded almost 12% free silica, samples 4, 5, and 6 resulted in slightly over 10% free silica.

C. Evaluation Criteria

The OSHA Standard for respirable crystalline silica is taken from Part 1910 of Title 29 of the Code of Federal Regulations, Section 1910.93, Table G-3.

Substance	mg/M^3
Silica:	
Crystalline:	
Quartz (respirable)----------	$\frac{10 \text{ mg/M}^3}{\%SiO_2+2}$

Therefore the calculated OSHA Standard for the respirable dust samples are:

$$\text{Samples \#1-3} = \frac{10}{11.8\%+2} = 0.72 \text{ mg/M}^3$$

$$\text{Samples \#4-6} = \frac{10}{10.4\%+2} = 0.81 \text{ mg/M}^3$$

D. Evaluation Discussion

The chief concern regarding excessive silica exposure is the development of silicosis. This form of pneumoconiosis usually occurs only after a number of years of exposure, although with severe exposure silicosis can occur in a short time. Early silicosis (termed "simple silicosis") is first diagnosed by chest x-ray examination. At this stage there is usually little if any functional impairment, and there are often no associated symptoms and signs. Symptoms occur when silicosis advances and becomes complicated by infection and emphysema.

The deposition of crystalline free silica in the lungs in sufficient amounts over a period of years may produce fibrous nodules. These nodules cause many individual alveoli (or air sacs) to be compressed and collapsed, thus reducing the lungs function. Continuous exposures

to elevated concentrations of dust containing free silica produces increased debilitating effects. These changes are marked by intolerance to exertion, episodes of coughing, and production of thick purulent sputum. When silicosis has progressed to this point, the chest x-ray is usually read as "conglomerate silicosis." Conglomerate silicosis many times progresses in spite of termination of exposure and becomes incapacitating to the affected workers.

Four workers who had been employed in the Cleaning Department in excess of four years were asked if they had any illnesses that they could associate with their job, in all cases the response was negative, however, in view of the insidious nature of silicosis, the high concentrations of respirable dust containing free silica, and the lack of adequate engineering control measures, it is felt that a potential health hazard exists.

E. Recommendations

1. Environmental

Every effort should be made to control the production of dust through engineering control, i. e., existing ventilation systems on the Wheel-A-Brator and the shot blast should be tested for collection efficiency, all hand and stationary grinding machines should be equipped with mechanical exhaust ventilation systems, and efforts to suppress the generation of dust from the floor sand should be continued. Attached to this report are suggested engineering prints for the design of ventilation systems for a surface grinder (VS-417), swing grinder (VS-414), hand grinder (VS-804), and hand sander (VS-805). The sandblast booth should also be repaired to prevent the dust from escaping to the adjacent environment.

2. Medical

A great deal of importance must be placed on the measured levels of silica in the working environment at Banner Iron Works. In view of the findings which demonstrate a silica exposure for many foundry workers from two to four times the present federal standard, it is most strongly recommended that immediate measures to lower silica air levels below the federal standard as well as implementation of a medical surveillance program be instituted. A sample surveillance program is outlined below; a program similar to it will likely become in the near future the official program to which all workplaces with a potential silica hazard must conform.

a. Preplacement: A comprehensive medical examination should take place within 30 days following an individual's employment in an occupation where airborne concentrations of free silica may occur. The examination should include, as a minimum:

(1) A chest x-ray (posteroanterior 14 x 17 or 14 x 14 inches) classified according to the 1971 ILO International Classification of Pneumoconioses.

(2) A medical and occupational history to elicit work exposure to free silica and signs and symptoms of respiratory disease.

(3) Pulmonary function tests including forced vital capacity (FVC) and forced expiratory volume at one second (FEVI).

(4) Tuberculin skin test

(5) A baseline body weight

(6) Height

(7) Age

b. Periodic examinations: At least once each three years, a comprehensive medical examination should be made available to employees engaged in occupations where exposure to airborne concentrations of free silica may occur. Such an examination should include as a minimum items (a.) (1), (2), and (3) above. Any employee reassigned to a job situation where exposure to airborne concentrations of free silica may occur should be offered a pre-placement examination and subsequent periodic examinations as already described.

c. Termination of employment: Within 30 days before or after termination of employment of an employee engaged in an occupation exposed to airborne concentration of free silica, a comprehensive medical examination should be made available, including as a minimum items a. (1), (2) and (3) above.

d. Recent examinations: If adequate records show that the employee has been examined within the past one-year period in accordance with paragraphs (a) and (b) above, no further medical examination is required of the employee.

e. Medical management:

(1) An employee with roentgenographic evidence of simple silicosis should be permitted to work in an environment with effective dust control (dust level below the recommended standard).

(2) An employee with conglomerate silicosis should be excluded from an industrial environment that contains known amounts of free silica.

(3) An employee with or without roentgenographic evidence of silicosis who also has respiratory symptomatology and/or pulmonary functional impairment should be fully evaluated by a physician qualified to advise the employee with the reference to continuing work in a dust environment.

(4) An employee found to have active tuberculosis (pulmonary) should be placed under treatment and should not be permitted to resume employment at a dusty occupation while under treatment for this disease. Workers with arrested or healed reinfection tuberculosis should be allowed to continue to work, but should observe the same precautions as the man with roentgenographic evidence of simple silicosis. Healed primary tuberculosis is not a contraindication for employment in a dusty trade.

IV. REFERENCES

1. Johnstone & Miller: Occupational Diseases and Industrial Medicine, pp. 199-251.

2. American Conference of Governmental Industrial Hygiene: Industrial Ventilation, A Manual of Recommended Practice, 12th Edition.

V. AUTHORSHIP AND ACKNOWLEDGMENTS

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Acknowledgments

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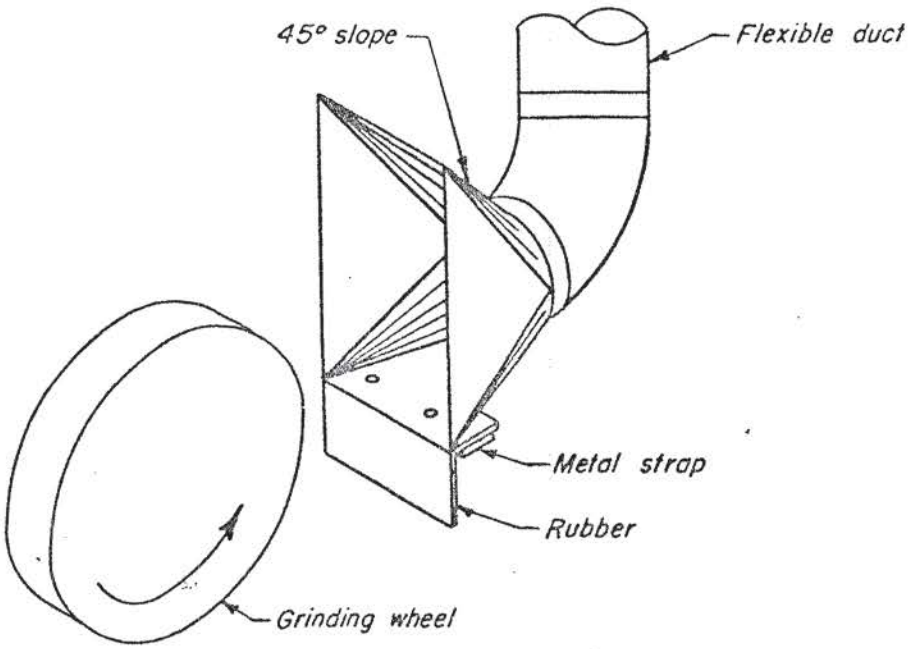
Western Area Occupational Health Laboratory
Salt Lake City, Utah

TABLE

PERSONAL SAMPLES

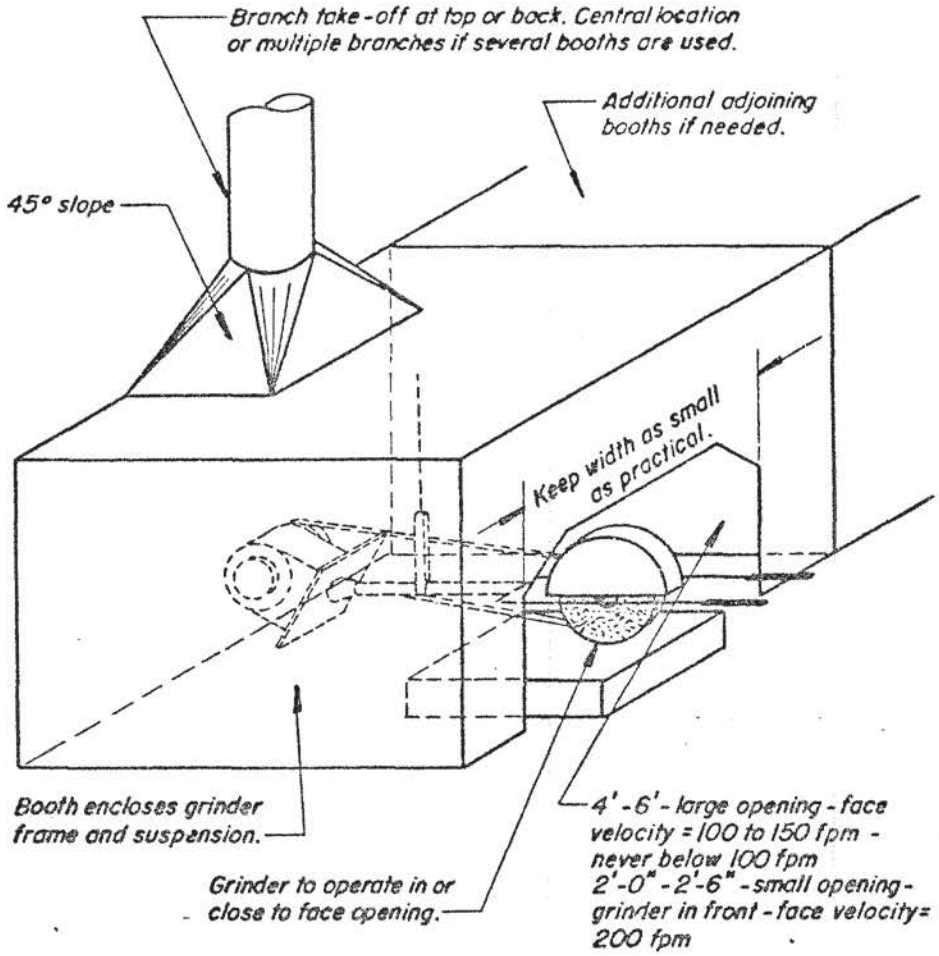
Sample No.	Location	Job	Dust Concentration
1	Soutn wall	Hand grinder	2.2 mg/M3*
2	North wall	Hand grinder	2.2 "
3	Wheel-A-Brator	Operator	1.1 "
4	South wall	Swing grinder	2.6 "
5	Shot blast	Operator	1.3 "
6	North wall	Stand grinder	2.7 "

*Milligrams per cubic meter of air.



Q = 220 cfm for wheels up to 5" diam
300 cfm for wheels 5" to 10" diam
Entry loss = 0.25 VP
Duct velocity = 3500 fpm minimum

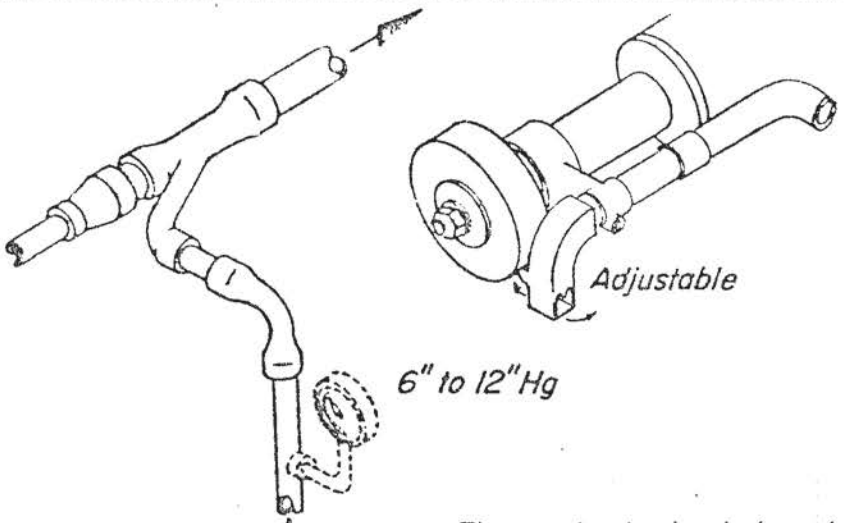
AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS	
SURFACE GRINDER	
DATE 1-66	VS-417

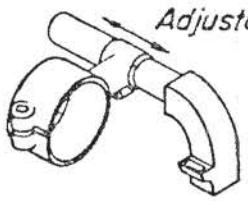


Minimum duct velocity = 3000 fpm
Entry loss = 0.5 VP

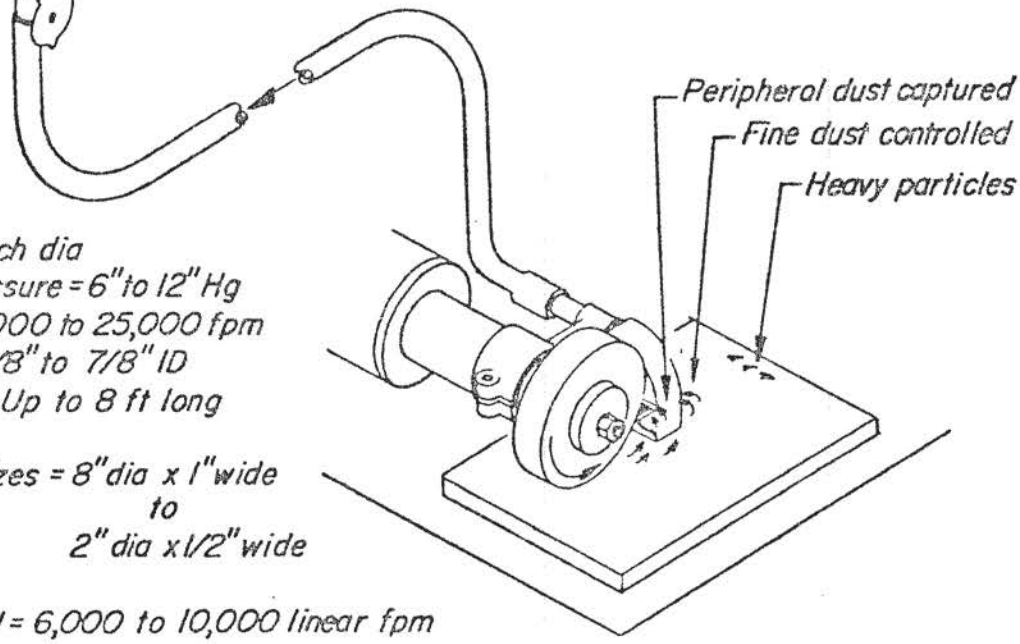
NOTE: Small local exhaust hoods mounted behind grinder wheel may trap the stream of sparks, but are usually not effective in control of air-borne dust.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS	
SWING GRINDER	
DATE 1-64	VS-414





These extractor heads have been specifically designed for work done inside castings or in awkward places when radial wheels of small diameter are most suitable. The heads are narrower than the grinding wheels and can preceed the wheel when a groove is being ground.



Q = 10-45 cfm/inch dia
Branch static pressure = 6" to 12" Hg
Slot velocity = 10,000 to 25,000 fpm
Flexible hose = 5/8" to 7/8" ID
Extension hose = Up to 8 ft long

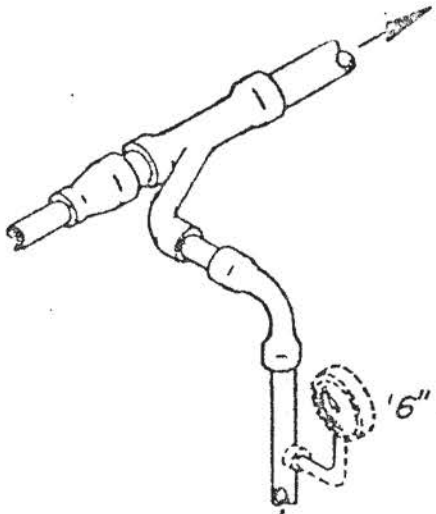
Grinding wheel sizes = 8" dia x 1" wide
to
2" dia x 1/2" wide

Peripheral speed = 6,000 to 10,000 linear fpm

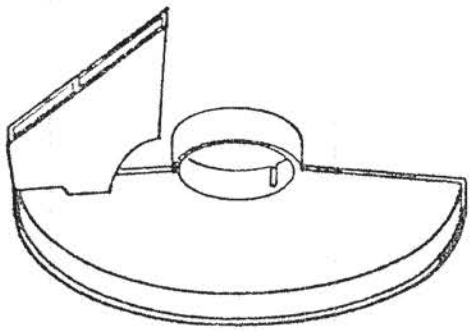
AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

EXTRACTOR HEAD FOR SMALL RADIAL GRINDERS

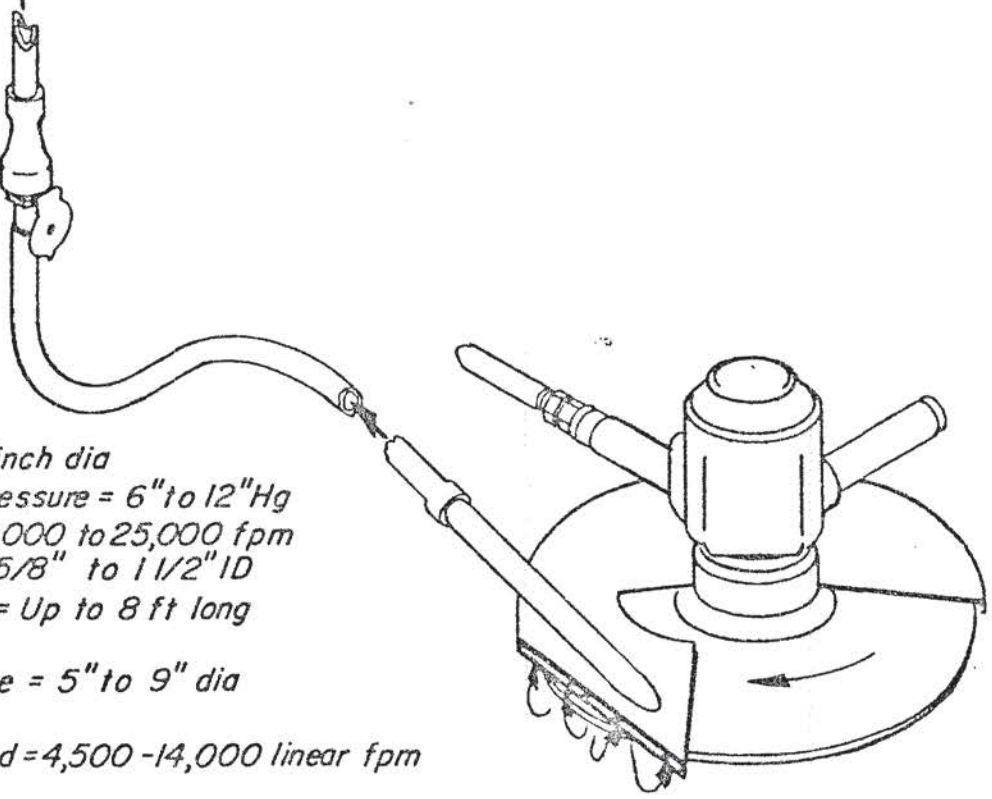
DATE 1-72	VS-804



6" to 12" Hg



Bottom view of extractor hood



Q = 10 - 30 cfm / inch dia
Branch static pressure = 6" to 12" Hg
Slot velocity = 10,000 to 25,000 fpm
Flexible hose = 5/8" to 1 1/2" ID
Extension hose = Up to 8 ft long

Sanding disc size = 5" to 9" dia

Peripheral speed = 4,500 - 14,000 linear fpm

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS	
EXTRACTOR HOOD FOR DISC SANDER	
DATE 1-72	VS-805