

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

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-101-190

INGERSOLL RAND - FOUNDRY DIVISION
ATHENS, PENNSYLVANIA

MAY 1975

I TOXICITY DETERMINATION

It has been determined that employees performing sand mulling, pouring and shakeout operations are exposed to potentially toxic concentrations of crystalline silica (quartz) which can cause the respiratory disease, silicosis. This determination is based on the finding of excessive concentrations of silica containing dust in the work environment in a study conducted from June 25, to 28, 1974.

Although physical agents are outside the scope of section 20(a) (6), it is NIOSH policy that where health hazards are observed in workplaces under investigation, specific mention of such be incorporated and reported. Excessive high noise levels were measured in many work locations, that can 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.

Finally, it was observed that excessive quantities of natural gas (mostly methane) was escaping from approximately 50 unlit gas nozzles. This gas created a potentially explosive gas hazard, as it approached 25 percent of the lower explosive limit for methane.

No medical investigation was considered necessary, at this time since the pathological effects of the observed exposures are well known and documented; their methods of diagnosis, (silicosis by pulmonary function testing and roentgenogram examination, and noise induced hearing loss by audiometric testing) and these medical examinations are the prime responsibility of the company's medical department. Specific environmental and medical control recommendations are presented in the main body of this 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) Ingersoll Rand - Foundry Division
- b) Authorized Representative of Employees
- c) U. S. Department of Labor - Region III
- d) NIOSH - Region III

For the purposes of informing the approximately 95 "affected employees" the employer will promptly "post" the Determination Report in a prominent place(s) near where effected 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 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) has received such a request from an authorized representative of employees regarding exposure to dust during normal foundry operations.

IV HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

This foundry is a semi-automated foundry consisting of core and sand molding, pouring, shakeout and cleaning areas. All of the above areas were evaluated for environmental contaminants.

Core molding is performed both manually and using core blowing machines. There are three machines in the area.

Sand molding is by an automated machine. Conditioned sand along with wood flour, bentonite and sea coal are mixed, conveyed to the molding machine where the molds are made and the cores are inserted. These mold are conveyed to the pouring station where the molten metal is poured from a ladle which is on a track. These casting are then conveyed at set speed to the shakeout area where the automated shakeout is performed..The sand is transported to the conditioning area and the cast iron is conveyed to an area where the excess metal is removed manually. These castings are then conveyed to the clean area for shot blasting and grinding and inspection.

B. EVALUATION PROGRESS

An initial survey of Ingersoll Rand - Foundry Division was conducted by Mr. Albert A. Maier, NIOSH, Region III, Industrial Hygienist on September 5, 1973. A follow-up environmental survey was conducted by Walter Chrostek and Wesley Straub, Industrial Hygienists, NIOSH, Region III on June 25-27, 1974.

C. EVALUATION METHODS

Employee exposures to airborne quartz containing dust were evaluated using personal air sampling equipment. Breathing zone samples were collected on pre-weighed PVC filters following a cyclone pre-sampler which removed non-respirable particles. Respirable dust concentrations were calculated from results of filter gravimetric analysis.

Samples of the respirable dust were analyzed for quartz content using the colorimetric method of Hyslop and Talvitie(1).

Occupational noise exposure levels (dBA re $2(10^{-5} \text{ N/M}^2)$) were determined using a General Radio Model 1565 B sound level meter.

The concentrations of natural gas in the work atmosphere were determined utilizing a Davis combustible gas meter, previously calibrated for methane gas response, supplied by Pennsylvania Southern Gas Company.

D. EVALUATION CRITERIA

1) ENVIRONMENTAL

Silica Dust

The Occupational Health Standard as proposed to the U. S. Department of Labor (OSHA) by the National Institute of Occupational Safety and Health (NIOSH) in the criteria for a recommended standard entitled "Occupational Exposure to Crystalline Silica"(2) is 0.050 milligram per cubic meter (mg/M³), time weighed average (TWA) as determined by a full-shift sample for up to a 10-hour workday, 40 - hour workweek.

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 noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 + C_n/T_n$ exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure permitted at that level."

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level."

2) MEDICAL

The National Institute of Occupational Safety and Health (NIOSH) has also proposed to the U. S. Department of Labor (OSHA) in the criteria for a recommended standard "Occupational Exposure to Crystalline Silica" the following medical criteria.

a) Medical examinations shall be made available to all workers subject to "exposure to free silica" prior to employee placement and at least once each 3 years thereafter. Examinations shall include as a minimum:

(1) A medical and occupational history to elicit data on worker exposure to free silica and signs and symptoms of respiratory disease.

(2) A chest roentgenogram (posteroanterior 14" by 17" or 14" by 14") classified according to the 1971 ILO International Classification of Radiographs of Pneumoconioses. (ILO U/C International Classification of Radiographs of Pneumoconioses 1971, Occupational Safety and Health Series 22 (rev). Geneva, International Labor Office, 1972).

(3) Pulmonary function tests including forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1) to provide a baseline for evaluation of pulmonary function and to help determine the advisability of the workers using negative- or positive- pressure respirators. It should be noted that pulmonary function tests may vary significantly in various ethnic groups. For example, in black persons, the test values for the FVC should be divided by 0.85 before the percentage value is compared with normal figures.

(4) Body weight.

(5) Height.

(6) Age.

(7) Initial medical examinations for presently employed workers shall be offered within 6 months of the promulgation of a standard incorporating these recommendations.

(b) Medical Management

An employee with or without roentgenographic evidence of silicosis who has respiratory distress and/or pulmonary functional impairment should be fully evaluated by a physician qualified to advise the employee whether he should continue working in a dusty trade.

(c) These records shall be available to the medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employee or former employee and of the employer.

(d) Medical records shall be maintained for at least 30 years following the employee's termination of employment.

NOISE

OSHA has proposed⁽⁴⁾ rules that a hearing conservation program be initiated in areas where employees are required to wear hearing protectors or where an employee receives a daily noise dose equal to or exceeding 0.5. The hearing conservation program shall include at least annual audiometric test. Audiometric testing shall be preceded by a period of 14 hours during which noise levels were less than 80 dBA.

E. EVALUATION RESULTS AND DISCUSSION

1) Silica Dust Exposure

Twenty respirable dust and general air samples were collected and analyzed gravimetrically. Of the twenty samples, twelve (12/20) were analyzed for quartz content. The calculated dust concentrations and quartz content are contained in Table 1.

As can be seen, exposure to quartz containing dust approached or exceeded the proposed Threshold Limit Value (TLV) at the sand mulling, pouring and shakeout operations.

At the sand mulling operation, the sources of atmospheric contamination were a) ruptures in the local ventilation ducts b) leakage, cause by back pressure, of dust from the bin containing the bentonite, and c) spillage of sand at transfer points.

The cause for the higher than expected exposures at the pouring station was the inadequate containment of the hot sand at the shakeout operation which is located directly behind the pouring station and the inoperable exhaust fan on the new section of the local exhaust ventilation hood.

Exposures to quartz containing dust approached the TLV shakeout (casting removal) station. Sources of the dust were the incomplete separation of the sand from the casting when it reached the casting removal station. Since the casting and sand are hot when they reach this point, the thermal rise causes the dust to dissipate into the breathing zone of the operator.

Noise Exposure

Noise exposure levels greatly exceeded the OSHA permissible levels at the casting removal, mulling, molding and grinding stations. Some authorities are attempting to further lower the permissible noise levels. The sources generating the noise were the roof fans, vibrators and castings clashing with each other. Modern technology has developed quieter fans and vibrators. Elimination of these sources will greatly decrease the noise levels. There may be other sources of noise which were not readily discernible. These also should be controlled as much as possible.

Natural Gas

Exposure to excessive amounts of natural gas were caused by approximately 50 gas nozzles on the core machine being left unlit. These nozzles were unnecessary for the operation and should have been capped. Allowing gas into the work atmosphere can cause not only unnecessary exposures but can also create an explosive atmosphere.

F. RECOMMENDATIONS

Engineering

In view of the findings of this evaluation which demonstrates a silica exposure which approached or exceeded the proposed levels recommended by NIOSH to OSHA, the following recommendations are made.

Silica Dust

1. Establish a periodic maintenance program for all ventilation systems. Special attention should be given to all duct ruptures and assuring that all fans are operating at maximum efficiency:
2. Install local exhaust ventilation at the shakeout (casting removal) station and sand return belt.
3. Decrease the free fall of sand from the belts at all locations.
4. Install a lid on the bentonite-sea coal bin.
5. Until such a time as dust exposures are controlled, supply and require that employees wear approved personal respiratory equipment.
6. Maintain the personal respiratory equipment in a clean and sanitary condition.

Noise

7. Investigate the use of quieter fans and vibrators. These are now available commercially.
8. Until such a time as noise levels are reduced, supply and require employees to wear ear protective devices.

Natural Gas

9. All jets which are not in use must be capped.

Medical

10. Adopt all the medical recommendations as outlined in "Medical Criteria" for silica dust and noise which were previously defined.

REFERENCES:

1. Talvitie NA, Hyslop F: Colorimetric determination of siliceous atmospheric contaminants. Am Ind. Hyg. Assoc. J 19:54-58, 1958.
2. Criteria for a Recommended Standard ... Occupational Exposure to Crystalline Silica. U. S. Dept. of Health, Education and Welfare, PHS, NIOSH, 1974.
3. Federal Register, Vol. 39, No. 125, Part II, Subpart G, June 27, 1974.
4. Federal Register, Vol 39, No. 207, October 24, 1974, page 37776.
5. American Conference of Governmental Industrial Hygiene: Industrial Ventilation, A Manual of Recommended Practice, 12th Edition.
6. U. S. Standard, Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises, 283.1 - 1968.

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TABLE I
Summary of Airborne Dust Concentration Data

Ingersoll Rand - Foundry Division
Athens, Pennsylvania

June 25 - 27, 1974

Quartz Dust Concentrations						
Sample No.	Job Description	Air Volume M ³	Dust Concentration		%Quartz	Remarks
			Total Respirable mg/M ³	Respirable Quartz **		
I R 1	Sand Mulling	1.03	.99	.070	7.1	Operator's exposure
I R 19		1.96	2.23	.158		
I R 2	Molding	1.06	.75	.029	3.8	Operator's exposure
I R 18		.88	.43	.016		
I R 3	Pouring	1.07	1.58	.112	7.1	Operator's exposure
I R 21		.83	1.01	.072		
I R 4	Shakeout	.97	.90	.083	9.2	Operator's exposure
I R 20		.99	.51	.047		
I R 5		2.16	.34	.004	1.1	General Air
I R 6		2.34	.37	.004		
I R 7	Grinding	.91	.54	.014	2.6	Operator's exposure
I R 10		1.01	.76	.020		
I R 8	Core Molding	.87	.04	.002	6.1	Operator's exposure
I R 9		.86	.30	.018		
I R 11	Core Mulling	.70	.70	.043	6.1	Operator's exposure
I R 15		4.97	.04	.002		
I R 12	Wheelabrator	.82	.20	.004	2.1	Operator's exposure
I R 16		.87	.55	.012		
I R 14	Laborer	.42	.23	.003	1.1	Operator's exposure
I R 17		.83	.49	.012		

* denotes -----milligram of dust per cubic meter of air sampled.

** denotes - NIOSH recommended standard for quartz dust - 0.050 milligram per cubic meter of air

TABLE II
Summary Noise Levels

Ingersoll Rand - Foundry Division
Athens, Pennsylvania

June 25 - 27, 1974

Allowable Exposure Times

Operation	Noise Level* dBA	Allowable Exposure Times		Normal Exposure Time (hours)	Remarks
		NIOSH** Hrs.	OSHA Hrs.		
Casting Removal	94-96	2.5	5	7	Operator's exposure
Mulling	100-102	0.9	1.8	7	Operator's exposure
		1.5	3		Between miller & dumping Adding station
Molding	95-96	2.5	5	7	Operator's exposure
Pouring	89	4	8	7	Operator's exposure
	90	4	8		North side Center
	92-93	3	6		South side
Grinding	91-92	3	6	7	Operator's exposure Idling
	94-95	2.5	5		Grinding
Wheelabrator	91-92	3	6	7	Operator's exposure

* A - Weighted sound pressure level having a reference level of 0.00002 N/M².

** Source - NIOSH criteria for a recommended standard for Occupation Exposure to Noise