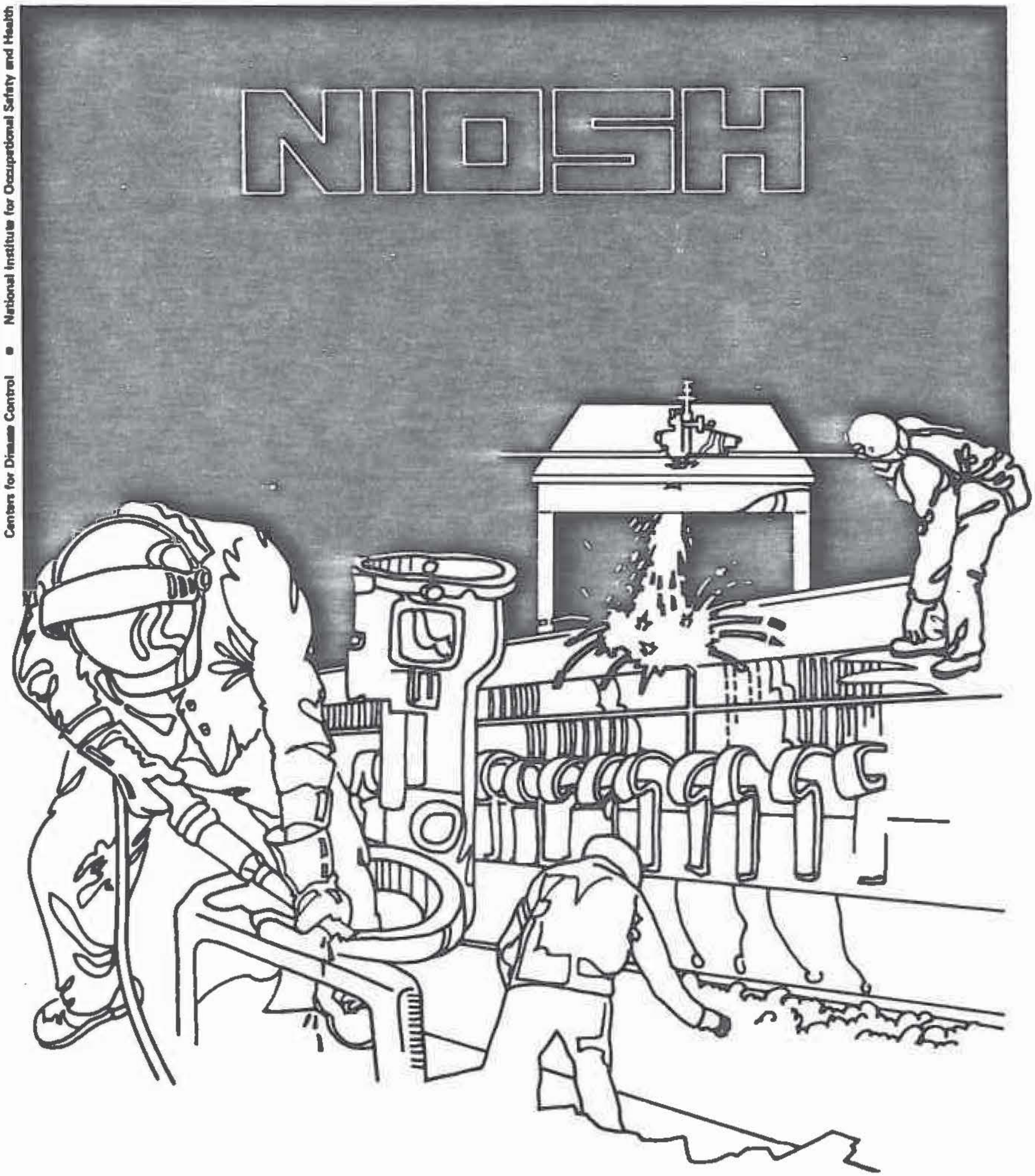
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-130-1348
JONES AND LAUGHLIN
STEEL CORPORATION
PITTSBURGH, PENNSYLVANIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-130-1348
AUGUST 1983
JONES AND LAUGHLIN STEEL CORPORATION
PITTSBURGH, PENNSYLVANIA

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I. SUMMARY

In January 1981, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate (1)occupational exposures and (2)the mortality experience of workers in the Steel Producing Department at the Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania. This department processes scrap iron and steel in electric-arc furnaces to produce carbon steel ingots.

In January and May 1981, NIOSH investigators conducted an environmental evaluation to measure exposures to respirable crystalline silica, iron oxide, manganese, nickel, respirable particulate, and carbon monoxide. The results of these samples showed that respirable crystalline silica (as quartz) was present in 5 (19%) of 26 samples; cristobalite was not present (detection limit of <0.03 mg per sample). The 8-hour time-weighted average (TWA) concentrations of quartz in 5 of 11 samples obtained in the breathing zone of mold preparers ranged from 0.04 to 0.11 mg/m^3 (mean 0.06, S.D. $\pm$0.03). The NIOSH recommended standard is 0.05 mg/m^3 8-hour TWA. The quartz content (percent by weight) in settled dust samples obtained from the mold preparation platform ranged from 42 to 44% and that in the refractory sideboards ranged from 54 to 72%. Twenty-six 8-hour TWA respirable dust concentrations ranged from 0.30 to 1.24 mg/m^3 (mean 0.52, S.D. $\pm$0.29); the OSHA permissible exposure limit (PEL) is 5.0 mg/m^3. Twenty-seven 8-hour TWA iron oxide concentrations ranged from 0.06 to 2.45 mg/m^3 (mean 0.43, S.D. $\pm$0.53); the OSHA PEL is 10 mg/m^3. Twenty-seven 8-hour TWA manganese concentrations ranged from 0.01 to 0.27 mg/m^3 (mean 0.04, S.D. $\pm$0.06); the OSHA PEL is 5.0 mg/m^3 as a ceiling limit. Nickel was present ($\overline{0}$.005 mg/m^3, 8-hour TWA) in 1 of 27 samples; the NIOSH recommended standard is 0.015 mg/m^3. Carbon monoxide concentrations ranged from 1 to 15 ppm. NIOSH recommended standards are 35 ppm 8-hour TWA, and a ceiling limit of 200 ppm.

To evaluate the mortality experience of the Steel Producing Department we reviewed a previously conducted mortality study of the steel industry and extracted the data for the plant in question. The mortality study included workers employed during the period 1953 to 1975. Results from that study were assumed to be indicative of the mortality patterns for the period 1976 to the present. The study found no excess risks of malignant disease. However, both white and non-white masons were at excess risk of death due to non-malignant respiratory disease, presumably silicosis. White electric furnace, open hearth, and janitorial workers were at excess risk of non-malignant digestive disease. Both white and non-white maintenance workers had a relatively large excess of death due to accidents. It is not known if all these associations are the result of occupational causes, but the risk of respiratory disease in masons is most likely occupational and is probably due to silica exposure.

On the basis of air, settled dust, and bulk sample analyses, NIOSH concludes that mold preparers are exposed to potentially toxic concentrations of respirable crystalline silica. Based on the results of a previous mortality study, masons are likely to be at increased risk of work-related, non-malignant respiratory disease. Recommendations concerning environmental and medical surveillance are presented in Section VIII of this report.

KEYWORDS: SIC 3310 (Blast Furnaces, Steel Works, and Rolling and Finishing Mills), crystalline silica, quartz, electric-arc furnaces, respiratory disease, masons, silicosis.

II. INTRODUCTION

In January 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from Local Union 1272, United Steel Workers of America, at the Jones and Laughlin Steel Corporation in Pittsburgh, Pennsylvania, to investigate current exposures to workers in the Steel Producing Department and the occurrence, since 1976, of cancer in several workers from that department.

NIOSH distributed Interim Report No. 1 for this investigation in February 1981, following the preliminary visit to the plant in January 1981. In September 1981, NIOSH distributed Interim Report No. 2, which presented the results of the May 1981 follow-up visit.

III. BACKGROUND

A. Description of Process

The Steel Producing Department of Jones and Laughlin Steel Corporation is engaged in the processing of scrap iron and steel in electric-arc furnaces to casting of ingots of various carbon steels. The electric-arc furnaces were installed and operating in 1978; prior to then, the department operated with open-hearth furnaces. The department employs approximately 750 persons.

The Steel Producing Department incorporates two multi-phase 3-electrode arc furnaces, each capable of yielding a 350-ton tapped heat. The two 32-foot diameter furnaces and electrode control mechanisms are mounted on a tilting rocker platform flush with the operating floor. The entire assembly tilts backwards about 15 degrees for slag removal through the rear door and forward about 40 degrees to tap the heat and drain the furnace completely of any remaining slag.

Iron and steel scrap and other metallic materials are charged from a clam shell drop bottom-type bucket brought over the furnaces by the charging crane. The cantilevered roof suspension system and electrode control mechanism swing away from the furnace top to facilitate the charging operations. After charging, the furnace roof is returned to close the arc furnace and the three electrodes are lowered to effect the melting of the charge. Oxygen additions for decarburization of the liquid metal are made through sidewall ports in each furnace using consumable pipes. Burnt lime additions for slag formation are made pneumatically through the furnace roof. Slag removal prior to tapping occurs through the back slag door into a positioned 600-cubic foot slag pot mounted on a transfer car located beneath the furnace in the pit area. Final slag removal is done after the metal tap and is into the same pot repositioned under the tapping spout. The slag pot is then moved to the teeming area, where its taken by crane from the transfer car to a set-down area. The slag is transferred from the set-down area by a contractor to a dumping and process area outside of the department.

The heat is tapped into a 350-ton teeming ladle on a transfer car in the pit area. The ladle is then carried by a crane to one of four pouring platforms where the liquid steel is teemed into a series of cast iron molds of the desired dimensions. Alloying materials are added immediately after the liquid steel is poured into the mold. The steel solidifies in each of the molds to form a casting called an ingot. After removal from the mold by a process called stripping, the ingot is placed with other ingots in a pit-type furnace called a soaking pit where it is brought to the proper temperature for hot working. (The soaking pit is located outside of Steel Producing Department.)

The molds and mold caps are transferred to the mold preparation areas (known as the new and old C&D platforms) for cleaning. Mold preparation involves blowing and/or vacuuming particulate matter from the base of the stripped mold and removal of the metal overflow deposited on the mold transfer car via a cutting torch. In addition, certain molds and mold caps, particularly those used for killed steels, are equipped with refractory hot top liners (exothermic inserts) to maintain the steel at the top of the ingot molten long enough to minimize the shrinkage cavity or pipe. Manufacturers specifications for the various exothermic inserts indicate the crystalline silica content varies between 25 to 90% (weight/weight).

The teeming ladles are relined in one of two areas. The ladles are presently lined with a high-alumina refractory brick containing 24 to 37% (weight/weight) crystalline silica and 59 to 70% (weight/weight) alumina, depending on the manufacturer. The crystalline silica content of the refractory brick used in previous years would likely have been higher.

B. Exposure Controls

The process fume emissions originating in the electric furnaces during meltdown and refining periods, including oxygen lancing, are controlled by a direct evacuation, water cooled duct exhausting through a port in the furnace roof. Further gas temperature reduction is accomplished by the introduction of dilution air and by radiant tube cooling before the gas stream enters a 600,000 acfm capacity baghouse. Additional process fumes generated in tapping or final slagging off of the furnaces are captured by a closely fitted hood on the teeming aisle side of the furnace. Fugitive emissions resulting from the charging of the materials into the furnace when the roof is open rise by natural convection into the overhead roof canopies. The canopies are ultimately exhausted through a secondary baghouse.

The teeming platforms and mold preparation areas are ventilated by natural air currents.

IV. STUDY DESIGN AND METHODS

The environmental evaluation focused on current exposures in the Steel Producing Department. The epidemiological evaluation focused on determining whether there had been a risk of cancer of the respiratory or other organ systems in workers in the same department from past exposures.

A. Environmental Evaluation

Air sampling was conducted to characterize exposures to respirable crystalline silica, respirable dust, three inorganic metals (iron oxide, manganese, and nickel), and carbon monoxide. The respirable crystalline silica, respirable dust, and metals were collected using calibrated constant-flow sampling pumps operating at 1.7 liters per minute (lpm). The respirable silica and respirable dust was collected on a tared polyvinyl chloride filter contained in a 2-piece cassette mounted in a 10 mm cyclonic separator. The crystalline silica content was determined using X-ray diffraction according to NIOSH P&CAM No. 259.[1] The respirable dust was determined gravimetrically by weight gain of the filter. The metals were collected on 0.8 um mixed cellulose ester filters in 3-piece closed-faced cassettes and analyzed using atomic absorption spectrophotometry according to NIOSH P&CAM No. 173.[1] Carbon monoxide concentrations were measured using a calibrated direct-reading instrument - Ecolyzer Model 6000. Samples of settled dust and two hot top liners were obtained for crystalline silica and asbestos analysis.

B. Epidemiologic Evaluation

The mortality experience in the Steel Producing Department, during the past five years was evaluated by reviewing company-specific results of the industry-wide study of Redmond et al.[2] This was a retrospective mortality study of 58,821 steel workers employed between 1953 and 1975. Since one of the companies included in that study was the Jones and Laughlin Steel Corporation, it was possible to extract from that study specific information pertaining to the Pittsburgh Works, including the steel producing plant. The assumption was made that the mortality experience of the last five years did not differ significantly from that of the previous 22 years. Hence, any mortality pattern found between 1953 and 1975 would prevail in the period 1976 to 1981.

The work areas that were included in the review were open hearth, electric furnace, general labor, electric maintenance assigned, mechanical maintenance assigned, and riggers and structural. These work area designations were the ones used by Redmond et al.[2] for the industry-wide study. All jobs and work areas in the industry were combined into 57 work area designations.

The relevance of these 57 industry-wide work area designations to the health hazard appraisal of a specific plant may be questioned. However, even though specific jobs or areas in the steel producing plant are combined into standardized categories, the mortality patterns are plant specific. This approach is, therefore, useful for detecting gross excesses of cause-specific death by standard work area. Any excesses must then be interpreted for the specific plant in question.

Cause of death information was reviewed for people who ever worked in the plant during one of the following periods, each defining an employment cohort:

1. Employment in a particular work area based on the first job held in 1953.[2] Men so employed are compared to all other steel workers.

2. Employment in a particular work area based on having worked in that area for at least one month prior to or during 1953. Men so employed in a given work area are compared to steel workers never employed in this work area through 1953.

3. Employment in a particular work area based on having worked in that area for the last five years prior to or during 1953. Men so employed in given work areas are compared to all other steel workers having accumulated five or more years experience in the steel industry prior to or during 1953.

For the Jones and Laughlin Pittsburgh Works, cohorts defined by the first and second definition were comprised of 11,562, workers of whom 3,809 were deceased. The third cohort was comprised of 7,881 workers, of whom 3,284 were deceased. The vital status of cohort members was determined as of the end of 1975. All deaths were classified according to the Seventh and Eighth Revisions of the International Classification of Diseases[2].

Mortality risks were analyzed by computing relative risks (RR) for selected causes of death by race, age at entry into the study, interest or comparison group, and calendar years of follow-up: 1953-57, 1958-62, 1963-67, 1968-72, 1973-75. Estimated relative risks for each stratum were combined to form an overall relative risk. The relative risk is a weighted average of the observed and expected number of deaths for each stratum where weights used are approximately proportional to the stratum precision. To test whether the relative risks differ significantly from 1.0, a summary chi-square with one degree of freedom has been calculated.[3]

An additional evaluation of the death certificates of four workers, named specifically at the opening conference, was performed for the presence of mesothelioma or some other consistent respiratory disease pattern.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

The environmental criteria and primary health effects associated with the substances evaluated are presented in Appendix A.

B. Epidemiologic Evaluation

In order to find out if there is an excess of deaths due to a particular cause in a workplace, a common approach is the retrospective cohort mortality study. This type of study involves first identifying all people who worked in a particular plant for a given minimum amount of time, then determining, as of a given date, who is alive and who is dead. For those who are dead, their death certificates are gathered and the number of deaths due to a specific disease, such as for example, lung cancer, are compared with the number that would be expected if the rates of disease were the same as some standard, such as, the general population or all the workers in a given plant.

The number of deaths observed are compared to the number expected by a measure known as the relative risk. If the relative risk is statistically greater than 1.0, an excess risk death due to that specific cause is believed to be present. Even if an excess relative risk is found, it must be interpreted in terms of consistency with other studies and biologic plausibility before it can be stated that a disease may be the result of some occupational situation.

VI. RESULTS

A. Environmental Evaluation

Table I presents the quartz and asbestos analyses for settled dust samples obtained within the Steel Producing Department and samples of two types of hot top refractory liners. The quartz content (percent by weight) in settled dust samples obtained from the mold preparation platforms ranged from 42 to 44%, and that in the hot top refractory liners ranged from 54 to 72%. Samples of settled dust obtained from surfaces around the 91 furnace and floor of teeming platform No. 4 contained 3.9 and 15% quartz, respectively.

Asbestos was not detected in any sample at the lowest level capable of being measured using polarized light microscopy and dispersion staining analytical techniques.

Table II presents the airborne exposure concentrations of respirable crystalline silica and respirable dust by mold preparers, teeming helpers, nozzle setters, and 700 series craneman. Quartz was the only polymorph of crystalline silica detected above the lower limit of quantitation (LOQ); the LOQ for quartz and cristobalite was <0.03 mg per sample. The results are, therefore, reported as milligrams of quartz per cubic meter of air sampled (mg/m^3).

Quartz was detected in five of 11 personal samples obtained in the breathing zone of the mold preparers. The 8-hour time-weighted average (TWA) concentrations ranged from 0.04 to 0.11 mg/m^3 (mean 0.06, S.D. $\pm$0.03). Analyses of the personal breathing zone, settled dust, and hot top refractory liner samples indicate that the mold preparers are at increased risk of exposure to crystalline silica above the NIOSH recommended standard. Quartz was not detected above the LOQ in the other 15 air samples collected on the teeming helpers, nozzle setters, and craneman. The relative respirable dust concentrations reported as mg/m^3 8-hour TWA by job classifications are: craneman (mean 0.68, range 0.30 to 1.24), nozzle setters (mean 0.64, range 0.53 to 0.75), teeming helpers (mean 0.38), mold preparers (mean 0.37, range 0.28 to 0.66). By comparison, the OSHA Permissible Exposure Limit (PEL) for respirable dust is an 8-hour TWA of 5.0 mg/m^3.

Table III presents the airborne exposure concentrations of iron oxide, manganese, and inorganic nickel by burners, steel pourers, teeming helpers, furnace helpers, and 700 series craneman. A maximum 8-hour TWA iron oxide concentration of 2.45 mg/m^3 was measured in the breathing zone of a burner, which is 25% of the OSHA PEL of 10 mg/m^3. The other 27 samples showed iron oxide concentrations of less than 17% of the OSHA PEL. The 8-hour TWA manganese concentrations ranging from 0.01 to 0.27 mg/m^3 were less than 5% of the OSHA PEL. Inorganic nickel was detected in one of 27 samples (limit of detection of 0.002 mg per sample). An 8-hour TWA concentration of 0.005 mg/m^3 was measured in the breathing zone of a burner; the NIOSH recommended standard is 0.015 mg/m^3.

Table IV presents the carbon monoxide concentrations measured at the No. 1 pouring platform, C&D platform, ladle crane 714, and charging crane 703. The carbon monoxide levels ranged between 1 to 15 ppm. By comparison, the NIOSH recommended standards are an 8-hour TWA of 35 ppm and a ceiling concentration of 200 ppm.

The potential exposures to crystalline silica by masons involved in teardown and relining of ladles were not evaluated. Neither operation was being conducted during the period of the survey. Excessive exposures to crystalline silica, however, is not uncommon during such operations, especially the teardown phase. Presently, much of the ladle relining work is contracted out.

B. Epidemiologic Evaluation

1. Mortality Patterns 1953 to 1975

Table V shows the cause specific mortality and statistically significant ($p<.05$) relative risks for work areas in this investigation. Both white and non-white electric furnace workers had an excess risk of dying from other cardiovascular-renal disease (RR 1.97 and 1.85, respectively). White workers in this area also had an excess risk from cirrhosis of the liver (RR 3.00), non-malignant digestive disease (RR 3.10), and other non-malignant digestive disease (RR 3.26). All but the non-malignant digestive disease were in the cohort defined by the first job held in 1953. These results were not observed in the other employment cohorts. White open hearth workers had a slight excess (RR 1.90) risk of death due to non-malignant digestive disease for the cohort with five or more years employment.

In the mason department, white workers showed excess mortality from non-malignant respiratory disease (RR 2.30-2.91) for all three employment cohorts. Non-white workers in the department were also at excess risk for that cause of death for the employment cohort that ever worked there through 1953. These findings were consistent with those of the overall industry-wide study, as were the findings of a slight excess (RR 1.24) risk for death from all causes.

Non-white workers in mechanical maintenance-assigned had significantly greater mortality than expected for cardiovascular diseases (RR 3.22) and arteriosclerotic heart disease (RR 3.52). Both white and non-white workers had excess risk of death due to accidents (RR 3.22 and 2.90, respectively).

White janitors showed a significant excess mortality from non-malignant digestive disease. This finding was consistent with the overall industry-wide study.

No excess mortality risks were found in the general labor, electric maintenance, and riggers and structural work areas. A striking finding was the failure to observe an excess risk for cancer in electric furnace workers since in the overall study this was significantly elevated.

2. Workers Who Died Between 1975 and 1981

No systematic evaluation was performed on these workers, but certain specific cases were evaluated because of the concern for excess deaths due to mesothelioma. There were reports that a number of workers from the Steel Producing Department had died of mesothelioma. Three of four identified former workers had cancer, but none were mesothelioma.

VII. DISCUSSION

The work areas used in the Redmond study[3] represent combinations of jobs grouped for the purpose of intra-industry comparisons. Consequently, the relevance of these categories to a specific investigation is limited to flagging standard work areas or job types that might need further detailed evaluation.

Excess risk of death due to malignancy of the respiratory system was not evident for the work areas of concern in either the industry-wide study or the subset representing the Jones and Laughlin Steel Corporation for the period ending 1975. It is not likely that the pattern of deaths occurring between 1976 and 1981 differs substantially from that occurring between 1953 and 1975. Hence, it is not expected that malignant respiratory disease would be in excess in workers who died between 1975 and 1981.

The method of analysis used by Redmond et al.[3] is designed to be more sensitive to identifying those work areas which consistently show an excess or deficit in mortality over time. In other words, statistical significance for the mortality patterns from 1953 to 1975 is most likely to be found whenever the differences observed in the five time periods are all in the same direction.

A variety of work areas in this investigation were found to be associated with excess cause-specific mortality. The question is whether any of these associations are likely to be due to occupational exposures, and which of the associations can be explained by direct selection for health, by selection for other characteristics associated with health and mortality, or as unlikely chance occurrences.

All of the causes of death that were significantly in excess for the work areas in the investigation were non-malignant diseases. Non-malignant digestive disease was found in excess in the electric furnace, open hearth, and janitorial departments. This result was found in the overall cohort as well as in the specific plant. Redmond et al.[2] did not speculate about the specific cause of this excess.

Two occupational exposures might be linked to this excess risk. Some investigators have reported higher incidences of digestive disorders and have related this to magnesium absorption, but the evidence is scant.[3] Magnesium has been found in steelmaking operations. Manganese also has been identified in the steel producing department. Manganese has a predilection for the liver and spleen.[4] Whether deposit in these organs is related to the excess risk of death due to non-malignant digestive disease is speculative. More substantial is the probable cause of the increased risk for masons due to non-malignant respiratory disease. This has been attributed to working with abrasive and dusty materials. Crystalline silica causes silicosis, a non-malignant respirtory disease.

The excess risk of cardiovascular-renal disease in electric furnace workers and mechanical maintenance-assigned workers, as well as arterosclerotic heart disease in the latter group, are not readily explainable. Carbon monoxide is the most common cardiovascular toxin identified in steel producing plants, but not found in excess in this investigation.

The finding of a relatively large excess of deaths due to accidents in mechanical maintenance workers assigned workers, both white and black, is curious. Such a finding was evident in white maintenance workers in the industry-wide study. It would be useful to find out if a large percentage of those accidents were occupational.

VIII. RECOMMENDATIONS

1. Additional personal breathing zone air sampling should be conducted to more fully determine the extent of crystalline silica exposures by the mold preparers. Section IV of the NIOSH recommended standard for crystalline silica[5] should be consulted for interim exposure control procedures. Environmental and medical surveillance programs[4] should be established and instituted according to the results of the recommended sampling.

2. Exposures to crystalline silica by masons involved in ladle repairs should be evaluated and appropriate exposure controls instituted accordingly. Masons should be evaluated periodically for respiratory disease, specifically silicosis if air sampling shows exposure.

3. The accident rate for mechanical maintenance workers should be evaluated to see if it exceeds in-plant norms.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania
2. United Steel Workers of America, Local Union 1272, Pittsburgh, Pennsylvania
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing approximately 750 affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Analyses of Bulk Solid Samples for Crystalline Silica* and Asbestos

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

January 15, 1981

Sample Description	% Present in Sample		
	Quartz	Cristobalite	Asbestos
Settled dust from surface around furnace 91	3.9	<1.5	ND**
Settled dust from floor on No. 4 teeming platform	15	<1.5	ND
Settled dust from floor of hot top platform	44	2.0	ND
Settled dust from floor of new C&D platform	42	<1.5	ND
Sample of unused unreco side board	54	<1.5	ND
Sample of unused universal side board	72	<1.5	ND

* Quartz and cristobalite are two polymorphs of crystalline silica.
** ND denotes non-detected.

TABLE II

Airborne Concentrations of Respirable Crystalline Silica and Respirable Dust[a]

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

May 11-15, 1981

Date	Sample Description	Sample Period	8-Hour TWA - mg/m^3	
			Quartz	Respirable Dust
5-11	Mold Preparer	1438-2156	<LOQ[b]	0.66
5-11	Mold Preparer	1528-2156	<LOQ	0.36
5-11	Mold Preparer	1500-2156	0.06	0.44
5-11	Mold Preparer	1439-2154	0.05	0.35
5-11	Mold Preparer	1440-2155	0.06	0.38
5-14	Mold Preparer	0645-1403	<LOQ	0.32
5-14	Mold Preparer	0714-1351	0.11	0.42
5-14	Mold Preparer	0651-1351	<LOQ	0.28
5-14	Mold Preparer	0650-1355	<LOQ	0.29
5-14	Mold Preparer	0628-1354	0.04	0.29
5-14	Mold Preparer	0735-1403	<LOQ	0.28
5-11	Teeming Helper	1438-2222	<LOQ	0.38
5-11	Teeming Helper	1444-2214	<LOQ	0.38
5-11	Nozzle Setter	1418-2133	<LOQ	0.53
5-11	Nozzle Setter	1437-2134	<LOQ	0.75
5-13	Crane Cab 703	0559-1413	<LOQ	1.02 (A)
5-15	Crane Cab 703	0605-1415	<LOQ	0.87 (A)
5-15	Crane Cab 704	0613-1415	<LOQ	0.76 (A)
5-13	Crane Cab 705	0556-1415	<LOQ	1.24 (A)
5-15	Crane Cab 705	0602-1415	<LOQ	0.77 (A)
5-13	Crane Cab 706	0607-1415	<LOQ	1.20 (A)
5-15	Crane Cab 712	0701-1345	<LOQ	0.33 (A)
5-13	Crane Cab 713	0640-1405	<LOQ	0.32 (A)
5-15	Crane Cab 713	0655-1347	<LOQ	0.29 (A)
5-13	Crane Cab 714	0650-1402	<LOQ	0.30 (A)
5-15	Crane Cab 714	0710-1347	<LOQ	0.30 (A)
Environmental Criteria			0.05[c]	5.0[d]

[a] Personal breathing zone concentrations, excluding those concentrations proceeded by "A" which are general area.
[b] LOQ denotes lower limit of quantitation; LOQ for quartz is 0.03 mg per sample.
[c] NIOSH recommended standard, 8-hour time-weighted average (TWA).
[d] OSHA Permissible Exposure Limit (29 CFR 1910.1000); 8-hour TWA.

TABLE III

Airborne Concentrations of Iron Oxide, Manganese, and Inorganic Nickel[a]

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

May 11-15, 1981

Date	Sample Description	Sample Period	8-Hour TWA - mg/m^3		
			Iron Oxide	Manganese	Nickel
5-12	Burner	0650-1401	2.45	0.03	0.005
5-12	Burner	0658-1408	0.55	0.02	<LOD[b]
5-14	Burner	0747-1419	0.43	0.01	<LOD
5-14	Burner	0654-1400	0.37	0.01	<LOD
5-11	Steel Pourer	1404-2005	0.30	0.01	<LOD
5-14	Steel Pourer	0716-1351	0.10	0.01	<LOD
5-14	Steel Pourer	0723-1355	0.15	0.01	<LOD
5-11	Teeming Helper	1401-2219	0.34	0.02	<LOD
5-11	Teeming Helper	1425-2225	0.17	0.01	<LOD
5-14	Teeming Helper	0712-1407	0.11	0.01	<LOD
5-14	Teeming Helper	0702-1350	0.12	0.02	<LOD
5-14	Teeming Helper	0658-1351	0.09	0.01	<LOD
5-12	Furnace 91: 2nd Helper	0631-1428	0.89	0.27	<LOD
5-15	Furnace 91: 2nd Helper	0620-1429	0.58	0.14	<LOD
5-12	Furnace 92: 2nd Helper	0627-1435	0.52	0.07	<LOD
5-15	Furnace 92: 3rd Helper	0646-1435	0.43	0.05	<LOD
5-13	Crane Cab 703	0559-1413	0.47	0.09 (A)	<LOD
5-15	Crane Cab 703	0605-1415	1.72	0.12 (A)	<LOD
5-15	Crane Cab 704	0613-1415	0.20	0.02 (A)	<LOD
5-13	Crane Cab 705	0556-1415	0.60	0.05 (A)	<LOD
5-15	Crane Cab 705	0602-1415	0.30	0.02 (A)	<LOD
5-13	Crane Cab 706	0607-1415	0.22	0.01 (A)	<LOD
5-15	Crane Cab 712	0701-1345	0.08	0.02 (A)	<LOD
5-13	Crane Cab 713	0640-1405	0.13	0.01 (A)	<LOD
5-15	Crane Cab 713	0655-1347	0.10	0.01 (A)	<LOD
5-13	Crane Cab 714	0650-1402	0.07	0.01 (A)	<LOD
5-15	Crane Cab 714	0710-1347	0.06	0.01 (A)	<LOD
Environmental Criteria			10[c]	5.0[c]	0.015[d]

[a] Personal breathing zone concentrations, excluding those concentrations proceeded by "A" which are general area.

[b] LOD denotes lower limit of detection; LOD for nickel is 0.002 mg per sample.

[c] OSHA Permissible Exposure Limit (PEL) (29 CFR 1910.1000): PEL for iron oxide is 10 mg/m^3 8-hour TWA; PEL for manganese is 5.0 mg/m3 as a ceiling.

[d] NIOSH recommended standard, 8-hour TWA.

TABLE IV

Work Area Concentrations of Carbon Monoxide

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

May 11-13, 1981

Date	Sample Description	Air Concentration Range - ppm
5-11	No. 1 Pouring Platform: Measurement period of 10 minutes during pouring of ingots	1 - 10
5-12	Ladle Crane 714: Measurement period of 25 minutes between furnace top through teeming	1 - 10
5-12	C&D Platform: Measurement period of 10 minutes	1 - 2
5-13	Charging Crane 703: Measurement period of 10 minutes included charging of the 91 and 92 furnaces	2 - 15
NIOSH Criteria:	8-Hour TWA	35
	Ceiling Value	200

TABLE V

Statistically Significant Relative Risks for
Work Areas Included in Hazard Evaluation 81-130

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

Industrywide Work Area	Cause of Death	Relative Risk: First Job in 1953	Relative Risk: Ever Worked Through 1953	Relative Risk: Worked 5+ Years	Highest RR Found in Whole Cohort
Electric Furnace	Other cardiovascular-renal disease	W1.97* NW185*			
	Cirrhosis of the liver	W3.00*			
	Non-malignant digestive disease	W3.10**			W1.83*
	Other non-malignant digestive disease			W3.26*	
Open Hearth	Non-malignant digestive disease		T1.69*	W1.90*	
Mason	All causes	1.24*			NW1.34**
	Non-malignant respiratory disease	W2.44*	W2.30* NW2.13**	W2.9**	W2.69**
Mechanical Maintenance Assigned	Cardiovascular-renal disease		NW3.22**	NW3.15**	
	Arteriosclerotic heart disease		W1.39* NW3.92**		W1.13*
	Accidents		W3.01	W3.22** NW2.90*	W1.27*
Janitor	Non-malignant digestive disease	W3.60*			W2.26**

W = White
NW = Non-white
T = W + NW
* Significant at 5% level
** Significant at 1% level

APPENDIX A

Evaluation Criteria and Primary Health Effects

Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania
HETA 81-130

May 1981

Substance	NIOSH*	ACGIH**	OSHA**	Primary Health Effects
Crystalline Silica (Respirable)	0.05 mg/m^3	$\frac{10\ mg/m^3}{\%\ Respirable\ quartz + 2}$	$\frac{10\ mg/m^3}{\%\ Respirable\ quartz + 2}$	Silicosis (non-malignant lung disease)
Respirable Dust	-	5 mg/m^3	5 mg/m^3	
Iron Oxide	-	5 mg/m^3	10 mg/m^3	Siderosis[a] (benign lung condition)
Manganese	-	5 mg/m^3 Ceiling	5 mg/m^3 Ceiling	Neurologic and personality abnormalities
Inorganic Nickel	0.015 mg/m^3	1 mg/m^3	1 mg/m^3	Dermatitis; lung and nasal cancer
Carbon Monoxide	35 ppm 200 ppm ceiling	50 ppm	50 ppm	Headache, dizziness, heart effects

* NIOSH recommendations based on up to a 10-hour exposure unless noted as a ceiling limit.

** Based on 8-hour exposure unless noted as a ceiling limit.

[a] Iron oxide in combination with crystalline silica can cause sidero-silicosis (a non-malignant lung disease).

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