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

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 78-66-542

U.S. STEEL SOUTH WORKS
CHICAGO, ILLINOIS

NOVEMBER 1978

I. TOXICITY DETERMINATION

A medical survey of foundry workers employed at U.S. Steel South Works was conducted in April 1978. Based on the results of medical examinations, including pulmonary function tests and chest X-rays, and a review of company medical records and chest X-rays, we determined that a health hazard exists from worker exposure to silica dust. There is evidence of silicosis in a number of currently employed and retired workers. Of 70 workers examined, 9 had silicosis; 5 of these - all chippers - had complicated silicosis. From company records and X-rays, 24 other definite or suspected cases of silicosis were identified.

A complete discussion of the results of the testing conducted at U.S. Steel South Works, as well as recommendations for environmental monitoring and medical surveillance, are included in this report.

II. DISTRIBUTION AND AVAILABILITY

Copies of this health hazard determination report are available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, this report will be available through The National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

A. U.S. Steel South Works
Chicago, Illinois

B. The requester of the health hazard evaluation

C. United Steel Workers Local 65

D. United Steel Workers International Union

E. U.S. Department of Labor, Region V, OSHA

F. NIOSH, Region V

For the purpose of informing affected workers, the employer shall promptly post for a period of 30 calendar days the health hazard determination report in a prominent place(s) near where the exposed employees work.

III. INTRODUCTION

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, Education, and Welfare, following a written request by an employee 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 received such a request to investigate the possibility of silicosis occurring among workers employed in the foundry at U.S. Steel South Works, Chicago, Illinois. In this respect, several workers were reported to have received medical examinations at a local occupational health clinic which indicated that they had silicosis. Furthermore, information was received from OSHA regarding its 1977 industrial hygiene inspection of the foundry which demonstrated crystalline silica concentrations in excess of the current federal standard. Of particular concern were employees involved in chipping operations, who were shown to have the highest exposures to crystalline silica.

Since the OSHA inspection, which included extensive sampling, had been conducted within the preceding year, NIOSH decided to perform only a medical evaluation of the exposed workers. As part of Contract No. 210-77-0160 for professional physician services, NIOSH contracted the Department of Environmental Health, University of Cincinnati through the Medical Center Fund of Cincinnati to perform the medical evaluation.

IV. HEALTH HAZARD EVALUATION

A. Background

Founding consists of pouring molten metal into a mold which is made to the outside shape of a pattern of the article required. It contains, in some cases, a core which will determine the dimensions of any internal cavity.

The making of a box to form the core and a pattern to form the mold; the melting and mixing of the metal and pouring it into an assembled mold; the knocking off of the mold and core materials; and the removal of excess, unwanted metal from the castings are all traditionally part of foundry work. The usual metals for casting are iron, steel, brass, and bronze; however, more recently, development of new casting techniques for other metals such as titanium, aluminum, chrominum, nickel, etc., have become popular. Molds were originally made from silica sand bound with clay, and mold coatings and dressings were simple inorganic mixtures. Wide use is now made of organic binders such as molasses, dextrin, starch, oils, pitch, and complex synthetic resins; mold castings and dressings are complex materials in volatile organic solvents and vehicles.

On the basis of the designer's drawings, a pattern is made of the finished casting, and from this pattern are produced cores and molds for the molten metal. Sand casting is the most common technique, but a variety of other procedures may be used. The metals or alloys are prepared and melted in a furnace, which may be the cupola, pot, etc., from which they are poured into the mold. When the metal has cooled, the mold material is removed (stripping and knock-out). The casting is then cleaned and dressed (fettling); this involves blasting, grinding, or chipping.

There are a number of hazards common to foundries no matter what the casting processes and metals employed. This discussion, however, will deal only with silica.

Silica exposure occurs in foundry work because sand and clay are used for developing molds. The use of sand molds and the processes of blasting, hammering, chiseling, and chipping create a dust environment containing quartz dust; iron oxide dust is also often present.

B. Description of Process and Exposures to Crystalline Silica

Exposure to crystalline silica by persons working in the ingot mold, stool, and iron foundries were evaluated by OSHA during its 1977 inspection. The process information and crystalline silica exposure data presented below were extracted from OSHA's records of that inspection.

1. Ingot Mold Foundry

a. Cleaning Building

Residual sand and iron deposits are removed from surfaces of tube-shaped ingot castings by workers known as "chippers." The castings are manually cleaned using pneumatic chisels, though hammer and chisel are used at times. A chipper will work both inside and outside of the casting. The castings in the north end of the building are usually larger than those at the south end. In the former, the chipper can spend most of the time kneeling while inside the mold; in the latter the chipper most often lies down and slides along on his back or front to get in and out of the mold. The amount of dust associated with chipping is variable. Some of the castings are open at both ends; others are closed, except perhaps for a small hole at one end. Some castings have less sand and more iron penetration than others. Repeated environmental samplings of the chipping operations showed 8-hour time-weighted average (TWA) concentrations of respirable dust containing crystalline silica of 27.8, 18.0, 10.4, 9.23, 3.59, 3.31, and 2.28 mg/cu m. The corresponding OSHA standards, based on the percentage of free silica in the samples*, are 1.3, 1.7, 1.7, 1.8, 0.95, 1.0 and 0.56 mg/cu m, respectively.

The cleaning building has two workers (sand handler laborers) who maintain the sand reclamation system. The workers share two work positions, working four hours at each. One work position is located in an unventilated tunnel under the floor of the cleaning building. The other position is located at the midpoint of the second sand transfer belt at the level of the cleaning building floor. The dust is primarily generated where the hopper cars of reclaimed sand are dumped onto the sand grate and at the conveyor transfer points. Eight-hour TWA concentrations of respirable dust containing crystalline silica, measured on two consecutive days, were 3.31 and 10.4 mg/cu m. The corresponding OSHA standards are 1.0 and 1.7 mg/cu m, respectively.

b. Ram Side

On the ram side of the ingot mold foundry, dust is generated by frequent moving of flasks and molds on surfaces which have accumulations of dry sand. Other dust sources include the dry sand swept off the sand slinger platform and sand from the conveyor belt of the reclamation

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* Quartz was the only polymorph of crystalline silica detected in the samples. Therefore, respirable crystalline silica refers to respirable quartz. The OSHA standard for respirable dust containing crystalline silica (quartz) depends on the proportion of free silca in the respirable dust and is calculated as $\frac{10}{\%\ \text{respirable free silica} + 2}$ mg/cu m.

systems. The work positions and levels of measured exposure (8-hour TWA) to respirable dust containing crystalline silica are (the corresponding OSHA standard is in parentheses, and all values are mg/cu m): the jacket finisher 2.04 (0.97), the jacket sand slinger 1.38 (0.84), the core sand slinger 1.66 (0.84), the hooker 1.01 (0.67), the muller 1.10 (0.77), the core finisher 0.97 (0.94), and the laborer 1.63 (1.0).

c. Casting Side

The workers associated with the casting side of the ingot mold foundry are exposed to crystalline silica particulates inherent to general work activities. The activities include lining and chipping of used ladles and shaking out of sand molds. Crystalline silica exposures of tipperman, gas man, oven puller-hooker, and flask closer were measured. The 8-hour TWA exposure levels to respirable dust containing crystalline silica were (the corresponding OSHA standard is in parentheses, and all values are mg/cu m): 0.35 (0.22), 0.49 (0.35), 0.55 (0.36), and 0.49 (0.35), respectively.

2. Stool Foundry

Workers use swing-frame grinders to clean sand and iron deposits off stool castings. Besides being exposed to the dust inherent to grinding, they also are exposed to that generated by a shakeout operator directly behind them. A grinder operator was exposed to a concentration of respirable dust containing crystalline silica of 1.16 mg/cu m (8-hour TWA), which exceeded the corresponding OSHA standard of 0.63.

Floor molders have dust exposures not specifically due to their work activities, but related to their work location near dust source areas. Dust is generated by the shakeout-grinder and sand-mulling operators. The molders' exposures to respirable dust containing crystalline silica were shown to be 1.14 and 0.96 mg/cu m (8-hour TWA), which exceeded the corresponding OSHA standards of 0.63 and 0.77, respectively.

3. Iron Foundry

The iron foundry makes ingot castings smaller than those previously described for the ingot mold foundry. These molds are made slightly different because of their size and the use of iron-foundry sand. The sand falls out of these castings more easily. The chippers do not have to position themselves more than a foot or so inside the casting. They use long extension chisels to get deep inside of the mold. The measured levels of respirable dust containing crystalline silica were 6.45 and 3.89 mg/cu m (8-hour TWA); the corresponding OSHA standards are 1.4 and 1.3, respectively.

C. Toxicity of Materials

The compound responsible for the development of silicosis is crystalline silica (silicon dioxide). The three most common crystalline forms of free silica encountered in industry are quartz, cristobalite, and tridymite.[1] Quartz, a mineral found in most classes of rock, is the most common form of silica. Quartz is an almost pure chemical compound, consisting of 46.7% silicon and 53.3% oxygen.[2] Quartz occurs almost everywhere and is an important constituent of igneous rocks such as granite and pegmatite. Quartz occurs in large amounts as sand in stream beds and seashores.

According to the U.S. Bureau of Census Statistical Abstracts, there were approximately 188,000 foundry workers exposed to silica in 1970.[3] NIOSH estimates that there are 1,200,000 workers in the United States exposed to free silica.[1]

Inhalation of microscopic silica particles into the lung periphery leads to a fibrogenic response. This results in the production of whorls of connective tissue encasing the silica particle(s). Initially, a few simple discrete nodular whorls of connective tissue (i.e., silicotic nodules) are present. The various stages of progression of silicosis lesions are related to the degree of exposure to free silica, duration of exposure, duration of time retained dust reacts with lung tissues, and certain host factors.[1,4,5] There are numerous theories to explain why silica results in lung fibrosis. These include certain characteristics of silica particles which relate to their physical shape, solubility, cytotoxicity to macrophages, or crystalline structure.[4]

Silicosis is usually a chronic disease with symptoms developing late. It is not common for the chest X-ray to become positive before 15-20 years of exposure. A more rapid onset of disease would indicate heavier exposure because of unusual circumstances of employment (lack of protection and work in enclosed spaces) or an infectious or immulogic complication.[4-6] In accelerated silicosis, the major features of the disease are identical to the chronic disease, but the chest X-ray usually becomes positive within four to eight years of initial dust exposure.[4-6] Silicoproteinosis is the name applied to a variety of rapidly developing silicosis in which there are characteristic histologic changes.[4-6] In this regard, symptoms may develop within six months of first exposure, and the natural history of the disease is one of rapid deterioration and death.

A number of investigations indicate that tuberculosis tends to complicate acute or chronic silicosis, causing silicotuberculosis.[4-6] In some persons with long-term silica exposure and negative chest X-rays, active tuberculosis may suddenly develop.

In cases of nodular silicosis, infection with tuberculosis may cause progression of silicosis and produce massive fibrotic lesions without associated nodular foci.

In instances where silica dust and another dust (e.g., iron oxide or coal) are present together, a modified lung response occurs; a more diffuse fibrosis, rather than nodular lesions, is seen. This is sometimes called a mixed dust fibrosis. The presence of silica, however, is a major component responsible for lung fibrosis.

The diagnosis of silicosis depends upon both historical and X-ray evidence. A history of significant exposure to free silica is required. X-ray changes provide evidence that exposure has in fact produced lung disease. Routinely, a posterior-anterior (PA) view of the chest is taken at full inspiration with a technique designed to demonstrate parenchymal lesions of the lung, which are described by the ILO U/C classification[7]. Simple silicosis is present when the nodules are less than 10 mm in size. Complicated silicosis is present when nodules become more than 10 mm in size, either due to coalescence of smaller nodules, superimposed infections (e.g., tuberculosis), or immunologic complication. Pulmonary function tests help substantiate the diagnosis. While no pulmonary function test is specific for silicosis, classically, reduction in ventilated lung volume (forced vital capacity) without airway obstruction (FEV_1/FVC* greater than 70%), i.e., a "restrictive lung defect," is seen. Pulmonary symptomatology, which begins insidiously, includes cough, shortness of breath, possible wheezing, and repeated, non-specific chest illnesses. The principal symptom of established silicosis is shortness of breath. This is usually associated with an X-ray showing complicated, rather than simple, silicosis.

A number of epidemiologic surveys of foundries have been reported. Renes, <u>et al</u> reported a study in 1948-49 involving 18 ferrous foundries and 1937 foundrymen. A 9.2% prevalence of pulmonary fibrosis was found.[8] Among foundry workers with 20 or more years of employment, a 25.8% prevalence of pulmonary fibrosis was reported. Environmental studies found that 90% of the airborne dust was 3 um or less in size. The amount of free silica in the dust varied with the operation and ranged from 13-29%. Dust levels were highest for shakeout operations and sand-slinger molding. Other foundry investigations have reported on extent of disease and dust exposure.[9-18]

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* FEV_1 = 1-second forced expiratory volume; FVC = forced vital capacity.

D. Description of Medical Program at U.S. Steel South Works

The Medical Department at U.S. Steel South Works is housed in a two-story building on the plant grounds that originally was used as a hospital. There is a fairly well-equipped emergency room, examination areas, X-ray facilities, and laboratory.

A physician is present at the medical facility, which provides 24-hour coverage. The number of physicians employed varies from time to time, being as many as eight or as few as four or five. Most of the physicians are part-time. There are two physicians who have been full-time employees for the past 25 years or so. One physician described his duties to include: examining new workers (i.e., pre-employment examination), periodic examinations, and medical re-checks. The pre-employment examination includes a history and physical examination, urinalysis, and 4" x 5" chest X-ray. The important medical problems for re-checking after sick leave were myocardial infarctions, hypertension, drug abuse, and alcoholism. The doctor determines work capacity based on the pre-employment exam. The medical director at U.S. Steel South Works is responsible for reading chest X-rays and for disability and/or pension examinations.

According to the X-ray technician, 4" x 5" chest x-rays were "routinely" performed beginning in 1962; no x-rays were taken before this. In 1972, 14" x 17" chest X-rays were first used. The same X-ray equipment was used for both film sizes: a Picker 300* (installed in 1962). Film development is by the hand-dipping technique.

A number of physicians have read the chest X-rays over the years, usually the medical director. There have been at least five medical directors over the years. One doctor who was reading the X-rays in 1972 liked "darker" films, and apparently 85 KVP was used for X-ray exposure. Another physician read films in 1975 and liked "lighter" films; the setting for exposure was 78-80 KVP. Apparently, X-ray surveys for foundry workers occurred periodically. In any event, surveys were taken in 1972 and 1975 over a 1-2 month period; physical exams were also performed. It is not clear exactly what the exam included. The nurse stated that an examination was given yearly and included a history, physical exam, weight, height, audiogram, urinalysis, vision, and possibly a chest X-ray. Recently, a Donti* spirometer was purchased, and some pulmonary function tests were performed. However pulmonary function tests have been performed only on management personnel, not on foundry workers.

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E. Study methodology

1. Selection of Workers to be Studied

Seventy foundry workers were selected for participation in the study. The reason why a specific worker was selected for study was based primarily on the worker's location of work and duration of employment. Foundry workers employed in the cleaning building, particularly those working as chippers, and certain other workers in the stool, iron, and ingot foundries were selected. Individuals with more than 15 years of employment were identified. Review of available medical records and past chest X-rays also identified workers who were subsequently examined. In general, the workers identified for examination were those who we considered to have had the greatest work exposure to silica dust for the longest period of time. These individuals, therefore, would be those most likely to develop silicosis. In addition, information from the union, OSHA, and a physician at a local hospital provided us with additional names of workers who were subsequently examined. Finally, by reviewing available medical records, we were able to uncover the names of certain workers who the Medical Department, U.S. Steel South Works had identified as having "silicosis." Thus, through the various means of identification, 70 workers were selected for the study.

2. Selection of X-rays

A total of 119 company chest X-rays were selected for review. These X-rays in most cases were taken in 1966, 1972, or 1975 and were part of the medical records of individual employees. In most cases, X-rays of workers with 15 or more years of work in the foundry were selected for review.

3. Medical Examination

Medical examination consisted of completing an occupational/medical questionnaire (Appendix 1), performing a physical examination of the chest (Appendix 2), performing pulmonary function tests, and obtaining a 14" x 17" PA chest X-ray.

A detailed occupational history was taken by either one of two chest physicians or a nurse chest specialist. The medical part of the questionnaire included questions concerning previous medical conditions, as well as questions concerning respiratory complaints. The questions relating to respiratory complaints were standardized and similar to the British Medical Research Council respiratory questionnaire and the National Institutes of Health questionnaire.

Pulmonary function tests were performed by trained NIOSH pulmonary function technicians using an Ohio Medical 800* dry rolling spirometer. From five trials, the best forced vital capacity (FVC) and forced expiratory volume at one second (FEV_1) were measured, and FEV_1/FVC was calculated. Predicted normal values for FVC and FEV_1 were calculated according to Morris, et al.[19] To account for racial differences in pulmonary capacity, the predicted values of the FVC and FEV_1 obtained by the Morris calculation were multiplied by 0.85 to obtain the predicted normal values for Black employees.

A 14" x 17" PA chest X-ray was obtained by a NIOSH X-ray technician using a General Electric CSX 110* portable X-ray machine; exposure time was varied at a fixed setting of 110 KVP. Chest X-rays were obtained, and pulmonary function tests were performed, in a NIOSH mobile van which has been extensively used in previous health hazard evaluations.

4. Chest X-ray Interpretation

All 70 chest X-rays which were taken as part of the medical examinations were reviewed by three physicians. Initially, the two chest physicians who examined the employees individually classified each X-ray using the standard ILO U/C classification (also known as the UICC/Cincinnati classification).[7,20] All X-rays were then reviewed by a radiologist who is a member of the Department of Radiology at the University of Cincinnati School of Medicine and an acknowledged authority on chest X-ray pneumoconiosis interpretation. He read them without knowledge of the results of the medical questionnaire, spirometry, or job history. When there were differences between the physicians' readings of a particular X-ray, the radiologist's interpretation was used.

The 119 chest X-rays reviewed in the Medical Department at U.S. Steel South Works were not available to the radiologist. ILO U/C classifications were made by the two chest physicians. In general, X-rays taken in the late 1960's (e.g., 1966) were overpenetrated and may have been "underread," while 1975 X-rays tended to be "light" (i.e., underexposed) and therefore may have been "overread." In any event, since there was fairly consistent agreement in X-ray interpretation of the 70 NIOSH X-rays between the two chest physicians and the radiologist, the interpretations of the 119 company chest X-rays, while having limitations, should be generally considered valid.

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F. Results of the Study

A total of 70 individuals, consisting of 66 current and four retired workers, were examined on April 19-21; Table 1 shows demographic data. All individuals had worked or were presently working in the foundry, except for one worker who spent 40 years in the pattern shop adjacent to the foundry. The workers examined had been employed for an average of 19.7 years in the foundry. While employees with long work histories were sought for the study, 14 of the workers examined had been employed less than 10 years (Table 2). Thirty-five (51%) of the employees examined had been employed for 20 years or more.

Half of the employees examined were current cigarette smokers; 16% (11 individuals) were nonsmokers (Table 3). Of the 54 current and former cigarette smokers, 25 (46%) had 20 or more pack-years of cigarette consumption; eight (15%) had greater than 40 pack-years of cigarette consumption (Table 4).

Upper respiratory symptoms, such as runny or stuffy nose, or symptoms of an upper respiratory infection were common (Table 5). Symptoms consistent with the diagnosis of allergic rhinitis occurred in 16 persons (23%). Thirty-one (44%) employees examined stated that they had symptoms which they identified as a "cold" within the preceding three weeks. Many said they presently had a "cold." The majority (71%) had at least one "cold" in the preceding four months.

Of the 70 employees examined, 54 (75%) admitted to having some lower respiratory symptoms/disease (Table 6). Chronic bronchitis was diagnosed in 32 (46%);[21] wheezing occurred in 36 (51%); repeated chest infections were said to occur in 12 (17%); one individual said he had bronchial asthma. Various degrees of shortness of breath were noted in 33 (47%) of the workers (Table 7). Eight (24%) of these 33 complained either of shortness of breath while dressing or walking about the house (6) or while sitting on a chair (2). The latter two employees were retired; one arrived for examination severely disabled and required constant nasal oxygen administration (he was subsequently shown to have complicated silicosis).

The physical examination of the chest was positive in 19 (27%) employees (Table 8). Rales were heard in five workers. Severe respiratory distress was noted in two retired employees, one of whom had complicated silicosis and the other of whom had severe chronic obstructive pulmonary disease.

Pulmonary function tests were abnormal in 23 (33%) employees (Table 9). Eleven (48%) of these 23 had "obstructive" pulmonary disease, with FEV_1/FVC being less than 70%. Eleven had an FEV_1 or FVC less than 80% of predicted normal and FEV_1/FVC 70% or greater, i.e., "restrictive" lung defect.

Twenty workers were found to have changes on company chest X-rays which were consistent with the diagnosis of silicosis (or another pneumoconiosis) (Table 10). Six of these employees were retired, and no work information was available for five of them. The majority of workers with chest X-rays consistent with the diagnosis of silicosis had worked 20 or more years in the foundry.

During the course of the investigation, it was discovered that apparently at least six workers were recognized by U.S. Steel in previous years to have silicosis (Table 11) but were not reported on the Log of Occupational Injuries and Illnesses (OSHA Form 101) prior to 1978. Only one of these participated in the NIOSH study; his ILO U/C X-ray classification was q 3/2. Two of the others declined to participate, and three were not available. Two employees not examined had changes consistent with silicosis on company chest X-rays in 1975.

Of the 70 study participants, nine were found to have definite silicosis (Table 12). All but two were chippers. Four had simple and five (all chippers) had complicated silicosis. Most of these latter workers also had abnormal pulmonary function tests and significant symptoms of breathlessness (breathlessness while dressing or walking about the house [Grade III] or while sitting on a chair [Grade IV]).

In addition to the nine employees with X-ray changes characteristic of silicosis, two had X-rays consistent with the diagnosis of pneumoconiosis but not necessarily silicosis (Table 13). One had a calcified pleural plaque; the other had interstitial disease (s 1/0). An additional 11 workers, in a variety of jobs, had abnormal chest X-rays (Table 14).

The majority of the workers with the diagnosis of silicosis worked as chippers. Table 15 summarizes the X-ray diagnoses and duration of employment of the 17 chippers in the study. Nine had "normal" chest X-rays; five of them worked less than 10 years as a chipper. Two chippers had simple silicosis, while five had complicated silicosis; all those with silicosis worked 10 or more years as chippers.

Medical records and X-rays of six retired workers, one of whom participated in the study, revealed a recorded diagnosis of silicosis or pneumoconiosis and/or X-ray evidence of silicosis.

V. DISCUSSION OF FINDINGS

This investigation demonstrated a number of cases of silicosis among retired and currently employed foundry workers at U.S. Steel South Works. Of the 70 workers examined, nine were found to have silicosis (Table 12); five had complicated silicosis, and four had simple silicosis. All of the employees with complicated silicosis had been chippers, working an average of 21 years at this job. The majority of the workers with silicosis were symptomatic; six of nine had moderate to severe breathlessness, that is, shortness of breath with minimal activity and/or at rest. Pulmonary function tests were abnormal in six of the nine affected workers.

Review of company records revealed 6 known cases of silicosis; one of these participated in the NIOSH study, and the diagnosis was substantiated. This gives a total of 14 cases of documented silicosis.

Review of company chest X-rays uncovered 20 chest X-rays consistent with silicosis, three of which were associated with the known cases mentioned above, and 6 of which were from retired workers. In addition, two workers had changes on their NIOSH X-rays which indicated previous dust exposure but did not show a nodular pattern. Thus, a total of 33 cases of definite or suspected silicosis were identified.

The greatest risk for developing silicosis was among the chippers. OSHA environmental surveys documented the excessive silica concentrations in the ambient air of the work environment. Eight of 17 chippers examined had chest X-rays consistent with the diagnosis of silicosis. Chipping would be expected to be associated with a greater risk for silicosis since the pneumatic tools used result in significant dust production, and work may be performed in an enclosed, poorly ventilated space.

It appears that one or two of the cases of complicated silicosis have had infection with tuberculosis. This undoubtedly contributed to the extensive X-ray changes noted. Tuberculosis, however, is an acknowledged complication of silicosis, and thus these cases would be diagnosed as silicotuberculosis.

It is apparent that the present medical/safety program for silicosis surveillance and prevention for the foundry workers at U.S. Steel South Works is inadequate. As regards the silicosis survellance program, no systematic organized medical program was operative at U.S. Steel South Works at the time of the NIOSH study. It appears that except for some short periods in the past, an effective preventive medicine program for silicosis has never been available to the workers. The company chest X-rays were often of poor quality and, in many cases, not suitable for interpretation. In most cases, physicians reading the chest X-rays were apparently not trained in the use of the ILO U/C classification. There were a number of instances where chest X-rays were read as "negative," when in fact, abnormalities suggestive of silicosis were present. Pulmonary function tests were not routinely obtained on foundry workers, and there was apparently no individual (physician or nurse) at U.S. Steel South Works trained in the performance or interpretation of pulmonary function tests. A number of recent reports have stressed the need for standardization of spirometry, and guidelines are available.[22]

The pre-placement and periodic medical examinations were not designed to elicit sufficient data on worker exposure to free silica or signs and symptoms of respiratory disease. It was not apparent from the present survey what the medical policies for managing employees with X-ray evidence of silicosis were. A number of workers with silicosis were working in areas where there were high concentrations of silica dust. OSHA reviewed the problem of personal protective equipment and work clothing and concluded that the respiratory protection program was not adequate. Finally, an effective health and safety education program for employees was not available.

There are other occupational hazards besides silica, such as noise, which should receive closer attention, but this health hazard evaluation does not address them.

VI. CONCLUSION

Based on the medical examination of 70 currently employed or retired foundry workers at U.S. Steel South Works, a review of approximately 20 medical records, interpretation of 119 existing chest X-rays, discussions with a physician at a local occupational health clinic who examined some of the employees, and interviews with medical professionals, union representatives, employees, and management, it was determined that a health hazard existed, at the time of this study and in the past, due to worker over-exposure to free silica dust. The chest X-ray abnormalities, physical and symptomatologic findings, and abnormal pulmonary function tests in the affected workers, particularly those employed as chippers, indicate that free silica of respirable size was deposited in the lung periphery and caused a fibrotic reaction resulting in the occupational lung disease of silicosis. The excessively high levels of free silica in the ambient air of the work environment was documented by a previous OSHA inspection. The current medical/safety program for foundry workers exposed to free silica is inadequate and, unless modified, will continue to result in the development of silicosis in exposed workers.

VII. RECOMMENDATIONS

An effective medical and environmental program for silica should be instituted at U.S. Steel South Works. The components of this program are described in the NIOSH criteria document for a recommended standard for occupational exposure to crystalline silica[1]. We consider the following recommendations of primary importance.

1. An industrial hygiene program is necessary so that occupational exposure to crystalline silica is controlled so that no worker is exposed to a time-weighted average (TWA) concentration of respirable free silica greater than 50 ug/cu m of air as determined by a full-shift sample for up to a 10-hour workday, 40-hour workweek[1]. Exposure should be determined by a personal (breathing zone) sample. Procedures for sampling, calibration and analyses of environmental samples are specified in Appendices in the NIOSH criteria document.

2. A number of work safety practices are necessary and should be required. These include procedures for dust suppression (e.g., water or wetting), proper ventilation, substitution of other materials for free silica when possible, labeling and appraisal of hazards, and protective equipment and clothing when necessary.

3. Proper protective equipment should be available, evaluated, and maintained when its use becomes necessary. Engineering controls should be used to maintain free silica dust exposure within the recommended standard.

4. Periodic dust monitoring is necessary in order to determine the extent of the potential silica problem and the effectiveness of engineering controls and work practices, and to identify particularly hazardous work areas where more frequent monitoring or examination of workers is necessary. Preferably, this is done at least once every six months.

5. The preplacement medical examination should include all of the following:

   a. A medical and occupational history to elicit data on previous exposure to free silica dust (or other fibrogenic dusts), any other significant occupational exposure, significant past medical illness, cigarette-smoking status, and signs and symptoms of respiratory disease. Appendix 1 is an example of a suitable medical questionnaire.

   b. A baseline 14" x 17" PA chest X-ray, classified according to the ILO U/C system.

c. Pulmonary function tests including at least FVC, FEV_1, and calculation of FEV_1/FVC to provide a baseline for evaluation and to rule out any significant pulmonary disease not identified by history or X-ray. Standardized procedures for calibrating the spirometer, performing the tests, calculating the results, interpreting the observed spirograms, and using accepted predicted normal values are available and should be utilized.

There are a number of physicians (radiologists or chest specialists) located in the Chicago area who could act as consultants for interpretation and administration of the screening tests (chest x-rays and pulmonary function tests).

6. A periodic medical examination should be performed at least once every three years, and perhaps yearly or every other year for employees with potentially higher risk jobs (such as chippers). Medical examinations should include a follow-up questionnaire concerning development or progression of respiratory symptoms, a chest X-ray (PA 14" x 17"), and pulmonary function tests as described above. Results of pulmonary function tests should be compared to previous best tests. A 10% reduction in FEV_1 or FVC over a 2-3 year period should be considered a significant change. Chest X-rays should be compared to baseline X-rays and interpreted by a qualified, trained radiologist or chest physician who is familiar with the use of the ILO U/C classification. Medical records should be of such a form that information is easily accessible and retrievable, so that comparisons can be made from one examination to the next.

Since the last organized medical survey at U.S. Steel South Works was in 1975, all current foundry workers should be medically evaluated in the manner described.

7. Medical management of an employee with or without X-ray evidence of silicosis who has significant respiratory symptoms or physical findings and/or significant abnormalities on pulmonary function tests should include full evaluation by a physician (preferably a chest specialist) qualified to advise the employee whether he/she should continue working in a dusty trade. Employees with definite or suspected silicosis should be promptly evaluated by a chest specialist.

Anyone with complicated or category I simple silicosis should be removed from further "exposure" to silica dust. Removal of an employee from "exposure" to silica dust does not necessarily require re-assignment to an area free of silica dust, although this is ordinarily the preferred control measure. For persons with simple silicosis who have no pulmonary function impairment, "removal from exposure" can also be accomplished, in effect, by a combination of environmental dust-control measures, reduced exposure time, and respiratory protection equipment.

If an employee has X-ray evidence of silicosis, he should be informed of this finding and of the risks of further exposure to silica dust. If he chooses to return to a silica-exposure area, and has no pulmonary function impairment, he may do so if the silica dust level in the air he is actually breathing meets NIOSH's recommended standard. If respirators are used to accomplish this, there must be an appropriate program of fitting, training, maintenance, and supervision (29 CFR, paragraph 1910.134). In general, however, respirators are considered a "last resort" control method, to be used temporarily pending the implementation of environmental dust-control measures, for operations where sufficient dust control is not feasible, and for short-term or non-routine exposures.

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AUTHORSHIP AND ACKNOWLEDGEMENTS

Principal medical investigator:	Stuart M. Brooks, M.D. Department of Environmental Health University of Cincinnati Cincinnati, Ohio 45267
Contributors:	Grady Campbell, M.D. Pulmonary Disease Division University of Cincinnati Cincinnati, Ohio 45267
	Marci Majors, R.N., M.S.N. Respiratory Nurse Specialist Providence Hospital 2446 Kipling Avenue Cincinnati, Ohio 45239
	John Kominsky, M.S. Industrial Hygienist Hazard Evaluations and Technical Assistance Branch (HETAB) NIOSH
Project Officer:	Mitchell Singal, M.D., M.P.H. Medical Officer, HETAB NIOSH
Originating office:	Jerome P. Flesch Chief, HETAB NIOSH

TABLE 1

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Foundry Employees who Participated in the NIOSH Study:
Demographic Data

	Number of Employees
Total participants	70
Race	
Black	67
White	3
Job Status	
Currently employed	66
Retired	4
Age (years)	
Mean: 48	
Range: 19-67	
Sex	
Female	2
Male	68

TABLE 2

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Foundry Employees who Participated in the NIOSH Study:
Years Employed in Foundry

	Number of Employees
Total participants	69*
Cumulative years	
<10	14
10-19	20
20-29	22
≥ 30	13

Mean number of years: 19.7
Range (years): 1 - 37

*Excludes one employee who worked in the pattern shop adjacent to the foundry.

TABLE 3

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Smoking History of 70 Foundry Employees
who Participated in the NIOSH Study

Smoking Status	Employees Number	Employees %
Current cigarette smokers	35	50
Former cigarette smokers	19	27
Cigar smokers	5	7
Non-smokers	11	16
Total	70	100

TABLE 4

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Cumulative Cigarette Consumption
in Present and Former Smokers (See Table 3)

	Number of Employees
Total cigarette smokers	54
Number of pack-years	
<10	17
10-19	12
20-29	8
30-39	9
≥40	8

TABLE 5

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Prevalence of Upper Respiratory Symptoms/Disease
in 70 Foundry Employees
who Participated in the NIOSH Study

	Employees	
	Number	%
Allergic rhinitis	16	23
Symptoms of a "cold"		
In preceding 3 weeks	31	44
In preceding 4 months	50	71

TABLE 6

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Prevalence of Lower Respiratory Symptoms/Disease
in 70 Foundry Employees
who Participated in the NIOSH Study

	Employees	
Lower respiratory symptom/disease	Number	%
Any symptom or disease	54	77
Diagnosis of chronic bronchitis	32	46
History of wheezing	36	51
Symptoms of shortness of breath	33	47
History of asthma	1	1.4
History of repeated chest infections	12	17

TABLE 7

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Severity of Shortness of Breath
Among the 33 Employees with that Symptom
(See Table 6)

	Positive Response	
Shortness of breath*	Number	%
More than most people of same age	33	100
When hurrying on level ground or walking up a slight hill	13	39
When walking with other people of same age on level ground	4	12
When walking at own pace on level ground	3	9
When dressing or walking about the house	6	18
When sitting on a chair	2	6

*See appendix 1, questions 18 - 23.

TABLE 8

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Physical Examination Findings
in 70 Employees
who Participated in the NIOSH Study

Finding*	Employees Number	Employees %
Any abnormality	19	27
Wheezes	8	11
Rales	5	7
Decreased breath sounds	10	14
Respiratory distress	2	3

*See appendix 2

TABLE 9

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Pulmonary Function Abnormalities
in 70 Employees
who Participated in the NIOSH Study

Pulmonary function abnormality*	Employees Number	Employees %
Any abnormality	23	33
FVC <80% of predicted normal	13	19
FEV_1 <80% of predicted normal	19	27
FEV_1/FVC <70%	11	16

*See text

TABLE 10

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Twenty Foundry Employees who had Abnormalities Suggestive of Silicosis/Pneumoconiosis on Previous Chest X-rays but Did Not Participate in the NIOSH Study

	Study number	Years employed in foundry	ILO U/C X-ray Classification*
Present employees	100	27	p 1/0
	101	32	q 1/1
	102	45	q 1/0
	103	39	q 1/1
	104	37	t 1/0
	105	—**	t 1/1
	106	30	t 1/0
	107	30	t 1/0
	108	9	r 1/0
	109	8	t 1/0
	110	12	s 1/2
	111	28	p 1/1
	112	28	q 1/0
	118	26	t 1/1
Retired employees	113	—	q 1/0
	114	—	q 1/0
	115	—	r 2/1
	116	—	r 2/2
	117	—	q 1/1
	119	14	q 1/1

*Where both regular and irregular opacities were seen, this list includes only the classification of the regular opacities.

**Information not available.

TABLE 11

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Six Employees Noted on Company Medical Records to have Silicosis
(Only One Participated in the NIOSH Study)

Years employed at the foundry
26[A]
14
32
27
39[B]
29.5[C]

A - 1975 chest X-ray classified t 1/1

B - 1975 chest X-ray classified q 1/1

C - NIOSH chest X-ray classified q 3/2

TABLE 12

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Cases of Silicosis Found among the 70 Employees
who Participated in the NIOSH Study

All 9 cases are in men. Individual ages and duration of employment are not presented in the table so that the individuals cannot be identified. Ages range from 37 to 61 years, with a median of 55. Total years of employment at the foundry range from 14 to 33, with a median of 23. Years of employment at the current job range from 10 to 33, with a median of 18.

Job Title	Grade of shortness of breath*	Chest X-ray classification*	Pulmonary function % of Predicted FEV_1	FVC	FEV_1/FVC	Stage of silicosis
Chipper	IV	q 3/2	93	89	84	Simple
Chipper	I	r 1/10	69	74	77	Simple
Stool Molder	I	q 2/1	92	91	83	Simple
Crane Operator	IV	q 1/0	77	79	74	Simple
Chipper	III	q 2/1 di, id A	74	70	78	Complicated
Chipper	I	r 1/1 id, b tbc	69	78	71	Complicated
Chipper	II	p 3/3 id, B	45	64	57	Complicated
Chipper	II	p 3/3 id, A	87	88	82	Complicated
Chipper	IV	p 3/2 wd, C	33	48	56	Complicated

*See text.

TABLE 13

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Two Cases of Chest X-rays Consistent with Pneumoconiosis,
but Not Necessarily Silicosis,
Found among the 70 Employees
who Participated in the NIOSH Study

Job title	Crane Operator	Chipper
Age (years)[1]	>40	>40
Sex	M	M
Years employed at current job[1]	>20	>20
Grade of shortness of breath[2]	III	IV
Chest X-ray[2]	Calcified plaque on diaphragm	s 1/0
Pulmonary function[2]		
FEV_1, % of predicted normal	75	81
FVC, % of predicted normal	85	100
FEV_1/FVC	75	66

1 - Specific ages and duration of employment are not presented in the table so that the individuals cannot be identified.

2 - See text.

TABLE 14

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Eleven Abnormal Chest X-rays,
Other than Findings of Silicosis/Pneumoconisis,
in the 70 Employees
who Participated in the NIOSH Study

X-ray findings
Bullet; blunted right costophrenic angle
Ghon complex; "emphysema"
Azygos lobe
Blunted right costophrenic angle
Enlarged aorta, right-sided soft tissue mass
Calcium - left shoulder
Granuloma - third rib
Enlarged right hilum (possible cancer)
Old rib fracture
Questionable lesion - left mid-lung
Old tuberculosis

TABLE 15

U.S. Steel South Works
Chicago, Illinois
HE 78-66

Relationship between Duration of Employment as a Chipper and Chest X-ray Diagnosis

Number of employees with X-ray diagnosis of	Years employed as a chipper			
	0-9	10-19	20-29	30-39
Simple silicosis	0	1	1	0
Complicated silicosis	0	3	1	1
Pneumoconiosis	0	0	1	0
No silicosis/pneumoconiosis	5	4	0	0

APPENDIX 1

Questionnaire used by
Department of Environmental Health,
University of Cincinnati College of Medicine
for NIOSH Health Hazard Evaluation 78-66

- - - - - - - - - - - - - - -

RESPIRATORY SYMPTOMS QUESTIONNAIRE

Dept. of Environmental Health
College of Medicine
University of Cincinnati

1. Name ________________________________

2. Address ________________________________

   ____

3. Social Security Number ________________

4. Rank or Grade ________________________

5. Current job designation ________________
   (For example: welder, torpedoman, etc.)

6. Sex ______

7. Date of birth ______________

8. Race or ethnic group ________________

9. List all jobs, occupations or types of work you have held or done throughout your life, beginning with the first and progressing in chronological order to your present job. Please fill in the requested information about each.

Job or Type of Work	Name and Location (City, State) of Company, if any	Length of Time Employed	Exposure to Any Toxic Gases, Dusts, Fumes or Chemicals	Describe Any Health Problems Related to These Exposures

APPENDIX 1 (Cont'd)

10. Have you ever been bothered by any of the following conditions:

____ a. Arthritis (swollen and painful joints)

____ b. Stomach trouble

____ c. Bowel trouble or colitis

____ d. Kidney trouble

____ e. Liver trouble

____ f. Any kind of heart trouble

____ g. High blood pressure

____ h. Diabetes

____ i. Dermatitis/skin trouble

____ j. Hardening of arteries

____ k. Hay fever or any other allergy that makes your nose runny or stuffy.

11a. Has a doctor ever told you you had any of the following?

____ a. Bronchitis (or bronchial trouble)

____ b. Chronic bronchitis

____ c. Emphysema

____ d. Bronchial asthma

____ e. Pneumonia

____ f. Broncho-pneumonia

____ g. Tuberculosis

____ h. Histoplasmosis

____ i. Lung surgery

____ j. Cancer of the lung

11b. Do you think you have ever had any or these chest disorders--asthma, any kind of bronchial trouble, or emphysema?

____ 1. Yes
____ 2. No
____ 3. Don't know

12a. Do you usually cough first thing in the morning?
1. Yes
2. No

b. Do you usually cough at other times during the day or night?
1. Yes
2. No

IF YES TO EITHER 12a OR 12b, ANSWER c AND d:

c. Do you cough on most days for as much as 3 months of the year?
1. Yes
2. No
3. Not sure

d. For how many years have you had this cough?
1. Less than one year
2. One to two years
3. Two to five years
4. More than five years

13a. Do you usually bring up phlegm, sputum or mucous from the chest first thing in the morning?
1. Yes
2. No

b. Do you usually bring up phlegm, sputum or mucous from your chest at other times during the day or night?
1. Yes
2. No

IF YES TO EITHER 13a OR 13b, ANSWER c AND d:

c. Do you bring up phlegm, sputum or mucous from your chest on most days for as much as 3 months of the year?
1. Yes
2. No
3. Not sure

d. For how many years have you raised phlegm, sputum or mucous from your chest?
1. Less than one year
2. One to two years
3. Two to five years
4. More than five years

14a. Have you ever coughed up blood?

______ 1. Yes, I still do
______ 2. Yes, but I no longer do
______ 3. No
______ 4. Not sure

16a. Does your chest ever sound wheezy or whistling?

1. Yes
2. No → *(GO TO Q 17)*
3. Not sure

IF YES TO 16 ANSWER b,c,d,e, and f:

b. Do you get this with colds?

1. Yes
2. No

c. Do you get this even when you don't have a cold?

1. Yes
2. No

d. Do you get this on most days?

1. Yes
2. No

e. Do you get this during exercise?

1. Yes
2. No

f. How long have you noticed wheezing or whistling sounds in your chest?

1. Less than one year
2. One to two years
3. Two to five years
4. More than five years

17. Have you ever had attacks of shortness of breath with wheezing?

1. Yes
2. No

18. Are you more short of breath than most people your age?

1. Yes
2. No
3. Do not know

19. Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?

1. Yes
2. No
3. Not sure

20. Do you get short of breath walking with other people of your own age on level ground?

1. Yes
2. No
3. Not sure

APPENDIX 1 (Cont'd)

21. Do you have to stop for breath while walking at your own pace on level ground?
1. Yes
2. No
3. Not sure

22. Do you get short of breath dressing or walking about the house?
1. Yes
2. No
3. Not sure

23. Are you short of breath sitting on a chair?
1. Yes
2. No
3. Not sure

24. Circle the months in which your shortness of breath have been most frequent.

OR: ( ) Check here if no relation to time of year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	2	3	4	5	6	7	8	9	10	11	12

25. How long have you been short of breath?
1. Less than one year
2. One to two years
3. Two to five years
4. More than five years

26a. Have you ever had asthma?
1. Yes, I still have it
2. Yes, but no longer have it
3. No: → *(GO TO Q 27)*

IF YES GO TO 26a, ANSWER EITHER b, c, d, e, OR f:

b. If in the past year, how many asthma attacks did you have?

____ 1. No attacks
____ 2. A few (1-3) attacks
____ 3. Several (4-12) attacks
____ 4. Many (13 or more) attacks
____ 5. Attacks almost every day

c. Circle the months in which your attacks have been most frequent.

OR: ( ) Check here if no relation to time of year

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	3	4	5	6	7	8	9	10	11	12

26	d. Have you ever seen a doctor about your asthma?	1. Yes 2. No
	e. Are you presently taking medication or treatment for your asthma?	1. Yes 2. No
	f. How old were you when you had your first asthma attack?	________ *(age)*

27a. Have you ever had hay fever or any other allergy that makes your nose runny or stuffy, apart from colds?

____ 1. Yes, I still have it
____ 2. Yes, but I no longer have it
____ 3. No → *(GO TO Q 28)*

b. During the past year, how much have you been bothered by it?

____ 1. Very little
____ 2. Little
____ 3. Moderately
____ 4. Much
____ 5. Very much

28. When did you have your last cold?

__________ *(Month)*

__________ *(Year)*

29a. During the past 3 years, how much trouble have you had with illnesses such as chest colds, bronchitis, or pneumonia?

____ 1. None
____ 2. Little
____ 3. Moderately
____ 4. Much
____ 5. A great deal

b. During the past 3 years, how often were you unable to do your usual activities because of illnesses such as chest colds, bronchitis, or pneumonia?

____ 1. One time
____ 2. 2-5 times
____ 3. More than 5 times

SMOKING:

30a. Do you now smoke cigarettes regularly or occasionally?

____ 1. Yes
____ 2. No
(Go to Q 31a)

IF YOU SMOKE REGULARLY NOW:

b. Do you inhale?
1. Yes
2. No

c. Do you smoke cigarettes with filters or without filters?
____ 1. With filters
____ 2. Without filters
____ 3. Both with and without filters

d. How many cigarettes do you usually smoke each day at the present time? *(Please give best estimate: One pack contains 20 cigarettes.)*
________ Number per day

e. How old were you when you began to smoke cigarettes?
________ *(age)*

f. What is the usual number of cigarettes you have smoked per day since you began to smoke? *(Please give best estimate: One pack contains 20 cigarettes.)*
________ Number per day

(IF YOU HAVE COMPLETED THIS SECTION, SKIP QUESTION 31 AND 32)

31a. If you do not smoke cigarettes now, did you ever smoke them regularly or occasionally?
____ 1. Yes
____ 2. No, never smoked cigarettes (Go to Q 32a)

IF YOU DO NOT SMOKE CIGARETTES REGULARLY NOW BUT USED TO SMOKE THEM:

b. What was the usual number of cigarettes you smoked per day? *(Please give best estimate: One pack contains 20 cigarettes.)*
________ Number per day

31 c. Did you inhale?
1. Yes
2. No

d. How old were you when you began to smoke cigarettes?
_____ *(age)*

e. How old were you when you stopped smoking cigarettes regularly?
_____ *(age)*

f. Were you influenced to stop because you had a cough, wheezing, or shortness of breath?
1. Yes
2. No

g. How long ago did you stop or quit smoking?
1. Less than 1 Mo. a
2. 1-3 months ago
3. 3-6 months ago
4. 6-12 months ago
5. 1-3 years ago
6. More than 3 yrs
7. More than 10 yrs

32a. Do you smoke pipes or cigars regularly
_____ 1. Yes
_____ 2. No
(Go to 33a)

IF YOU SMOKE PIPES OR CIGARS REGULARLY NOW:

b. How many pipefuls or cigars do you usually smoke each day?
_____ Number each day

c. How old were you when you first smoked?
_____ *(age)*

d. Do you usually inhale when you smoke either pipes or cigars?
1. Yes
2. No

(IF YOU COMPLETED THIS SECTION, SKIP QUESTION 33

33a. If you do not smoke cigars or pipes now, did you ever smoke them regularly or occasionally?
_____ 1. Yes
_____ 2. No, never smoked pipes or cigars

APPENDIX 1 (Cont'd)

33 IF YOU DO NOT SMOKE PIPES OR CIGARS REGULARLY NOW BUT USED TO SMOKE THEM:

b. How many pipefuls or cigars did you usually smoke each day? __________ Number each day

c. How old were you when you first smoked pipes or cigars? __________ *(age)*

d. How old were you when you stopped smoking pipes or cigars? __________ *(age)*

e. Did you usually inhale when you smoked either pipes or cigars?
1. Yes
2. No

APPENDIX 2

Physical Examination Protocol
Used by Department of Environmental Health,
University of Cincinnati College of Medicine
for NIOSH Health Hazard Evaluation 78-66

- - - - - - - - - - - -

Date ____________________

RESPIRATORY
PHYSICAL EXAMINATION

1. Name ______________________________

2. Address ____________________________

____

3. Rank or grade ______________________

4. Current job description ____________________
(For example: welder, torpedoman, etc.)

5. Sex _______

6. Date of birth ____________________

7. Race or ethnic group _________________________

8. Blood pressure _________ Pulse _____________

Body weight ___________ Height ____________

9. Cyanosis
_____ None
_____ Questionable
_____ Definite

10. Clubbing
_____ None
_____ Questionable
_____ Definite

11. Stature
_____ Normal
_____ Obesity
_____ Significant skeletal or neuromuscular deformity

(Please specify) ________________________________

____

____

12. Respiratory distress at rest

_____ None

_____ Tachypnea and/or hyperpnea

_____ None at rest but present with slight exertion

_____ Severe and obvious (hyperventilation, use of accessory muscles, asthmatic attack)

13. Chest configuration

_____ Normal

_____ Mild Kyphoscoliosis

_____ Moderate to severe Kyphoscoliosis

_____ Increased A-P diameter

_____ Other (Please specify)

____

14. Breath sounds

_____ Normal bilaterally

_____ Decreased-localized

_____ Decreased-generalized

_____ Other (Please specify)

____

15. Wheezing

_____ None

_____ Occasional-scattered

_____ Elicited by forced expiration only

_____ Obvious and generalized

_____ Other (Please specify)

____

16. Rales

_____ None

_____ Inspiratory crepitant (dry) unilateral

_____ Inspiratory crepilant (dry) bilateral

16. Rales (continued)

_____ Moist rales - unilateral

_____ Moist rales - bilateral

_____ Other (Please specify)

____

17. Friction rub

_____ Yes

_____ No

18. Other significant abnormalities

_____ Yes (describe)

_____ No

____

____

____