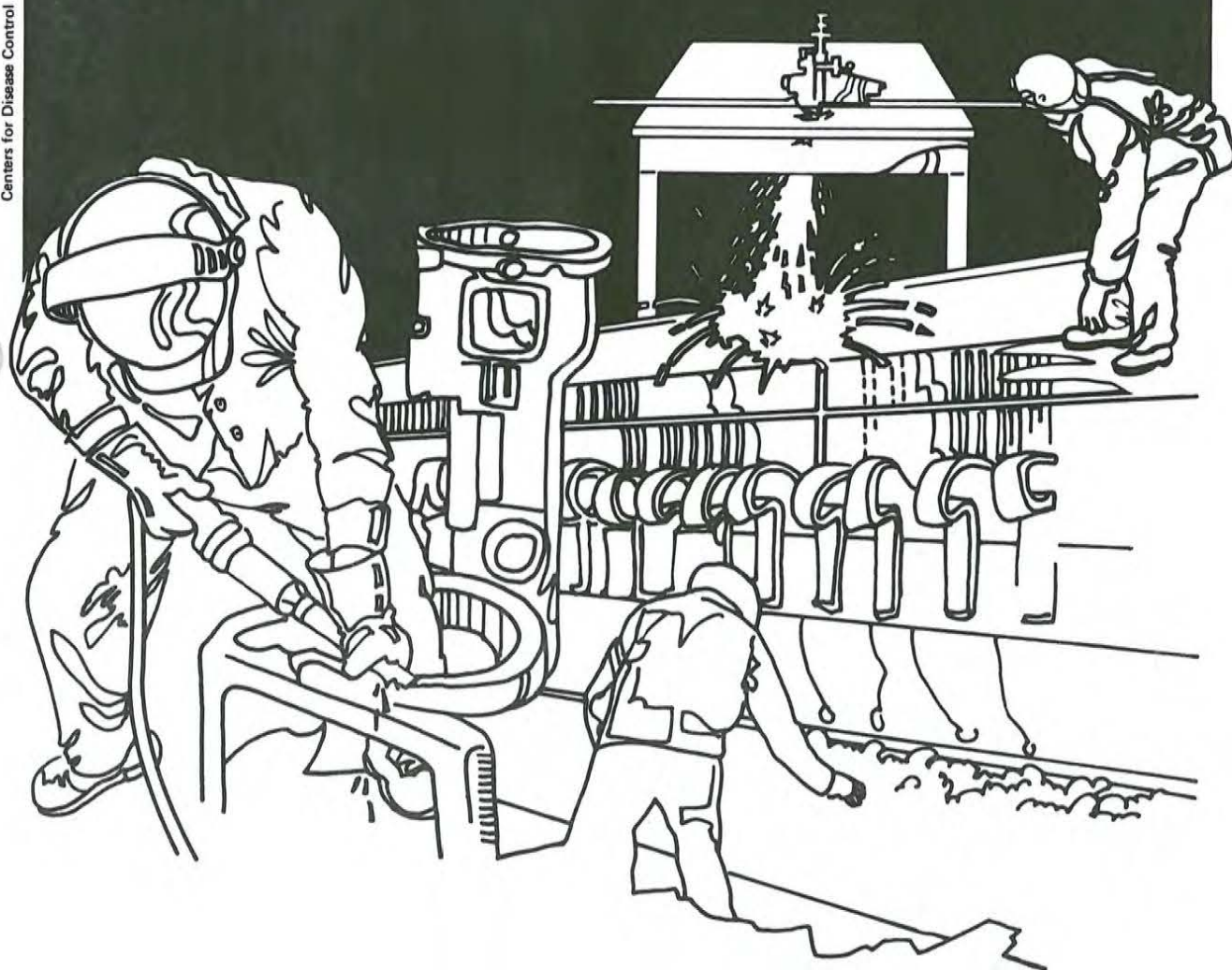


# NIOSH



## Health Hazard Evaluation Report

HHE 80-090-1016  
BETHELEHEM STEEL CORPORATION  
CHESTERTON, INDIANA

## 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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HHE 80-090-1016  
DECEMBER 1981  
BETHELEHEM STEEL CORP.  
CHESTERTON, INDIANA

NIOSH INVESTIGATORS:  
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## I. SUMMARY

On March 17, 1980, authorized representatives of the United Steelworkers of America, Local No. 6787, requested a health hazard evaluation at Bethlehem Steel Corp., Chesterton, Indiana. The request concerned potential employee exposures to dust and other contaminants generated during steel casting operations at the continuous castor shop.

On June 3-6, 1980 NIOSH conducted an environmental/medical survey. Personal air samples were collected for determination of total particulate levels and iron oxide fume. Additional personal samples were collected for particulate inorganic fluorides which were present as a result of the use of fluoride based fluxes. A questionnaire was also administered to 20 workers in the continuous castor shop to evaluate the prevalence and severity of work-related health problems.

Three personal samples were collected to determine particulate and iron oxide levels and four personal samples were taken for fluorides. Sampling periods ranged from 1-2 hours. The samples were collected during operations which were expected to generate the highest exposure levels. Total particulate concentrations were found to range from 0.8mg/M<sup>3</sup> to 2.2 mg/M<sup>3</sup> [8 hr time-weighted-average (TWA) permissible exposure level (PEL) - 10 mg/M<sup>3</sup>] and iron oxide levels were found to range from 0.04 mg/M<sup>3</sup> - 1.0 mg/M<sup>3</sup> (8 hr TWA PEL - 5 mg/M<sup>3</sup>). Fluoride concentrations were measured from 0.04 mg/M<sup>3</sup> to 1.7 mg/M<sup>3</sup> (8 hr TWA PEL - 2.5 mg/M<sup>3</sup>). The PEL's are all 8 hour TWA concentrations. For comparison, if a worse case situation is considered where the workers are exposed at the measured concentrations for the full 8 hour shift, exposures would still be below the recommended criteria. Visual evaluation of the process, however, indicated that the majority of the exposures to fluoride probably occurs during much shorter time periods than the sampling periods used in the study. The majority of the exposure appeared to occur during 1-5 minute periods when the powdered flux was being added to the process. If this is the case, workers were exposed to high levels of fluoride for very short time periods which would not be reflected by the sample results.

Seventeen of the 20 workers interviewed reported one or more acute, intermittent work-related health problems; most frequently, respiratory tract and mucous membrane irritation.

Based on the environmental/medical data obtained during this investigation, NIOSH determined that no hazardous exposures to nuisance particulate or iron oxide fume existed during the time of this study. The data does suggest that workers are exposed to an irritant material(s), probably fluorides, for short time periods at levels sufficient to cause acute episodes of mucous membrane and respiratory tract irritation. Additional studies should be performed by the company to further evaluate the situation. Recommendations on environmental evaluation and work practices are present in Section VIII of this report.

Key words: SIC 3312 (Blast Furnances, Steel Works, and Rolling Mills) nuisance particulate, iron oxide, inorganic fluoride, respiratory irritation, mucous membrane irritation.

## II. INTRODUCTION

On March 17, 1980, authorized representatives of United Steelworkers of America, Local No. 6787, requested a health hazard evaluation at Bethlehem Steel, Chesterton, Indiana. The purpose of the study was to evaluate complaints of employee exposure to dusts and other contaminants generated during steel casting operations at the continuous castor shop. A NIOSH environmental/medical survey was conducted on June 3-6, 1980.

## III. BACKGROUND

The continuous castor shop is engaged in the manufacture of slab steel. The process begins with ladles of steel (approximately 300 ton capacity) being transported to the continuous castor shop. A ladle is placed directly above the continuous castor and steel pours through a bottom opening into a receptacle (referred to as a tundish), where impurities are skimmed off. From the tundish, the steel is poured directly into a water-cooled, downcurving mold. Sufficient "skin" forms to enable the steel to solidify gradually as it travels downward. The steel emerges from the mold as a continuous rectangular ribbon.

A ladle control operator and a floorman are located on an elevated platform adjacent to the ladle-tundish interface. The floorman is responsible for addition of flux to the tundish. Two strandhelpers are located on the floor and are responsible for a) monitoring the level of metal in the mold and adjusting the flow of steel from the tundish into the mold and b) introducing various quantities of non-asbestos mold powder into the mold.

All operations employees are outfitted with extensive personal protective equipment including aluminized outer wear, gloves, and helmets with face shields. Six large mancooling fans and four venturi blowers contain and direct the upward flow of process fumes. Fiberglass curtains and a ceramic shroud designed to prevent "showering of metal" are also utilized.

Approximately 85 workers, four crews, are employed on three shifts in the Castor Section Steelmaking Department.

## IV. Evaluation Design and Methods

### A. Environmental

Samples for total particulate and iron oxide were collected on polyvinyl chloride copolymer filters at flow rates of 1.7 liters per minute (lpm). Particulate weights were determined gravimetrically. The samples were analyzed for iron by atomic absorption spectrophotometry according to NIOSH P&CAM Method No. 173.



Fluoride samples were collected on cellulose ester membrane filters at a flow rates of 1.6 lpm. The samples were analyzed by iron specific electrode utilizing NIOSH P&CAM Method No. 212.

No environmental samples were collected for mold powders. The powders were determined to be inert, non-toxic materials such as vermiculite and no environmental measurements were deemed necessary.

#### B. Medical

By observation of the continuous castor section, NIOSH personnel identified four job classifications (40 of 85 workers) as most exposed to the dusts and other airborne contaminants generated during steel casting in the continuous castor. The 40 workers (10 of each crew), all full time employees, were ranked by job title from most exposed to least exposed as follows: floormen, ladle control operators, strand helpers and strand operators. NIOSH included in the questionnaire survey two entire crews (A and B) and the floorman and ladle control operator from a third crew (C), since there was only one of each of these two workers per crew.

The NIOSH medical investigator administered a medical questionnaire to employees to assess the prevalence and severity of worker-reported exposures and possible work-related health problems. Questions were asked concerning work histories, current workplace exposures, acute and chronic health problems, and current medication and past and present smoking histories.

#### V. EVALUATION CRITERIA

The environmental evaluation criteria for this study are presented below. Listed for each substance is the permissible exposure limit, the source of the recommended limit and the current OSHA standard. Following is a brief discussion pertaining to the primary health effects resulting from exposure to fluorides.

<u>Substance</u>	<u>Permissible Exposure Limit</u> (mg/M <sup>3</sup> )	<u>Source</u>	<u>OSHA Standard</u> (mg/M <sup>3</sup> )
Nuisance particulate	10	ACGIH*	15
Iron oxide	5	ACGIH	10
Inorganic fluoride	2.5	NIOSH	2.5

\*ACGIH - American Conference of Governmental Industrial Hygienists.

Fluoride Dust - Short-term exposure to fluoride containing dust may cause irritation of the skin, eyes, mucous membranes and lungs.

## VI. RESULTS

### A. Environmental Results

Results of the environmental sampling for total (nuisance) particulate and iron oxide are shown in Table 1. Three personal air samples for total particulate and iron oxide were collected. Sampling periods ranged from approximately 1 to 2 hours. The samples were collected during operations which were expected to generate the highest exposure levels. Total particulate concentrations were found to range from 0.8 mg/M<sup>3</sup> to 2.2 mg/M<sup>3</sup> and iron oxide levels were found to range from 0.04 mg/M<sup>3</sup> to 1 mg/M<sup>3</sup>. The 8 hours TWA PEL's for total particulate and iron oxide are 10 mg/M<sup>3</sup> and 5 mg/M<sup>3</sup> respectively. For comparison, if a worse case situation is considered where the workers are exposed at the measured concentrations for the full 8 hour shift, exposures would still be below the recommended criteria.

Fluoride concentrations, measured under the same conditions as described above, were found to range from 0.04 mg/M<sup>3</sup> to 1.7 mg/M<sup>3</sup> for the 1 to 2 hour sampling periods (Table 2). Again considering the worse case situation, the recommended 8 hour exposure limit of 2.5 mg/M<sup>3</sup> would not have been exceeded. Visual evaluation of the process, however, indicate that the majority of the exposure to fluorides probably occurs during much shorter time periods than the sampling periods used in the study. The majority of the exposure appeared to occur during 1-5 minute periods when the powdered flux was being added to the process. If this is the case, workers are being exposed to high levels of fluorides for very short time periods which would not be reflected by the sample results. Based on the fact that fluorides are irritants (levels of 5 mg/M<sup>3</sup> reportedly cause eye and respiratory tract irritation), brief high level exposures could result in acute intermittent symptoms not expected based on longer term sample results.

### B. Medical Results

Twenty-three day shift employees (Crews A,B,C) working in the Castor Section Steelmaking Department were interviewed. Twenty of the 23 workers were included in the data analysis: floorman - 3, ladle control operator - 3, strand helper - 8, strand operator - 6. Three of the workers were excluded from analysis of the questionnaire data as their primary job titles were not one of the four titles identified above.

The age range of the 20 men included in the survey was 28 to 54 years, with a median age of 37.5 years. Length of employment at Bethlehem Steel ranged from six to 16 years with a median of 12 years. Length of employment in the continuous castor ranged from one to nine years with a median of four years.

All twenty workers reported exposures to dust and fume generated during the periodic addition of flux and mold powder. A variety of symptoms were reported, predominantly respiratory tract and mucous membrane irritation of the eyes, nose and throat, but there was no apparent association between symptoms, individually or collectively, and job title. Seventeen of twenty workers (85%) reported one or more acute intermittent work-related health problems; three reported none. Fifteen of the seventeen symptomatic workers temporally related their acute symptoms to intermittent acute episodes of exposure to dusts, powders or fumes generated during the addition of flux and powders.

There was no unusual prevalence of any chronic disease nor any apparent clustering by job title.

#### VII. DISCUSSION AND CONCLUSIONS

The environmental and medical data collected during this evaluation indicate no excessive exposure to nuisance particulate and iron oxide. The data does suggest that workers are exposed to an irritant material(s), probably fluorides, for short time periods at levels sufficient to cause acute episodes of mucous membrane and respiratory tract irritation. Additional studies of the process should be conducted by the company to further evaluate the problem.

#### VIII. Recommendations

1. Conduct additional monitoring for fluorides or other potential irritants used in the process. Sampling should document both short and long term exposures.
2. Appropriate respiratory protection should be provided to all workers and used during periods of increased dust generation. A respiratory protection program should be established and maintained in accordance with 29 CFR 1910.134.

#### IX. REFERENCES

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5. Occupational Diseases, A Guide to Their Recognition, Revised Edition, DHEW (NIOSH) Publication 77-181, pp. 360-1.
6. General Industry Standards: Occupational Safety and Health Administration Safety and Health Standards (29 CFR 1910) revised January 1976.

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XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standard Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. 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 the following:

- A. United Steelworkers of America Local No. 3312
- B. United Steelworkers International
- C. U. S. Department of Labor, OSHA - Region V
- D. Bethlehem Steel Corp., Chesterton, Indiana
- E. NIOSH Regional Offices/Divisions

For the purpose of informing the approximately 40 "exposed employees", copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days by the employer.



Bethlehem Steel Co.  
Chesterton, Indiana

TABLE 1

RESULTS OF BREATHING ZONE SAMPLING FOR IRON OXIDE DUST AND TOTAL NUISANCE PARTICULATE

JUNE 6, 1980

<u>Job/Location</u>	<u>Time of Sample</u>	<u>Iron Oxide Mg/M3</u>	<u>Total Particulate mg/M3</u>
ladle operator/platform	0906-1007	0.59	2.2
strandhelper/floor	1253-1446	0.04	0.8
strandhelper/floor	1249-1445	1.0	1.5

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EVALUATION CRITERIA-----5

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Abbreviations: mg/M<sup>3</sup>= milligrams per cubic meter of air

Bethlehem Steel Co  
Chesterton, Indiana

TABLE 2  
RESULTS OF BREATHING ZONE SAMPLING FOR INORGANIC FLOURIDE  
JUNE 6, 1980

<u>Job/Location</u>	<u>Time of Sample</u>	<u>Inorganic Flouride mg/M3</u>
Strandhelper/floor	0850-1006	0.04
Strandhelper/floor	0854-1003	0.14
Floorman/platform	0846-1000	0.58
Ladle operator/platform	1255-1451	1.7

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EVALUATION CRITERIA----- 2.5

Abbreviations: mg/M<sup>3</sup>= milligrams per cubic meter of air

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