

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION REPORT  
HE 80-156 -747

FANSTEEL ELECTROMETALS INCORPORATED  
NORTH CHICAGO, ILLINOIS

October 1980

I. SUMMARY

On May 19, 1980, the National Institute for Occupational Safety and Health (NIOSH), received a request for a health hazard evaluation at Fansteel Electrometals in North Chicago, Illinois. The request was submitted by Local #1777 of the International Association of Machinists and Aerospace Workers (I.A.M. and A.W.). The requester had heard reports that the engineering department at Fansteel Electrometals was developing a new process using chromium powder which would soon be introduced into the production area. Employees were concerned about potential exposures to chromium powder and its' health effects.

Management estimated that only 1 employee would be involved in the actual process, however, 10 to 15 additional employees in the area might be exposed.

On June 18, 19 and 20, 1980, NIOSH conducted a health hazard evaluation of the pilot process. Environmental samples were collected by both general area and personal sampling techniques during working conditions simulated by the engineering department. In addition, NIOSH reviewed Fansteel's plans for installing ventilation to control dust when the process reached the actual production stage.

Results of the personal and area air samples were well within the environmental criteria/standards for chromium metal and chromium VI. Chromium metal samples ranged from 0.04 mg/M<sup>3</sup> to 0.20 mg/M<sup>3</sup>, with a mean of 0.12 mg/M<sup>3</sup>. The NIOSH recommended criteria for chromium metal is 1 mg/M<sup>3</sup>. All area and personal samples for chromium VI were below the limit of detection (0.2 ug).

On the basis of data obtained in the investigation, NIOSH determined that concentrations of the above substances measured were within acceptable limits. Recommendations to further reduce exposures (personal protection, personal hygiene and ventilation maintenance) are presented on pages 3 and 4.

Keywords: SIC 3471 (Electroplating, Plating, Polishing, Anodizing and Coloring) Chromium, Chromium VI.

## II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the toxic effects of substances found in the workplace. The International Association of Machinists and Aerospace Workers requested such an investigation from NIOSH on May 19, 1980 to evaluate the possible health effects of chrome powder in a pilot process, which was being developed by Fansteel Electrometals of North Chicago, Illinois.

The NIOSH Industrial Hygienist met with management and union representatives for the opening and closing conferences, walk-through survey and environmental sampling on June 18, 19, and 20, 1980.

## III. BACKGROUND

The entire process which uses chromium powder is considered proprietary information by Fansteel Incorporated. Therefore, a process description is not included.

## IV. EVALUATION DESIGN AND METHODS<sup>1</sup>

Discussions with management involved the collection of information concerning process description, engineering controls, personal protective equipment and clothing, work practices, training programs and monitoring for the areas in question. Interviews with employees in the engineering department focused on the job description, work practices, training programs and the means for converting the pilot process into the regular production schedule.

The area samples and personal air samples for total chromium were collected on cellulose ester membrane filters using portable pumps at a flowrate of 1.7 liters per minute. These samples were analyzed by atomic absorption according to NIOSH Method S323.

Area air samples and personal air samples for chromium VI were collected on PVC filters using portable pumps with a flowrate of 1.7 liters per minute. The samples were then analyzed by NIOSH Method P&CAM 169.

In this method, the filter is washed in 0.5N H<sub>2</sub>SO<sub>4</sub>, diphenyl-carbazide is added, and additional acid is added to bring the volume to 15 ml. The absorbance of the solution at 540 nm is read and compared to the absorbance of standards.

The personal sampling was designed to determine the workers' exposure to chromium in his breathing zone. Area samples were taken to determine whether any procedure in the process created an excessive dust hazard. Sampling times during the observation of the pilot process were short, but simulated actual working exposures. Current management projections anticipate that employee exposures during the process will be no more than two hours per week.

Bulk samples were obtained of both used and unused chromium powder. A colorimetric spot test using sulphuric acid and s-diphenyl-carbazide was performed to determine the possible presence of hexavalent chromium. Portions of each sample were treated with nitric and perchloric acids and then taken to near dryness. The residue was dissolved in hydrochloric acid and the resulting solutions analyzed for trace metals by inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

#### V. EVALUATION CRITERIA<sup>2-8</sup>

Chromium - (Refer to Table 1 for Environmental Standards)

Chromium may exist in one of three valence states in compounds, +2, +3, and +6. The +3 (trivalent) and +6 (hexavalent) states are the most biologically significant. Routes of entry to the body include skin absorption, inhalation and ingestion.

Local Effects - In some workers, chromium compounds act as allergens which cause dermatitis to exposed skin. They may also produce pulmonary sensitization, leading to attacks of respiratory distress even at low exposure levels.

Systemic Effects - Chromium compounds in the +6 state are irritants and corrosive. Acute exposures to dust or mist may cause coughing and wheezing, headache, dyspnea, pain on deep inspiration, fever and loss of weight. Tracheobronchial irritation and edema persist after other symptoms subside. Hexavalent chromium causes ulceration of the nasal septum with subsequent perforation. Certain forms of hexavalent chromium have been found to cause increased lung cancer among workers.

#### VI. RESULTS AND DISCUSSION

Results of the personal and area air samples were well within the environmental criteria/standards for total chromium and hexavalent chromium. The results of this air sampling are presented in Table II. They range from 0.04 mg/M<sup>3</sup> to 0.20 mg/M<sup>3</sup> for total chromium. All hexavalent chromium samples were below the detection limit of 0.2 ug.

The spot test of the bulk samples was negative for hexavalent chromium. ICP-AES analysis of the bulk samples indicated the unused powder was 89.8 ± 10% chromium, the used powder was 88.4 ± 10% chromium.

While the results obtained during the pilot process do not indicate a potential health hazard, continued good work practices are encouraged. At the time of the sampling, protective gloves and a dust respirator were in use. The weighing table was covered with paper. A vibrating separator was equipped with an enclosed flexible duct to recover excess chromium dust. Fansteel Electrometals Incorporated has developed plans for local exhaust ventilation at both the weighing bench and the separator which should ensure continued low levels of exposure.

VII. RECOMMENDATIONS

The following recommendations are intended to minimize contact with the chromium powder and prevent acute and chronic disease.

1. Protective gloves, coveralls and a NIOSH approved dust respirator should be used during weighing, pouring, separating and clean-up operations.
2. Head, arms, neck and face should be washed before breaks and lunch, and a thorough wash up or shower should be taken before leaving work.
3. Work clothes should be kept in a separate locker from street clothes; work clothes should not be brought home.
4. No smoking, eating or drinking should be allowed in the area where chromium is used.
5. The weighing table should be covered with paper to aid in clean-up operations. Spills, leaks and dust accumulations should be cleaned up immediately by either dry/wet vacuuming or wet-mopping.
6. All weighing and separating activities should be performed only when the local exhaust ventilation, which Fansteel Electrometals Incorporated is installing, is properly functioning.
7. All ventilation units should be monitored and maintained on a regular basis.
8. Environmental monitoring of the actual production process should be performed to determine exposure levels during normal working conditions.
9. Medical surveillance should be implemented to monitor for potential sensitization to the chromium powder by employees.
10. A comprehensive health and safety program should be initiated to alert employees to the potential health effects of chromium. Special emphasis should be placed on work practices which will reduce the possibility of contaminating the work area with chromium powder.

VIII. AUTHORSHIPS AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, Publications Dissemination, 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 the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

- a.) Fansteel Electrometals, Incorporated
- b.) I.A.M. and A.W.
- c.) NIOSH, Region V
- d.) OSHA, Region V