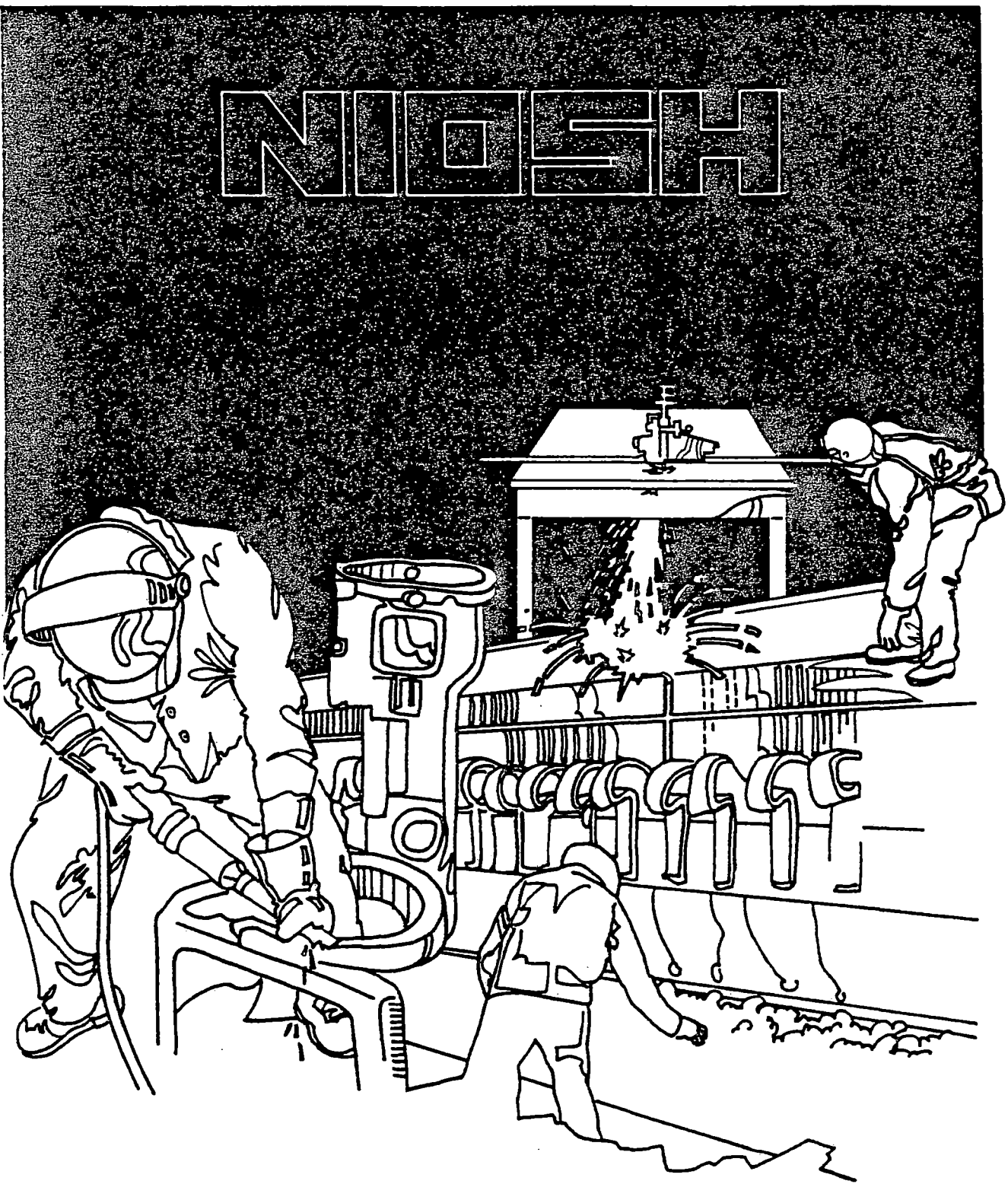


# NIOSH



## Health Hazard Evaluation Report

79-14-760

## 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. 699(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.

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

HHE 79-14-760  
OCTOBER 1980  
GENERAL ELECTRIC COMPANY  
EVENDALE, OHIO 45215

NIOSH INVESTIGATORS:  
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## I. SUMMARY

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) at the General Electric Company in Evendale, Ohio on January 25 and May 22, 1979, to evaluate employee exposures to air contaminants generated during the grinding and polishing of jet engine fan blades. Personal samples were obtained for airborne metallic vanadium and nuisance particulates. Bulk samples of dust were analyzed for metallic nickel and cobalt, and for crystalline silica content. Health questionnaires were completed on 27 exposed workers and medical records obtained for six workers with lower respiratory tract symptoms.

Bulk samples of dust collected at various work stations did not contain detectable amounts of metallic nickel, cobalt, or crystalline silica (in the form of quartz or cristobalite).

None of the 13 personal samples showed metallic vanadium concentrations (range 0.01 - 0.23 mg/M<sup>3</sup>) in excess of the 1.0 mg/M<sup>3</sup> NIOSH criteria or OSHA standard. One personal sample obtained in the "outside shroud area" showed nuisance particulate levels (16.9 mg/M<sup>3</sup>) in excess of the 10.0 mg/M<sup>3</sup> ACGIH TLV and 15.0 mg/M<sup>3</sup> OSHA standard. The workers were also exposed to increased levels of nuisance particulates during the short and intermittent periods while polishing fan blades. A personal sample obtained for actual exposure periods during the work shift (totaling 22-minutes) showed an air level of 17.6 mg/M<sup>3</sup>. Although this concentration, when expressed as an 8-hour TWA (0.81 mg/M<sup>3</sup>), does not exceed the referenced ACGIH TLV or OSHA standard, the levels should be reduced to minimize unpleasant deposits of particulates in the workers eyes and nose that may occur. The health questionnaires revealed that several workers had respiratory tract symptoms including irritation of the nose. Review of available medical data showed that one worker had a mild airway obstruction with no X-ray evidence of pneumoconiosis.

On the basis of data obtained in this evaluation, NIOSH determined that a health hazard to nuisance particulates existed in the "open shroud area". Workers in this area are exposed to concentrations of nuisance particulates in excess of the ACGIH TLV and OSHA standard. Health and safety recommendations are offered in Part VII of this report.

KEYWORDS: SIC 3510 (Engine and Turbines), vanadium, nuisance particulates, jet engine fan blades.

## II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970\*, NIOSH investigates the toxic effects of substances found in the workplace. An authorized representative of the United Automobile Workers International Union, Local #647 requested that NIOSH conduct a Health Hazard Evaluation in the jet engine fan blade finishing area, Building 700, Columns G-1 and G-2. The request concerned employee exposure to dust possibly containing crystalline silica and vanadium generated from grinding and polishing operations. Approximately 88 workers are employed in the fan blade area, of which 48 work the first shift (6:48 a.m. to 3:18 p.m.) and 40 of which work the second shift (3:18 p.m. to 11:48 p.m.). The evaluation was specifically requested for the second shift.

Interim Report No. 1 (July 1979) presented the results of the industrial hygiene survey conducted by NIOSH on May 22, 1979.

## III. BACKGROUND

Rough fan blade forgings composed of approximately 90% titanium, 6% aluminum, and 4% vanadium are machined for specified thickness, tolerance, balance, etc. The panel or body portion of the blade is machined using locally exhausted floor belt sanders. The shroud or structural aspect of the blade is machined using miscellaneous hand-held pneumatic abrasive tools. The machined blade is polished on a locally exhausted dual pedestal grinder known as the "flapper". The wheels of the pedestal grinder are basically brushes composed of emery cloth sheets. Figure 1 is a schematic of the fan blade area.

The workers are potentially exposed 8-hours per day, five days per week to metallic vanadium. They also are exposed to other particulates such as aluminum, titanium, and emery which are classed with the group of industrial dusts which are regarded as "nuisance particulates".

## IV. EVALUATION DESIGN AND METHODS

### A. Environmental

Personal air samples were obtained to evaluate concurrent exposures by workers to total metallic vanadium and total nuisance particulate.

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\*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 and Human Services, following a written request by an 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.

Metallic vanadium and total nuisance samples were obtained using calibrated personal sampling pumps operating at 2.0 L/min and 0.8  $\mu$ m DM-800 membrane filters in 3-piece, closed-faced cassettes. The filter was prepared and analyzed for total metallic vanadium by atomic absorption spectrophotometry according to NIOSH Method #173. Total particulate was determined gravimetrically by wet gain. Bulk samples of dust collected at various work stations were analyzed for metallic nickel and cobalt according to NIOSH Method #173. The same bulk samples were analyzed for two polymorphs of crystalline silica (quartz and cristobalite) using X-ray diffraction according to NIOSH Method #109.

#### B. Medical

The workers were privately interviewed by a physician's assistant concerning past occupational history and present or recent medical symptoms.

### V. EVALUATION CRITERIA

NIOSH recommends that occupational exposure to metallic vanadium be controlled so that employees are not exposed at a concentration greater than 1.0 mg/M<sup>3</sup> measured as a time-weighted average (TWA) concentration for up to a 10-hour workday, 40-hour workweek. (The OSHA standard also is 1.0 mg/M<sup>3</sup> 8-hour TWA.) Inhalation of metallic vanadium may cause nose, throat, and respiratory tract irritation.

NIOSH does not have a recommended standard for nuisance particulate. The OSHA standard for nuisance particulates is 15.0 mg/M<sup>3</sup> 8-hour TWA. While the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) is 10.0 mg/M<sup>3</sup>. Inhalation of excessive amounts of nuisance particulates is not known to cause adverse effects in the lungs; elevated concentrations reduce visibility and may result in unpleasant deposits in the eyes and nose, plus injury to the mucous membrane through mechanical action.

### VI. RESULTS AND DISCUSSION

#### A. Environmental

Thirteen personal samples were collected to determine environmental concentrations of metallic vanadium and total particulate. Ten of the samples were taken throughout the work shift; the remaining three samples were collected during the "flapping" operation. Results of these samples are presented as 8-hour TWA's in Table I.

None of the 13 samples showed airborne metallic vanadium concentrations in excess of the NIOSH criterion and OSHA standard of 1.0 mg/M<sup>3</sup>. The maximum 8-hour TWA concentration of metallic vanadium measured was 0.097 mg/M<sup>3</sup>. One sample obtained in the outside shroud area showed that the shroud grinder operator was exposed to total particulate concentrations (16.8 mg/M<sup>3</sup>) in excess of 15.0 mg/M<sup>3</sup> OSHA standard and 10.0 mg/M<sup>3</sup> ACGIH TLV.

Although the time required to polish or "flap" a fan blade was less than 10 minutes, the operating characteristics of the polishing machine suggested potential for increased exposure to airborne particulates. Therefore, a sequential sample was obtained for each of 3 workers to determine the exposure concentration contributed by this operation, i.e., a sampler was worn by the worker only during the operation. The workers also wore a second sampler to address the overall 8-hour workday exposure. One (1/3) personal sample obtained showed a concentration of 17.6 mg/M<sup>3</sup> for the "actual exposure period" calculated to be 22 minutes. The "actual exposure period" is the summation of the workers' sequential periods of exposure at the polishing operation over the 8-hour workday. This exposure level, however, would be significantly reduced when expressed as an 8-hour TWA in accordance with the OSHA standard. The concentration calculated on an 8-hour TWA basis would be 0.81 mg/M<sup>3</sup>. By comparison the OSHA standard is 15.0 mg/M<sup>3</sup>; the ACGIH TLV is 10.0 mg/M<sup>3</sup>. The corresponding 8-hour TWA sample taken on the same worker (to include exposures resulting from all activities during the workday) was 1.8 mg/M<sup>3</sup>.

#### B. Medical

Interviewed were 1 Methods Engineer, 8 workers identified as Grinders, 7 workers identified as Hand Grinders, and 11 workers identified as Precision Hand Grinders. The Methods Engineer, 5 people in grinding, 2 people in hand grinding, and 5 people in precision hand grinding had no job-related complaints. Two people in hand grinding and 1 person in precision hand grinding complained only of hearing loss; another 3 people in precision hand grinding complained of hearing loss in addition to other problems. One worker in precision hand grinding complained only of nose bleeds in the past when exposed to the metal dust from the rotary files. The eight others' complaints involved "sinus" problems, "sinus" headache, irritation of the nose, dust collecting in the nose, "bronchitis," and shortness of breath.

Medical information was obtained from the private physicians of six workers with lower respiratory tract symptoms. Except for one case, the condition did not seem to be serious, and pulmonary function tests that had been done with one exception were within normal limits. The one exception was a precision hand grinder who had previously been evaluated by two pulmonary medicine specialists because of shortness of breath and other symptoms. Pulmonary function tests showed mild airway obstruction.

A NIOSH contract radiologist with training and certification in the X-ray interpretation of pneumoconiosis (a "B"-reader) reviewed the grinders chest X-rays of October 1978, February 1979, December 1979 and March 1980 and found no evidence of pneumoconiosis.

### VII. CONCLUSIONS AND RECOMMENDATIONS

Workers in the outside shroud area were exposed to concentrations of nuisance particulate in excess of the OSHA standard and ACGIH TLV.

Particulate-removing respirators should be worn by workers in this area until acceptable concentrations ( $<15.0 \text{ mg/M}^3$ ) are confirmed by additional environmental sampling. The existing local exhaust ventilation system should be adjusted or amended accordingly until the particulate concentrations are within acceptable levels.

Although the exposure period is brief, workers are exposed to high levels of particulate during the polishing of fan blades. Particulate removing respirators should be available for use by these workers. A periodic inspection of the ventilation system should be conducted to insure that conditions such as obstructions (easily created by the emery cloth), leaking duct connections, fan belt slippages, etc., are not preventing the attainment of maximum efficiency.

#### VIII. ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY OF DETERMINATION 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 Road, 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:

1. General Electric Company, Evendale, Ohio
2. Local No. 647, United Automobile Workers of America, Cincinnati, Ohio
3. U.S. Department of Labor - OSHA - Region V
4. NIOSH Regional Program Consultant - Region V

For the purpose of informing the approximately 88 affected employees, the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where exposed employees work.



TABLE I  
 PERSONAL EXPOSURES TO AIRBORNE METALLIC VANADIUM AND TOTAL PARTICULATES  
 GENERAL ELECTRIC COMPANY  
 FAN BLADE AREA  
 BUILDING 700, COLUMNS G1 & G2  
 May 22, 1979

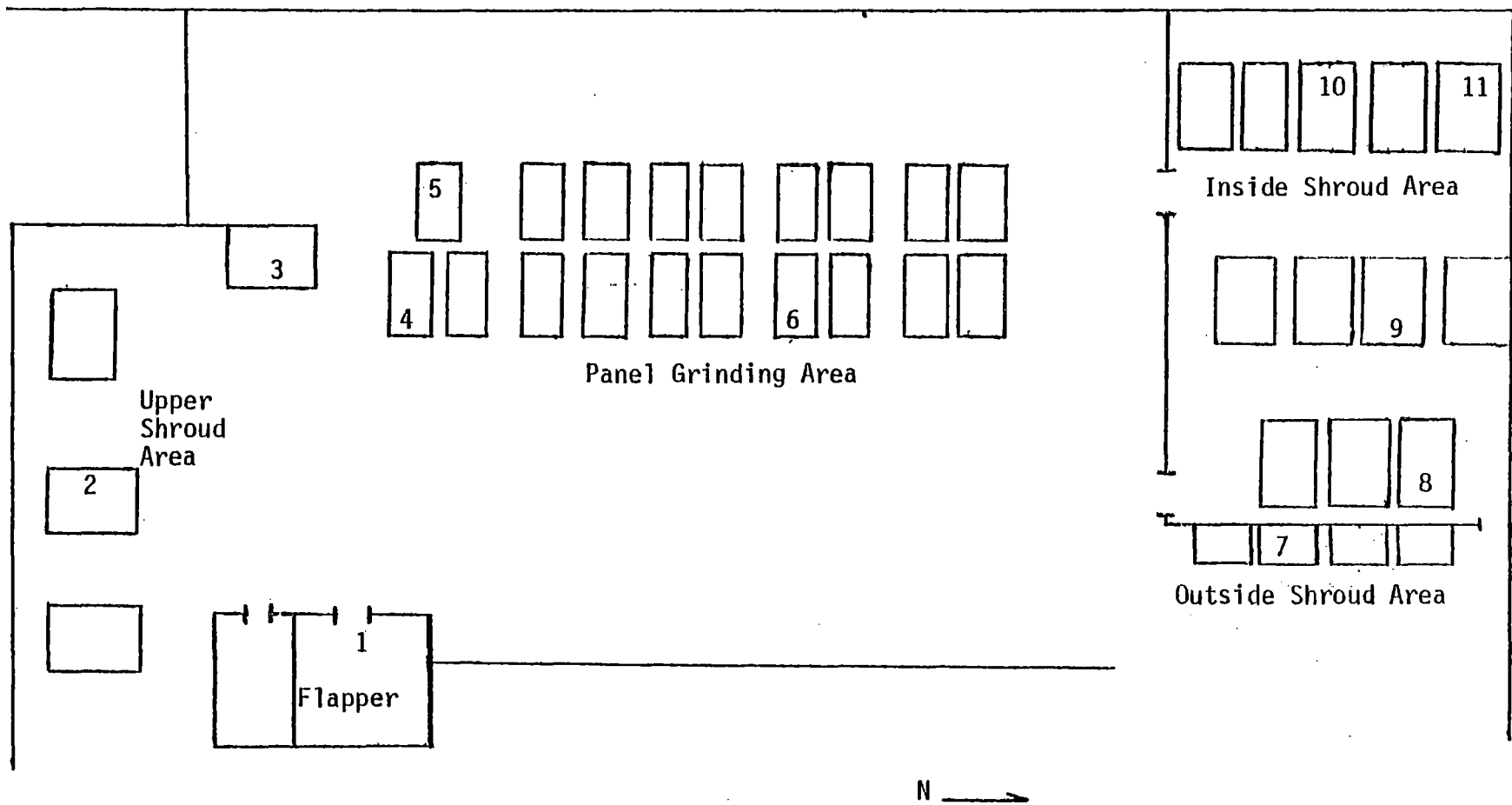
Sample Number	Job Description	Sample Location	Station No. <sup>1</sup>	Sample Time Hours	Sample Volume Liters	Airborne Concentration-mg/M <sup>3</sup>	
						Vanadium	Total Particulates
D-2096	Shroud Grinder	Inside Shroud Area	9	6.53	784	0.033	2.95
D-2118	" "	" " "	10	6.78	814	0.011	1.22
D-2110	Edge Grinder	Inside Shroud Area	11	7.52	902	0.017	1.76
D-2111	" "	" " "	8	7.67	920	0.016	1.76
D-2097	Shroud Grinder	Outside Shroud Area	7	6.62	794	0.052	16.87
D-2099	Shroud Grinder	Upper Shroud Area	3	6.70	804	0.019	1.20
D-2109	" "	" " "	2	7.67	920	0.016	5.64
D-2098	Panel Grinder	Panel Grinding Area	5	7.73	928	LLD <sup>2</sup>	0.53
D-2105	" "	" " "	4	7.72	926	0.008	1.81
D-2117	Panel Grinder	Panel Polishing Area	6	6.63	796	0.009	1.69
D-2100	Panel Polisher	Flapper	1	0.60	72	0.097	6.60*
D-2102	" "	"	1	0.37	44	0.227	17.61*
D-2104	" "	"	1	0.17	20	LLD	10.25*
Environmental Criteria:						1.0	15.0

1. Work stations of employees. Refer to Figure 1.

2. Lower limit of detection. The LLD is 0.007 mg per sample.

\*. Concentration for actual exposure period, not an 8-hour TWA.

Figure 1.  
Work Locations of Employees Sampled by NIOSH  
HE 79-14  
General Electric Co.  
Fan Blade Area  
Building 700, Columns G1 & G2  
May 22, 1979



Drawing not to scale

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