U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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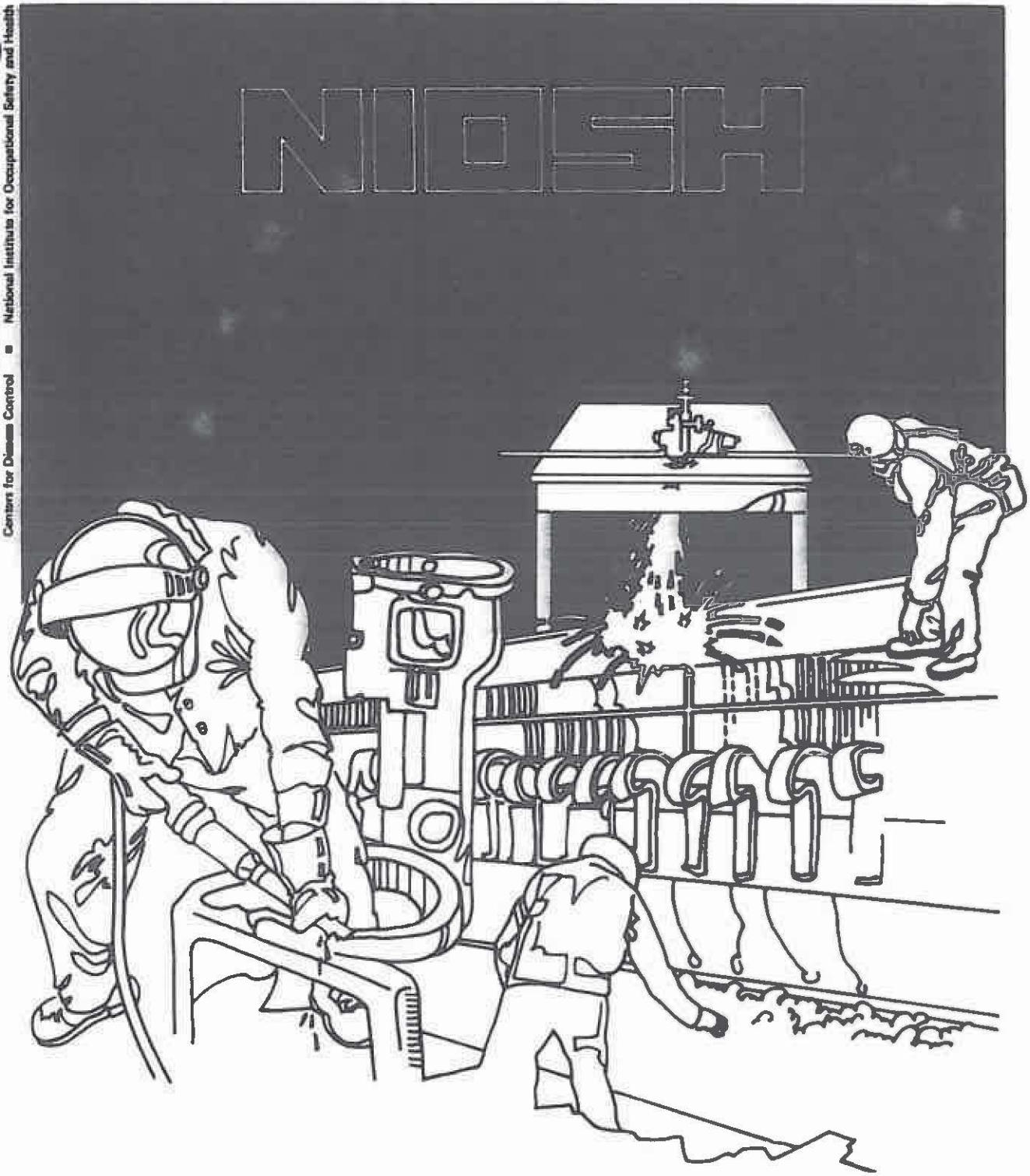
NIOSH



# Health Hazard Evaluation Report

HETA 82-132-1406
HUNTINGTON ALLOYS, INC.
HUNTINGTON, WEST VIRGINIA

## 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 nygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 82-132-1406
JANUARY 1984
HUNTINGTON ALLOYS, INC.
HUNTINGTON, WEST VIRGINIA

NIOSH INVESTIGATORS:
Michael T. Donohue, P.A.-C.
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## I. SUMMARY

In February, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate complaints of headache, nausea, dizziness, glandular swelling, fever, facial lesions and numbness in the hands occurring among office workers at the administration building of Huntington Alloys Incorporated, Huntington, West Virginia.

In April, 1982, NIOSH investigators conducted an initial survey. Preliminary environmental samples were collected to determine qualitatively the type of airborne metals and organic vapors present in the office complex.

In January, 1983, initial interviews with several workers were conducted during the walk-through evaluation of the administrative building. NIOSH investigated the heating, ventilating and air-conditioning (HVAC) unit responsible for air delivery to office areas which the requestors identified as problematic, and found that it had been dismantled and removed. Company medical and environmental records were reviewed.

Analysis of the environmental samples revealed individual metal concentrations ranging from non-detectable to 12.8 micrograms per cubic meter ($ug/m^3$).All detectable metal concentrations were less than 1% of their respective OSHA standards. The organic vapor analyses indicated detectable levels of limonene (commonly found in cleaning solvents), xylene and toluene. These analyses also revealed the presence of small amounts of terpinene dimethyloctane and 2-ethyl 1-hexanol. All organic compound concentrations were less than 1% of their respective OSHA standards.

Analysis of the medical questionnaires revealed a low prevalence of reported work related symptoms in current employees (5 individuals). This prevalence of symptoms is in sharp contrast with a company memorandum which reported symptoms in 25 office workers. These contrasting reports of health complaints may be indicative of a decrease of symptoms due to the company's efforts to correct HVAC problems, or to under reporting of health problems by this work force in the NIOSH survey.

On the basis of the environmental data NIOSH concluded that there was no health hazard to work place substances during the time of our survey. A health hazard may have existed prior to Huntington Alloy's engineering changes on the ventilation system. This is, however, difficult to determine since the reported health problems existed before the NIOSH survey. Recommendations on work place health surveillance/monitoring and ventilation concerns necessary to avoid potential health hazards in the future are included in the Recommendations Section of this report.

KEYWORDS: SIC 8321, office buildings, ventilation, indoor air pollution.

## II. INTRODUCTION

In February, 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request from three workers at Huntington Alloys, Incorporated, West Virginia to evaluate complaints of headache, nausea, dizziness, glandular swelling, fever, facial lesions and numbness in the hands occurring among office workers. A combined medical/environmental evaluation was conducted in April, 1982 and January, 1983, which included air monitoring, wipe samples, evaluation of the ventilation system, interviews and questionnaire sampling of employees who worked in the office complex. Prior to our January visit, NIOSH was advised that it would not be admitted to the company to conduct a follow-up survey. Subsequently, NIOSH sought and obtained an administrative inspection warrant from the local U.S. magistrate. A questionnaire survey was then conducted in January, 1983.

## III. BACKGROUND

The administrative offices of Huntington Alloys, Incorporated are located in a three-story (and basement) brick building adjacent to the plant's main gate. The office areas in the building are provided with heating, ventilation and air-conditioning by four separate HVAC units. HVAC unit #2 served the interior halls and offices as well as the basement and reproduction room. During our initial walk-through, several workers located in office areas served by the #2 HVAC unit, complained of "black stuff" and strong organic odors emanating from the ventilation ducts for several months prior to our visit. The health complaints of the three requestors had been both chronic and episodic in nature. Their diagnosed health problems included adenopathy in the anterior cervical region, dermititis of the face, neck and hands, and irritation of the eyes, nose and throat. The requestors provided NIOSH a list of sixty-five employees purported to suffer similar problems.

In October 1981, an industrial hygiene consulting firm (Industrial Health Foundation, Inc. (IHF)) was hired by Huntington Alloys to perform an environmental survey of selected areas in the plant and office complex. The IHF study revealed low levels of airborne particulates and vapors in the office building.

## IV. EVALUATION DESIGN AND METHODS

### A. Environmental

Environmental sampling was conducted at the Huntington Alloys, Inc. plant in Huntington, West Virginia on April 7, 1982. To help determine if there was a cause/effect relationship between environmental contaminants and medical complaints, NIOSH investigators sampled for both metals and vapors. A total of 4 particulate area air samples for metals analysis were collected in four representative locations of the office building on mixed cellulose ester membrane (AA) filters at a flow rate of 1.5 liters per minute (lpm). The

purpose of these samples was to determine the presence and the type of airborne metals and organic vapors in the office complex. A total of six area air samples for organic vapors were collected in 3 different locations of the office building on 3 pairs of charcoal and Tenax® tubes at a flow rate of 1.5 lpm. Wipe samples were collected at eleven representative locations in the building for metals analysis using Whatman® smear-tab filter media. Finally, to respond to an alleged radiation problem, measurements for ionizing radiation levels using a Dosimeter® direct-reading instrument were obtained on each of the four office floors.

B. MEDICAL

NIOSH reviewed the administrative employees OSHA accident and illness logs for January 1979 through March 1982. NIOSH distributed 110 and received 75 completed, self-administered medical questionnaires from current workers and three from former employees. The questionnaire was designed to elicit complaints and/or symptoms believed by the employees to be work related. The workers were questioned about their medical history, current symptoms/health problems, possible work place exposures, and occupational history. Employer-generated medical records were reviewed.

## V. EVALUATION CRITERIA

### A. Environmental

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

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

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

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

Listed below are the evaluation criteria for the sampled substances in this evaluation.

| Substance | ACGIH TLV | OSHA Standard | NIOSH Recommended Standard |
|---|---|---|---|
| Metals | | | |
| Nickel | 1 $mg/m^3$ | 1 $mg/m^3$ | 0.015 $mg/m^3$ |
| Calcium Oxide | 2 $mg/m^3$ | --* | -- |
| Magnesium | -- | -- | -- |
| Sodium | -- | -- | -- |
| Zinc Oxide Dust | 10 $mg/m^3$ | -- | 5 $mg/m^3$ |
| Organic Vapors | | | |
| Toluene | 375 $mg/m^3$ | 750 $mg/m^3$ | 375 $mg/m^3$ |
| Xylene | 435 $mg/m^3$ | 435 $mg/m^3$ | 435 $mg/m^3$ |
| Limonene | -- | -- | -- |

*No criteria

Building-Related Illness Episodes

Building-related illness episodes have been reported more frequently in recent years as buildings have been made more air-tight in order to conserve energy and to reduce air conditioning expenses. Modern high-rise office buildings are constructed primarily of steel, glass, and concrete, with large windoes that cannot be opened, thus making the building totally dependent on mechanical systems for air conditioning. Contaminants may be present in make-up air or may be introduced from indoor activities, furnishings, building materials, surface coatings, and air handling systems and treatment components. Symptoms often reported are eye, nose, and throat irritation, headache, fatigue, and sinus congestion. Occasionally, upper respiratory irritation and skin rashes are reported. In some cases, the cause of the symptoms has been ascribed to one of several possible contaminants found in indoor air such as formaldehyde, tobacco smoke, or insultation particles. However, most commonly, a single cause cannot be pinpointed.

Imbalance or malfunction of the air conditioning system is commonly identified, and in the absence of other theories of causation, illnesses are often attributed to inadequate ventilation, heating/cooling, or humidification.

Ventilation and Temperature/Humidity

Neither NIOSH nor OSHA has developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by (ASHRAE) the American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

Until recently, the ASHRAE Ventilation Standard 62-73 (1973) was utilized, but recommendations were based on studies performed before the more modern, air-tight office buildings became common. These older buildings permitted more air infiltration through leaks in cracks and interstices, around windows and doors, and through floors and walls. Modern office buildings are usually much more airtight and permit less air infiltration. Due to the reduced infiltration, ASHRAE questioned whether the 1973 minimum ventilation values assure adequate outdoor air supply in modern air-tight buildings.

Subsequently, ASHRAE has revised its standard and has published the new standard, ASHRAE 62-1981, "Ventilation for Acceptable Indoor Air Quality." The new standard is based on an occupant density of seven persons per 1000 $ft^2$ of floor area, and recommends higher ventilation rates for areas where smoking is permitted. The new ASHRAE standard states that indoor air quality for "General Offices" shall be considered acceptable if the supply of outdoor air is sufficient to reduce carbon dioxide to less than 2500 ppm and to control contaminants, such as

various gases, vapors, microorganisms, smoke, and other particulate matter, so that concentrations known to impair health or cause discomfort to occupants are not exceeded. However, the threshold levels for health effects from these exposures are poorly documented. For "General Offices", where smoking is not permitted, the rate recommended under the new standard is 5 cfm of outdoor air per person. Higher ventilation rates are recommended for spaces where smoking is permitted because tobacco smoke is one of the most difficult contaminants to control at the source. When smoking is allowed, the amount of outdoor air provided should be 20 cfm per person. Areas that are nonsmoking areas may be supplied at the lower rate (5 cfm/person), provided that the air is not recirculated from, or otherwise enters from, the smoking areas.[3]

The majority of references addressing temperature and humidity levels as they pertain to human health frequently appear in the context of assessing conditions in hot environments. Development of a comfort chart by ASHRAE presents a comfort zone considered to be both comfortable and healthful for most people. This zone lies between 73 and 77°F (23 and 25° C) and 20 to 60 percent relative humidity.[4]

## VI. RESULTS

### A. Environmental

Analyses of the particulate area air samples revealed (Table I) the following individual metal range concentrations: Calcium (3.4 to 6.1 micrograms per cubic meter ($ug/m^3$)), magnesium (non-detected (N.D.) to 2.5 $ug/m^3$), sodium (3.2 to 12.8 $ug/m^3$), and zinc (N.D. to 5.1 $ug/m^3$). Several other metals (Table I) were all non-detectable. All detectable metal concentrations were less than 1% of their respective OSHA and NIOSH standards. The organic vapor analyses (Table I) of the charcoal tubes indicated detectable levels of limonene (.27-.44 milligrams per cubic meter ($mg/m^3$), which is commonly found in cleaning solvents, and the common solvents xylene, (.05-.07$mg/m^3$), and toluene (.01-.02 $mg/m^3$). The charcoal tube analyses also revealed the presence of small, but nonquantifiable, amounts of terpinene, dimethyloctane, and 2-ethyl 1-hexanol. The Tenax® tubes did not reveal any compounds in significant levels. All organic compound concentrations were less than 1% of their respective OSHA Standards and NIOSH Criteria.

All wipe samples (Table II) revealed detectable amounts of several metals. The largest quantities of these metals were found on the samples from the basement, particularly from the heating and air-conditioning room. Although no standards exist for comparing wipe sample results, higher levels of nickel and lead were found in the basement than on the other three floors of the office building.

The radiation levels for the four floors of the office building were not significantly different from background outdoor radiation levels (approx. 0.5 milli-rems per hour).

B. Medical

Only 5 of 75 current employees reported any symptoms which they thought might be job related. This lack of reported symptomotology made any statistical analyses of these data difficult. The overall lack of reported health problems and/or symptoms in this group of office workers was unexpected. NIOSH was provided an evaluation request which detailed persistent health problems thought to be related to the office environment. A Huntington Alloys Incorporated memorandum reported symptoms in 25 office workers. Our review of the OSHA data revealed a one percent increase in accident and illnesses reported for each of these four yearly periods. This increase may be noteworthy in view of an overall decline in the administrative work force over the same four year period.

## VII. DISCUSSION AND RECOMMENDATIONS

During our initial visit, the air sampling conducted by NIOSH at the Huntington Alloys office building showed low levels of airborne particulates and organic vapors. The IHF study[1] also revealed low levels of airborne particulates and vapors in the office building. However, these and NIOSH's results do not preclude the possibility of significant exposures having occured at times other than during the aforementioned surveys. Prior to NIOSH's first plant entry, the requestors employment was terminated by Huntington Alloys Incorporated. The workplace inaccessibility of the requestors created logistic problems for the investigators, and may have contributed to the possible under reporting of health problems.

Because of the removal of the original #2 HVAC system, a detailed evaluation of the ventilation was not performed during the April, 1982 survey. However, during our discussions with plant officials and during our walkthrough investigations we became concerned about several aspects of the ventilation system. First, shortly before our initial visit, the primary air-handling units in the office complex were dismantled and removed. Several workers had complained of contamination from these systems. Second, some office workers, particularly on the periphery of the building, complained of large chunks of "black soot" emanating from the air ducts. Third, a photography laboratory was located in the basement of the office building. Since the HVAC systems did not have organic vapor filtering capability and since the systems operate with 90% recirculated air[1] (10% fresh air), airborne contaminants, particularly vapors and gases, may have circulated through the building. Finally, according to company officials, the last time the

air-conditioning system had been balanced was in August, 1962. Since that time numerous modifications had been made to the system.

We recommend the air system be completely rebalanced to ensure proper ventilation. We also recommend that the photography area be supplied by a separate air-handling unit or if feasible, that organic vapor/gas filtering elements be installed in the existing air system.

## VIII. REFERENCES

1. "An Industrial Hygiene Evaluation of Corporate Facilities," report to Huntington Alloys, Inc. by Industrial Health Foundation, Inc., Pittsburgh, PA. 15232, October 19-23, 1981.

2. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1982. Cincinnati, Ohio: ACGIH, 1983-84.

3. National Institute for Occupational Safety and Health. The Industrial Environment: it's evaluation and control. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW (NIOSH) publication no. 74-117).

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5. Office Hazards, How Your Job Can Make You Sick, Makower, J. 1981. Tilden Press, Washington, D.C.

6. American Society for Heating, Refrigeration, and Air-Condition Engineers. Ventilation for acceptable indoor air quality (ASHRAE Standard 62-1981). American Society for Engineers, 1791 Tullie Circle, N.E., Atlanta, GA 30329, 1981.

7. American Society for Heating, Refrigeration, and Air-Conditioning Engineers, Handbook of Fundamentals. New York, N.Y., 1977.

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## XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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

1. Huntington Alloys, Inc.
2. NIOSH, Region III.
3. OSHA, Region III.

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

Table I

Metals and Organic Vapor Analyses for Area Samples

Huntington Alloys, Inc.
Huntington, West Virginia
HETA 82-132
April 7, 1982

METALS

| Sample Location | Duration | Metal Concentration[1] (ug/m$^3$) Ca | Mg | Na | Zn | Ni |
|---|---|---|---|---|---|---|
| Basement | 10:20-14:42 | 3.8 | 2.5 | 4.8 | 5.1 | N.D. |
| 1st Floor | 10:09-14:40 | 3.4 | N.D. | 12.0 | N.D. | N.D. |
| 2nd Floor | 10:01-14:33 | 3.9 | 2.5 | 3.2 | N.D. | N.D. |
| Outside | 10:16-14:37 | 6.1 | N.D. | 12.8 | N.D. | N.D. |

ORGANIC VAPORS

| Sample Location | Duration | Organic Vapor Concentration (mg/m$^3$) Toluene | Xylene | Limonene |
|---|---|---|---|---|
| 1st Floor | 10:09-14:40 | .01 | .05 | .27 |
| 2nd Floor | 10:01-14:33 | .02 | .07 | .44 |

(Continued)

Table I
(Continued)

EVALUATION CRITERIA

| Substance | ACGIH TLV | OSHA Standard | NIOSH Recommended Standard |
|---|---|---|---|
| METALS | | | |
| Nickel | 1 $mg/m^3$ | 1 $mg/m^3$ | 0.015 $mg/m^3$ |
| Calcium Oxide | 2 $mg/m^3$ | -- | -- |
| Magnesium | -- | -- | -- |
| Sodium | -- | -- | -- |
| Zinc Oxide Dust | 10 $mg/m^3$ | -- | 5 $mg/m^3$ |
| ORGANIC VAPORS | | | |
| Toluene | 375 $mg/m^3$ | 750 $mg/m^3$ | 375 $mg/m^3$ |
| Xylene | 435 $mg/m^3$ | 435 $mg/m^3$ | 435 $mg/m^3$ |
| Limonene | -- | -- | -- |

1 The following elements were non-detectable (N.D. < 1.0 ug/sample) in all the metals analysis samples: Ag, Al, As, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, P, Pb, Pt, Se, Sn, Te, Ti, Tl, V, Y, and Zr.

Table 11

Metal Analysis for Wipe Samples

Huntington Alloys, Inc.
Huntington, West Virginia
HETA 82-132
April 7, 1982

| Sample Location | Metals[1] (ug/sample) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Al | Ca | Cr | Cu | Fe | Mg | Mn | Mo | Na | Ni | P | Pb | Sn | Tl | Zn | Zr |
| 3rd Floor - East | 1.7 | 13.7 | N.D. | N.D. | N.D. | 2.5 | N.D. | N.D. | 55.9 | 1.0 | 1.1 | N.D. | N.D. | N.D. | 1.3 | N.D. |
| 3rd Floor - Library | 13.2 | 81.3 | 1.0 | 4.0 | 10.2 | 11.4 | N.D. | N.D. | 63.2 | 5.5 | 3.2 | 5.6 | 1.2 | 1.1 | 12.1 | N.D. |
| 3rd Floor - South | 81.2 | 104.0 | N.D. | 3.6 | 3.7 | 23.8 | N.D. | N.D. | 315.0 | 3.9 | 6.8 | 1.6 | N.D. | 1.3 | 7.0 | 5.6 |
| 2nd Floor - Center | 49.5 | 122.0 | 1.4 | 7.5 | 33.2 | 22.1 | 1.2 | N.D. | 151.0 | 7.9 | 6.0 | 6.8 | 1.7 | 1.8 | 22.5 | 3.1 |
| 2nd Floor - Center | 3.9 | 40.3 | N.D. | 2.3 | 10.0 | 4.0 | N.D. | N.D. | 65.8 | 2.8 | 1.4 | 2.6 | N.D. | N.D. | 6.7 | N.D. |
| 1st Floor - East | 29.4 | 26.9 | N.D. | 1.5 | N.D. | 4.8 | N.D. | N.D. | 140.0 | 1.5 | 1.5 | 1.7 | N.D. | N.D. | 3.0 | 2.2 |
| 1st Floor - Center Aisle | 1.0 | 15.3 | N.D. | 1.4 | N.D. | 3.6 | N.D. | N.D. | 43.5 | N.D. | 1.2 | N.D. | N.D. | N.D. | 2.5 | N.D. |
| 1st Floor - Room 112 | 233.0 | 344.0 | 17.0 | 29.3 | 199.0 | 54.8 | 10.3 | 2.6 | 429.0 | 83.0 | 11.2 | 72.6 | 2.9 | 12.6 | 127.0 | 4.0 |
| Basement - H/AC | 158.0 | 1186.0 | 16.6 | 168.0 | 1060.0 | 154.0 | 16.0 | 5.4 | 124.0 | 154.0 | 20.8 | 132.0 | 63.0 | 16.2 | 119.0 | N.D. |
| Basement - H/AC | 251.0 | 644.0 | 13.0 | 59.6 | 1250.0 | 213.0 | 11.4 | 2.2 | 515.0 | 98.7 | 1.8 | 90.6 | 9.2 | 11.1 | 1085.0 | 3.5 |
| Basement - Graphic Services | 62.7 | 279.0 | 5.8 | 43.8 | 152.0 | 42.5 | 4.2 | 2.1 | 137.0 | 35.6 | 9.5 | 32.7 | 12.4 | 5.8 | 83.5 | N.D. |

1 The following elements were non-detectable (N.D. < 1 ug/sample) in all the wipe samples: Ag, As, Be, Cd, Co, Li, Pt, Se, Te, Tl, V, and Y.

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