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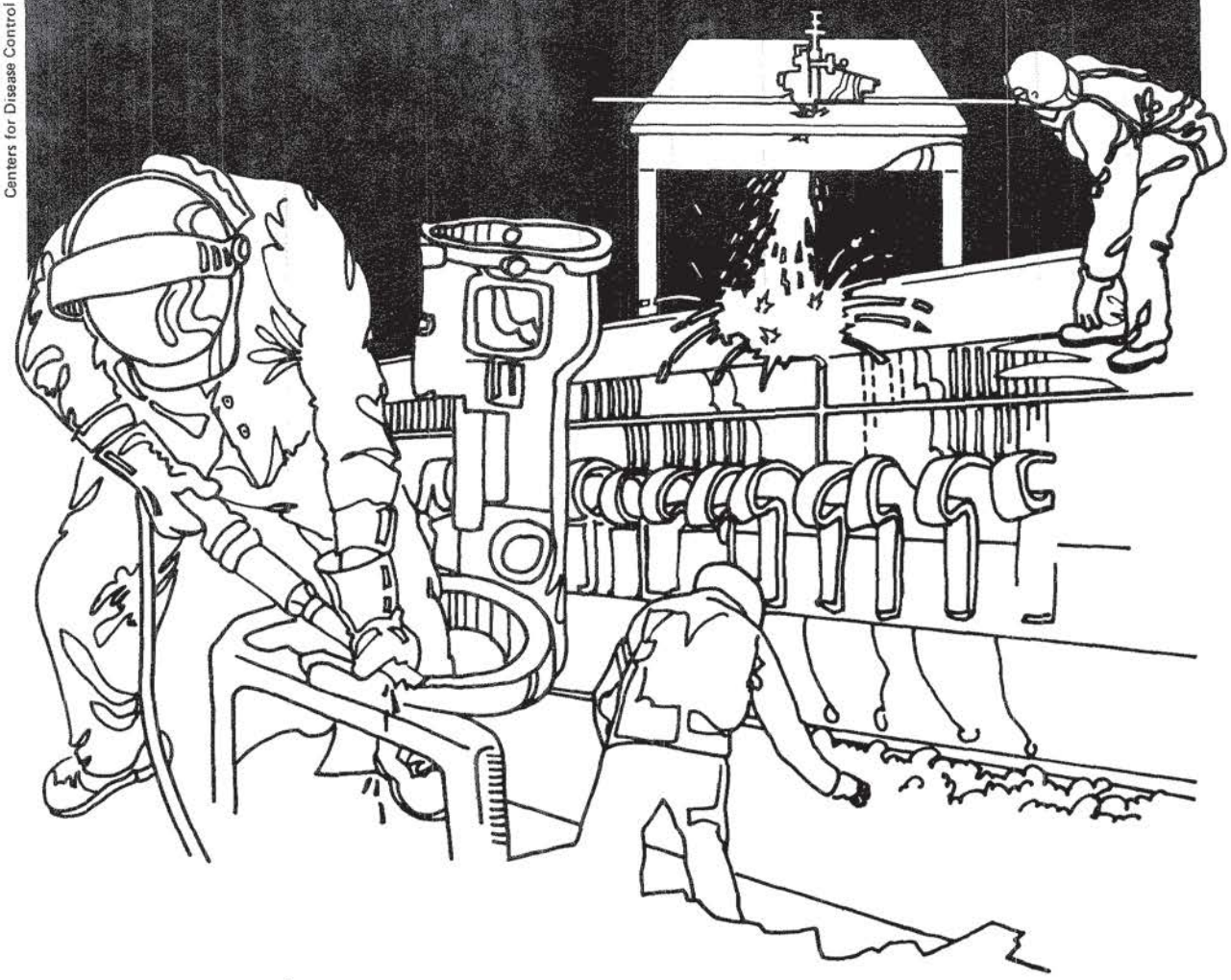
NIOSH



Health Hazard Evaluation Report

HHE 80-227-873
U.S. ASSAY OFFICE
SOUTH SAN FRANCISCO ANNEX
SAN FRANCISCO, CALIFORNIA

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.

HE 80-227-873
May, 1981
U.S. Assay Office
South San Francisco Annex
San Francisco, California

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I. Summary

On August 13, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the American Federation of Government Employees, Local 51, at the U.S. Assay Office, South San Francisco Annex. The requestor was concerned that employees at the facility were exposed to excessive levels of trichlorotrifluorethane (freon 113), hydrochloric acid, sulfuric acid, and other cleaning solvents. Several cases of upper respiratory irritation and unidentified skin rashes were reported.

Environmental and medical surveys were conducted at the U.S. Assay Office on August 20, 1980 and a follow-up survey on October 8, 1980. Eighteen personal breathing zone and general area air samples were collected for Freon from the Coin Wash Room, the lunch room, the Coin Weighing Room and the Coin Reviewing Room. Freon concentrations ranged from 2-861 ppm (parts per million parts of air by volume). None of the samples exceed the California Occupational Safety and Health Administration (Cal-OSHA) standard of 1000 ppm. Four personal breathing zone air samples were collected for hydrochloric acid vapors from the Coin Wash Room. Only one sample detected hydrochloric acid vapors at a concentration of 0.03 ppm, which is below the Cal-OSHA standard of 5 ppm. Three general area air samples were collected for nickel and copper dust from the Coin Review Room. No nickel dust was detected on the filters. Copper dust was detected on each filter at a concentration of 0.006 mg/m^3 (milligrams of substance per cubic meter of air); the Cal-OSHA standard for copper is 1 mg/m^3.

The NIOSH medical investigators interviewed several employees. Medical questionnaires were distributed to employees working in the Coin Wash Room (7), the Coin Review Room (21), the 6-Coin Packaging Room (31), and medical records maintained in the medical department were reviewed for dermatologic and upper respiratory symptoms The findings of the questionnaires, information from the records and the industrial hygiene monitoring results indicated that the symptoms were probably caused by irritation from metal particles and residual Freon on the wet coins. Drowsiness and dizziness due to Freon exposure was also found in all respondents in the Coin Washing Room.

On the basis of this evaluation, NIOSH has determined that employees were not overexposed to Freon 113, hydrochloric acid, nickel or copper dust on the date of this survey. However, it is apparent from the questionnaire and the medical interviews that skin irritation is suffered by many workers who directly handle wet or dry coins. Symptoms of sleepiness and dizziness were reported by employees working in the Coin Wash Room. Recommendations are incorporated in the body of the report to help reduce worker exposure to Freon 113 and metallic dusts.

KEYWORDS: SIC 9999 (U.S. Assay Office) Trichlorotrifluorethane, Freon 113, Hydrochloric acid, nickel and copper dusts, narcotic symptoms, CNS depression.

II. INTRODUCTION

In August 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from an authorized union representative of the American Federation of Government Employees, Local 51. The request was to evaluate workers exposures to trichlorotrifluoroethane (Freon 113), hydrocholoric acid, sulfuric acid, nickel and copper dust in three work areas of the U.S. Assay Office, South San Francisco Annex. Employees complained of dermatitis and upper respiratory tract irritation.

An initial environmental and medical survey was conducted August 20, 1980, and a follow-up survey was conducted October 8, 1980. The environmental air sampling results were reported to the requestor and the employer representative during a telephone conversation on November, 1980. No sulfuric acid was found to be used in the operation.

III. BACKGROUND

The U.S. Assay Office, South San Francisco Annex, is the only site in the U.S. Mint System where coins are directly handled extensively by workers. The Annex is housed in a renovated warehouse and has been at its present location since 1978.

There are approximately 100 full-time and 140 part-time employees. Of these, 6 work in the Coin Wash Area, 3 work in the Coin Weighing Area and 33 (coin inspectors) work in the Coin Reviewing Room. Three of the six workers in the Coin Wash Area are required to wear rubber boots, gloves and aprons, and all the coin inspectors wear a thin nylon glove.

Proof and uncirculated sets of coins from Denver, Philadelphia and San Francisco mints are prepared and packaged at the facility. The uncirculated coins are placed in baskets and dipped into a sequence of five solutions: (buffered hydrochloric acid (2), hot water rinse (1), cold water rinse (2)) for approximately 20-30 seconds each. A canopy exhaust hood is positioned above the sinks. Connected to the hood is an exhaust duct which provides slot exhaust ventilation. A movable louver is used to control air flow through either the canopy hood, the slot duct or both. After the coins are cleaned the baskets are dipped into a freon solvent drying system. This system is very similiar to a vapor degreaser system. One sump contains trichlorotrifluoroethane (Freon 113) and the two other sumps contain Freon 113 with a surfactant (quarternary ammonium alkyl phosphate). The baskets are vigorously shaken in the Freon baths afterwhich the coins are emptied onto towels and dried by two workers. The semi-dry coins are placed in trays, taken to another area to be weighed, and delivered to the Coin Reviewing Room where they are inspected. This room has three circular exhaust fans which provide general room air ventilation.

IV. HAZARD EVALUATION DESIGN

A. Evaluation Criteria and Health Effects

Occupational exposure criteria have been developed to evaluate a workers' exposure to chemical substances. Two sources of criteria were used to assess the workroom concentrations: (1) NIOSH Criteria for a Recommended Standard, and (2) California-Occupational Safety and Health Administration (Cal-OSHA) standards. These values represent concentrations to which it is believed that nearly all workers may be exposed for an 8-hour day, 40-hour work week throughout a working lifetime without experiencing adverse health effects.

TABLE A
EVALUATION CRITERIA

SUBSTANCE	TIME-WEIGHTED AVERAGE (TWA)[a]	CEILING
Freon 113 (Cal-OSHA)	1000 ppm[b]	2000 ppm
Hydrochloric Acid (Cal-OSHA)	5 ppm	-
Nickel (NIOSH)	0.015 mg/m^3[c]	-
Nickel (Cal-OSHA)	1.0 mg/m^3	-
Copper (Cal-OSHA)	1.0 mg/m^3	-

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a) TWA - NIOSH exposure is based on a work day up to 10 hours long, whereas Cal-OSHA standard is based on an 8-hour work day.

b) ppm - Parts of a vapor or gas per million parts of contaminated air by volume.

c) mg/m^3 - Milligrams of a substance per cubic meter of air.

B. Materials and Methods

1. Environmental

Eighteen personal breathing zone and general area air samples were collected for Freon 113 using a charcoal tube and a MDA® pump operating at a flowrate of 20 cubic centimeters per minute (cc/min). The samples were analyzed according to NIOSH Physical and Chemical Analytical Method (P&CAM) S-129 with modifications.

Four personal breathing zone air samples were collected for hydrochloric acid using a silica gel tube and a Sipin® pump operating at a flowrate of 100 cc/min. The samples were analyzed according to NIOSH Method P&CAM 310.

Three general air samples were collected for nickel and copper dust using a 37-millimeter filter (m-5/vinyl metricel filters) and a MSA® pump operating at a flowrate of 1.5 liters per minute. The samples were analyzed according to NIOSH Methoc P&CAM 173.

2. Biological Monitoring Design and Methods

NIOSH medical and industrial hygiene staff conducted a walk-through survey on August 20, 1980. Individual interviews were conducted with 6 workers who had been identified by the union representative as having specifically complained of symptoms they felt to be work-related. Informal interviews were conducted with workers in various work areas as to medical symptoms they had experienced. On October 1, 1980 a questionnaire was administered to three groups of workers:

7 people in the Coin-Washing Room who dip buckets of coins in a series of hydrochloric acid, water, and Freon drying agent baths.

21 people in the Coin Reviewing Room who sort newly washed coins by hand for packaging into sets of uncirculated coins.

31 people in the 6-Coin Packing Room who handle dry coins for proof sets.

On October 8, 1980 additional interviews were conducted with workers from the Coin Washing Room, where there had been the most complaints. Medical questionnaires were re-administered to the 6 workers in the Coin Washing Room to validate the impressions of earlier interviews.

Pertinent records for 9 of the interviewed workers kept by the Assay Office medical department were reviewed, and medical records of 5 of the interviewed workers who had consulted private physicians for pertinent health problems were reviewed.

C. Toxicological Effects

1. Freon 113

Freon is a trade name for fluorinated hydrocarbons. Freon TF (Freon 113) is trichlorotrifluoroethane and it is used as a solvent and drying agent. Freon can be a mild eye, nose and throat irritant, and it can cause mild irritation and dryness of skin.[1] Experimental soaking of the skin in Freon 113 has caused tingling, numbness, coldness and then transient redness of the exposed areas.[2] Freon can be absorbed through the skin but this has not been shown to cause the general effects described below.

When inhaled at elevated concentrations, Freon is a central nervous system depressant causing sleepiness, loss of concentration and manual dexterity and "heaviness" in the head. These symptoms usually disappear within fifteen minutes of the end of exposure. It may also cause cardiac arrythmias (heart palpatations) by sensitizing the heart to the effects of adrenaline.[3]

2. Hydrochloric Acid (HCl)

The odor of HCl can be detected by most people and it can cause mild burns and irritation of the skin. At elevated concentrations in the air, it can irritate the nose and throat causing coughing, burning and choking. Erosion of the teeth has occurred with prolonged vapor exposure and severe irritation and painful burns and visual problems can result from direct contact with the eyes.[1]

3. Nickel Particulates

Allergic dermatitis due to nickel sensitization is common.[4] Skin irritation, or "Nickel Itch", can develop rapidly or several years after initial exposure. It is characterized by a red, itchy, raised rash which may discharge and become crusted. Nickel particles may also cause non-allergic direct irritation of the skin.[5] There is some evidence that exposure to nickel compounds cause cancer in humans, but not enough is known to be certain whether nickel particulates alone represent a potential cause of cancer.

4. Copper Particulates

Copper dust exposure may cause nose, throat and eye irritation, a metallic taste in the mouth, and a direct, non-allergic irritation of the skin.[1]

V. RESULTS AND CONCLUSION

A. Environmental

Eighteen environmental air samples (Table 1) were collected for Freon 113 from four areas: Coin Wash (7), adjacent lunch room (2), Coin Reviewing (7), and Coin Weighing (2). None of the air samples exceeded the Cal-OSHA standard of 1000 ppm. The highest air concentrations were measured in the Coin Wash Room and these ranged from 241-861 ppm. The Freon 113 concentrations in the other areas were well below these measured concentrations.

Four personal breathing zone air samples were collected for hydrochloric acid vapors (Table II) during coin washing. One of these measured acid vapors at a concentration of 0.03 ppm which is below the Cal-OSHA standard of 5 ppm.

Three general area air samples were collected for copper and nickel dust in the Coin Reviewing Room. No nickel dust was detected on the filters and copper dust was detected at a concentration of 0.006 mg/m^3 per sample. This concentration was below the NIOSH recommended criteria of 1.0 mg/m^3.

The combination canopy exhaust hood over the sinks also had a slot exhaust duct to collect acid vapors. An adjustable louver controls whether the air is exhausted through the slot or the canopy hood. The slot duct was not working properly when smoke tubes were used to determine the air flow patterns. It was discovered that the adjustable louver was unknowingly opened by the laborer to increase the canopy exhaust hood ventilation. As a result, the slot exhaust duct was ineffective in pulling the acid vapors away from the workers breathing zone. All the louvers were closed and the slot exhaust duct worked properly.

The solvent drying system is essentially a vapor degreaser unit. The system removes water from metallic and plastic parts and assemblies. The worker places the baskets of wet coins into the Freon sump for a prescribed time. Prior to removing the baskets, the baskets are shaken vigorously, removed from the tank and emptied onto a towel. Consequently, the cooling coils inside the freon tank don't allow the coins to dry properly. Also, pulling the baskets from the tank quickly allows the Freon to boil over the top of the tank.

The workers do not wear a protective glove when they towel dry the coins thus their hands come in contact with the Freon solvent.

The coin inspectors (reviewers) wear a nylon glove whenever handling coins. The coins are not thoroughly dry or free of metallic particulates when they are brought to the Coin Reviewing Area. Thus metallic particulates accumulate on the tablecloth and in some cases despite protective gloves become embedded on the workers hands and forearms. Also, it was observed that the coins are not always thoroughly dry when they are brought into the Coin Review Room.

B. Medical

The most common symptom reported by all workers was dermatitis. Itching, redness, papular rash, burning, dryness and peeling of the skin were all reported; particularly on the hands and arms but also on the face, neck and other sites. Workers complained that metal particles from the coins were irritating and became embedded in the skin even though thin nylon gloves were worn.

The irritation appears to be sporadic, lasting variously for days or weeks, although some workers reported fairly continuous itching or dryness. Creams and medications (primarily hydrocortizine and over-the-counter lotions) provide relief for some workers. Several workers reported that the irritation subsides during vacations. In addition, there were several complaints of tingling and numbness of the fingers.

The second major complaint was of upper respiratory tract and eye irritation. Workers reported burning of the eyes, nose and throat, stuffiness and runny nose. One worker reported that she could see metal particles when she blew her nose. Many workers in areas other than the Coin Wash Room reported sleepiness, and heart palpations and shortness of breath were reported by a few. Workers stated that all symptoms, but particularly those un-related to the skin, appeared or became worse when the coins came from the Wash Room wetter than usual.

Wash Room workers who were interviewed complained of sleepiness and dizziness particularly when they are working directly over the Freon baths. They also complained of pain in their joints from lifting the heavy bags and buckets of coins.

Workers generally considered ventilation in the work area to be seriously inadequately and complained of vapors, stuffiness and heat, particularly in the Coin Reviewing Room.

The results of the self-administered written questionnaire paralleled those of the interviews. A higher incidence of symptoms was reported by those working in the Coin Reviewing Room compared to those in the 6-Coin Packaging Room. This was statistically significant for skin irritation and sleepiness (Table 1).

Table 1: Frequency of Complaints Among Workers in the Coin Reviewing Room and 6-Coin Rooms*

	Percent Reporting	
	Coin Reviewing	6-Coin Proof
Nose/Throat Irritation	62%	45%
Joint Problem	48%	32%
Numbness or Tingling	29%	16%
Skin Irritation	76%	52%
Sleepiness, Dizziness	71%	23%
Headaches	33%	39%
Heart Palpations	24%	10%

* 78% of the workers in the Coin Reviewing Room are female and 47% of the workers are over 40 years of age; 65% of the workers in the 6-Coin Proof Room are female and 24% of the workers are over 40.

Table II: Frequency of Complaints Among Workers in the Coin Wash Room

	Percent Reporting
	Coin Wash
Nose/Throat Irritation	29%
Joint Problems	86% (100)*
Numbness or Tingling	43%
Skin Irritation	29%
Sleepiness, Dizziness	100%
Headaches	43%
Heart Palpations	43%

* Six of the seven workers (86%) in the Coin Wash Room lift quantities of coins. All of these reported joint pain. They are all young men under 30 years of age.

Medical records from both the U.S. Assay Office and private physicians did not identify a cause for the dermatitis seen in the work population. At the request of the Assay Office physician, three workers who had shown symptoms were patch tested for sensitivity to a variety of substances. None showed sensitivity to nickel and only one showed a light reaction to copper. Several workers had pre-existing conditions that their physicians felt were exacerbated by workplace exposure, particularly to Freons. One workers was tested for allergic sensitivity to Freon, but showed only the primary irritant effect of Freon.

It seems clear that the irritant skin effects are caused by an irritant process rather than allergic sensitization. The dermatitis is intermittent, there is little evidence of sensitization, and it is poorly correlated with wet and/or dust coin handling.

The high incidence of dermatitis and sleepiness in the Coin Reviewing Room is consistent with the skin irritant and CNS depressant effects of Freon. The fact that workers reported that symptoms worsened when the coins were brought in wetter than usual further supports this conclusion. Other symptoms were not seen with statistically increased frequency. It is possible that the increased, but not statistically significant, rate of complaints of mucous membrane irritation was due to the handling of larger number of Freon-wet coins batches on other days. Workers in areas where they were not directly exposed to Freon detected odors believed to be coming from the Wash Room. Some complained of nose and throat irritation and a lack of adequate ventilation throughout the facility.

Sleepiness and dizziness in the Coin Reviewing Room may be due to a number of causes in addition to or instead of Freon; the high level of heat was cited as a particular problem in that work area. The work is particularly repetitive and limited in motion compared to that in the 6-Coin Room, which may also contribute to this problem. The 100% incidence of unusual sleepiness or dizziness in the Coin Wash Room is very probably due to the intermittently high levels of Freon in that work area.

The potential cardiac sensitization effects of Freon are hard to evaluate in this context. The exposures measured in the Coin Reviewing Room were low and only five workers reported "heart palpitations". The increased incidence of "heart palpitations" in the Coin Wash Room, however, is noteworthy; particularly so because of the younger mean age of the workers. Freon levels were measured there in excess of the 300 ppm which has been associated with an increase in cardiac arrhythmias in other studies.[7]

VI. RECOMMENDATIONS

(1) Laborers in the Coin Wash Room should be instructed not to alter the louvers so that the slot exhaust system works properly.

(2) The Freon Solvent Drying System should be used according to the manufacturers procedures so that the Freon does not escape from the tank. Otherwise, the Freon unit should be retrofitted with local exhaust ventilation to collect fugitive vapors.

(3) The laborers who dry the coins should wear protective gloves when drying coins to prevent skin contact.

(4) Steps should be taken to assure the coins are properly dried before they are removed from the room to prevent contamination of other areas.

(5) Coins should be cleaned more thoroughly to prevent contamination of the Coin Review Room with metal particulate which are being embedded into the inspectors arms, hands and face.

(6) The ventilation system in the Coin Review Room should be checked to assure that the room has an adequate number of air changes per person. The California State Energy Code recommends 14 cubic feet per minute per person.

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IX. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 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, Spingfield, Virginia, 22151. 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:

1. American Federation of Government Employees, Local 51
2. U.S. Assay Office, San Francisco, California
3. U.S. Department of Labor, Region IX

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

TABLE I

SUMMARY OF AIR SAMPLES COLLECTED

FOR TRICHLOROTRIFLUOROETHANE (FREON 113)

U.S. ASSAY OFFICE, SOUTH SAN FRANCISCO ANNEX

SAN FRANCISCO, CALIFORNIA

OCTOBER 8, 1980

HE 80-277

Sample Location	Sample Period	Sample Volume (Liters)	Concentrations (ppm)[1]
Area Samples:			
Lunch Room Adjacent to Coin Wash Room	0725 - 1045	4.3	157
Lunch Room Adjacent to Coin Wash Room	1055 - 1355	3.7	24
Personal - B.Z.[2] Samples:			
Laborer-Coin Wash Room	0715 - 1050	4.8	326
Coin Dryer	0723 - 1110	5.3	320
Coin Dryer	1110 - 1400	3.8	241
Coin Washer	0721 - 1050	3.2	343
Coin Washer	1050 - 1355	2.9	329
Coin Dryer	0723 - 1055	4.4	861
Coin Dryer	1055 - 1345	3.4	350
Coin Reviewer	0745 - 1115	5.0	20
Coin Reviewer	1115 - 1450	4.7	15
Coin Reviewer	1110 - 1430	4.4	14
Coin Reviewer	0750 - 1115	5.0	8
Coin Reviewer	1120 - 1430	4.5	2
Coin Reviewer	0750 - 1125	5.4	29
Coin Reviewer	1125 - 1430	2.3	26
Coin Weighing	0720 - 1055	2.4	46
Coin Weighing	1055 - 1350	2.3	19

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1) PPM - Parts of a vapor or gas per million parts of contaminated air by volume.

2) B.Z. - Breathing Zone

Evaluation Criteria

(1) Cal-OSHA Standard - 1000 ppm

TABLE II

SUMMARY OF PERSONAL AIR SAMPLES COLLECTED

FOR HYDROCHLORIC ACID VAPORS

U.S. ASSAY OFFICE, SOUTH SAN FRANCISCO ANNEX

SAN FRANCISCO, CALIFORNIA

OCTOBER 8, 1980

HE 80-277

Sample Location	Sample Period	Sample Volume (Liters)	Concentrations(ppm)[1]
Coin Washing-Laborer	0720 - 1055	21.4	0.03
Coin Washing-Laborer	1055 - 1350	15.6	ND[2]
Coin Washing-Laborer	0720 - 1105	18.8	ND
Coin Washing-Laborer	1105 - 1345	12.2	ND

(1) PPM - Parts of a vapor or gas per million parts of contaminated air by volume.

(2) ND - None Detected

EVALUATION CRITERIA

Cal-OSHA Standard - 5 ppm (8-hour time-weighted average)

TABLE III

SUMMARY OF AREA AIR SAMPLES COLLECTED

FOR NICKEL AND COPPER

U.S. ASSAY OFFICE, SOUTH SAN FRANCISCO ANNEX

SAN FRANCISCO, CALIFORNIA

OCTOBER 8, 1980

HE 80-227

Sample Location	Sample Period	Sample Volume (Liters)	Concentrations (mg/m^3)[1] Nickel	Copper
Coin Reviewers Table	0750 - 1435	608	ND[2]	0.006
Coin Reviewers Table	0750 - 1430	600	ND	0.006
Coin Reviewers Table	0750 - 1435	608	ND	0.006

(1) MG/M^3 - Milligrams of a substance per cubic meter of air.

(2) ND - None Detected

EVALUATION CRITERIA

(1) Nickel - 15 Microgram per cubic meter of air - NIOSH Recommendation

(2) Copper - 1 mg/m^3 - Cal-OSHA Standard

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