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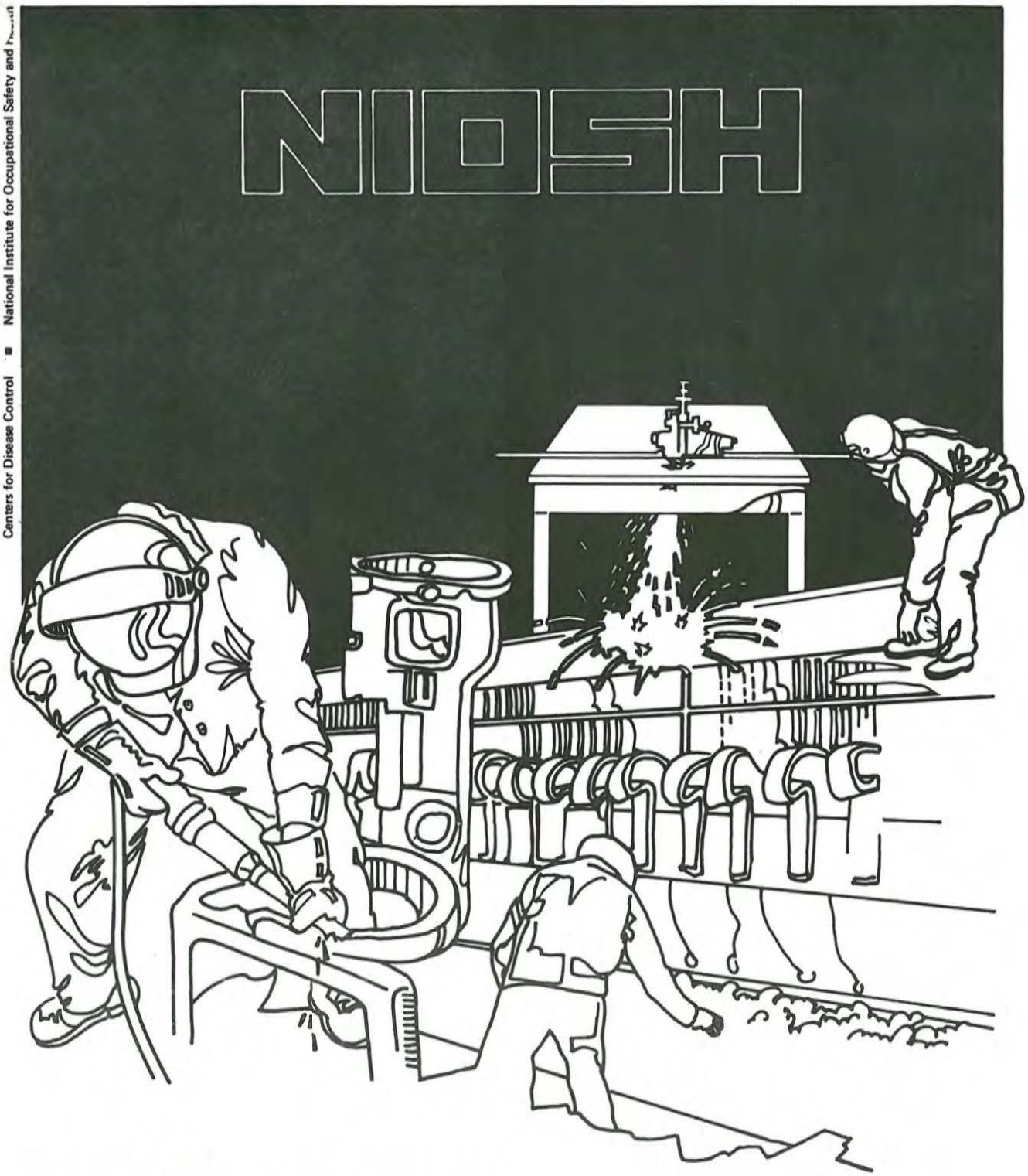

# Health Hazard Evaluation Report

HETA 80-148-1025
MOUNTAIN BELL
DENVER, COLORADO

## 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.

HETA 80-148-1025
DECEMBER 1981
MOUNTAIN BELL
DENVER, COLORADO

NIOSH INVESTIGATOR:
Paul Pryor, I.H.

## I. SUMMARY

In May 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from an employee of Mountain Bell, Denver, Colorado, to evaluate potential exposures to various chemicals (sodium hydroxide, ethyl alcohol, triethylamine, hexane, hydroquinone, acetic acid, sulfuric acid, diethylaminoethanol, and methylaminoethanol) at their film process and developing laboratory. Approximately ten employees work in this department. Prior to the NIOSH environmental surveys in June and September, the developing department process was changed from an open chemical bath process to a closed system and some chemicals were eliminated.

Both personal and area samples were well below the NIOSH and OSHA evaluation criteria established for this survey. That is, sodium hydroxide, ethyl alcohol, triethylamine, hexane, and hydroquinone were below 2 $mg/M^3$, 1900 $mg/M^3$, 100 $mg/M^3$, 360 $mg/M^3$, and 2 $mg/M^3$, respectively.

It was also determined that the existing exhaust ventilation system in the dark rooms was inadequate for the operations performed in these rooms.

The results of the medical questionnaire showed that all of the graphics clerks interviewed experienced some adverse health effects prior to the June process change, e.g., eye, nose, throat irritation; chest tightness; and dermatitis.

On the basis of the data obtained in this evaluation, NIOSH determined that exposures to the film processing and developing operators, as well as the other employees in this department, were below applicable criteria for the chemicals evaluated. The medical data, however, does indicate that exposure to hazardous materials may have existed in the past. It was also determined that the exhaust ventilation system in the dark rooms was not operating effectively and that personal protective clothing and safety concerns must be improved to adequately protect the employees working in this department. Recommendations are included in Section VIII of this report.

KEYWORDS: SIC 481 (Telephone Communication - Wire and Radio), publication, film processing and developing, dark room, etching, paint and pill, camera ready, sodium hydroxide, ethyl alcohol, triethylamine, hexane, hydroquinone, acetic acid, sulfuric acid, diethylaminoethanol, methylaminoethanol and potassium hydroxide.

## II. INTRODUCTION

In May 1980 the National Institute for Occupational Safety and Health received a request from an employee at Mountain Bell, Denver, Colorado, to determine if there was a health hazard from various chemicals used in the film developing and processing department. An environmental survey was conducted June 19-20, 1980, and September 2-3, 1981, to evaluate exposures to sodium hydroxide, ethyl alcohol, triethylamine, hexane, and hydroquinone. The hexane and sodium hydroxide were not evaluated until September due to seasonal production slowdown.

The following chemicals were used in an open chemical film process that was eliminated prior to NIOSH's initial investigation: acetic acid, sulfuric acid, diethylaminoethanol, methylaminoethanol, and sodium hydroxide. These chemicals are however addressed in this report in terms of their health effects. A review of the exhaust ventilation systems and of Mountain Bell's safety and health procedures in this department was also evaluated.

## III. BACKGROUND

Mountain Bell's film developing and processing department (lab) is primarily responsible for preparing art work/advertising used in Mountain Bell's yellow page directories. This department prepares the directories for Mountain Bell's midwestern states and has been performing this service since 1976. Until recently (June 1980) they have been using open chemical baths in the film developing and processing operations. In June 1980 the department converted the open chemical bath process to a closed developing system.

The new system allows the film to be processed by inserting the negative in one end of the machine and receiving the finished product at the other. These machines (Kodak 420-A's) have self-contained exhaust systems and the potential for hazardous vapors, as well as skin contact, is eliminated with the new developing process.

Under the old system one to two employees were required to manually transfer a negative from one chemical bath to the next until the process was complete. There were four steps in the old process and the chemicals involved included acetic acid, sulfuric acid, diethylaminoethanol, methylaminoethanol, and sodium hydroxide. The potential for inhalation of vapors and skin absorption from the chemicals used in the old process was very high. The new system requires only one employee and there is no personal contact or potential inhalation from the chemicals used in the new units.

There were three additional jobs evaluated in this department. Two of these are performed in the Etch Room and include the etching and burning process and the opaquing process. The etching and burning process requires one operator to use a solution containing sodium hydroxide and ethanol. During this process the operator submerges and washes with a sponge the developed negative with the solution. The operator wears gloves during this process and an eye wash bottle is available in the Etch room for emergencies. For approximately six months a year (during the busy season) this process is performed for six to eight hours per day. The remaining months this process occurs occasionally during the day.

The second job evaluated in the Etch-Room was the opaquing process which is usually performed by one person and again is seasonal, i.e., six months of heavy activity and six months of infrequent activity per day. The opaque material contains a triethylamine compound and is brushed on the negative.

Another concern evaluated in this department was the use of a glass cleaning solution which contains a hexane base material. Each of the graphic clerks use this material to clean the various glass surfaces used on the photographic and graphic equipment. The majority of the clerks use this material only occasionally each day; however, there were two workers who used this frequently each day and in large amounts. These workers did not use any protective clothing and it was noted that one worker's hands did appear white after using this solution. This is an indication that there is absorption by the intact skin and is having a defatting effect.

Each of the rooms in this department has a general ventilation system. There was no make-up air systems in the dark rooms but there was return air ducts (10" x 18") in these rooms. The only potential for chemical exposures in these rooms (i.e., after the June process change) is from the use of the cleaning solution described above. The operators who used the solution frequently did spend the majority of their time working with this material in the dark rooms.

The last concern addressed in this department was Mountain Bell's health and safety procedures. Again, there are various caustic chemicals used in the different processes described and at present this department does provide protective gloves and goggles for the employees and eye wash facilities. It was determined that only a few employees wear the protective equipment when working with the various chemicals and as was described earlier one employee did show skin irritation to the hands. It was also reported to NIOSH that one employee, recently experienced eye irritation from a chemical spill and this person was not wearing eye protection during the episode.

## IV. ENVIRONMENTAL DESIGN AND METHODS

### A. Environmental

The chemicals that were used in the old process were not sampled for environmentally (i.e. acetic acid, sulfuric acid, diethylaminoethanol, methylaminoethanol, and sodium hydroxide).

A variety of sampling techniques were used to evaluate the remaining contaminants in the film department. Personal and area samples were taken for hexane, sodium hydroxide, ethyl alcohol, triethylamine, and hydroquinone. The following is a description of the techniques used:

1. Hexane and Ethyl Alcohol -- Personal and area samples for hexane and ethyl alcohol were taken using charcoal tubes and low flow pumps. The pumps drew the air through the tubes at a flow rate of 200 cc per minute. The charcoal tube samples were collected using NIOSH Methods S-90 and S-56.

2. Sodium Hydroxide and Hydroquinone -- Personal and area samples for sodium hydroxide and hydroquinone were taken in the Etch room using AA filters and high flow pumps. The pumps operated at a flow rate of 1.5 liters per minute (lpm). The filter samples were analyzed using NIOSH Method P&CAM 241 and S-57.

3. Triethylamine -- Personal and area samples for triethylamine were taken in the Etch room using silica gel tubes and low flow pumps. The pumps drew the air through the tubes at a flow rate of 200 cc per minute. The silica gel samples were analyzed using NIOSH Method P&CAM 221.

B. Medical

A medical questionnaire was administered to each of the graphics clerks.

## V. EVALUATION CRITERIA AND TOXICOLOGY

In this study numerous sources of environmental exposure criteria and existing research data were used to assess the worker's exposure to the suspected chemicals evaluated in the workplace at Mountain Bell.

The exposure limits to toxic chemicals are derived from existing human and animal data, as well as industrial experience, to which it is believed that nearly all workers may be exposed for an 8-10 hour day, 40-hour work week, over a working lifetime with no adverse effects. However, due to variations in individual susceptibility, a small percentage of workers may experience effects at levels at or below the recommended exposure limit; a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by development of an occupational illness.

The environmental and medical (toxicological) evaluation criteria used for this investigation are presented in Table 1. Recommended environmental limits and/or general information concerning each substance are listed, i.e., the source of the recommended limits, the present OSHA standard, and a brief description of the primary health effects known to date.

## VI. RESULTS AND DISCUSSION

A. Environmental

Employee exposure to suspected airborne concentrations of hexane, triethylamine, sodium hydroxide, ethyl alcohol, and hydroquinone were evaluated. An evaluation of the ventilation systems and the existing health and safety program in this department were also assessed. The following are the results and conclusions of NIOSH's evaluation:

1. Hexane

A total of four samples were collected for hexane, two personal and two area samples. (Refer to Table 2.) These samples were collected on and around the graphics clerk operators who are

responsible for cleaning the various glass surfaces in the dark rooms. The hexane levels ranged from 0.40 - 1.6 milligrams per cubic meter of air ($mg/M^3$) which is far less than the lowest criteria cited (i.e. NIOSH's recommended standard of 360 $mg/M^3$). However, these employees did have skin irritation on their hands that does reflect a defatting effect, a sign of direct skin contact with hexane.

2. Triethylamine

A total of four samples were collected for triethylamine, two personal and two area samples. (Refer to Table 2.) These samples were collected for the operators who work in the Etch Room. The triethylamine levels all were non-detectable (ND).

3. Sodium Hydroxide

A total of five samples were collected for sodium hydroxide, three personal and two area samples. (Refer to Table 3.) These samples were collected for the graphics clerks who are responsible for developing and processing the negatives using the new system. The sodium hydroxide concentrations for these samples ranged from ND to 0.027 $mg/M^3$ which is below NIOSH's recommended criteria of 2 $mg/M^3$.

4. Ethyl Alcohol and Hydroquinone

A total of four personal samples for ethyl alcohol and four personal samples for hydroquinone were collected on the graphics clerks who work in the dark rooms and Etch Room. Each of these samples showed non-detectable levels for both ethyl alcohol and hydroquinone. (Refer to Table 4.)

5. Ventilation

The ventilation system in this department is a general room ventilation type and has ten air changes per hour. The dark rooms, however, in this department are approximately 18 x 20 x 10 feet and have only one general ceiling return air duct (10 x 18 inches) per room. Based on the size of these dark rooms there should be approximately 720 cubic feet per minute (cfm) air capacity in order to meet the twelve air changes per hour (AC/HR) recommended for dark room operations. (Art Hazards News, August 1981, "Kodak - Recommendation for room air changes in dark rooms.)

6. Health and Safety

Mountain Bell's film and processing department has a number of caustic chemicals which can be a hazard to the workers. At present there are gloves and goggles which can be used by the employees who work with these materials. The Etch room also has an eye wash unit that is hung on the wall if an emergency does occur. The problems that were noted concerning the existing health and safety program in this department included the

need for impervious aprons, gloves, and goggles for all employees who handle caustic materials, education regarding the hazards with the chemicals used, and education concerning the proper use of the emergency eye wash unit.

B. Medical

Each of the graphics clerks gave medical histories. The results showed that all of the clerks experienced some adverse health symptoms, e.g., eye, nose, and throat irritation, chest tightness, and dermatitis. All the clerks felt that the symptoms occurred while in the dark room with the old open bath process. Each felt that the majority of symptoms subsided once the new film processing system was installed.

The medical data elicited from the employees does indicate that the clerks had symptoms suggestive of exposure to acetic acid, sulfuric acid, diethylaminoethanol, methylaminoethanol, and sodium hydroxide, which were used in the old process. Finally, those chemicals used in the Etch Room, sodium hydroxide and ethanol, can produce a number of the symptoms described above; therefore, adequate personal protective devices and good work practices are mandatory in order to reduce and/or eliminate any potential health hazard.

## VII. CONCLUSIONS

1. All the samples taken during the survey period indicate that exposure levels to the existing chemicals used in the film department were below the criteria established.

2. Due to the film process change that occurred prior to NIOSH's environmental investigation, it was impossible to determine the exposure levels that existed with the open chemical bath process. However, the medical symptoms described by all the employees strongly suggest that a health hazard did exist with the old system.

3. Those clerks who work in the Etch Room and those employees who frequently work with the glass cleaning solution lacked adequate personal protective clothing. This was indicated by the eye, nose, and skin irritation mentioned by the employees who work with these materials, the irritation noted on the hands of the clerks who work with the glass cleaner, and the incident where the clerk experienced eye irritation from a chemical spill.

4. The ventilation in the dark rooms is insufficient in terms of providing adequate make-up air to these areas.

## VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental study, as well as personal communications with individuals in the film processing department, the following recommendations are made to provide a better work environment for the concerned employees:

1. Provide adequate dilution ventilation in the dark rooms. The existing recommended number of air changes per hour for this type of operation is twelve.

2. Those employees who work with the etching solution should wear impervious gloves and apron, as well as protective goggles. Also, those persons who frequently work with the glass cleaning solution should wear impervious gloves.

3. Each of the graphics clerks in this department should know the location of the eye wash unit and understand its proper use. Therefore, if an accident should occur any one of these employees could assist in aiding the injured worker.

4. Employees who work with the various chemicals used in the department should be made aware of their hazard and educated on their proper use and handling. Material Safety Data Sheets can be obtained from the vendors and these normally provide information on safe handling and emergency care procedures.

## IX. REFERENCES

1. Industrial Hygiene and Toxicology, second edition, Frank Patty (editor), Interscience Publishers, 1967, Vol. II.

2. Industrial Toxicology, third edition, Hamilton and Hardy, Publishing Service Group, Inc., 1974.

3. "Threshold Limit Values for Chemical Substances in Workman Air", America Conference of Governmental Industrial Hygienists, 1981.

4. "Kodak - Recommendation for room air changes in dark rooms," Art Hazards News, Vol. 4, No. 6, August 1981.

5. Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill Book Company, New York.

6. Occupational Diseases, A Guide to Their Recognition, U.S. Department of Health, Education, and Welfare, Public Health Service Publication (NIOSH) No. 77-181.

## X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

Paul Pryor, M.S.
Industrial Hygienist
NIOSH, Region VIII
Denver, Colorado

Originating Office:

Hazard Evaluation and Technical Assistance Branch (HETAB)
Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
NIOSH, Cincinnati, Ohio

Report Typed By:

Marilyn K. Schulenberg
Occupational Health Technician
NIOSH, Region VIII
Denver, Colorado

## XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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), 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:

1. Mountain Bell.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado State Department of Health.
5. State Designated Agency.

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

TABLE 1

ENVIRONMENTAL CRITERIA AND TOXICOLOGY

Mountain Bell
Film Processing/Developing Department
Denver, Colorado

| Substance | Recommended Environmental Limit[A] | Reference Source | Primary Health Effects | OSHA Standard[A] |
|---|---|---|---|---|
| Hexane | 360 mg/M$^3$ | NIOSH | Lightheadness, headaches; eye, nose, and throat irritation; dermatitis. | 1800 mg/M$^3$ |
| Hydroquinone | 2 mg/M$^3$ | ACGIH[B] | Eye irritation, conjunctivitis; keratitis, nausea, and dizziness. | 2 mg/M$^3$ |
| Sodium Hydroxide | (C) 2 mg/M$^3$ | NIOSH | Irritation of nose, eyes, and skin. | 2 mg/M$^3$ |
| Ethyl Alcohol | 1900 mg/M$^3$ | ACGIH | Lightheadness; eye, nose, and throat irritation. | 1900 mg/M$^3$ |
| Triethylamine | 100 mg/M$^3$ | ACGIH | Irritation of eyes, respiratory system, and skin. | 100 mg/M$^3$ |
| Chemicals no longer in use: | | | | |
| Acetic Acid | 25 mg/M$^3$ | ACGIH | Eye, nose, and throat irritation; skin irritation. | 25 mg/M$^3$ |
| Sulfuric Acid | 1 mg/M$^3$ | NIOSH | Eye, nose, throat, and skin irritation. | 1 mg/M$^3$ |
| Diethylaminoethanol | 50 mg/M$^3$ | ACGIH | Nausea, vomiting; respiratory irritation, and skin and eye irritation. | 50 mg/M$^3$ |
| Methylaminoethanol | NEL | ----- | Nausea, vomiting; respiratory irritation, and skin and eye irritation. | NEL |

A All air concentrations are expressed as time-weighted average (TWA) exposures for up to a 10 hour workday unless designated (C) for Ceiling which should not be exceeded.
B ACGIH = American Conference of Governmental Industrial Hygienists.
NEL = No Exposure Level has been recommended or standard set.
mg/M$^3$ = Approximate milligrams of substance per cubic meter of air.
(C) = Ceiling level which should not to be exceeded even instantaneously.

TABLE 2

SUMMARY OF AIR SAMPLES FOR HEXANE AND TRIETHYLAMINE

Mountain Bell
Denver, Colorado

September 1980

| Job/Area Description | Sampling Time (minutes) | Type of Sample | Hexane ($mg/M^3$) | Triethylamine ($mg/M^3$) |
|---|---|---|---|---|
| Dark Room | 360 | Area | 0.40 | ND |
| Graphics Clerk | 330 | BZ | 1.6 | ND |
| Graphics Clerk | 330 | BZ | 0.08 | ND |
| Dark Room | 360 | Area | 1.1 | ND |
| EVALUATION CRITERIA: | | NIOSH<br>OSHA | 360 $mg/M^3$ (C)<br>1800 $mg/M^3$ | ---<br>100 $mg/M^3$ |
| LIMIT OF DETECTION: | | | 0.01 mg | 0.01 mg |

mg = milligrams
$mg/M^3$ = milligrams of substance per cubic meter of air
ND = non-detectable
BZ = breathing zone

TABLE 3

SUMMARY OF AIR SAMPLES FOR SODIUM HYDROXIDE

Mountain Bell
Denver, Colorado

June 1981

| Job/Area Description | Sampling Time (minutes) | Type of Sample | Sodium Hydroxide ($mg/M^3$) |
|---|---|---|---|
| Etch Room | 360 | Area | ND |
| Graphics Clerk | 360 | BZ | .003 |
| Etch Room | 360 | Area | ND |
| Graphics Clerk | 360 | BZ | .003 |
| Graphics Clerk | 360 | BZ | .027 |
| EVALUATION CRITERIA | | NIOSH | 2 $mg/M^3$ |
| LIMIT OF DETECTION | | | 1 ug |

ug = micrograms
$mg/M^3$ = milligram of substance per cubic meter of air
ND = non-detectable
BZ - breathing zone

TABLE 4

SUMMARY OF AIR SAMPLES FOR ETHYL ALCOHOL AND HYDROQUINONE

Mountain Bell
Denver, Colorado

June 1981

| Job/Area Description | Sampling Time (minutes) | Type of Sample | Ethyl Alcohol | Hydroquinone |
|---|---|---|---|---|
| Graphics Clerk | 360 | BZ | ND | ND |
| Graphics Clerk | 360 | BZ | ND | ND |
| Graphics Clerk | 360 | BZ | ND | ND |
| Graphics Clerk | 360 | BZ | ND | ND |
| EVALUATION CRITERIA: | | OSHA | 1900 $mg/M^3$ | 2 $mg/M^3$ |
| LIMIT OF DETECTION: | | | 0.001 mg | 0.01 mg |

mg = milligrams
$mg/M^3$ = milligrams of substance per cubic meter of air
ND = non-detectable
BZ = breathing zone

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