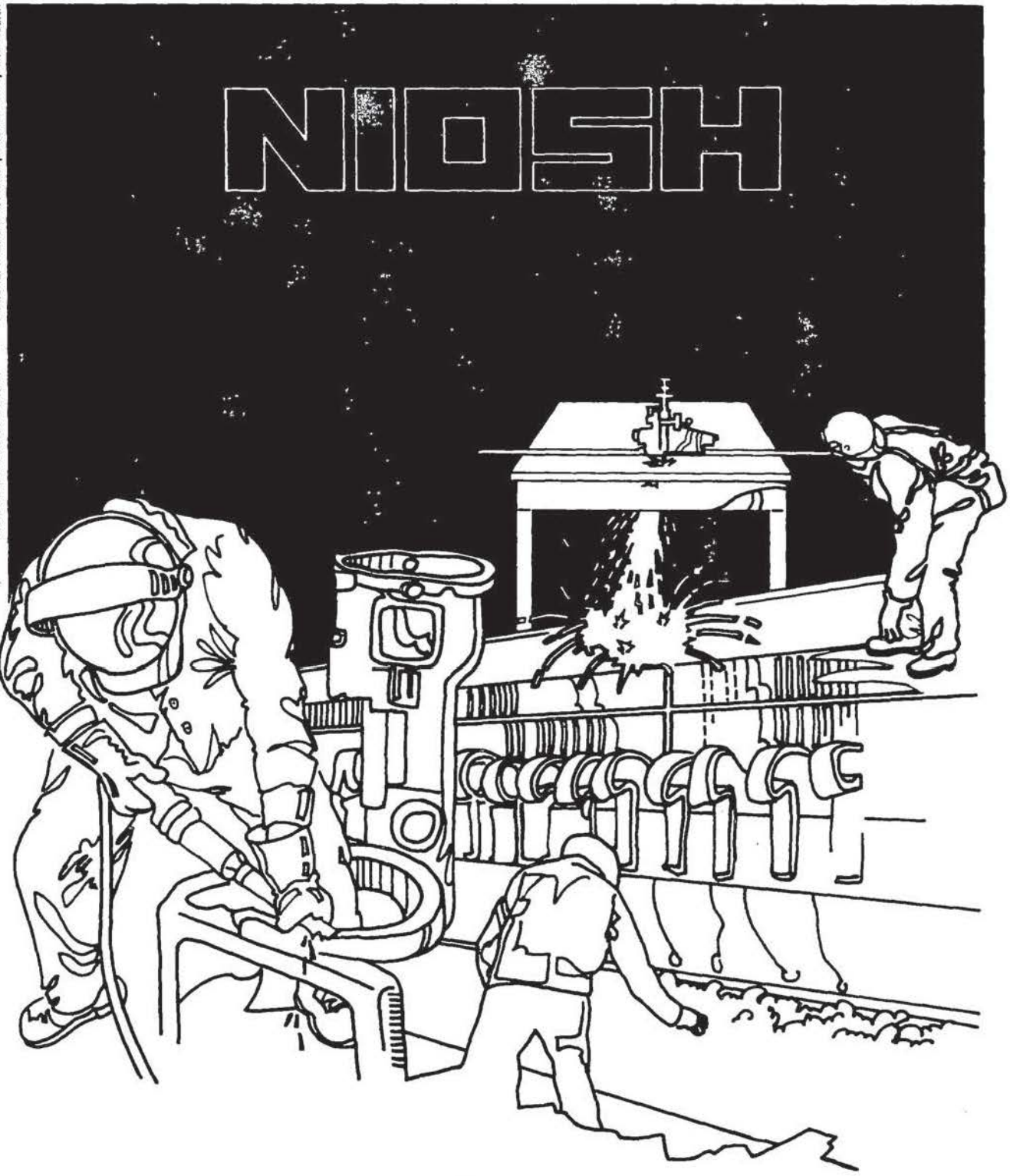
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-071-1015
YELLOW SPRINGS INSTRUMENT CO.
YELLOW SPRINGS, OHIO

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.

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

HETA 81-071-1015
December 1981
Yellow Springs Instrument Co.
Yellow Springs, Ohio

NIOSH INVESTIGATOR:
G. E. Burroughs

I. SUMMARY

On November 10, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the management of the Yellow Springs Instrument Company, Yellow Springs, Ohio, to determine the effectiveness of measures taken to prevent exposure of their employees to potentially toxic concentrations of sodium azide in the production of a buffer reagent. The reagent is produced by measuring, mixing and dispensing the required materials in dry powder form, and is to be done in a glove box for employee protection. While there are approximately ten employees in the department which produces this product, only one at any time is involved in this operation.

NIOSH investigators visited the worksite on January 22, 1981, to discuss the proposed production process with employees and employer. On June 24, 1981, a return visit was made to measure environmental concentrations of sodium azide using battery powered sampling pumps to collect the material on polycarbonate filters. Samples were also collected in an adjacent area for cyclohexanone using activated charcoal collection media with battery powered pumps. These samples were collected at the request of employees who were concerned about their exposures in the manufacture of cellulose acetate membranes.

All measurements of sodium azide in the work area were below the limit of detection of 0.004 milligrams per cubic meter of air (mg/cu meter) with the exception of two samples actually taken inside the glove box to test the sampling and analytical method. The recommended maximum environmental concentration of sodium azide is 0.3 mg/cu meter as a "ceiling" concentration. The cyclohexanone measurements ranged from below the limit of detection of 0.04 parts per million parts of air (ppm) to 0.8 ppm. The recommended maximum environmental concentration for cyclohexanone is 25 ppm, as an eight hour time-weighted average concentration.

Based on the results presented in this report, NIOSH concludes that there is no health hazard associated with exposure to sodium azide in the production of the reagent buffer, nor to cyclohexanone in the manufacture of cellulose acetate membranes. To prevent possible transient irritant effects, and to reduce employee anxiety regarding the inhalation of toxic substances, the continued use of respiratory protection by the buffer maker may be desirable.

KEYWORDS: SIC 3811, Sodium azide, cyclohexanone, irritation, buffer reagent

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, the National Institute for Occupational Safety and Health (NIOSH) investigates the toxic effects of substances found in the workplace. A request to conduct such an investigation was received in November, 1980, from the management of Yellow Springs Instrument Company, Yellow Springs, Ohio. The requestor was concerned with the protection of employees from toxic concentrations of sodium azide and other particulate material in the manufacture of a reagent buffer used with analytical instrumentation also manufactured by this corporation. The production of this buffer was a new process to be introduced into the workplace, and NIOSH was asked to determine if local exhaust ventilation and other protective measures planned for use with this process were adequate.

A visit was made to the plant on January 22, 1981, to evaluate the system prior to commencement of production, and to discuss with employees the hazards associated with the compounds as well as proper use of personal protective equipment. On January 29, a written review was submitted to the company of the pertinent points discussed regarding the local exhaust system evaluated on this visit. On January 26, and April 1, information was sent to the company regarding respiratory protection, recommended maximum environmental concentrations and toxicity of various chemical substances, and general information on occupational health. The first normal production run was made on June 24, 1981, and at that time NIOSH investigators were present to collect personal breathing zone and area samples, and make other relevant environmental measurements. These data were reported on July 22, 1981.

III. BACKGROUND

The Yellow Springs Instrument Company employs approximately three hundred fifty people in the production of scientific and industrial instrumentation in its single facility in Yellow Springs, Ohio. A recent addition to its product line, an instrument to measure cholesterol in blood, requires the use of a reagent buffer in its operation. The production of this reagent buffer, designated "YSI 2381 Buffer A1 Concentrate Kit," became the responsibility of the company's chemical division which employees approximately ten people.

The reagent buffer is comprised of the following components:

Disodium phosphate
Monosodium phosphate
Sodium chloride
Sodium benzoate
Dipotassium EDTA
Cholic acid
Sodium azide

The mixture is formulated by weighing the appropriate masses of each material (in a dry state) and combining them in a mixing machine to obtain a homogeneous dry solution. Subsequent to mixing, the material is dispensed into vials containing 7.5 grams of buffer each, using a pneumatic dispenser.

In anticipation of potential exposure of employees to the azide and other dusts from the weighing, mixing, and dispensing processes, the company established an area for this production process, installed a protective enclosure to prevent the release of dust into the employee's breathing area, and developed detailed standard operation procedures (referred to internally as "process sheets") to assure that the operation was conducted in a safe and healthful manner. The buffer production is conducted in a room which is used exclusively for that purpose at that time. By this method, potential exposure is reduced to one employee. A plexiglass glove box approximately six feet long, four feet high, and two feet deep was built to house the necessary equipment for weighing, mixing and dispensing the materials. This glove box is of a recirculation design with a filter and electrostatic precipitator unit in series to remove particulate from the airstream which is pulled from the right side of the box before it is reintroduced into the box on the left. The process sheets contain detailed descriptions on how to conduct all phases of the operation, including safety precautions and respirator information.

In addition to the azide reagent, the chemical division also manufactures a cellulose acetate membrane which involves the use of and potential employee exposure to cyclohexanone. This operation is performed in a laboratory hood using quantities of cyclohexanone on the order of a few hundred milliliters. There was concern among the three employees involved in this operation regarding their exposures.

IV. EVALUATION DESIGN AND METHODS

Subsequent to the receipt of this request in November, 1980, contact was made with the company to obtain information regarding the materials used in the process and other operational parameters. Available information on the toxicity of the materials was reviewed. The sodium azide was determined to be the only substance with an appreciable degree of toxicity, and it was decided to use this compound to monitor personal exposure.

In January, 1981, construction of the glove box and production facilities was completed and it was decided that simulated operation of the system would take place using sodium chloride in place of the sodium azide. The purpose was to discover any design and operational faults, to give employees experience with the equipment, and to judge

the adequacy of the protection. NIOSH investigators were present for the trial run. Observations of work practices and system design, along with evaluation of the ventilation and filtration system, lead to some recommendations for change prior to the use of the system in normal production. The toxicity of the various substances, along with safe work practices, were discussed with the employees during this visit.

On June 24, 1981, a production run was make using the sodium azide. Environmental samples were collected using battery powered sampling pumps to determine personal and area concentrations of sodium azide by collection on 37mm polycarbonate filters. The NIOSH research chemist responsible for the recent development of this sampling and analytical method was also present. Samples were collected in the breathing zone of the person producing the buffer reagent, as well as at various points throughout the immediate and adjacent work areas. Two samples were also collected inside the glove box to facilitate testing of the sampling and analytical method. Samples were collected at a flow rate of two liters per minute for six to seven hours. Analysis was by ion chromatography following a thirty minute extraction in deionized water in a sonic bath.

On June 24, three samples were also collected for cyclohenanone in the cellulose acetate room. One was a personal breathing zone sample on the employee producing the membranes, two were area samples in the room. All were collected on activated charcoal using battery powered sampling pumps at a flow rate of 200 cc per minute over a five hour period. Ventilation measurements were also made at the hood where this operation was performed.

V. EVALUATION CRITERIA

Most of the compounds used in the production of the buffer reagent are non-toxic, and many are commonly used as food additives. Other than irritation, the effects of these compounds are dissimilar, and one would not expect interaction or synergism to cause adverse health effects from exposure to any combination at low levels. Sax[1] provides the following information on these substances:

DISODIUM PHOSPHATE and MONOSODIUM PHOSPHATE---Both of these compounds are used as food additives. Both are classified as mild irritants with no long term effects.

SODIUM CHLORIDE---This is also a food additive. (Sodium chloride is common table salt). It is also slightly irritating with no long term effects when inhaled.

SODIUM CHOLATE (synonym: CHOLIC ACID, SODIUM SALT)---This also is listed as a food additive but has an undetermined toxicity. Since Sax

did not make a determination, a computer search of published literature was made. No adverse effects were noted in humans. Animal tests for irritation and other effects were negative.

SODIUM BENZOATE---The toxicity of this material is rated "none to slight." Large doses may cause nausea and vomiting. It is used as a food preservative and fungicide.

POTASSIUM EDTA DIHYDRATE---Various EDTA salts are given to patients suffering from metal poisoning. The disodium salt is used as a food additive. Overexposure to these compounds could result in loss of necessary body metals such as zinc due to chelation.

SODIUM AZIDE---This is the only compound in this group for which the American Conference of Governmental Industrial Hygienists (ACGIH) has a published recommended airborne limit.(2) The ACGIH recommends a maximum exposure of 0.3 milligrams of sodium azide per cubic meter of air. This is denoted as a "ceiling" value, that is, a concentration which should not be exceeded even for short periods of time. Overexposure to sodium azide can result in a fall in blood pressure, headaches, bronchitis, and eye irritation.

CYCLOHEXANONE---This compound is an eye, skin and mucous membrane irritant, and can also affect the central nervous system. NIOSH recommends a maximum eight hour time weighted average environmental concentration of 25 parts per million (ppm) to prevent harmful effects due to this compound.(3)

VI. RESULTS AND DISCUSSION

The results of environmental measurements of sodium azide concentrations are presented in Table 1 of this report. From this table it will be seen that no measurable amount of this compound was found on any of the samples (including the personal sample on the person manufacturing the buffer) which were taken outside the glove box. The analytical limit of detection of these samples was approximately 0.004 mg/cu meter. The recommended maximum safe environmental concentration is 0.3 mg/cu meter. That is to say, the measured concentrations (outside the glove box) were approximately a hundred times below the lowest level that would be expected to cause any harmful effects.

Due to sampling and analytical limitations, it is not possible to determine if the ceiling limit of azide was exceeded at any instant during the production of buffer. However, calculations using the limit of detection of azide (0.004 mg/cu meter) and the total sampling time (335 minutes for the sample on the buffer maker) indicate that the 0.3 mg/cu meter value was not exceeded for any five minute period.

While no azide was detected on the long term environmental samples, a slight, short term, transient irritation was detected by the NIOSH industrial hygienist and one company representative who were monitoring the sampling and production processes. The production employee was wearing a respirator and did not notice any irritant effects. At approximately 11:20, when the buffer reagent mixture was being

transferred from the mixer into a trough from which it was dispensed into vials, a mild mucous membrane irritation was detected near the center of the room. A check of the glove box using smoke tubes indicated a small air flow out of the box below the closed doors. It was probable that buffer was leaking out of the box at this point and being carried through the center of the room by the general air current which flowed toward an exhaust hood on the wall opposite the glove box. The irritation is thought to be due to a combination of all ingredients in the mixture and not just the azide. As a result of this observation, the entire box was checked for leaks with smoke. The only leaks detected were under the access doors. These were marked for later repair.

The three samples collected for cyclohexanone in the cellulose acetate room also indicated levels of exposure well within safe limits. The personal sample on the employee making membranes indicated an exposure of 0.1 ppm. A sampler inside the hood indicated a concentration of 0.8 ppm at that location, and a sample taken on a shelf above a desk where another employee was working was below the limit of detection of 0.04 ppm. Again, the highest concentration except for the sample inside the hood was approximately a hundred times lower than the acceptable level.

Ventilation measurements at the face of the laboratory hood in the cellulose acetate room indicated air velocities in a range of 60 to 110 feet per minute (fpm) when one hood door was open, and approximately 50 fpm when two hood doors were open. An average velocity of approximately 100 fpm is desirable for a hood of this design.(4) Therefore, when possible, this system should be operated with only one door open.

VII. RECOMMENDATIONS

The efforts of management and attitudes of employees at the Yellow Springs Instrument Company toward occupational health are to be commended. No overexposures to chemical substances were measured during this evaluation, and no likely problems were observed. To assure a continued same and healthy workplace, however, requires the continued awareness of both employer and employees.

The environmental measurements indicated that the use of a respirator by the employee producing the buffer reagent is not necessary, although it may be desired to prevent transient irritation or for other reasons. However, it should be noted that if there is in the future a situation where respiratory protection is required, the current program is not adequate. Problems such as improper fit and improper use---all respirators are designed to seal against a clean shaven face, and the dust prefilters are designed to be used in combination with an approved cartridge---must be addressed. Toward this end, several publications have been provided to the company regarding respiratory protection.

VIII. REFERENCES

1. Dangerous Properties of Industrial Materials, N. Irving Sax, 4th ed., 1975

2. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1981, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio

3. Criteria for a Recommended Standard...Occupational Exposure to Ketones, U. S. Dept. of Health, Education and Welfare, PHS, CDC, NIOSH, June, 1980, Publication No. 78-173

4. Industrial Ventilation---A Manual of Recommended Practice, 16th ed., 1980, American Conference of Governmental Industrial Hygienists, Lansing, Mich.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Evaluation Conducted and Report Prepared by:	G. E. Burroughs Industrial Hygienist Industrial Hygiene Section
Analytical Method Development:	Doris V. Sweet, Research Chemist Methods Research Branch Division of Physical Science and Engineering
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations, and Field Studies
Report Typed By:	Patty Johnson Secretary Industrial Hygiene Section

X. DISTRIBUTION AND AVAILABILITY OF REPORT

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 22161.

Copies of this report have been sent to:

1. Yellow Springs Instrument Company

2. OSHA Region V

3. NIOSH Region V

For the purpose of informing the approximately ten "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.

Sodium Azide Concentration

Yellow Springs Instrument Co.
Yellow Springs, Ohio
HETA 81-71

June 24, 1981

Location	Duration	Concentration
Personal sample, on buffer maker	8:55 AM - 11:55 AM 12:30 PM - 3:05 PM	None Detected*
Buffer room, breathing level on shelf behind buffer maker	8:57 AM - 4:32 PM	None Detected
Buffer room, at face of hood behind buffer maker	9:00 AM - 3:45 PM	None Detected
Buffer room, on top of glove box	9:02 AM - 3:45 PM	None Detected
Cellulose acetate room, breathing level above desk	9:20 AM - 3:05 PM	None Detected
Big room, on table approximately 15 ft. from buffer room	9:12 AM - 3:37 PM	None Detected
Inside glove box, on shelf above mixer	9:35 AM - 4:32 PM	0.4 mg/M^3
Inside glove box, on right side near exhaust	8:55 AM - 4:32 PM	0.6 mg/M^3
Recommended maximum concentration		0.3 mg/M^3 (ceiling)

*Limit of detection approximately 0.004 mg/M^3.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE. $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396