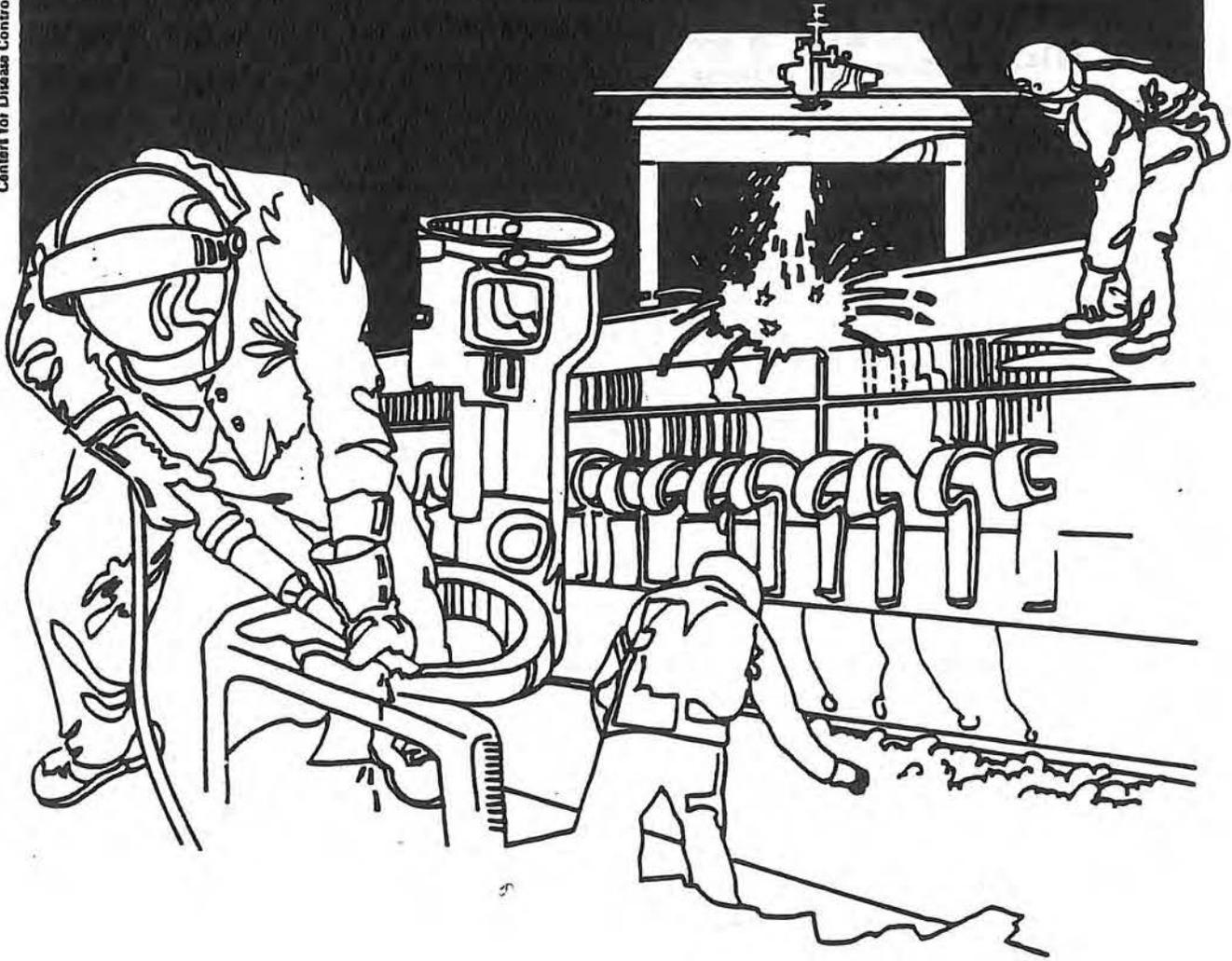


# NIOSH



## Health Hazard Evaluation Report

HETA 85-434-1655  
RUAN TRANSPORT CORPORATION  
DES MOINES, IOWA

## 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 85-434-1655  
JANUARY 1986  
RUAN TRANSPORT CORPORATION  
DES MOINES, IOWA

NIOSH INVESTIGATORS:  
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## I. Summary

In May, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate complaints of occupational illness by an employee of the Ruan Transport Corporation. In the application, numerous symptoms were described by the employee. NIOSH assigned the evaluation to the Iowa State Department of Health under the NIOSH-Iowa HHE Cooperative agreement.

In May and June, 1985, on-site visits were conducted by the Iowa State Department of Health. Medical questionnaires were administered to and completed by keypunch operators working on the northwest corner of the fifth floor of Ruan Transport Corporation. The original request involved a day-shift employee. Employees working the night shift were selected for comparison as no illness complaints had been filed by this section with management.

Both shifts of VDT operators reported similar symptoms which included headaches, watery eyes, blurred vision, dizziness, drowsiness, chills and cough.

Based upon environmental and medical information provided, it was determined the symptoms could be associated with the workplace. Some of the potential factors which could have contributed to the reputed complaints include: video display terminals (VDTs), work station ergonomics, smoking in work area and room conditions such as room temperature, humidity and lighting.

The problem appeared to be isolated to the particular work area utilized by the keypunch operators. The Ruan Transport building complex is a large, 36-story office building and no other health complaints were reported involving other sections of the building.

Based on the results of the Iowa State Department of Health investigator's findings, it is determined that ergonomics (or work space design) could be a factor in causing some of the employee symptoms. In addition, ventilation improvements need to be made to meet ASHRAE 62-1981 standards. Necessary recommendations to improve the working environment are included in this report.

KEYWORDS: SIC 3573, Indoor Air Quality, Video Display Terminals, Ergonomics

## II. Introduction

This health hazard evaluation was requested by a Ruan Transport employee working on the northwest corner of the fifth floor in the keypunch room. In the application for a health hazard evaluation it was reported that the keypunch operators were suffering from a variety of symptoms including red watering eyes, itchy skin, headaches, upset stomach, tightness in chest, sneezing, coughing, runny nose and sore throat. In May and June, 1985, the Iowa State Department of Health conducted a health hazard evaluation on the fifth floor of the Ruan Building located at Seventh and Grand in Des Moines, Iowa. Permission to visit and inspect the area of the reported illness was obtained from appropriate management personnel (i.e., keypunch operation supervisors, building safety and general management). After the initial visit on May 31, 1985, investigators returned for follow-up visits on June 6, June 11 and June 13, 1985, to conduct specific tests and collect necessary information.

## III. Background

The Ruan Center Corp. building was built in 1974-1975 as a multi-purpose office building housing various banking, insurance and legal offices as well as the Ruan Transport Corp. There are over 3,000 people working in this complex.

The keypunch operators work eight-hour shifts performing data entry. The day shift works from 8:00 a.m. to 5:00 p.m. daily Monday through Friday and the night shift works from 5:00 p.m. to 1:00 a.m. daily. A total of 25 employees were working as keypunch operators for Ruan at the time of our survey (15 on the day shift and 10 on the night shift). It was originally intended that the night crew would only be included in this survey as a control. However in view of our determination that both shifts had similar symptomology this health hazard evaluation addresses all keypunch operators.

## IV. Methods and Materials

During the environmental investigation, carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>) samples were obtained utilizing the Gastec Model 800 air sampling pump and analyzer tubes. Room air temperatures were usually kept too cool for a comfortable work environment.

On subsequent visits work station design and seating was measured by tape measure and evaluated.

Room light was measured using the DigAphot, Model 3303.

A short medical history was obtained from each employee to rule out pre-existing conditions. An example of the form given to each employee to complete is attached as Appendix 1.

## V. Evaluation Design and Methods

### A. Environmental

The Iowa State Department of Health investigators inspected the work area with particular attention to the presence of chemicals or vapors known to cause the type of symptoms experienced by these employees. None were routinely used in this work area and only small amounts of cleaning solvents were used elsewhere in this building. It was, therefore, determined that there was no opportunity for hazardous chemical exposure to these employees.

Building-related illness episodes have been reported more frequently in recent years due to construction aimed toward air tight energy conservation. The area of concern had a separate 5 ton BTU air conditioner to cool the computer equipment located in this area. Contaminants may be present in make-up air or be introduced from furnishings, building materials, surface coatings, etc. Since this area was used for approximately eight years within the same location. This was considered unlikely.

Lighting in relation to VDT operation was considered due to the amount of glare which was noticed by the inspection team even on an overcast day.

Smoking in the workplace was considered because: Tobacco smoke contains several hundred toxic substances, the more important of which are: carbon monoxide, nitrogen dioxide, hydrogen cyanide, formaldehyde, hydrocarbons, ammonia, benzene, hydrogen sulfide, benzo(a)pyrene, tars and nicotine. Tobacco smoke can irritate the respiratory system and, in allergic or asthmatic persons, often results in eye and nasal irritation, coughing, wheezing, sneezing, headache, and other related sinus problems. People who wear contact lenses often complain of burning, itching, and tearing eyes when exposed to cigarette smoke. While cigarette smoking is the leading cause of lung cancer in the United States, currently available evidence is not sufficient to conclude that passive or involuntary smoking causes lung cancer in non-smokers.

### B. Ventilation Evaluation Criteria

Neither NIOSH nor OSHA has developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by ASHRAE.

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 air tight 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 7 persons per 1000 feet 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 carbon monoxide to 9 ppm and to control contaminants, such as various gases, vapors, microorganisms, smoke, and other particulate matter, below levels which would impair health or cause discomfort to occupants. Inside the more modern, airtight office buildings, ASHRAE recommends that the carbon dioxide level not exceed 1000 ppm. For "General Offices" where smoking is not permitted, the ventilation 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 since tobacco smoke is impracticable to control at the source. When smoking is allowed, the amount of outdoor air provided should be 20 cfm per person. Areas that are non-smoking 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.

Ergonomic studies were evaluated using NIOSH and online computer evaluations as outlined in references B, C, and F. Factors influencing lighting and glare as well as operator comfort were dealt with in the health hazard evaluation.

## VI. Results

- A. Environmental - The illumination level recommended for reading from a source document, as well as operating VDTs is normally considered to be 300 to 500 LUX. Actual room illumination readings are shown on Figure 2 and exceeded 600 LUX in most general work areas and are as high as 800 LUX. Since illumination levels exceeding 500 LUX were measured in the lighted room on an overcast day, it would be expected that on sunlit days levels could be in excess of 1000 LUX. Direct and indirect glare are factors that must be considered. It appears that the combination of sun and overhead fluorescent lights used for this room will cause both types of glare problems.

In addition to the excessive illumination (direct glare) levels, employee eye discomfort can be further aggravated by direct glare observed during the health hazard evaluation.

1. Table top surfaces were observed to be a glossy black.
2. The toggle switch plate found on all of the keyboards had a brushed aluminum finish and is another source of indirect glare to the VDT screen.

The air testing showed no detectable levels of carbon monoxide in the work area. However, a level of 3000 ppm of carbon dioxide was found in the office air. This level is a significant fraction of the OSHA

limit of 5000 ppm and in excess of the current ASHRAE criteria of 2500 ppm.

Smoking in a confined space such as that used by the keypunch operator's has been known to cause cold-like symptoms such as those experienced by these employees. The Ruan Corp. has initiated action requiring smokers to provide, at their own cost, smokeless ash trays with filters which they are to use when smoking at their work station. It is doubtful that these devices will be effective in controlling the amount of cigarette smoke in such a small area. A large portion of the time cigarettes were observed being smoked and held in the hand particularly while the operators entered data. These smokeless ash trays cannot be expected to reduce the smoke which is emitted while the cigarettes are not placed on the device.

During the first visit the room temperatures were observed to not exceed 70°F. On subsequent visits, air temperature was observed to be 72°F or higher on each occasion.

It was determined that there was insufficient leg space under the table (too little depth). It was also noted there are only limited adjustments that can be made in each work station to compensate for variations of height and length of arms and legs.

Work stations designed to permit adequate adjustment of the employees seat and working surfaces to his or her individual comfort and needs are recommended and should be considered when replacing current equipment.

- B. Epidemiology - After evaluating the results of the epidemiological survey, it was determined that similar problems existed during both work shifts. The night crew had fewer complaints than the day crew in all categories; however with respect to headaches 90 percent of the night crew reported symptoms compared to 75 percent of the day crew (see Figure 1).

Symptoms which were experienced by at least 33 percent of both crews of keypunch operators were considered significant and were evaluated with respect to the probability that they originated in the workplace.

Smoking was permitted at individual work stations and an excessive amount of smoke was evident in the room on the initial visit. Four of the fifteen employees working the day shift smoked. Although seven of the ten night crew stated they were smokers, no more than three employees were observed smoking at any one time.

Tests to determine the validity of the symptoms could not be performed. It appears that smoking, excessive glare and inadequate attention to ergonomics may be factors contributing to employee complaints. Headaches, watering eyes, blurred vision, vertigo and drowsiness can result from either excessive glare or cigarette smoke. In addition exposure to cigarette smoke can cause an upset stomach, sneezing, coughing, a runny nose and a sore throat. An employee's relationship with the work space (VIZ. ergonomics) which is uncomfortable can create mental tension and result in such symptoms as itchy skin, headache, upset stomach and tightness in chest.

The prevalence and duration of symptoms cited in Figure 1 were reported by the employees.

In many cases, 50 percent or more of the employees interviewed during a given shift described the same symptoms. In most cases it appears that the observed conditions can be changed. Proposed changes which may alleviate many of these problems will be covered under the Recommendations section of this report.

## VI. Discussion and Conclusions

In this office environment, the carbon dioxide level of 3000 ppm exceeds the current ASHRAE standard of 2500 ppm and is three times the proposed ASHRAE standard of 1000 ppm. There is a need for more fresh air containing a lower carbon dioxide level to be mixed with the building's recirculated air.

In work environments where VDTs are used, past studies indicate that improper work station design including illumination must be considered a serious deficiency since it can compromise productivity and adversely affect the operator's sense of well being.

- A. Improper lighting was probably the major cause of the symptoms reported.
- B. Most of the symptoms described by the employees appear to be subjective rather than objective.

The current work stations should be replaced with units that permit the adjustment of all working surfaces, without use of special tools, by the employee. Educating workers in correct posture, seating arrangements and effects of glare on the VDT screen should be accomplished concomitantly with this equipment change.

## VII. Recommendations

It is recommended that the following action be taken to alleviate the reported employee complaints.

- A. Lighting
  - 1. Relocate VDTs (keypunch operators) into a center location where external lighting is reduced or can be eliminated.
  - 2. The illumination level of overhead lights should be reduced to 300-500 LUX at the work surface.
- B. Smoking - Smoking could be permitted only at break times. More frequent and shorter breaks are recommended for VDT operators.
- C. Ergonomics - Surfaces which are textured and of a flat black color would be much more effective in absorbing indirect glare. Change work

station's furniture to adjustable models as replacement becomes necessary and install either screen hoods or anti-glare filters on VDT screens.

- D. Ventilation - More outside fresh air should be used to reduce the carbon dioxide concentration to less than 2500 ppm in the office atmosphere. A better office environment would exist if the carbon dioxide level was lowered to 1000 ppm in the office area as recommended by ASHRAE.

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X. Distribution and Availability of Report

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications 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, 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. Ruan Transport Corporation
2. Banker's Life
3. NIOSH, Region VII
4. Iowa Bureau of Labor, IOSH

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 1

## RUAN TRANSPORT COMPANY ENVIRONMENTAL SCREENING RESULTS

	<u>Carbon Dioxide (CO<sup>2</sup>)</u>	<u>Carbon Monoxide (CO)</u>
Office area Fifth Floor	3,000 ppm <sup>1</sup>	None Detected <sup>2</sup>
OSHA Permissible Exposure Level	5,000 ppm	50 ppm
NIOSH Time Weighted Average	10,000 ppm	35 ppm
ACGIH Time Weighted Average	5,000 ppm	50 ppm
ASHRAE Criteria	2,500 ppm	9 ppm

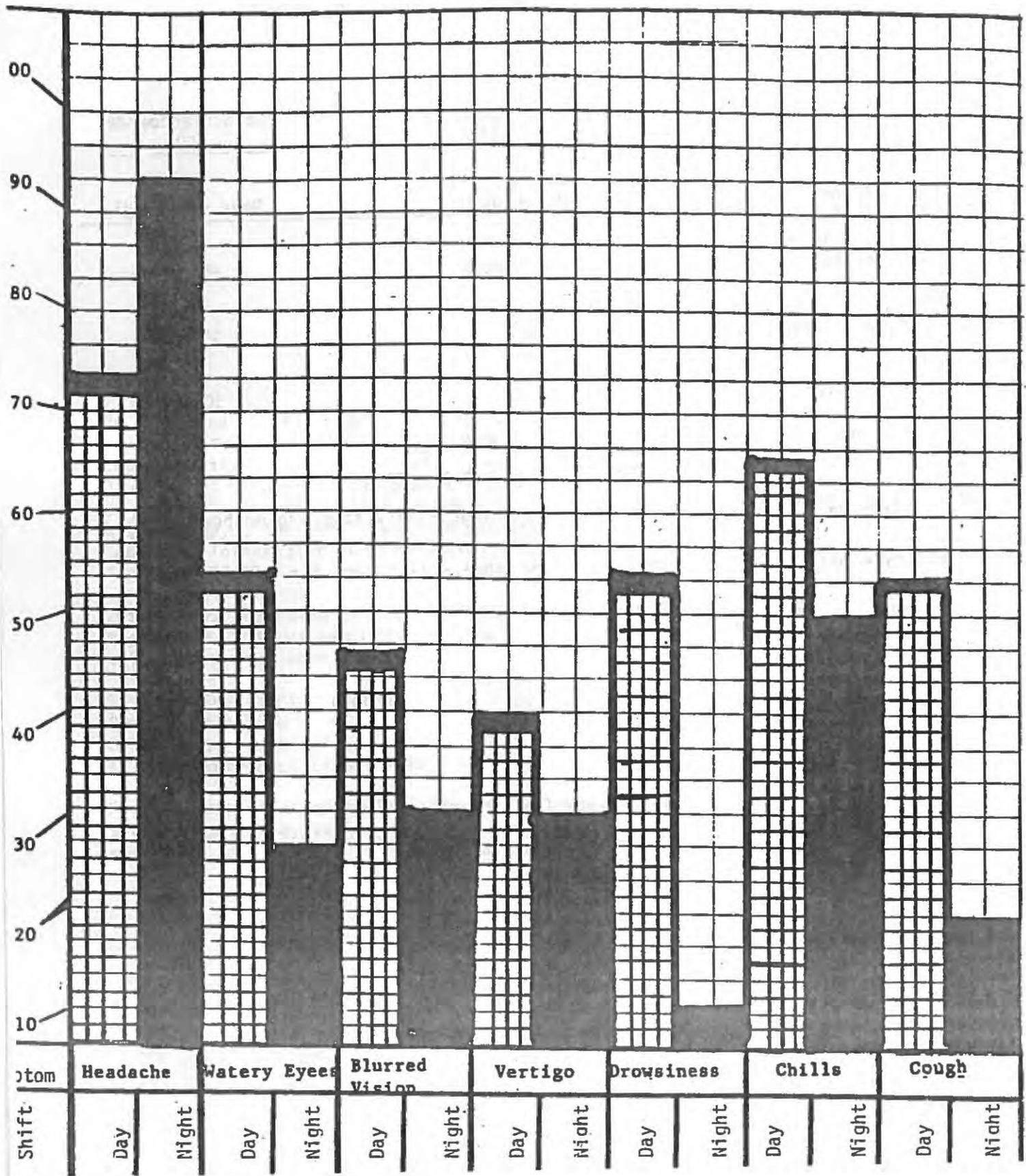
<sup>1</sup>Sensidyne Gastec Analyzer Tube, CO<sup>2</sup> - Low range - ±25% sampling method error

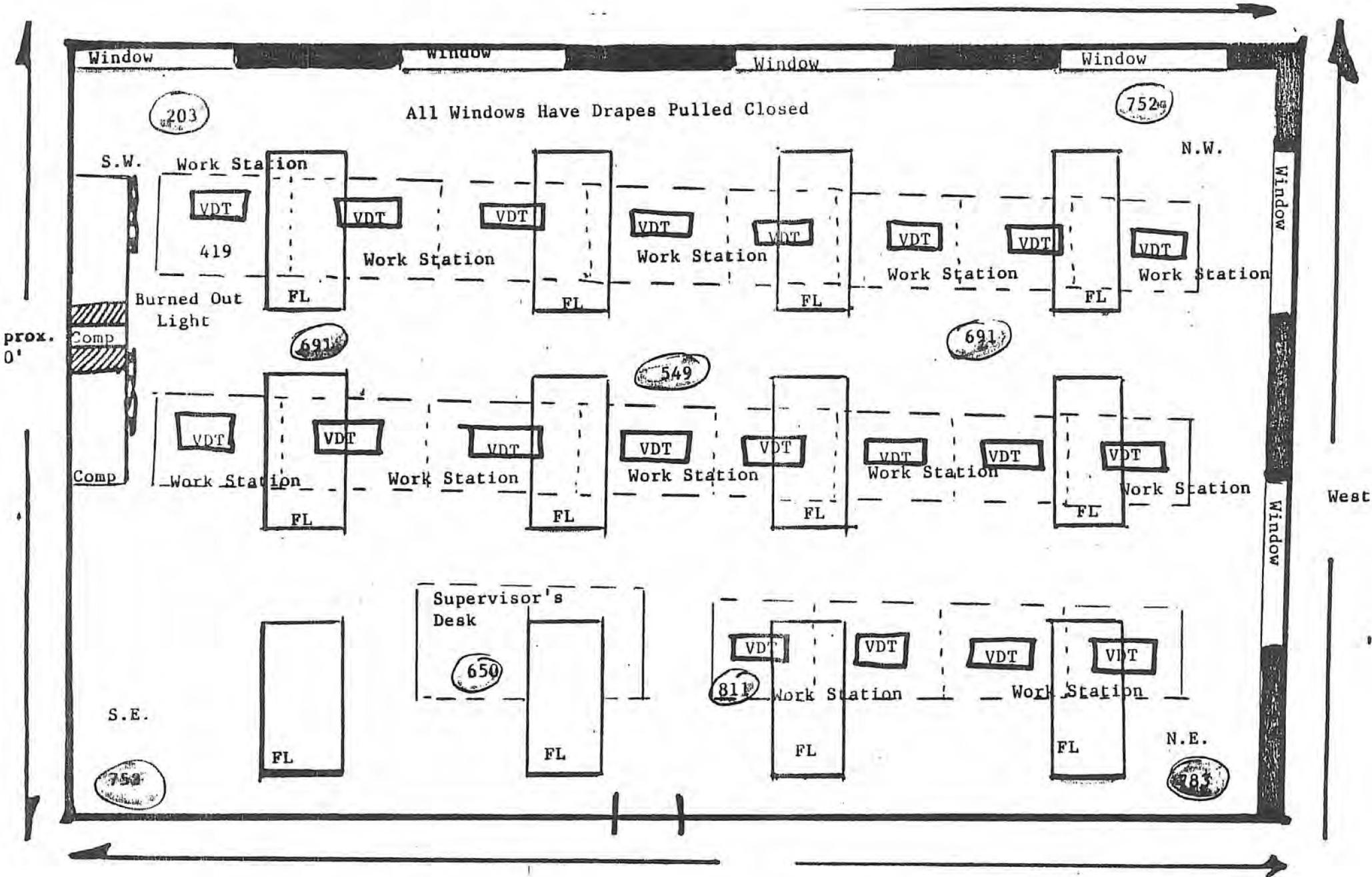
<sup>2</sup>Sensidyne Gastec Analyzer Tube, CO - Low range - ±25% sampling method error

PERCENTAGE OF EMPLOYEES WITH SYMPTOMS

FIFTH FLOOR KEYPUNCH OPERATORS OF RUAN BUILDING (BY WORK SHIFT)

MAY 31, 1985





FL = Fluorescent Lights  
 Comp = Computer Terminal

(Approximate Set-Up)  
 Office Arrangement

000 Lux Reading (300-500) Maximum Necessary

Ruan Building - Key punch Room

FIGURE 2 - OFFICE LIGHTING LEVELS

APPENDIX 1

Case Number \_\_\_\_\_  
Form Number \_\_\_\_\_

Iowa State Department of Health  
Work Related Disease Program  
(IHE of NIOSH)

Date Collected \_\_\_\_\_  
Epi Investigator \_\_\_\_\_

Preliminary Epidemiologic Data Survey Form

COUNTY \_\_\_\_\_ CITY \_\_\_\_\_ LOCATING INFO IF RURAL \_\_\_\_\_

PT. NAME \_\_\_\_\_ AGE \_\_\_\_\_ SEX: M F RACE: WH BL OTHER PHYSICIAN \_\_\_\_\_

HOSPITALIZED:  YES  NO WHERE \_\_\_\_\_ ADM. DATE \_\_\_\_\_ DISCH. DATE \_\_\_\_\_

OCCUPATION \_\_\_\_\_ SECONDARY OCCUPATION, IF ANY \_\_\_\_\_ EMPLOYERS \_\_\_\_\_

CLINICAL SYMPTOMS:

- |                                  |   |   |  |
|----------------------------------|---|---|--|
| <input type="checkbox"/> FEVER   | <input type="checkbox"/> HEADACHE         | <input type="checkbox"/> NAUSEA             | <input type="checkbox"/> CONSTIPATION  |
| <input type="checkbox"/> CHILLS  | <input type="checkbox"/> WEAKNESS         | <input type="checkbox"/> VOMITING           | <input type="checkbox"/> DIARRHEA      |
| <input type="checkbox"/> MALAISE | <input type="checkbox"/> LOSS OF APPETITE | <input type="checkbox"/> ABD. PAIN (CRAMPS) | <input type="checkbox"/> BLOODY STOOLS |

DATE OF ONSET \_\_\_\_\_

Time of onset and end of symptoms  
if they were of short duration:  
Began \_\_\_\_\_ AM End \_\_\_\_\_ AM  
PM PM

DURATION OF SYMPTOMS \_\_\_\_\_

LABORATORY FINDINGS:

Laboratory Name	Date	Specimen - Blood, Stool, Urine	Type of Test	Result

EPIDEMIOLOGICAL DATA SECTION

How were you exposed?  Breathing  Swallowing  Skin contact  Other (Please list)

Are symptoms still present?  Yes  No Date first aware of symptoms \_\_\_\_\_ Duration of symptoms \_\_\_\_\_

Was a physician contacted?  Yes  No Name \_\_\_\_\_ Address \_\_\_\_\_

Phone number of physician (if contacted) \_\_\_\_\_