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CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION  
REPORT HE 78-134-630

OZARK AIRLINES  
PEORIA, ILLINOIS

November 1979

I. TOXICITY DETERMINATION

In August 1978, numerous reservation agents at Ozark Airlines, Peoria, Illinois experienced symptoms of dizziness, lightheadedness, headaches, fainting, and burning and swelling eyes. On the basis of these symptoms and the inability to document the presence of any toxic chemical or biological exposure in the reservations office, it is NIOSH's conclusion that there was no chemical or biological health hazard during this episode. However, it was concluded that these employees were exposed to a variety of conditions and/or factors which acted in a synergistic manner and thus, collectively served as the "triggering mechanism" which precipitated an event that will be referred to as an episode of Mass Illness of Synergistic origin. Included in these factors and/or conditions are:

1. Elevated temperature and humidity conditions that existed in the Peoria area during the August episode.
2. A malfunctioning ventilation system which elevated the temperature and humidity levels in the central reservations facility beyond normal.
3. Potential low levels of chemical contaminants, e.g., jet exhaust emissions (containing unburned hydrocarbons, carbon monoxide and carbon dioxide); jet fuel vapors (containing hydrocarbons); and insecticide (containing primarily pyrethrin). Also, carbon monoxide and carbon dioxide from auto and truck emissions.
4. Irritation created by an insect problem in the facility.
5. Ergonomic problems, such as; inadequate background illumination levels, communication interferences from high noise levels within the work environment, and spatial work difficulties due to the present work station layout in the reservations office.
6. Psychological or stress components brought on by heightened anxiety to what was perceived as a health threatening situation.

The recommendations presented in this report are those presented in our Interim Report dated December 1978 and January 1979 closing conference. It is hoped that these recommendations will prevent such episodes from occurring in the future.

## II. DISTRIBUTION AND AVAILABILITY

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, Springfield, Virginia 22151. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent:

1. Director, Safety and Security, Ozark Airlines
2. Union Steward, Lodge 2307 International Association of Machinists, Greater Peoria Airport.
3. International Office, International Association of Machinists and Aerospace Workers.
4. Assistant Director of Airports, Greater Peoria Airport Authority.
5. Peoria Area, OSHA
6. U.S. Department of Labor, OSHA, Region V
7. NIOSH, Region V

For the purpose of informing the approximately 325 affected employees, copies of the report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

## III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employee 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.



On September 5, 1978, an authorized representative of the employees at Ozark Airlines submitted such a request. The request stated that during the week of August 14-18, 1978, airline reservationists experienced dizziness, lightheadedness, headaches, burning and swelling eyes, and fainting from unknown causes. Before NIOSH was contacted, the Peoria Area OSHA office, Peoria County Health Department, the Environmental Protection Agency, and an Ozark insurance carrier industrial hygiene consultant had been requested to review the situation at the reservation facility. Their findings were generally inconclusive. On September 27 and 28, 1978, NIOSH personnel conducted a combined environmental/medical evaluation at the Central Reservation Office, Ozark Airlines.

A NIOSH interim report, dated December 12, 1978, was provided to all the concerned groups. This report provided a chronology of events, findings and recommendations to correct the problems noted during that investigation. Portions of that information are also presented in summary of this determination report.

#### IV. HEALTH HAZARD EVALUATION

##### A. Description of Process/Operations

The Ozark Airlines Central reservations office employs approximately 325 people as reservation agents. The reservation office is open 24 hours per day, seven days per week. During the August episode there were nine shifts working in the reservation office: 12 midnight - 8 am, 2 agents; 6 am - 2 pm, 22 agents; 7 am - 3 pm, 24 agents; 8 am - 4 pm, 44 agents; 9 am - 5 pm, 43 agents; 2 pm - 10 pm, 16 agents, therefore the majority of the reservation staff work between 6 am to 12 midnight. Each agent is required to respond to approximately 17 calls per hour, or based on 7-hour work day, 119 calls. The room in which the agents work is approximately 130 feet by 40 feet by 9 feet (46, 800 cubic feet) and there are presently nine work rows within the room. The majority of rows are divided by a two-foot partition and there are 11 work stations on each side of a row. The agents perform their job at a keyboard/video display terminal and use a telephone operator-type head set to communicate with the caller.

##### B. Chronology

The episode began on August 15, 1978 at 10:00 am. A single employee became ill at that time. An ambulance was called. Over the next forty-five minutes seven other persons became ill. At 10:45 am, the Airport Authority was contacted because of a problem with the heating system in the work area. The Airport Authority evaluated the ventilation system and determined that the controls were not operating properly, therefore, they manually opened the cold air ducts into the work area to restore the temperature to normal. They also evaluated the outside air intake system which was operating normally. The reported temperature between work rows (East end of the facility) was approximately 78°. By this



time, five other employees reported illnesses. Other illnesses continued to be reported throughout the afternoon. Union officials requested the local area OSHA office to evaluate the facility, and they arrived at 2:00 pm. The facility was evacuated from 2:25 pm until 3:05 pm based on OSHA's request. At that time, OSHA officials advised that the facility could be used but additional break periods should be granted. OSHA was also advised of a jet fuel spill earlier in the day directly southwest of the outdoor air intakes. It was OSHA's tentative opinion that due to the southwesterly direction of the wind and the jet fuel spill, combined with the outside temperatures and flight operations, that these pollutants could be brought into the reservation room via the ventilation system, and therefore, could result in the symptoms experienced by the employees. OSHA conducted multiple tests in the facility during that first day, and all were negative with the exception of traces of formaldehyde. Between 4:45 pm and 6:45 pm, seven people were reported ill. The temperature in the work area was still 80° F at 7:00 pm.

The next day at 10:40 employees again began experiencing illnesses. OSHA officials returned at 1:00 pm. By that time, eight persons were reported ill. Also, representatives of the Environmental Protection Agency and the County Health Department were requested to come in and they both did evaluations of portions of the facility. Although a bacterial contamination was found in a stopped-up drinking fountain, no correlation to the illnesses could be found with this finding. Throughout the afternoon additional breaks were given to employees, however, sixteen employees reported illness up to 9:00 pm. At 9:15 that evening, a meeting was held with union, management, OSHA and a company consulting physician. The physician's opinion was that an "irritant" appeared to be present in the facility. It was also discussed that an "insect spray" for "mites", which was alleged to cause the irritation, was used by employees on numerous occasions in the facility. However, it could not be determined that insects were present nor that the insect spray was the etiologic agent. The active agent in this insecticide is pyrethrin compounds (pyrethrum) which are a natural extracted product from flowers. It was later determined that the pyrethrins pose only a low acute oral or moderate inhalation toxicity hazard. From 1:00 am until 6:00 am the next morning, the reservations area was cleaned thoroughly.

The next day, three employees became ill at 11:00 am and five others later in the evening. An airlines insurance carrier sent an industrial hygienist to evaluate the illnesses. He conducted a thorough survey during this day.

A clinical psychologist was retained on the recommendation of the company's consultant physician. The medical consultants concluded that the illness outbreak had placed employees into a stressful situation. The psychologist recommended that the employees participate in relaxation therapy and he worked with volunteer employees on a relaxation program.

### C. Evaluation Design and Methods

Since other investigative groups had previously surveyed the episode at Ozark's reservations office and had not been able to resolve the problem it was decided that NIOSH would consider the problem from three approaches: 1) Environmental, 2) Medical, and 3) Ergonomic.

#### 1. Environmental

The environmental factors investigated by NIOSH centered primarily on: reviewing the environmental data collected by OSHA and the Ozark Airline insurance carrier during and shortly after the episode; reviewing the ventilation system, layout and physical features of the work environment (both in the reservation office and around the airport terminal); and finally, obtaining information from the National Weather Service and the Peoria Air Pollution Service.

Based on all the information gathered after our initial investigation it was determined that the most likely chemical substances and/or contaminants in the workplace, if any, were: a) carbon monoxide and carbon dioxide from either jet exhaust or auto and/or truck emissions, b) unburned hydrocarbons (previously  $C_5-C_8$ ) from jet exhaust and jet fuel vapors, c) pyrethrin, which was the compound in the insecticide used at the reservations facility to control insects, and d) various insects found at the facility which were thought to pose a health problem. Additional environmental concerns (discussed in Section IV C-3 Ergonomics) were: background lighting levels, communication difficulties, heat and humidity problems, and work space difficulties in the reservation facility. The following is a more specific description of the environmental concerns described above and how NIOSH conducted and evaluated these factors:



## a. Ventilation System

Based on all the information collected the most likely source of transmission of the various contaminants described above was by way of the ventilation system. The ventilation system used in the reservations office is a system known as constant volume dual duct system. A large air supply unit is located in the basement at the extreme west end of the terminal building. This unit contains a filter section and a blower which delivers a constant volume mixture of 80 percent recycled and 20 percent outside air (at minimum conditions), and a coil which is split so that one portion contains a heating coil and one portion a cooling coil. At the discharge of the unit, one duct is connected to the section containing the heating coil, and the other duct to the cooling coil. Both of these ducts then run up to the second floor (Ozark's CRO) where they then branch off into two basic areas, the office on the north side and the reservations room on the south side. Branching off from each of these hot and cold ducts are smaller ducts which lead to mixing boxes that are located in the ceiling. These are large boxes where mixing of the cold and hot air occurs. Thus, each box has a cold and hot duct connection with a damper at each of the respective inlets.

The dampers are controlled by a room thermostat, which on a call for heat, responds by closing the damper at the cold inlet and opening the damper at the hot duct inlet. The reverse occurs on a call for cooling. A single duct then leads from the outlet of the mixing box to the ceiling diffuser or air outlet into the work area. Therefore, the quantity of air (8000 CFM) delivered to the work area remains constant at all times and equals about ten air changes per hour. The ambient temperature in the work area is normally in the low 70's (°F) and the relative humidity is 50-60 percent.

The return air passes through slots in the ceiling, into a plenum space, and is drawn back to the basement, via the return air ducts. From here a portion of the return air is exhausted to the outside (minimum 20 percent) and a portion is returned to the air supply unit (maximum 80 percent). Fresh air (minimum 20 percent) is then drawn in from the outside via louvers on the west end of the building. (Refer to Figures 1 and 2 - Reservation facility ventilation diagram/air make-up location.) Therefore, if the control boxes were not operating properly in the facility on the first day of the episode, as described in the chronology, it is possible that contaminants from either outside or inside the facility may have build up in the ventilation system, and thus, released into the room when the dampers were manually opened.

b. Potential Chemical Contaminants

1. Carbon monoxide and carbon dioxide: These chemicals were measured with detector tubes at various times at the facility, i.e., OSHA sampled for these agents during the episode; the consultant industrial hygienist - three days after the initial episode; and NIOSH - during both survey periods (using NIOSH certified gas detector tubes).

2. Hydrocarbons: The consultant industrial hygienist sampled for a series of aliphatic hydrocarbons shortly after the episode. The charcoal tubes used to sample for hydrocarbons were analyzed by gas chromatography. Also, NIOSH sampled for total hydrocarbons both inside and outside the facility. It should be noted that there is no standard for such measurements since the measuring device responds to the entire range of organic compounds rather than a specific compound.

c. Insects and Insecticide

1. Insects: The potential adverse health effects of insects found in the central reservation facility were evaluated by NIOSH. The insect specimens were mailed to an entomologist with the Vector-Borne Diseases, Division of the Center for Disease Control, Fort Collins, Colorado. A brief history of the illness episode and a description of the central reservation work area was also provided.

2. Insecticide: The insecticide used to contend with the insect problem was a professional grade consisting of pyrethrin as the active ingredient. The only attempt to sample for pyrethrum concentrations was by the consultant industrial hygienist after the intensive cleaning that had taken place on the morning of August 17. Glass fiber filters were used as the sampling technique to collect possible pyrethrum concentrations in the work environment. These samples were extracted in hexane and analyzed using gas chromatography with an electron capture detector employed on the gas chromatography.

2. Medical

The NIOSH medical personnel determined the type and extent of the illness from many sources: the chronology described, company insurance forms, and a self-administered questionnaire. (Refer to Attachment I for the medical questionnaire used in this investigation.)

The company insurance forms were considered accurate for those persons who were taken to the hospital. It is not always true that the most ill are taken to the hospital; however, the forms do give accurate times of persons taken to the hospital despite the degree of illness. The medical questionnaire provided the best description of the illness during August 15-16, 1978. However, it did not provide an adequate chronologic description of the episode.



The NIOSH medical team re-evaluated the work area on January 24-26, 1979, however, no new medical evaluations were performed during this survey. The two surveys performed by NIOSH provided a thorough source of medical information and based on this information the primary toxic factors of concern were: heat and humidity conditions; aircraft exhaust emissions of carbon monoxide, carbon dioxide, and hydrocarbon acids; insects or insecticide; and possible psychological stress.

### 3. Ergonomic Factors

From the information collected on the first investigation at the reservations office, it was decided that in order to thoroughly evaluate the August episode it would be necessary to address the ergonomic factors which may have contributed to the episode. This included the interaction between the worker and such traditional environmental elements and/or atmospheric contaminants, such as: noise, lighting, heat and humidity, and the tools and equipment pertaining to the performance of ones job at the work station. The following are the means by which these factors were evaluated in the reservationists' work environment.

#### a. Noise Level Evaluation

A noise survey was performed during our follow-up investigation at the reservations office. The primary purpose of doing the noise survey was to evaluate potential exposures in relation to speech interferences, comfort or hearing interferences and/or loss, and for use in controlling suspected problems. The noise levels were determined by using a Type 1565-B Sound-Level Meter in the A-weighted (slow response) network. The following criteria was used to determine the potential noise problems in the reservations office: 1) the type of job being performed, 2) the location of a single reservationist in reference to other reservationists around the work site, and 3) the type of noise produced, i.e., continuous vs intermittent noise. Based on this criteria ten areas in the facility were sampled under the following conditions. First, sound level measurements (SLM) were taken around each of the ten test areas in order to determine the continuous/background noise levels. Second, measurements were taken with two reservationists sitting side by side typing and communicating with a caller at the same time. Third, measurements were taken with two reservationists sitting next to each other typing but only one communicating with a caller. Fourth, two reservationists sitting next to each other typing but neither communicating with a caller. Again, each of these conditions/treatments were tested in ten separate areas of the facility.

#### b. Lighting Evaluation

A lighting survey was performed during the January investigation with a Weston Footcandle Meter-Model 614. Numerous measurements were taken throughout the reservations facility to determine illumination levels on the work station surfaces, as well as the illumination intensity from the luminous source.



c. Temperature and Humidity Evaluation

Temperature and humidity tests were run during both survey periods. A Bendex Model 566 Psychrometer was used to determine the temperature and humidity levels in the office. Also, a number of thermometers were positioned throughout the facility to determine the accuracy of the control thermostat in the office.

d. Spatial Work Space Evaluation

There were a number of other factors that were evaluated at the reservationist's office and will be categorized under spatial/work space concerns. That is, the overall comfort, physical welfare, and performance of the worker in relation to the general physical facilities and/or their individual work station, e.g., seating, available work space, the arrangement of the work space, and the specific items required to perform one's job at their work station. Based on these concerns various physical measurements were taken of the physical features of the reservations office and the individual work stations.

D. Evaluation Criteria

1. Environmental Assessment

In this study, numerous sources of environmental exposure criteria and existing research data were used to assess the workers exposure to the suspected chemical, ergonomic/human factors, and medical concerns evaluated in the occupational setting at the airlines reservation facility.

a. Chemical Criteria

The exposure limits to toxic chemicals are derived from existing human and animal data and 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 three sources of chemical criteria for this study are: 1) Criteria for a Recommended Standard by the National Institute of Occupational Safety and Health; 2) Occupational Safety and Health Standards for General Industry by the Department of Labor's Occupational Safety and Health Administration; and 3) Threshold Limit Values (TLVs) and their supporting documentation by the American Conference of Governmental Industrial Hygienists.

The following table lists the levels recommended by this author for the specific chemical substances studied in this evaluation. The most current criteria is presented with a brief reference to source and other pertinent information.

Substance	Evaluation Criteria 8-hour Time Weighted Average (TLV-TWA)	Ceiling Value*
Carbon monoxide <sup>1</sup>	33 ppm	200 ppm***
Carbon dioxide <sup>2</sup>	9,000 mg/M <sup>3</sup> **	
Formaldehyde <sup>3</sup>	3 mg/M <sup>3</sup>	10 ppm
Pyrethrin <sup>4</sup>	5 mg/M <sup>3</sup>	
Hydrocarbons(C <sub>5</sub> to C <sub>8</sub> )****		
Pentane <sup>5</sup>	1,800 mg/M <sup>3</sup>	
Hexane <sup>6</sup>	360 mg/M <sup>3</sup>	
Heptane <sup>7</sup>	1,600 mg/M <sup>3</sup>	
Octane <sup>8</sup>	1,450 mg/M <sup>3</sup>	

\*Ceiling value = concentrations which should never be exceeded.

\*\* mg/M<sup>3</sup> = approximate milligrams of substance per cubic meter of air.

\*\*\*ppm = parts of substance per million parts air.

\*\*\*\*The principal components of jet fuels are aliphatic hydrocarbons ranging from C<sub>5</sub> to C<sub>8</sub>.

- 1) NIOSH Criteria Document (1972). Note: The OSHA Standard (1976) is 50 ppm.
- 2) ACGIH TLV (1978). Current OSHA Standard is also 9,000 mg/M<sup>3</sup>.
- 3) ACGIH TLV (1978). Current OSHA Standard is 4 mg/M<sup>3</sup>.
- 4) ACGIH TLV (1978). Current OSHA Standard is also 5 mg/M<sup>3</sup>.
- 5) ACGIH TLV (1978). Current OSHA Standard is 2,950 mg/M<sup>3</sup>.
- 6) ACGIH TLV (1978). Current OSHA Standard is 1,800 mg/M<sup>3</sup>.
- 7) ACGIH TLV (1978). Current OSHA Standard is 2,000 mg/M<sup>3</sup>.
- 8) ACGIH TLV (1978). Current OSHA Standard is 2,350 mg/M<sup>3</sup>.

#### b. Ergonomic Criteria

The comfort and/or exposure limits to ergonomic concerns such as those evaluated in this investigation, e.g., excessive noise, improper lighting levels, temperature and humidity and spatial/work space factors, are also derived from existing human and animal data. The criteria by which each of these factors is measured or compared is described below.



1. Noise Criteria: The present U.S. Department of Labor (OSHA) Federal Occupational Health Standards for noise is presently 90 dBA and is designed to guard against hearing loss. However, lesser noise exposures may also be a problem in terms of interference with job performance and disruption of speech communication. It was these latter concerns which were addressed during the investigation at the central reservations office, and therefore, the following table lists the noise criteria established for this survey:

<u>Range of Levels</u>	<u>Communication Environment</u>
50-60 dBA*	Person-to-person communication satisfactory, telephone use satisfactory
60-70 dBA	Communication unsatisfactory for two or more persons; telephone use slightly difficult
70-80 dBA	Person-to-person communication with raised voice satisfactory 1 to 2 ft; telephone use difficult.
80-90 dBA	Person-to-person communication slightly difficult with raised voice 1 to 2 ft; telephone use very difficult.

\* dBA = decibel in the A weighted network which discriminates against very low frequencies.

2. Lighting Criteria: At present there is no standard set by OSHA for lighting levels, either task or backgrounds in office environments. Therefore, the criteria used to compare the lighting levels found at the reservations office are those recommended by Patty's Industrial Hygiene and Toxicology, edition, the Illuminating Engineering Society and the American National Standards Practice for Industrial Lighting. The existing range for good to excellent illumination for background lighting in work environments similar to those found at Ozark is between 70-100 footcandles.

NOTE: The task (CRT display) lighting requirements are 50-75 footcandles.

3. Temperature and Humidity Criteria: The temperature and humidity standards established by OSHA for adequate working conditions pertain only to very cold and very warm and humid work environments. The only criteria that can be used for an office work environment is that recently recommended by the presidents council on energy conservation, i.e., 78°F for the summer months and 68° for the winter months with a relative humidity of 35-50 percent. However, additional factors which must be addressed in this area are the temperature of objects in the work environment which affect the heat exchange of the individual, e.g., walls, ceilings, etc. and how they come into play through the individuals radiation process. That is, that process of heat gain or loss by the individual which is dependent on the air movement, the skin temperature, and the temperature and humidity of the immediate surroundings. Establishing a criteria for these concerns is very difficult, however, marked changes of + 8-10°F from the above criteria could be considered as a problem which needed to be resolved.

## 2. Spatial/Work Space Criteria

The last concerns evaluated in the ergonomics area were the spatial/work space concerns or those needs required by the reservationists to perform the job adequately at the work site without undue stress. Therefore, based on the requirements of the reservationist's job (telephone communications, scheduling, visual scanning of the CRT display, typing, etc.) the following concerns were evaluated at the work site: 1) The horizontal and vertical work surface area, i.e., the total width of a work site, the depth of the working surface, the height from the floor to the work surface and the height from the work surface to the highest object required to perform the task, and 2) the seat design, i.e., the height from the floor to the seat bottom and the type of backrest used. The criteria used for these concerns is from the National Safety Councils, Fundamentals of Industrial Hygiene, 1971 and McCormicks, Human Factors Engineering, 1970. The criteria presented below are ranges which cover the 95th percentile population for both males and females performing work at a desk in a seated position.

### a. Work Surfaces

Width (from side to center point) = 14-15 inches  
Depth (from front to rear surface) = 15-16 inches  
Height (from floor to surface) = 24-25 inches  
Height (from surface to highest  
object to perform task) = 15-16 inches

### b. Seating Design

Seat height (from floor to seat bottom) = 14-17 inches  
Seat backrest (piveting backseat-variable angle) = 10-15°



### 3. Medical/Toxicological Criteria

a. Carbon monoxide: Carbon monoxide is a colorless, tasteless, and odorless gas. It is principally produced as a waste product of incomplete combustion of carbon-containing materials. The internal combustion engine produces large amounts of carbon monoxide. The turbine engine is much more efficient in the combustion of hydrocarbon fuels, so much less carbon monoxide is produced, but it certainly has the potential for production of the gas.

Carbon monoxide combines with hemoglobin to form carboxyhemoglobin. Carboxyhemoglobin has a reduced ability to carry oxygen. The central nervous system is the most vulnerable to the effect of CO. Symptoms of the first stage exposure may include a feeling of weakness, a bandlike constriction or throbbing of the head, mental confusion, headache, roaring in the ears or nausea. The second stage is characterized by increasing weakness and confusion, dizziness, and an inability to think clearly or act with energy. Additionally, in acute cases of CO intoxication, the victim may have pink lips and cheeks.

b. Carbon dioxide: Carbon dioxide is a colorless, tasteless, and odorless gas. Carbon dioxide and water are the products of completely efficient combustion.

Its primary effect in low concentrations is simple asphyxiant by replacing oxygen in inspired air. A concentration of 5% may produce shortness of breath and headache. Concentrations above 10% have a direct toxic effect by depressing the central nervous system and respiration. Death may occur at very high levels.

c. Formaldehyde: Formaldehyde is an intense irritant of the upper respiratory passages. For this reason, systemic poisoning is unlikely since workers would be compelled to leave the exposure area before levels sufficient to cause systemic poisoning were reached. Formaldehyde also irritates the eyes, causing a burning, stinging sensation with consequent tearing.

d. Pyrethrin: Pyrethrins are constituents of plants and are the oldest of insecticides. Contact with the skin can cause dermatitis. The systemic effects are nausea, vomiting, gastroenteritis with diarrhea, hyperexcitability, incoordination, tremors, muscular paralysis and death, but severe poisonings are rare.

e. Hydrocarbons: The Federal Aviation Administration provided NIOSH with information concerning jet aircraft fuels and exhaust.

The fuel is similar to commercial kerosene. The exhaust products "do contain substances which can be very unpleasant and in sufficiently high concentrations could be toxic."

Kerosene is derived from petroleum and is a combination of hydrocarbons primarily of 8 to 12 carbons in length. Kerosene is only slightly volatile and usually does not cause vapor hazards at room temperature unless confined. Inhalation of high vapor concentrations for extended periods can cause headache and stupor. These materials are also irritating to mucous membranes.

## V. EVALUATION RESULTS AND CONCLUSIONS

### A. Environmental

Employee exposure to suspected airborne concentrations of carbon monoxide, carbon dioxide, hydrocarbons (C<sub>5</sub> to C<sub>8</sub>), and pyrethrin were evaluated by either review of the Peoria Area OSHA survey data, the Ozark insurance carrier industrial hygienist survey data or the NIOSH environmental survey data. Also, an evaluation of the ventilation system and the suspected insect problem was assessed. The following are the results and conclusions of the environmental evaluation:

#### 1. Carbon monoxide:

Carbon monoxide samples were taken by each of the three groups who investigated the episode at the reservations office. NIOSH's carbon monoxide determinations were obtained by using certified gas detector tubes. A total of 10 samples were taken during our first survey. Six of these were taken inside the reservations room and four were taken next to the ventilation intake system outside the facility during different periods of the day. This sampling procedure was repeated on our return visit to the reservation facility. All of these values were within 5-10 ppm which is well below the criteria set for this survey. Similar sampling procedures were performed by OSHA and the insurance carrier industrial hygienist. OSHA was the only investigative group who had an opportunity to sample during the episode and their findings were less than 5 ppm. The insurance carrier also found carbon monoxide levels below 5 ppm.

#### 2. Carbon dioxide:

Carbon dioxide measurements were taken by NIOSH investigators, using certified gas detector tubes, at the same time as the carbon monoxide samples. A total of 10 carbon dioxide samples were taken inside the facility during the first survey and 10 during the second investigation. All of these samples showed non-detectable levels, i.e., not above normal background.



### 3. Hydrocarbons (Specifically C<sub>5</sub>-C<sub>8</sub>)

Hydrocarbon measurements were taken by NIOSH and Ozark's insurance industrial hygienist. The insurance industrial hygienist was concerned primarily with the following hydrocarbons: benzene, toluene, xylene, equivalent hexane, methyl ethyl ketone, trichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2,2-trifluoroethane, methyl isobutyl ketone, acetone. Also, these samples were scanned for all other hydrocarbons and all of these samples showed non-detectable levels (refer to Attachment II). NIOSH sampled for hydrocarbons using gas detector tubes and the sampling strategy was identical to that described for carbon monoxide. All of these samples showed non-detectable levels. Again, it should be noted that the detector tubes for hydrocarbons are non-specific, i.e., this measuring device responds to the entire range of organic compounds.

### 4. Pyrethrin

Pyrethrin was sampled only by the insurance carrier's industrial hygienist. A total of three general area samples were taken during his investigation and all of these samples showed non-detectable levels. It should be noted that these samples were taken after the reservation facility was thoroughly cleaned, and therefore, the likelihood of any remaining pyrethrin compounds was reduced substantially because of this cleaning.

### 5. Insects

NIOSH investigators were given a number of different species of insects which the employees felt might be a health problem. These samples were submitted to the Bureau of Laboratories, Vector-Borne Disease Division, Fort Collins, Colorado. The following identifications were made: six flower beetles, one ground beetle, one cricket, one plantfeeding hemiparasite, one small beetle, and one orabated mite. It was concluded that none of the specimens represented posed a public health threat. However, one cannot rule out the possibility that the small flower beetles might become annoying if present in large numbers, but the latter seems unlikely in this type of habitat.

### 6. Ventilation System

During both surveys performed by NIOSH it was determined that the ventilation system was operating in a normal mode, i.e., there were approximately 10 air changes per hour in the reservations room and this accounts for approximately 8000 cubic feet per minute of air. The system was operating on a 90% recirculation and a 10% fresh air intake ratio which is what the system was designed to perform at. However, during the week of the episode a number of conditions developed which lowered the effectiveness/design specifications given above, and thus, resulted in elevated temperatures of 80-85°F in the reservations facility as reported by OSHA during their initial investigation. Therefore, it can be concluded that the ventilation system, as a whole, was not operating effectively, e.g., malfunctioning dampers, thermostat irregularities, doors to the outside of the facility were being opened which alters the systems effectiveness, etc. All of these abnormal conditions would result in an uncomfortable (80-85°F temperatures) working atmosphere.

## B. Ergonomic Factors

Employee exposure to suspected low level airborne chemical contaminants was only a portion of what was suspected to be the main problem at Ozark reservations facility during the August episode. The results received on those ergonomic factors evaluated, e.g., noise, lighting, heat and humidity, and spatial/work space factors, were also felt to play a major roll in the situation which evolved during August. The following are the results and conclusions regarding these factors.

### 1. Lighting

The results of the lighting survey performed by NIOSH on the second investigation are quite impressive in terms of illustrating a situation/problem which can develop if ergonomic concerns are overlooked. Illumination levels in the reservations facility were reduced substantially in order to comply with energy concerns, as well as complaints about glare on the CRT screens. Thus, the reduced lighting conditions resulted in inadequate illumination in the majority of the facility for months. The lighting survey (refer to Figure 3) found that the illumination levels along the outer perimeter of the reservations area ranged from 75-100 footcandles (fc) and accounted for approximately 25% of the lighting in the room. The illumination levels in the remaining 75% of the room, primarily through the center of the facility, averaged 20 fc. Therefore, the majority of the reservationist had been performing their job for months with illumination levels far below the criteria of 75-100 fc that is necessary to perform their job efficiently.

### 2. Noise

The results of the noise survey illustrated conditions which could be extremely frustrating at various times during a working day for the type of job being performed by these workers. The overall background or continuous noise levels found in the facility ranged from 55-65 dBA which was considered acceptable. However, when evaluating the noise levels for the reservationists during their regular working conditions, i.e., either two reservationist sitting side by side typing and communicating with a caller at the same time, the noise levels for the ten sample groups evaluated ranged from 65-85 dBA which is unacceptable. Also, when sound level measurements were taken with two reservationists sitting side by side, both typing and only one communicating with a caller, the dBA range for the ten sample areas was 60-70 dBA which can also produce communication difficulties. The last condition tested was two reservationists sitting side by side and neither were communicating with a caller. The sound level measurements ranged from 50-60 dBA for the ten areas measured under this condition and this range is considered acceptable.



### 3. Temperature and Humidity

The temperature and humidity levels in the reservations facility were evaluated by all of the investigative groups. OSHA's data was the only temperature data (80-85°F) which was indicative of those conditions which existed during the episode. The insurance carrier industrial hygienist measured temperature levels from 77-79°F and 67-70% relative humidity two days after the episode. NIOSH's measurements were 70-75°F and 52-55% relative humidity for our September survey and temperature readings of 68-72°F and 50-52% relative humidity for our January investigation. Therefore, the only results which can describe the uncomfortable temperature conditions which existed during that period are those evaluated by OSHA.

Another concern which NIOSH evaluated in regards to effects of temperature within this work environment was the accuracy of the thermostats in the rooms and the potential temperature variations at different locations in the facility. Each of the thermostats were evaluated by placing thermometers next to the wall thermostats and temperature readings were taken every hour. The results of this survey indicated that each wall thermostat did not vary more than  $\pm 1^\circ\text{F}$  from test thermometers.

The results of our survey concerning temperature variations within the facility indicated a difference of 8-10°F from the outer wall, i.e., along the concrete wall to the inner wall. Therefore, reservationists sitting at locations along the outer concrete wall could expect temperature levels 10°F lower or higher than at other locations in the facility and this temperature difference could be very uncomfortable during certain periods of the year.

### 4. Spatial/Work Space

The final ergonomic concerns evaluated at the reservation facility were those spatial/work space factors. That is, the type of seating requirements and the available work surface required to adequately perform ones job without undue stress and discomfort. The results of this portion of the investigation showed that there was one style of seat being used by the reservationists and there were two basic row/seating configurations, i.e., the reservationists sat in parallel rows of either 10 or 11 work stations per row. The row of 10 work stations had a total work surface length for each location of approximately 36 inches wide by 23 inches deep. Those rows with 11 work locations had a total work surface length of 32 inches wide by 23 inches deep. Each location has a CRT terminal (12 x 23 inches) located in the center of the table and a phone dialing terminal (approximately 10 x 10 inches) sitting on either side of the terminal. Based on the reference materials used by the reservation agent during the job (3-5 reference sources); personal items kept around the work site (e.g., purse, clothing, etc.); the size of the CRT and phone terminals; and the criteria established for this portion of the investigation, it appears that the work surface area required to adequately perform the reservationists job is marginal at best. That is, that average work surface available per location is adequate for 2 possibly 3 items, besides the terminals, but becomes very cluttered when 3 or more items are on the work surface.

The seats used by the reservationists are designed to adjust to ones own comfort. The seat bottoms are adjustable and can be raised or lowered as needed. Based on the criteria used this type of seating is the best type of seating that could be used, assuming that it is adjusted properly, for the type of work being performed by the reservationist.

### C. Medical

The medical survey was conducted by the NIOSH physician and physician's assistant, and this consisted primarily of a questionnaire. The questionnaire elicited information such as presence in the workplace August 15 and 16, presence of illness and description of symptoms, medical attention sought, and personal habits. There was also one question regarding the work station used on those days by the employee. Since most agents complained of the symptoms and only a few noted the work station, we were unable to isolate the illness to any portion of the room. The questionnaire also asked if medical tests were performed and their results if known.

A list of 313 agents and supervisory personnel names was given to NIOSH. Copies of the questionnaire were distributed to many of these agents at the time of the initial visit. The questionnaire was mailed to the remainder of persons on the list so that all agents obtained the questionnaire. Of the questionnaires distributed, (refer to Table 1) 232 (71%) were completed and returned and the information was compiled for August 15 and 16. Of the 232 agents, 59 percent indicated some symptoms on these two days. Sixty-one agents required transportation to the hospital as indicated by company insurance forms. The symptoms requested by direct questioning are presented in Table 2. All symptoms except for faintness were noted by a large proportion of the agents. Lightheadedness, headache, and eye irritation were the most frequent complaints.

The percentages given in the tables are of persons determined to be at work that day and who developed that symptom. An agent's attendance at work was determined by personnel records and questionnaire response.

NIOSH was successful in obtaining medical records on 13 agents on whom laboratory tests were performed. A multitude of tests were performed by various physicians. Some persons received chemistry screens, blood counts, chest x-rays and thyroid function tests. There were no noteworthy laboratory abnormalities among these tests. Two persons had carboxyhemoglobin tests performed. Both agents smoked and the test values were normal for smokers.



The questionnaire results indicted that a large number of persons developed at least one symptom. These symptoms are not diagnostic of any specific disease process, but they may be consistent with a number of adverse health effects including acute toxicities to hydrocarbons, carbon monoxide, organophosphate insecticides and hyperventilation syndrome. These illnesses can be differentiated, but it is necessary to see patients at the time of the illness.

The information in Table 1 is important because it illustrates that the problem was in fact widespread involving approximately one-half of the agents and many of the agents experienced multiple symptoms and felt quite ill during the episode.

#### D. Summary

The environmental and medical aspects of this hazard evaluation were not able to document the presence of an unsuspected chemical substance, i.e., the presence of hazardous levels of carbon monoxide, carbon dioxide, hydrocarbons, or pyrethrin. This result also applied to those insects investigated as potential health problems. However, based on the ergonomic considerations evaluated it appears that the following factors were the most probable source of chronic strain in the reservation center during the August episode.

##### 1. Illumination

Alternately reading materials from the video display terminals and the printed airline manuals and/or other reading materials at the worksite requires constant adaptation and accommodation. This problem has previously been noted by McCormick (1964) who stated:

"The illumination problem is especially sticky where the CRT display terminal is to be used in a situation in which the individual also has other visual tasks to perform which require moderate to high levels of illumination. For reasonably optimum viewing, a CRT preferably should be viewed under generally dim illumination conditions in order to preserve the contrast between the targets and their background on the CRT scope. On the other hand, other visual tasks, e.g., reading materials, normally require higher levels. These divergent objectives not only impose conflicting illumination requirements but also impose upon those working in the situation the frequent requirement to change their visual adaptation."

This is precisely the situation which existed at the reservations office. At one time the overhead fluorescent lighting was adequate for reading the printed airlines manuals, but produced glare on the CRT screens, a condition which has been related to general eye strain, burning, and headache (Hultgren & Knave, 1973; Gould, 1968). As a consequence, the majority of workers opted to turn off the overhead lighting to eliminate the glare. Thus producing illumination values ranging from 5-20 footcandles in the majority of reservation center, an intensity well below the 75-100 footcandle level recommended for this type of work, and therefore this produced a situation likely to result in eye strain and headache.

## 2. Noise

Noise readings taken by NIOSH investigators from the ten work areas sampled, ranged from 65-85 dBA, depending on the location and the volume of incoming calls. Although these levels do not exceed the current standard of 90 dBA, it is reasonable to expect that there is a considerable impairment of communication clarity. Also, when one considers the noise criteria established for this survey and the fact that the majority of calls handled by the reservationists are "long distance" and subject to line distortions and poor connections, it is not surprising that the communication link is impaired for both the reservationist and the customer. This is consistent with a recent study by Goodrich (1978) in which he found that 47% of a sample of secretarial workers reported problems of being distracted by surrounding conversations, resulting in feelings of uneasiness or irritability. These symptoms are compatible with complaints previously expressed by the Ozark reservationists.

## 3. Spatial/Work Space

Based on the specific measures taken, it was apparent that crowding and cluttered work conditions were a probable source of discomfort at the Ozark facility, and thus, resulting in some postural complaints.

Muscular aches and pains are not uncommon among computer terminal operators. Gunnarsson and Ostberg (1977) reported that 65% of the terminal operators surveyed in a study conducted in a Swedish airline reservation center, complained of some form of muscular discomfort. Cakin, et al, (1978) reported that 51% of the video display terminal operators in their investigation reported neck pains and 60% reported back pain.

The above ergonomic problems are likely to be compounded by feelings of psychological distress related to the crowded and congested work spaces assigned to the individual operators at the reservations facility. The positioning of workers along parallel rows of 10-11 individuals each produces a degree of spatial competition and stimulus overload arising from the visual and auditory inputs from surrounding work stations. This may increase sensitivity to minor irritants (e.g., faint odors, stuffy or congested air, temperature variations, etc.).



#### 4. Temperature and Humidity

We have chosen to summarize these concerns last primarily because it is felt that the elevated temperature and humidity factors, along with the ventilation system malfunction, were the acute triggering factors in the August episode and the noise, illumination and the spatial/work space factors were the chronic factors in this episode.

It should be noted that these conclusions in no manner imply that the individually affected employee was not ill. On the contrary, the workers were in our opinion sick and their symptoms were real. An analogy to the problem which developed at Ozark Airlines in our opinion, would be an individual with a peptic ulcer. That is, there are often strong psychological or stress components in the etiology of a peptic ulcer, but this does not minimize the seriousness of the condition. Therefore, like the individual with the ulcer, it is felt that the combined factors and/or conditions listed above contributed to the affects experienced by the individual, and thus, created the mass illness episode in the group.

#### VI. RECOMMENDATIONS

Based on the results and conclusions of this investigation the following recommendations are offered to management and union officials to ensure worker safety and health. A number of these recommendations were presented in our interim report and our January closing conference, however, they are presented here again in order to update the progress that has been made by Ozark's management at the reservations facility (A progress report was received by NIOSH on September 4, 1979 from Ozark):

1. A back-up system telling of malfunctions in the ventilation system should be designed, e.g., a visual device showing the on-off modes for the heating phase and cooling phase. Also, additional thermostats and humidity indicators, apart from the existing system, should be installed to assist in monitoring the ambient air conditions in the reservation office. Ozark's progress, as stated in the September letter, is that the heating and cooling system for the entire building has been extensively modified resulting in an independent control system for the reservations floor only. This will enable people to better control their environment from a temperature and airflow standpoint. Also, the concrete wall has been covered with furring strips, plasterboard and carpeting which should assist in maintaining the temperature along this area.

2. Based on the levels of lighting measured in the reservation room during the survey, a survey of the present lighting conditions, both task and background, should be performed and appropriate levels set. Also, any surfaces which reflect glare, e.g., papers around the work place, grill covers over lights, etc. should be eliminated. A

number of solutions were recommended for reducing these illumination problems during our closing conference. Alternatives include the use of recessed lights, glare shields on the video screens and directly on the light source, or the use of the so-called "blue lights" recently introduced for use with video display terminals. The most preferred solution would be the installation of individual light sources of variable intensity at each work station. These could easily be shielded to eliminate glare on the terminal screens while permitting the reservations to select a level of illumination which allows them to comfortably read the printed manuals. Ozark has submitted bids through the Peoria Airport Authority on replacing the existing fluorescent light tubes with the blue spectra-lights. Final action on purchasing these tubes is pending.

3. All exhaust and intake registers should be cleaned on a regular basis.

4. Techniques to reduce background noise should be considered, e.g., partitions between work stations with noise dampening surfaces or headsets covering both ears. Ozark installed sound dampening partitions at every other position for the reservation agents. Initial noise level samples indicate an average reduction of 10 dBA as a result of the partitions. Also, the DBZ machine and the teletype machine have been enclosed in sound dampening enclosures. No noise levels have been recorded since enclosing these machines; however, the noise reduction was noticeable. Finally, the south wall of the reservations center, as mentioned earlier, was recovered with furring strips, plasterboard and carpeting for further noise reduction. This has also caused a noticeable reduction in the noise level.

5. Reduction or elimination of aircraft departing on the southwest taxi runway should be encouraged, especially during days which have high temperatures, high humidity, and inversion conditions.

6. Fencing off the area where the air make-up system is presently located should be considered in order to prevent possible contamination from auto exhausts via cars parking in this area.

7. Increased communications between management and the employees at Ozark Airlines should be maintained regarding the findings from the August episode. Also, any other physical changes should be communicated to the employees and time tables set for completion of such projects.



8. NIOSH also recommended that an ideal solution to many of the problems discussed above would involve the installation of small work "pods" of 4-6 individuals (refer to Figure 4). These are presently manufactured by a number of companies for use with video display terminals. Arranged in a hub or wheel design, these units provide each worker with a distinct work station having acoustic sides, shelving, individual storage space and variable intensity reading lamps. Such an arrangement would reduce communication interference, provide adequate work space, and allow each worker a well-defined work area with a demarcated personal space for the duration of the shift. Extension cords on their receivers would further permit workers to occasionally stretch to avoid much cramping and fatigue.

9. Based on the recommendations of Holler et al. (1975) following an intensive study of 14 video display terminal operators, workers should be given at least a 15-minute break every two hours to avoid a detriment in visual functioning with accompanying physical strain.

At present, thirteen reservation sales positions have been relocated at the reservations facility to the adjacent training rooms to provide more "elbow room."

Also, it is planned to expand into an adjacent office on the same floor to provide an additional 4,000 square feet of space. More persons are being hired, but this will also provide more room for the existing employees.

10. Insect control should be performed as scheduled maintenance by competent professionals. Ozark stated that each reservation agent's position has been completely cleansed and disinfected as of the September correspondence. Also, the Peoria Airport Authority is arranging, at the request of Ozark, to have the Reservations facility sprayed with an insecticide that would be compatible with the existing occupancy. Finally, bids are also being requested to have the carpeting cleaned and disinfected, using only chemicals that would be compatible with the occupancy.

## VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Union and Management:

NIOSH is thankful to the management and the employees of Ozark Airlines for their cooperation and assistance with this Health Hazard Evaluation. The information gathered from this study will not only assist in maintaining the health and safety of those persons working at Ozark, but also other companies who perform similar operations.



#### VIII. BIBLIOGRAPHY

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", American Conference of Governmental Industrial Hygienist, (1978).
4. Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill Book Co., New York.
5. Industrial Ventilation, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, 14th Ed. (1976).
6. Hutchison, M.D. A Guide to Work-Relatedness of Diseases. HEW Publication No. (NIOSH) 77-123.
7. U.S. Department of Health, Education, and Welfare. Occupational Diseases, A Guide To Their Recognition, Public Health Service Publication (NIOSH) No. 77-181.
8. Wosler, John E., Acting Director of Environmental and Energy, Federal Aviation Administration, Communication with Paul Pryor, HHE 78-134, Project Officer, December 13, 1978.
9. Gerande, H.W., The Aliphatic (Open Chain Acyclic) Hydrocarbons, in Industrial Hygiene and Toxicology, Vol. II, 2nd Ed., Patty, Ed., Interscience Publishers, N.Y. 1963, pg. 1195-1196.
10. Sax, I.N., Dangerous Properties of Industrial Materials, 3rd Ed., Van Nostrand Reinhold Co. N.Y., 1968, pg. 857.
11. Arena, J.M., Poisoning, 3rd Ed., Charles C. Thoos, Pub., Springfield, Illinois, 1974. pg. 140.
12. Gleason, M. N., R.E. Gosslin, H.C. Hodge, R.P. Smith, Clinical Toxicology of Commercial Products, 3rd Ed., The Williams and Wilkins Company, Baltimore, 1969, Section II. Ingredients Index, Pg. 115.

13. Mitchell, C.J. Research Entomologist, Bureau of Laboratories, Vector-Braun Diseases Division, CDC, Personal Communication with Paul Pryor, December 19, 1978.
14. Beranek, L.L. and Newman, R.B. Speech interference levels as criteria for rating background noise in offices. Journal of the Acoustical Society of America, 1950, 22, 671.
15. Cakir, A., Reuter, H.J., Schmude, L., and Armbruster, A. Untersuchungen zur anpassung von Bildschirmarbeitsplatzen an die physische und psychische Funktionsweise des Menschen. Ed. Der Bundesminister fur Arbeit und Sozialordnung, P.O.B. D-5300 Bonn. Cited by Dainoff (1979).
16. Dainoff, M. Occupational stress factors in secretarial/clerical workers: Annotated research bibliography and analytic review. Report prepared for the National Institute for Occupational Safety and Health, 1979.
17. Goodrich, R. Office environment post-occupancy evaluation. Man-Environmental System, 1978, 8, 175-190.
18. Gould, J.D. Visual factors in the design of computer-controlled CRT displays. Human Factors, 1968, 10, 359-376.
19. Gunnarsson, E. and Ostberg, O. The physical and psychological working environment at a terminal-based computer storage and retrieval system. Report 1977;35. The Swedish National Board of Occupational Safety and Health, Department of Occupational Medicine. Cited by Dainoff (1979).
20. Holler, H., Kundi, M., Schmid, H., Stidl, H.G., Thaler, A. and Winter, N. Arbeitsbeanspruchung und Augenbelastung an Bildschirmgeraten. Ed. Automationsausschuss des \*Gewerkschaftsbundes. 1975. Cited by Dainoff (1979).
21. Hultgren, G., and Knave, B. Contrast blinding and reflection disturbances in the office environment with display terminals. Arbete Och Halsa, 1973.
22. McCormick, E.J. Human Factors Engineering. New York: McGraw-Hill, 1964.
23. Ostberg, O. Towards standards and TLVs for visual work. Paper presented to 2nd World Conference of Ergophthalmology. Stockholm, 1977.
24. Ostberg, O. CRTs pose health problems for operators. Journal of Occupational Health and Safety, November-Dec., 1975.



25. Woodson, W.E., and Conover, D.W. Engineering Guide for Equipment Designers (2nd Ed.). Berkeley, Ca.: Univ. of California Press, 1966.
26. General Radio Company: Handbook of Noise Measurement; Concord, Massachusetts, 1973.
27. National Safety Council: Fundamentals of Industrial Hygiene; Chicago, Ill., 1971.

TABLE 1  
Questionnaire Participation  
Case History of Unexplained Illness

Demography of Population

Males	10%
Females	90%

Questionnaires Distributed	313
Returned	232
Percent Returned	77.3

Total Present Day 1	210
Present and Returned Questionnaire Day 1	171 (81% of present)
Present Day 2	207
Present and Returned Questionnaire Day 2	157 (76% of present)



TABLE 2  
Percent Symptomatic Complaints  
Case History of Unexplained Illness

	Total Present Who Returned Questionnaire	Nausea	Unusual Taste	Weakness	Visual Disturbance	Short of Breath	Chest Pain	Dizziness	Light Headed	Headache	Eye Irritation	Faintness
% Persons Complained												
Day 1	171	18	33	27	15	25	12	34	43	49	45	5
Day 2	157	20	27	31	13	27	10	38	49	55	48	6

Figure 1

AIR RESERVATIONS OFFICE

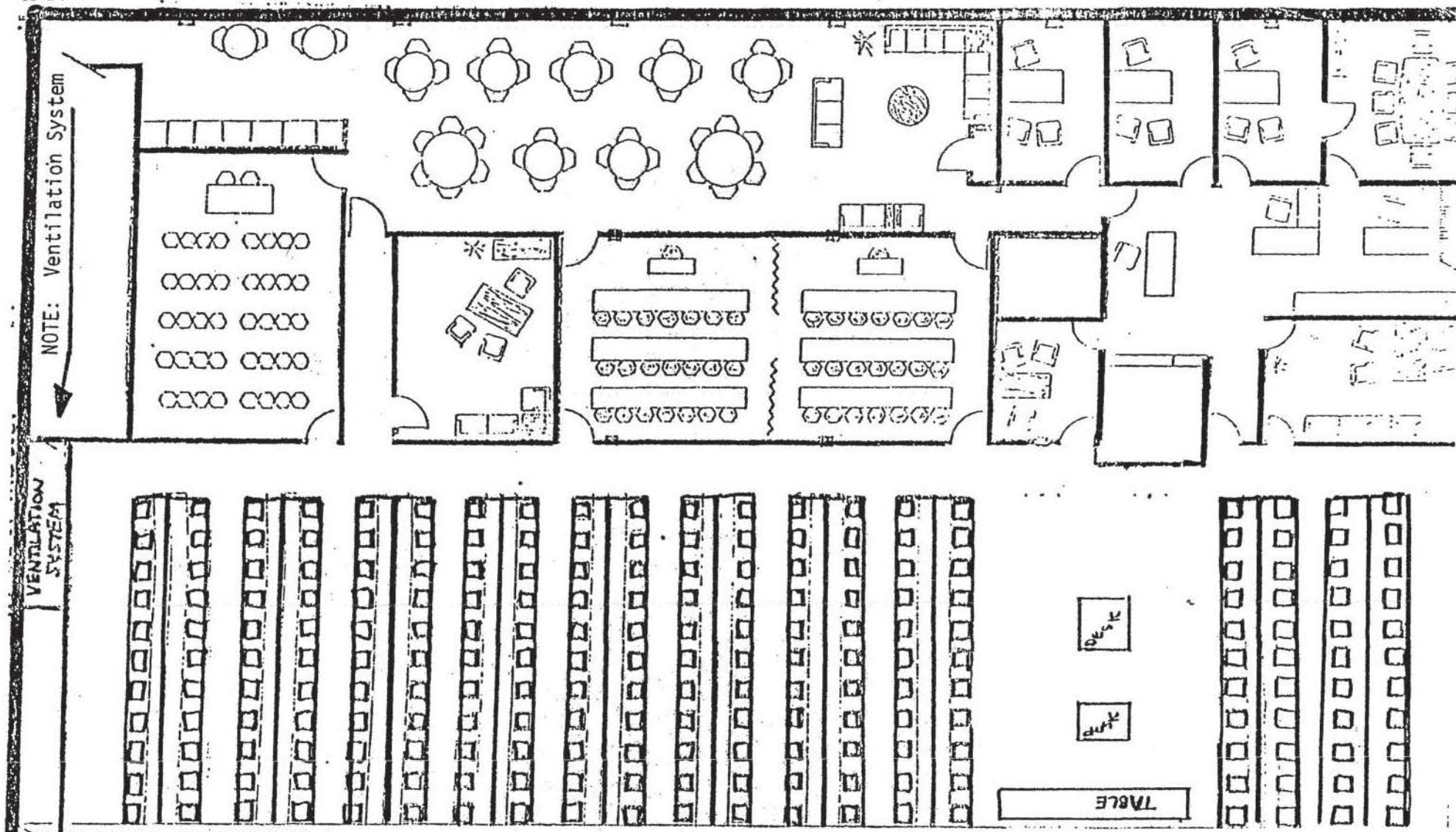




Figure 2

AIRLINE RESERVATIONS  
AIR MAKE-UP SYSTEM AND AIRPLANE DEPARTURE TAXI WAY

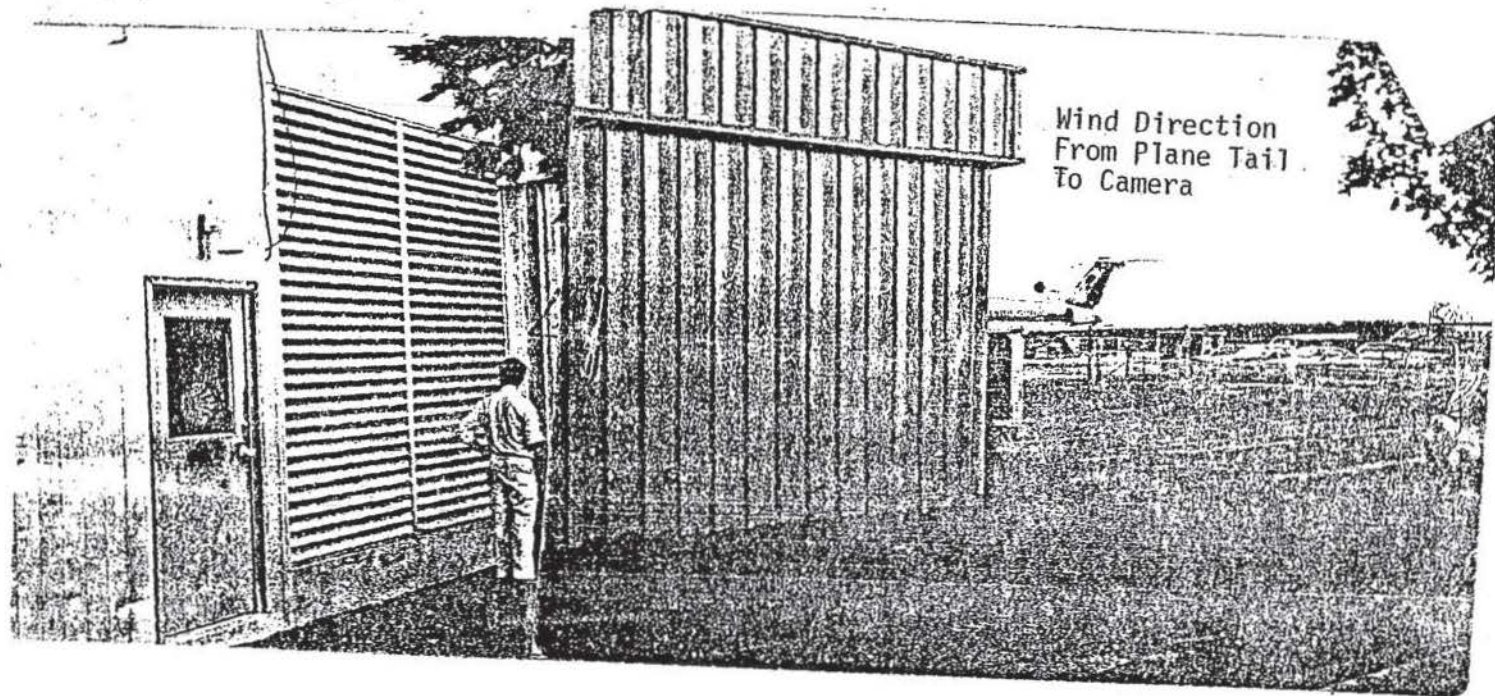


Figure 3 - Lighting Survey Data

AIRLINE RESERVATIONS OFFICE

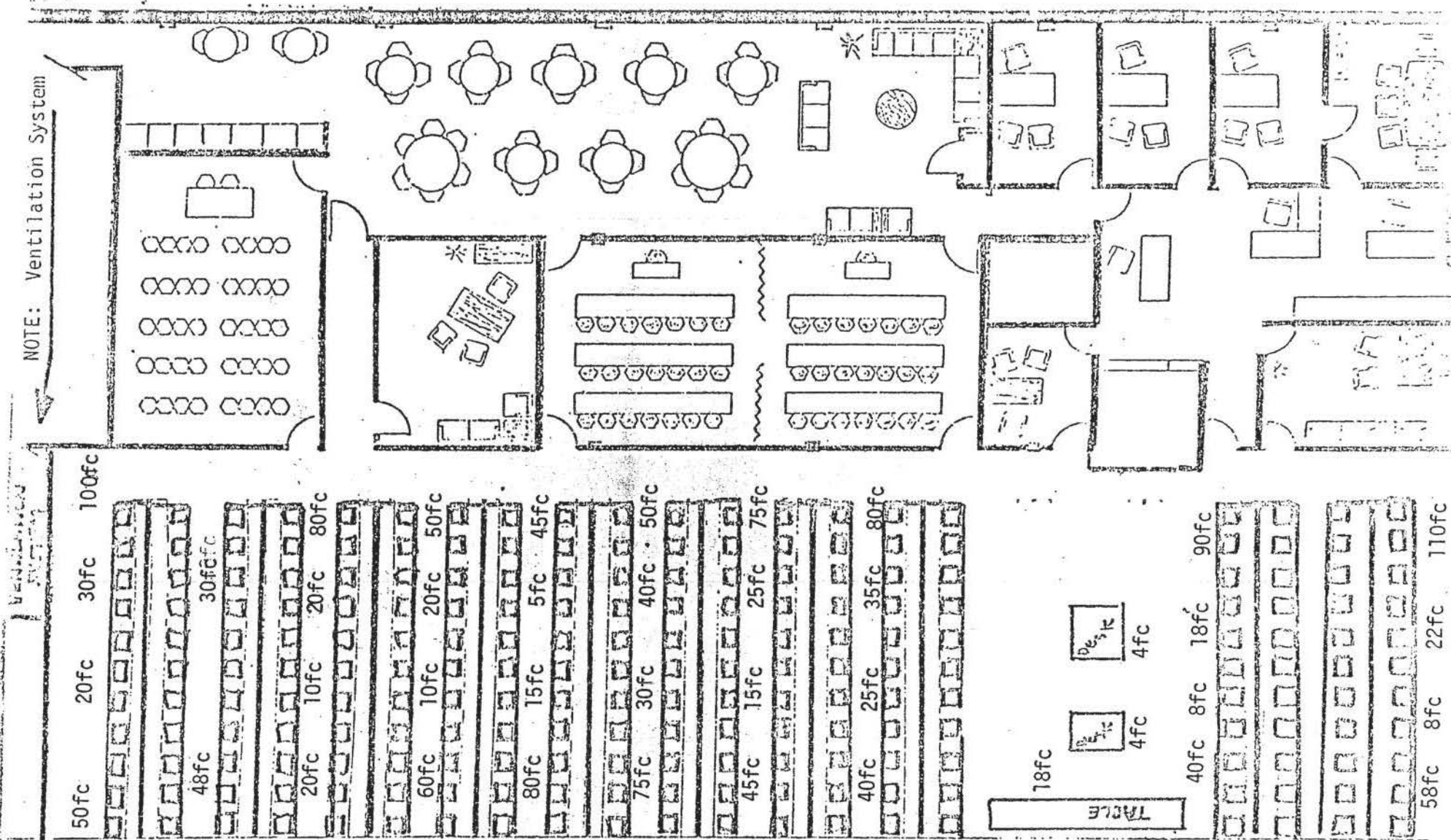




Figure 4

RECOMMENDED WORK STATIONS



U.S. DEPARTMENT OF HEALTH EDUCATION, AND WELFARE  
PUBLIC HEALTH SERVICE  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45226

This questionnaire is being distributed by the National Institute for Occupational Safety and Health in conduction of health hazard evaluation HE 78-134. This survey was requested by the International Association of Machinists Union.

All information gathered in this evaluation will not be disclosed in a manner which will identify you except with your written permission or except as required by law. The information will be used by NIOSH primarily for purposes of the health hazard evaluation and also for occupational health research.

We request this information to better understand and determine if any adverse affects have occurred among employees of the Ozark Reservation agents at Peoria, Illinois.

MEDICAL QUESTIONNAIRE

NAME: \_\_\_\_\_  
(please print)

AGE: \_\_\_\_\_

SEX (circle): M F

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

Job Description:

1. Have you ever noted any health problems that you feel are related to your work? Yes \_\_\_\_\_ No \_\_\_\_\_

If yes; describe with dates that problems occurred.

Date

Problem

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_



NAME: \_\_\_\_\_

1. Were you working in the Reservation area August 14, 15, or 16?

YES \_\_\_\_\_ NO \_\_\_\_\_

2. If yes, please indicate any health effects that you experienced. When did you experience these symptoms? (Indicate exact date and time when symptom(s) began and ended)

Began  
(Date & Time)      Ended  
(Date & Time)

_____ Nausea	_____
_____ Unusual taste or odor	_____
_____ Weakness	_____
_____ Blurred Vision	_____
_____ Difficult Breathing	_____
_____ Chest Pains	_____
_____ Dizziness	_____
_____ Lightheaded	_____
_____ Headaches	_____
_____ Burning eyes	_____
_____ Fainting Episode	_____
_____ Other (specify) _____	_____

Did anything you do relieve the symptoms? \_\_\_\_\_

3. If Question #1 yes, did you seek medical aid.

YES \_\_\_\_\_ NO \_\_\_\_\_

Name of physician or other medical personal seen (indicate if company physician).

a. \_\_\_\_\_

b. \_\_\_\_\_

Where any tests performed?

YES \_\_\_\_\_ NO \_\_\_\_\_

What kind of tests, and were you told results? \_\_\_\_\_

4. Do you relate your illness to anything you noted at work?

YES \_\_\_\_\_ NO \_\_\_\_\_

Explain: \_\_\_\_\_

5. Have you ever experienced these symptoms at work prior to August 14-16 or since August 14-16? YES \_\_\_\_\_ NO \_\_\_\_\_

If yes, when? \_\_\_\_\_

Have you experienced these symptoms other than at work? YES \_\_\_\_\_ NO \_\_\_\_\_

If you consulted any medical personal please complete the release of medical information form (back page)



Name: \_\_\_\_\_

- 4 -

U.S. Department of Health, Education, and Welfare  
National Institute for Occupational Safety and Health  
HHE 78-134  
Reservation Agents, Ozark Airlines

ADDENDUM

6. If you experienced symptoms prior to Aug. 14-16 or since Aug. 14-16, what were they?  
describe \_\_\_\_\_  
\_\_\_\_\_

7. Where did you eat each of these meals? ( Indicate name of restaurant or if you brought your meal or exactly where you got it )
- |  | Breakfast | Lunch | Dinner |
|--|-----------|-------|--------|
|--|-----------|-------|--------|

Aug. 15	_____	_____	_____
Aug. 16	_____	_____	_____
Aug. 17	_____	_____	_____

8. How many cigarettes per day do you smoke? (This is all day and not just at work) ( If you do not smoke, write zero)

\_\_\_\_\_ cigarettes per day

9. Do you have any allergies? \_\_\_\_\_ If yes, to what? \_\_\_\_\_

10. Do you wear glasses? \_\_\_\_\_

If yes, are you near or far sighted? \_\_\_\_\_

If yes, do you have clear or tinted lenses? \_\_\_\_\_

11. What table number in the reservation room did you work at on each of these days?

Aug. 14 \_\_\_\_\_  
Aug. 15 \_\_\_\_\_  
Aug. 16 \_\_\_\_\_  
Aug. 17 \_\_\_\_\_

On any other day in which you experienced symptoms (Indicate the date and the table number)

Date \_\_\_\_\_ Table \_\_\_\_\_  
Date \_\_\_\_\_ Table \_\_\_\_\_

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45202

REQUEST AND AUTHORIZATION FOR RELEASE OF INFORMATION

I, \_\_\_\_\_, hereby request and authorize  
(print name)

Dr. \_\_\_\_\_ and/or Dr. \_\_\_\_\_

Address: \_\_\_\_\_ Address \_\_\_\_\_

to release to the National Institute for Occupational Safety and Health  
such of my medical records as are requested by the National Institute  
for Occupational Safety and Health as a part of Health Hazard Evaluation  
Number HE 78-134.

Signature \_\_\_\_\_ Date \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_



## Attachment II

ATMOSPHERIC SOLVENT VAPOR CONCENTRATIONS  
 OZARK AIRLINES CENTRAL RESERVATIONS OFFICE  
 PEORIA, ILLINOIS  
 AUGUST 17, and 18, 1978

SAMPLE NUMBER	LOCATION AND DATE	TIME START/STOP	VAPOR CONCENTRATION (ppm) <sup>a</sup>
OSHA Allowable Limits			b
<u>OPERATORS' BREATHING ZONES</u>			
Y605	M. Alexander, operator at terminal #2020 (8/18/78)	0725/1007	N.S.
Y608A	Same as Y605 (8/18/78)	1007/1357	N.S.
Y606	C. Graham, operator at position 1109, group desk (8/18/78)	0745/1402	N.S.
<u>GENERAL AREA SAMPLES</u>			
Y600	Breathing zone level, at terminal #37-OA-10-1014 (8/17/78)	1653/1940	N.S.
Y601	Breathing zone level, at terminal #35-10-35-1418 (8/17/78)	1655/1940	N.S.
Y602	Breathing zone level, at terminal #35-18-20-2016 (8/17/78)	1700/1941	N.S.
Y603	2" above carpet, below terminal #37-02-31-1501, near area where insecticide had been sprayed (8/17/78)	1948/2028	N.S.
Y604	2" above carpet, below terminal #35-18-22-2020, girl had just left terminal due to "smell" (8/17/78)	2004/2033	N.S.
Y607	2" above carpet, below terminal #37-OA-19-2103, in area where one girl had just fainted (8/18/78)	0914/1400	N.S.

SAMPLE NUMBER	LOCATION AND DATE	TIME START/STOP	VAPOR CONCENTRATION (ppm) <sup>a</sup>
Y608	Breathing zone level, at east outside door, door open(8/18/78)	1318/1348	N.S.
Y609	Breathing zone level, at west doorway open (8/18/78)	1316/1354	N.S.

<sup>a</sup> parts solvent vapor per million parts of air sampled.

<sup>b</sup> OSHA Allowable Limits, based on an eight hour time weighted average exposure, are listed for the following chemicals which were checked for on all samples:

<u>CHEMICAL</u>	<u>ALLOWABLE LIMIT (ppm)<sup>a</sup></u>
Benzene	1
Toluene	200
Xylene	100
Equivalent Hexane	500
Chlorofluorocarbons (Freon 111, 112, 113)	1000
Acetone	1000
Methyl ethyl ketone	200
Methyl isobutyl ketone	100
Trichloroethylene	100
Perchloroethylene	350

N.S. - No significant concentration of solvent vapors was found on the sample, above the limit of detection. The limit of detection for these particular samples was about 0.02 ppm for benzene and about 1 ppm for the other solvents analyzed and listed in footnote b.