HETA 99-0320-2791
Immigration and Naturalization Service
Salt Lake City, Utah

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PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

HETAB also provides, upon request, technical and consultative assistance 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 NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Randy L. Tubbs and Teresa A. Seitz of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Lisa J. Delaney, M.S., HETAB. Desktop publishing was performed by Denise Ratliff. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Information Officers' Work Space for Noise and Ventilation at the INS

NIOSH investigators were asked by an employee representative to measure the noise levels, air movement, and office temperatures and humidity at the Salt Lake City, Utah, office where employees would give information to the public's questions.

What NIOSH Did

- Measured the noise levels in the information officers' work area and in the public reception area.
- Measured air movement, temperature, humidity, and carbon dioxide levels in the work area.
- Talked to employees about their work area and how it could be made better.
- Reviewed the medical reports from one information officer who was medically retired because of voice problems.

What NIOSH Found

- Noise in the public reception area was too high for good speaking conditions.
- The plexiglass partition blocked speech sounds.
- Not enough outdoor air was brought into the waiting area.
- Office temperature was too cold.

What Immigration and Naturalization Service Managers Can Do

- Add barriers between customer positions and soft materials to the reception area walls and floor.
- Purchase amplifier headsets for the information officers
- Change ventilation system to bring in more outdoor air.
- Have better control over the temperature in the office.

What the Immigration and Naturalization Service Employees Can Do

- Do not shout or raise their voice to overcome the poor listening conditions.
- Report uncomfortable temperatures and air conditions to management.

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National Institute for Occupational Safety and Health
NIOSH

Health Hazard Evaluation Report 99-0320-2791
Immigration and Naturalization Service
Salt Lake City, Utah
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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of employees at the Salt Lake City, Utah, office of the Immigration and Naturalization Service (INS) concerning communication problems in the work area. The office configuration made the information officers raise their voices to be heard and understood by the public. One INS employee had been seen by a physician and told that the office conditions led to this person's voice loss. Other employees felt there was an increased illness rate related to poor ventilation in the building. NIOSH representatives visited the INS office on September 29, 1999, to conduct a health hazard evaluation (HHE). During the evaluation, the area of concern was investigated by measuring the area noise levels and the ventilation parameters as well as interviewing employees who worked in this location.

The noise levels in the public reception area were found to be incompatible with good communication guidelines. The INS information officers were not being heard clearly by the public. Poor acoustic conditions in the public area and a plexiglass barrier between the officers and public contributed to the poor communication environment. The indoor environmental quality measurements made by NIOSH investigators revealed that the heating, ventilating, and air conditioning (HVAC) system was not supplying proper amounts of outdoor air to the waiting area and that temperature and relative humidity levels were outside of recommended ranges for indoor office environments.

The results of the HHE confirmed that the INS information officers and the public were attempting to communicate in a space that was not optimally configured for such communication. Also, the indoor environmental quality measurements revealed problems with thermal comfort and the supply of outdoor air. Recommendations are given in the report to help alleviate these general areas of concern.

Keywords: SIC 9721 (Immigration Services-Government); information officers, customer service, communications, noise, indoor environmental quality, IEQ

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INTRODUCTION

On August 19, 1999, the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of employees at the Salt Lake City, Utah, office of the U.S. Department of Justice, Immigration and Naturalization Service (INS). The INS information officers were concerned about verbal communication problems when they interacted with the public in their office. The office configuration made the information officers raise their voices in order to be heard and understood by the public customers that they served. One INS employee had been seen by a physician and told that the office conditions led to this person's voice loss. The employees felt that the plexiglass barrier between the information officers and the public, and the ventilation system that conditioned the air in the office were the contributing factors of the communication difficulties. The employees also expressed concern about a perceived increase in illnesses thought to be related to poor ventilation.

NIOSH representatives visited the INS office on September 29, 1999, to conduct a hazard evaluation. During the evaluation, the areas of concern were investigated by measuring the area noise levels and the ventilation parameters as well as interviewing employees who worked in this location. A brief conference with employee representatives and INS management was held at the beginning and end of the day.

BACKGROUND

The INS office in Salt Lake City is located on the first floor of a multi-story office building. A large portion of the General Service Administration (GSA) leased space has individual offices or larger multi-person offices. The location also has a holding cell for people detained by the INS. The area of the employees' concern is a public waiting room and reception area where INS information officers meet with the public to answer questions about immigration to the U.S. and to distribute forms needed in the immigration process. Most people that visit the INS do not use English as their first language, and many of them are unable to speak any English at all.

In 1996, one of the INS information officers began to experience voice problems at work. The employee was seen over many months by an audiologist who believed that ventilation problems, high ambient noise levels, and no voice amplification system were contributing to the patient's vocal symptoms. The audiologist recommended that the employee be given an amplification system to reduce the strain on their voice. However, the modifications that were made to the work area did not include such a system. After these changes were made, the information officer never completely recovered and eventually retired.

METHODS

Noise

Real-time area noise sampling was conducted with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559 ½" random incidence response microphone. The analyzer allows for the analysis of noise into its spectral components in a real-time mode. The ½" diameter microphone has a frequency response range (± 2 decibels [dB]) from 4 Hertz (Hz) to 21 kilohertz (kHz) that allows for the analysis of sounds in the region of concern. One-third octave-bands and full octave bands consisting of center frequencies from 20 Hz to 20 kHz were integrated and stored in the analyzer. The analyzer was mounted on a tripod and was placed at various locations where the INS information officers and the public conducted business, with the microphone placed at approximately the level of peoples' ears.

Indoor Environmental Quality

A discussion was held with the GSA representative responsible for the building lease to determine if there had been a history of indoor environmental quality (IEQ) complaints and to obtain background information on the ventilation systems serving the INS space. To evaluate current environmental conditions, air temperature, relative humidity (RH), and carbon dioxide (CO_2) measurements were made with TSI Q-Trak Model 8550 IAQ Monitors. Two stationary monitors placed in the information officer reception area and the customer side reception area recorded temperature, RH, and CO_2 concentration every five minutes from about 7:45 a.m. until 1:45 p.m. One additional monitor was used to take periodic (spot) measurements throughout the day in the records room, investigations work area, public waiting room, computer room, and a private office.

A TSI Model 8370 AccuBalance Flow Measuring Hood was used to measure supply and return air flow rates in the waiting room, reception areas, and a private office. Smoke tubes were used to visually assess air flow patterns in the waiting room and reception areas. Access to the air handling units for visual inspection was not possible during the NIOSH site visit.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assess-ment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[3] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5.(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

Noise

The A-weighted decibel [dB(A)] is the preferred unit for measuring sound levels to assess worker noise exposures. The dB(A) scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dB(A) scale is logarithmic, increases of 3 dB(A), 10 dB(A), and 20 dB(A) represent a doubling, tenfold increase, and 100-fold increase of sound energy, respec-tively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The occupational noise regulation promulgated by OSHA,[4] as well as the limits published by NIOSH [5] and ACGIH,[2] are not appropriate for the situation observed at this work location. The above referenced criteria are designed to prevent hearing losses from exposures to intense noise levels. However, noise of intensities lower than that which may cause a loss of hearing can be disruptive in the workplace. Interference with speech and interruption of office activities are possible results of unwanted noise. The noise can interfere with the efficiency and productivity of the office staff and can be detrimental to the occupants' comfort, health, and sense of well-being. One set of noise criteria for occupied interior spaces, the balanced noise criteria (NCB) curves, has been devised to limit noise to levels where satisfactory speech intelligibility is achieved.[6,7,8] The noise criteria were devised through the use of extensive interviews with personnel in offices, factories, and public places along with simultaneously measured octave band sound levels. The interviews consistently showed that people rate noise as troublesome when its speech interference level is high enough to make voice communications difficult. The recommended space classifications and suggested noise criteria range for steady background noise heard in various indoor occupied activity areas are shown in Table 1.

Indoor Environmental Quality

Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building-related occupant complaints.[9,10] Among these factors are imprecisely defined characteristics of heating, refrigerating, and air-conditioning (HVAC) systems, cumulative effects of exposure to low concentrations of multiple chemical pollutants, odors, elevated concentrations of particulate matter, microbiological contamination, and physical factors such as thermal comfort, lighting, and noise.[9,10,11,12,13] Reports are not conclusive as to whether increases of outdoor air above currently recommended amounts are beneficial.[14] However, rates lower than these amounts appear to increase the rates of complaints and symptoms in some studies.[15] Design, maintenance, and operation of HVAC systems are critical to their proper functioning and provision of healthy and thermally comfortable indoor environments. Indoor environmental pollutants can arise from either indoor or outdoor sources.[16]

There are also reports describing results which show that occupant perceptions of the indoor environment are more closely related to the occurrence of symptoms than the measurement of any indoor contaminant or condition.[17] Some studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and comfort complaints.[18,19]

Problems that NIOSH investigators have found in the non-industrial indoor environment have included poor air quality due to ventilation system deficiencies, overcrowding, volatile organic chemi-cals from office furnishings, office machines, structural components of the building and contents, tobacco smoke, microbiological contamination, and outside air pollutants; comfort problems due to improper temperature and relative humidity (RH) conditions, poor lighting, and unacceptable noise levels; adverse ergonomic conditions; and job-related psychosocial stressors. In most cases, however, no environmental cause of the reported health effects could be determined.

Standards specifically for the non-industrial indoor environment do not exist. With few exceptions, pollutant concentrations observed in the office work environment fall well below the NIOSH, OSHA, and ACGIH published occupational standards or recommended exposure limits.[1,2,3] The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation and thermal comfort guidelines.[20,21] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related symptoms that might be caused by airborne living organisms or their effluents.[22]

Measurement of indoor environmental contaminants has rarely proved to be helpful, in the general case, in determining the cause of symptoms and complaints except where there are strong or unusual sources, or a proved relationship between a contaminant and a building-related illness. However, measuring ventilation and comfort indicators such as carbon dioxide (CO_2), temperature, and RH is useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems.

Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of outside air are being introduced into an occupied space. ASHRAE's most recently published ventilation standard, ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Qual-ity, recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces, and 15 cfm/person for reception areas, classrooms, libraries, auditoriums, and corridors.[21] Maintaining the recommended ASHRAE outdoor air supply rates when the outdoor air is of good quality, and there are no significant indoor emission sources, should provide for acceptable indoor air quality.

Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration (range 300-350 parts per million [ppm]). Carbon dioxide concentration is used as an indicator of the adequacy of outside air supplied to occupied areas. When indoor CO_2 concentra-tions exceed 800 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected.[23] Elevated CO_2 concentra-tions suggest that other indoor contaminants may also be increased. It is important to note that CO_2 is not an effective indicator of ventilation adequacy if the ventilated area is not occupied at its usual level.

Temperature and Relative Humidity

Temperature and RH measurements are often collected as part of an indoor environmental quality investigation because these parameters affect the perception of comfort in an indoor environment. The perception of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperature.[24] Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The American National Standards Institute (ANSI)/ASHRAE Standard 55-1992 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable.[20] Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68-74°F in the winter, and from 73-79°F in the summer. The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained between 30 and 60% RH.[20] Excessive humidity can support the growth of micro-organisms, some of which may be pathogenic or allergenic.

RESULTS

The information officers deal with customers of the INS in three areas; a public waiting area, a separate reception area where the customer speaks to an information officer, and the area where up to three officers work with the public. Customers enter the building and pass through a security check-point, including a metal detector, are seated, and wait in turn until their number is called by an information officer through an intercom system. Once called, they go through a door into the reception area to meet with an information officer. This area is open with three positions where the customer meets with an officer. There is a plexiglass barrier between the officers and the customers with a 4" diameter round hole, approximately 5 feet above the floor, designed for the two individuals to talk with each other. A slot is located above a counter at the bottom of the plexiglass barrier to allow papers and forms to be passed back and forth. There are no barriers between the three customer positions.

On the officers' side of the barrier is a small room that contains three work positions along with shelves for forms, a laser printer, and a cash register. Each of the three positions has a working counter that is 23" deep at the slot and 31" deep on either side of the slot. A personal computer with video screen and keyboard is located on the counter surface at each position. An additional plexiglass barrier is located on the counter between each of the three officer positions. Each officer location has a tall chair for use if desired by the employee. The chair at one location has a seat pan 28" from the floor with the working counter at a height of 42". Thin, rubberized mats were on the floor at each officer position. Prior to the NIOSH site visit, a round, metal, slotted device had been placed in the barrier hole as a way to further reduce the air moving through the hole. It had no sound amplification capabilities and the employees felt that it degraded communications too much and was removed by the time of this evaluation.

Noise

Area noise measurements were made throughout the day in the area where the information officers worked. The measurements were made while the INS officers were conducting business with the public, so that the noise levels represent the ambient sound levels in an occupied space. Both A-weighted and unweighted sound pressure levels (SPL) were recorded in addition to the spectral measurement. Noise levels in the information officers' room were measured between 64 and 67 dB(A) and between 67 and 70 dB SPL. On the customers' side of the barrier, similar measurements were recorded between 58 and 66 dB(A) and between 65 and 70 dB SPL.

To compare the occupied room noise levels to the NCB criteria, octave-band sound levels were recorded on the customers' side of the reception area (Figure 1). When three customers were at the information positions, the A-weighted level was measured at 65 dB(A) and the unweighted sound at 70 dB SPL. The individual octave bands were fairly consistent having sound levels between 55 and 65 dB. A direct comparison to the NCB-40 criterion which is recommended for reception areas (Table 1) and to the NCB-60 criterion, which is the cutoff level when communication is desired in the occupied area, shows that the higher frequency noise components (2k, 4k, and 8k Hz) of the room are nearing the NCB-60 curve. With the exception of the two lowest frequency bands, the NCB-40 criterion is exceeded by the measured sound levels in the customer reception area.

Another sound measurement made during the evaluation was an attempt to show the effect of the plexiglass barrier on communications between the information officer and the customer. Smaller bands of sound, one-third octaves, were recorded on both sides of the hole in the plexiglass. On the customer side of the barrier, the microphone was placed at the height of the opening, but 6-10" to the side to duplicate the situation where the customer does not have their ear directly in the opening. The microphone was approximately 6-10" from the mouth of the officer for the measurement made on the officer's side of the barrier. Both measure-ments integrated the sound for 60 seconds while the officer and customer were conversing. These results are shown in Figure 2. The barrier does reduce the sound produced by the information officer, particularly in the higher frequency bands above 1 kHz. The reduction was found to be as much as 10 dB in the frequencies that are involved in human speech recognition.[25]

Indoor Environmental Quality

The GSA representative indicated that he had received complaints in the past regarding thermal comfort and problems with air flow in the reception area. He also indicated that the building owner is the current building manager. At the time of the NIOSH site visit, mechanical diagrams and ventilation system specifications were not available for review. The building owner was contacted during the site visit and on two subsequent occasions to obtain this information, but phone calls were not returned.

As shown in Table 2 and Figures 3 and 4, CO_2 concentrations ranged from about 600 ppm to nearly 3200 ppm on the day of measurement. Carbon dioxide concentrations exceeding the NIOSH guideline of 800 ppm were recorded throughout the evaluated area. Thermostats controlling air delivery to the INS space were located in the waiting room, investigations area, records room, and computer room. The thermostats could be set on "heating," "cooling," or "off," as well as on "automatic" or "fan" modes. In the automatic mode, air is supplied only when the thermostat calls for heating or cooling; when the thermostat is satisfied or placed in the "off" position, there is no air delivered to the space. When placed in the fan mode, there is a continuous supply of air. The air is conditioned (heated or cooled) as needed depending on the thermostat set points. The thermostats were found to be set on "off" and "auto," with the exception of the computer room thermostat which was set on "auto" and "cooling."

At 9:10 a.m., there were 43 people present in the waiting room, and the CO_2 concentration approached 3200 ppm. At that time, the thermostat in the waiting room was re-set by NIOSH investigators to "cooling" and "fan" mode (with a 72°F set-point). The ventilation system responded by supplying air to the space and diluting CO_2 concentrations. At 10:10 a.m., despite a continued high room occupancy, the CO_2 concentration had decreased to about 2000 ppm. Figure 4 shows this build-up of CO_2 early in the day in the adjacent customer reception area. Note that the CO_2 concentrations decreased after about 9:40 a.m. due to the dilution affect from the provision of supply air.

At 11:30 a.m. the remaining thermostats were re-set to the "on" position and "fan" mode, and the temperature set points were maintained at their existing settings. The temperature set points were 70°F in the investigations area and computer room, and 68°F in the records room. As shown in Table 2, there is about a 4°F discrepancy between the temperatures measured by NIOSH and those shown on the thermostats in the computer room and investigations area. The thermostat in the records room was in good agreement with the NIOSH measurement.

Table 2 lists the temperature and RH results from the spot measurements taken throughout the day in several office areas. Figures 3 and 4 provide a graphical presentation of the continuous measurements made in the information officer reception area and customer side reception area, respectively. The indoor temperatures ranged from about 68 to 76°F; the RH ranged from about 24 to 40%. Most of the measurements fell within, but at the far end of ASHRAE's acceptable ranges of operative temperature and humidity for people in typical winter clothing (heavy slacks, long-sleeve shirt and sweater). The acceptable ranges are based on a 10% dissatisfaction criteria. Measurements that fell outside the acceptable ranges did so because of low RH. However, for persons dressed in typical summer clothing (light slacks and short-sleeve shirt) as might occur during this transitional season, the measurements generally fell outside the acceptable ranges due to a combination of low RH and relatively low air temperature.

Results of the air flow measurements are shown in Table 3. Because additional information could not be obtained on the ventilation system, the NIOSH data could not be compared with design specifications or data from prior test and balance reports. The information does show, however, that the amount of outdoor air delivered to the waiting room does not meet current ASHRAE guidelines. Considering the maximum occupancy that we observed (48 persons) and the ASHRAE recommendation of 15 cfm of outdoor air per person in reception areas, 720 cfm of outdoor air would be needed to provide acceptable indoor air quality. The total air supplied to this room was only 645 cfm; the proportion of this amount that is outdoor air is unknown.

The smoke tube traces showed that the building was under positive pressure with respect to the outside. The waiting room was found to be under positive pressure with respect to the customer reception area, and the customer reception area was under positive pressure with respect to the information officer reception area and the adjacent corridor. Thus, air from the waiting room was mixed with air in the office areas. The degree or air mixing that occurs as a result of recirculation of air within the mechanical ventilation system is not known because ventilation system diagrams and specifications were not made available to the NIOSH investigators.

DISCUSSION

From an acoustical perspective, there were two different situations observed at the INS office in Salt Lake City. There was little sound isolation within the information officers' work area and the customers' reception area. Conversations and office noises reverberated throughout the two areas, leading to interference in speech under-standing. However, the plexiglass barrier between the two areas was causing a loss of sound energy, particularly in the higher frequencies. This will lead to additional impact on communications between information officers and the public they are serving. This communication decrement further complicates the situation where there are language barriers that must be overcome between the officers and the customers. During the one-day evaluation, the NIOSH investigator noted individuals needing assistance from the INS who were of Spanish/Latin, German, Russian, and Asian descent. One of the three INS information officers was fluent in Spanish. In one situation, an English-speaking lawyer was referred to a local German bakery where one of the owners could translate the INS information into a language that their client could understand. In other cases, the children of the customers were observed serving as interpreters for their parents. The fixed height of the hole in the plexiglass forced many of the smaller children to stand on tiptoes for their ears to be at the level of the information officer's mouth.

The metal, slotted covers that were once placed over the holes in the plexiglass barrier to reduce air movements between the reception and work areas would further reduce communications between officers and their customers. There is no ampli-fication system in the covers that would boost the signals. It is assumed that this was one of the reasons that they had been removed by the time of the NIOSH site visit.

With respect to IEQ concerns, ventilation and comfort indicators were measured to assess current environmental conditions. Three of the four thermostats located in the areas of concern had been turned off, thus there was no air being supplied to these areas. It is not known how long the thermostats had been off. Because of the relatively mild outdoor air temperatures at the time of the survey (58°F in the morning and 66°F in the afternoon), thermal comfort may have been acceptable to many occupants. However, after the thermostats had been turned on by the NIOSH investigators and set to the cooling mode with continuous fan operation (maintaining the existing temperature set points), complaints of being "too cold" were received from some employees. When compared with the ASHRAE guidelines for thermal comfort, most of the temperature and humidity measurements fell at the far ends of the acceptable ranges recommended for persons dressed in typical winter clothing, and were completely outside the acceptable ranges for persons dressed in typical summer clothing. Thus, it is not surprising that some employees reported thermal comfort complaints.

In addition to providing acceptable thermal comfort, mechanical ventilation systems are intended to provide acceptable indoor air quality by diluting (and removing) general contaminants and odors (bioeffluents). NIOSH investigators mea-sured CO_2 concentrations in the office and waiting areas as an indicator of the adequacy of outdoor air supplied to occupied areas. In the waiting room where there was a high level of occupancy, CO_2 concentrations had risen to almost 3200 ppm by around 9:00 a.m. This CO_2 concentration is well in excess of 800 ppm, the concentration that NIOSH believes should trigger further evaluation of the ventilation system due to suspected inadequate ventilation. Although the CO_2 concen-trations decreased in this and other areas after the thermostats were set to "fan" mode, CO_2 concentrations remained above 800 ppm through-out the evaluated area.

CONCLUSIONS

The acoustical parameters measured during the NIOSH HHE showed that communications are difficult in the work area of the information officers. The ambient noise levels in the reception area are above the criteria developed for occupied spaces where communication is needed.[2] Added to the less than optimal communication space is the finding that the plexiglass barrier and fixed opening reduce the sound levels of peoples' voices, making it more difficult to hear, particularly in the situation where language is an issue between the speaker and the listener. Based on these findings, the INS should initiate action to see that changes are made in the room characteristics and in the way in which communicated information is passed between the officers and the public.

The IEQ evaluation indicates that more attention needs to be paid to the operation and maintenance of the ventilation system, and that the amount of outdoor air delivered to the waiting area should be increased. It is not clear from this limited evaluation to what extent recirculation of air from the waiting area contributed to the elevated CO_2 concentrations in other office areas.

It is generally not good practice to completely turn off the ventilation system in an area even if there is acceptable thermal comfort. This practice can lead to a build-up of contaminants and odors, and can result in air stagnation. This is particularly important in areas where there is a high occupant density, such as in the customer waiting room and reception area. Informal discussions with employees revealed that thermostats were often adjusted or turned off completely, primarily because of feeling "too cold." This suggests that temperature set points should be adjusted. The temperature and humidity levels that NIOSH investigators measured confirmed that the existing set points were not appropriate. ASHRAE guidelines can be used to determine the appropriate temperature set points that will result in minimal occupant dissatisfaction.[20,21] The low humidity levels in this area of the country will need to be considered in selecting appropriate temperature set points for different seasons.

RECOMMENDATIONS

Based on the observations and measurements made during the health hazard evaluation, the following recommendations are made to INS management to improve the conditions in the information officers' work area.

1. The listening conditions in the customer reception area are not conducive to the communication requirements for the space. The ambient noise levels need to be reduced for the public to adequately hear the information the officers are giving them. Because the existing walls and floors are made of relatively hard materials (painted wall board, glass, and floor tiles), sounds generated in the room reflect off of these surfaces. Introduction of softer materials (carpet and draperies) will help to reduce these reflections. Also, much of the interfering noise is generated by the public conversing with the information officers. There is no separation between individual customers so that conversations to the side will disrupt the flow of information. Consideration should be given to adding barriers between each of the three positions. The barriers will have to be long enough and tall enough to block conversations between customers. At a minimum, the walls will have to completely separate the customers from each other to effectively block the sound. Temporary changes to the reception area can be made by INS or the building manager's maintenance staff to see if the recommended changes have a positive effect on the listening conditions in the room. However, an acoustical engineer may need to be consulted for the proper materials and design.

2. The round hole through the plexiglass does not allow for adequate communications. It was observed to be at an incorrect height for several customers and information officers. Since it is impossible to adjust the height of the opening in the plexiglass, it is recommended that an amplification system be installed. A model for the system is the headset/speaker configuration seen in most fast food restaurants. The officers would have their own headset and microphone issued to them. Because hygiene would be an issue for the customers, a speaker/microphone is appropriate rather than a headset or telephone receiver. A system of this type will allow the INS officers to

speak at a normal level without raising their voices and still be heard and understood by the public.

3. To ensure that outdoor air is being supplied to the office and waiting areas during occupied periods, the thermostats should be set to the “fan” mode and to heating or cooling, as appropriate. ASHRAE standard 55-1992, Thermal Environmental Conditions for Human Occupancy, should be used to determine appropriate temperature settings.[20]

4. The amount of outdoor air supplied to the waiting area should be increased. ASHRAE standard 62-1999, Ventilation for Acceptable Indoor Quality, recommends a minimum of 15 cfm of outdoor air per person in reception areas and 20 cfm of outdoor air per person in general office areas.[21] Outdoor air supply rates should be reviewed for other office areas, and supply rates increased if necessary to meet the ASHRAE criteria.

5. Because of the intermittent and variable occupancy in the waiting room, it would be prudent to contact a qualified mechanical engineering firm for advice in selecting appropriate ventilation rates and the advisability of having a separate ventilation system dedicated to this area.

6. The thermostats should be calibrated to ensure accuracy of the readings and the thermal control system should be further evaluated. The 2-3°F temperature flux between demand and satisfied modes shown in Figure 3 may be contributing to thermal comfort complaints. If thermostats are replaced, consideration should be given to purchasing units without an “off” setting. At a minimum, the thermostats should be locked and access minimized to avoid unnecessary tampering.

7. A complete test and balance of the HVAC system should be performed after modifications are made to ensure that the system operates as intended. The test and balance should be performed by a qualified HVAC technician familiar with the system at the INS.

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Table 1
Recommended Space Usage for Balanced Noise Criteria Range in Occupied Indoor Areas
Immigration and Naturalization Service
Salt Lake City, Utah
HETA 99-0320-2791
September 29, 1999

Type of Space and Acoustical Requirements	NCB Curve
Concert halls, opera houses, and recital halls	10 - 15
Large auditoriums, large drama theaters, and large churches	Not to exceed 20
Small auditoriums, small theaters, small churches, music rehearsal rooms, large meeting and conference rooms, and executive offices	Not to exceed 30
Bedrooms, hospitals, residences, apartments, hotels	25 - 40
Private or semi-private offices, small conference rooms, classrooms, libraries	30 - 40
Large offices, reception areas, retail shops and stores, cafeterias, restaurants	35 - 45
Lobbies, laboratory work spaces, drafting and engineering rooms, general secretarial areas	40 - 50
Light maintenance shops, industrial plant control rooms, office and computer equipment rooms, kitchens, and laundries	45 - 55
Shops, garages	50 - 60 *
Work spaces where speech or telephone	55 - 70

* Levels above NCB-60 are not recommended for any office or communication situation.

Table 2
Indoor Environmental Quality Data
Immigration and Naturalization Service
Salt Lake City, Utah
HETA 99-0320-2791
September 29, 1999

Location	Time	Temp (°F)	RH (%)	CO_2 (ppm)[†]	Comments
Public Waiting Rm.	9:03	72.4	40.1	3180	43 people - ventilation system off
	10:10	72.6	33.5	2002	48 people - vent. system on at 9:10a.m.
	11:39	72.0	33.6	1980	
	1:00	72.1	30.9	1375	16 people
	2:00	71.6	29.8	1255	20 people
Room 120	8:58	71.3	26.9	662	private office, 1 person
	9:55	72.5	25.5	820	3 people
	10:55	73.0	23.7	715	
	12:47	68.4	29.6	915	1 person
	1:47	70.8	30.2	1115	3 people
Investigations Area	11:30	72.0	31.8	1485	open work area, thermostat reads 68°
	12:50	69.4	31.4	1080	
	2:02	71.5	29.5	1250	
Records Room	11:32	71.9	27.0	1300	thermostat reads 72°
	12:55	69.4	29.2	860	
	2:05	70.2	28.6	1100	a lot of in-and-out traffic
Computer Room	11:35	68.5	26.9	1102	thermostat reads 64°
	12:55	69.4	29.2	860	
Outside	10:25	58.2	26.9	307	
	1:05	65.8	19.6	311	sunny and breezy

[†] ppm = parts per million

Table 3
Airflow Measurements
Immigration and Naturalization Service
Salt Lake City, Utah
HETA 99-0320-2791
September 29, 1999

Location	Total Supply Air (cfm)[†]	Total Return Air (cfm)
Information Officers Side Reception Area	264	173
Customer Side Reception Area	182	145
Public Waiting Room	645	362
Private Office, Room 120	205	232

[†]cfm = cubic feet per minute

Figure 1

Octave Band Sound Levels
Customer side: center of room

INS - Salt Lake City
HETA 99-0320

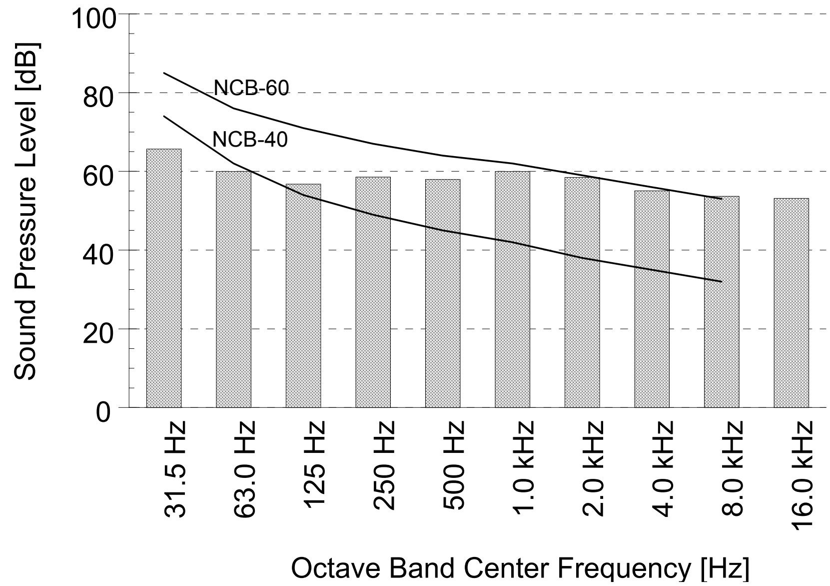


Figure 2

One-third Octave Band Sound Levels
Across plexiglass barrier comparison

INS - Salt Lake City
HETA 99-0320

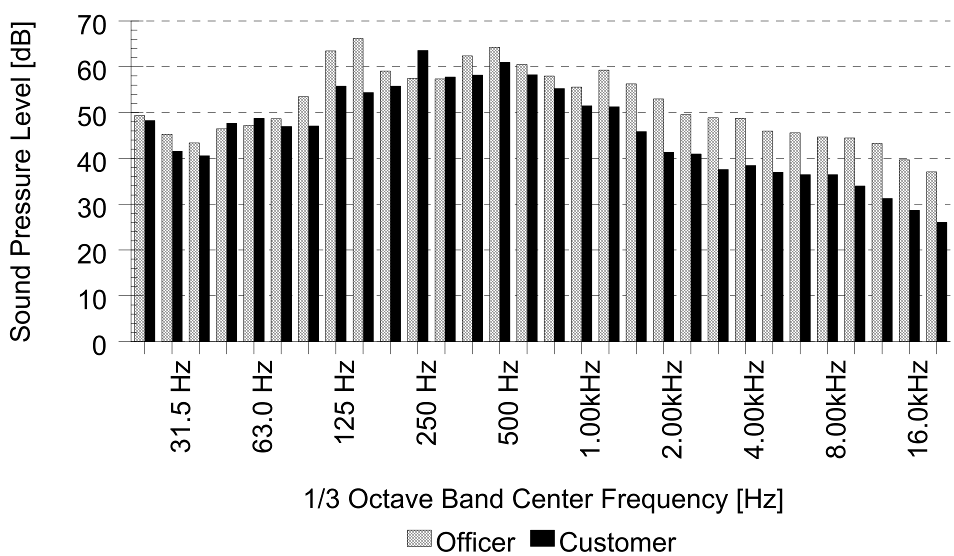


Figure 3 -- Indoor Environmental Quality Data from Information Officer Side Reception Area
HETA 99-0320

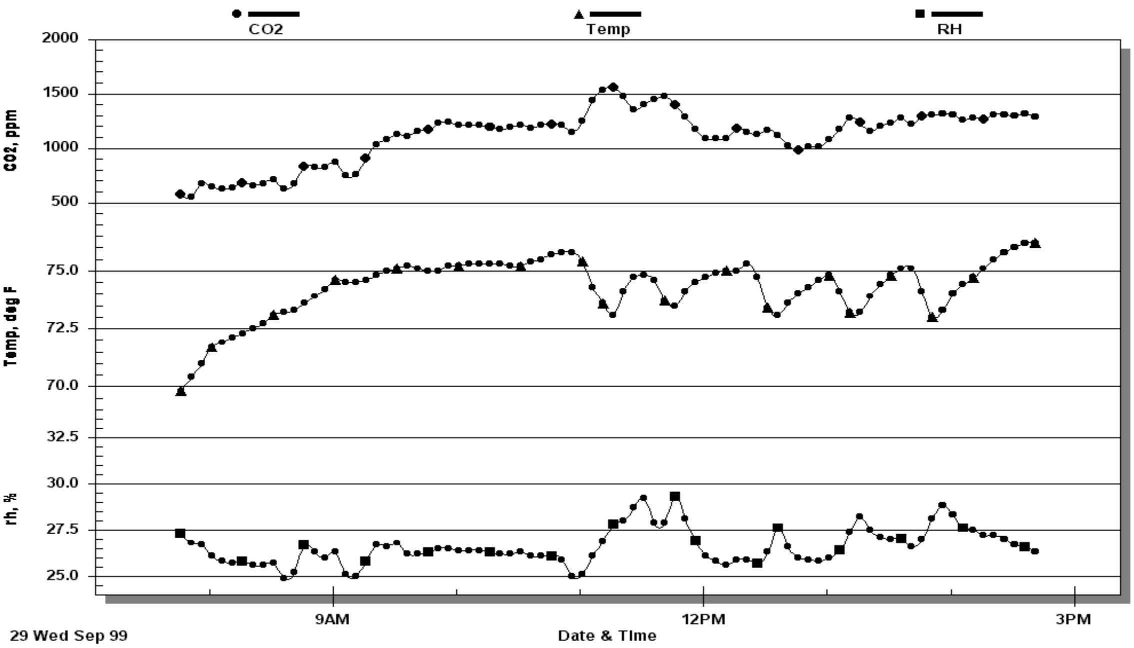
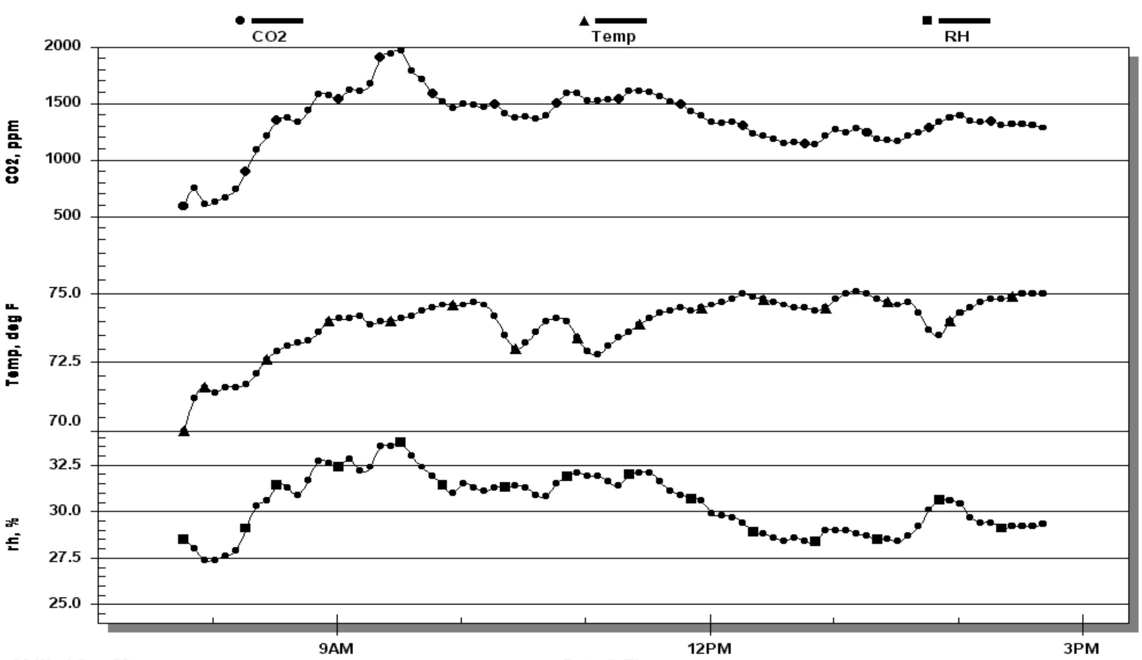


Figure 4 -- Indoor Environmental Quality Data from Customer Side Reception Area
HETA 99-0320



For Information on Other Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Web site at:
www.cdc.gov/niosh

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