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NIOSH

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I. SUMMARY

On November 4-5, 1992, industrial hygienists from the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at the Internal Revenue Service (IRS)-Appeals Office in Omaha, Nebraska in response to a union request to evaluate indoor environmental quality (IEQ) concerns and the asbestos management program.

On November 5, temperature, relative humidity, carbon dioxide (CO_2), and particle counts were made throughout the area three times during the day. The heating, ventilating, and air-conditioning (HVAC) units that serviced the office area were opened and visually examined. Asbestos sampling data were reviewed. Questionnaires were distributed to the 22 employees in the office to obtain information regarding employees' symptoms and perceptions of the building environment.

All of the indoor CO_2 concentrations [range: 450 to 650 ppm] were less than 1000 parts per million (ppm), a guideline suggested by American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Temperature and relative humidity measurements during the site visit were just outside acceptable ranges suggested by ASHRAE. Indoor temperatures ranged from 70.5 to 74.8°F and relative humidities ranged from 25.2 to 28.2% (accepted guideline - 30%). Inside particle counts ranged from approximately 12,000 to 71,000 particles per 0.1 cubic foot (ft^3) of air in the greater or equal to ($\geq$) 0.3 micron range, whereas, particle counts outside ranged from approximately 13,000 to 21,000 particles per 0.1 ft^3 of air in the $\geq$ 0.3 micron range. The ventilation systems seemed well maintained. Smoking was allowed in the IRS Appeals manager's office, in the restrooms on the even numbered floors of the building, and in the cafeteria.

Twenty out of 22 questionnaires were returned and analyzed. The most common environmental concerns were temperature extremes, lack of humidity, and lack of air movement. The four most frequently-reported symptoms were stuffy or runny nose, or sinus congestion; tired or strained eyes; headache; and unusual tiredness, fatigue or drowsiness.

Environmental tobacco smoke (ETS) was identified as a health hazard in this building. The walk-through survey identified open smoking areas, potential sources of dust, and safety hazards. Recommendations for improving the work environment and eliminating ETS in the workplace can be found in Section VIII of this report.

KEYWORDS: SIC 9311 (Public Finance, Taxation, and Monetary Policy), indoor environmental quality, IEQ, carbon dioxide, temperature, relative humidity, asbestos.

II. INTRODUCTION

On November 4-5, 1992, industrial hygienists from the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at the Internal Revenue Service (IRS)-Appeals Office in Omaha, Nebraska. This site visit was made in response to a request from the National Treasury Employees Union to evaluate indoor environmental quality (IEQ) concerns. The request stated that employees were experiencing sore throats, sinus problems, cold-like symptoms, burning eyes, and headaches. The request also expressed concern about asbestos-containing insulation that was being managed in place at the worksite.

III. BACKGROUND

The IRS-Appeals Office is located on the third floor of the Zorinsky Federal Building. The building is 10 stories high with a basement and sub-basement and was completed in 1960. Twenty-five individuals work in the IRS-Appeals office (22 employees were in the office during the site visit). The original office area had been remodelled with the current design in 1974-75. No changes have been made since 1975.

Constant volume ventilation systems service the Appeals Office. Two separate heating, ventilating, and air-conditioning (HVAC) systems (30,000 cubic foot per minute [cfm] exhaust and supply fans for each system) service the perimeter offices. One system supplies the north and east perimeters and the other supplies the south and west perimeters. These units are located on the 10th floor. The minimum outside air supply is set at 10%. The HVAC systems are inspected weekly and the individual perimeter units on the floors are cleaned annually. The two thermostats located in the office area are pre-set by maintenance staff.

The central office area is serviced by a separate recirculating HVAC system located on the third floor. Supply air is provided by an open air plenum powered by two 50,000 cfm fans on the tenth floor. Air is exhausted through an open plenum which is serviced by two 50,000 cfm fans housed on the tenth floor. The exhaust plenum is on a raised portion of the roof and approximately 100 feet away from the outside air intake. Particulate filters (35% efficiency rating) in the outside air intake are on a roller system and are changed once a week. Cooling and heating for all systems are provided by heating and cooling coils. The ventilation systems were designed to work with no humidification sources and run from 5:00 a.m. to 6:00 p.m.

The cleaning staff dusts the furniture and vacuums the floors of the office area in the late morning (approximately 11:00 a.m.). Cleaning of the carpeting on the walls of the two conference rooms is not done on a regular basis. Smoking was allowed in the manager's office of the Appeal's Office, in the restrooms on the even numbered floors of the building, and in the cafeteria.

Insulation, containing asbestos as a fire retardant, had been sprayed on the building structure above the corridor and office suspended ceilings during the building's construction.

IV. EVALUATION DESIGN

Real-time temperature and relative humidity measurements for thermal comfort were made using a LCD Digital Hygrometer (Cole-Parmer Instrument Co.). Real-time carbon dioxide (CO_2) levels were measured using a Gastech Model RI-411A, portable CO_2 meter. Particle counts were collected using a Met One, Inc. Model 227 hand-held particle counter to qualitatively determine the presence of small particles in the different areas of the office for comparison to each other and the outside. To solicit information about indoor environment issues, 22 questionnaires were given out to all members of the staff and management in the office.

Temperature, relative humidity, particulate, and CO_2 measurements were made at 23 locations three times during the day of the site visit to determine changes in these parameters throughout the day. Measurements were taken outside the main entrance and throughout the Appeals Office. A diagram of the Appeals area showing the 23 sample locations is included as Figure 1. Measurements were made at each location between 7:14-7:59 a.m. (beginning of the workshift), 11:10-12:04 p.m., and 4:14-4:57 p.m. (near the end of the workday).

With the assistance of U.S. General Services Administration (GSA) and maintenance personnel, the HVAC units which served the third floor were opened and visually examined for microbial contamination, standing water, position of outside air intake dampers, general cleanliness, and particulate filter condition.

V. EVALUATION CRITERIA

NIOSH investigators have completed over 1100 investigations of the occupational indoor environment in a wide variety of non-industrial settings. The majority of these investigations have been conducted since 1979.

The symptoms and health complaints reported to NIOSH by building occupants have been diverse and usually not suggestive of any particular medical diagnosis or readily associated with a causative agent. A typical spectrum of symptoms has included headaches, unusual fatigue, varying degrees of itching or burning eyes, irritations of the skin, nasal congestion, dry or irritated throats and other respiratory irritations. Typically, the workplace environment has been implicated because workers report that their symptoms lessen or resolve when they leave the building.

A number of published studies have reported high prevalences of symptoms among occupants of office buildings.[2-6] Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building-related occupant complaints.[7,8] Among these factors are imprecisely-defined characteristics of 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.[9-14] Indoor environmental pollutants can arise from either outdoor sources or indoor sources.

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 any measured indoor contaminant or condition.[15-17] Some studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and comfort complaints.[17-20]

Less often, an illness may be found to be specifically related to something in the building environment. Some examples of potentially building-related illnesses are allergic rhinitis, allergic asthma, hypersensitivity pneumonitis, Legionnaires' disease, Pontiac fever, carbon monoxide poisoning, and reaction to boiler corrosion inhibitors. The first three conditions can be caused by various microorganisms or other organic material. Legionnaires' disease and Pontiac fever are caused by *Legionella* bacteria. Sources of carbon monoxide include vehicle exhaust and inadequately ventilated kerosene heaters or other fuel-burning appliances. Exposure to boiler additives can occur if boiler steam is used for humidification or is released by accident.

Problems NIOSH investigators have found in the non-industrial indoor environment have included poor air quality due to ventilation system deficiencies, overcrowding, volatile organic chemicals from furnishings, 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 conditions, poor lighting, and unacceptable noise levels; adverse ergonomic conditions; and job-related psychosocial stressors. In most cases, however, these problems could not be directly linked to the reported health effects.

Standards specifically for the non-industrial indoor environment do not exist. NIOSH, the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have published regulatory standards or recommended limits for occupational exposures.[21-23] With few exceptions, pollutant concentrations observed in non-industrial indoor environments fall well below these published occupational standards or recommended exposure limits. ASHRAE has published recommended building ventilation design criteria and thermal comfort guidelines.[24,25] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related complaints that might be caused by airborne living organisms or their effluents.[26]

Measurement of indoor environmental contaminants has rarely proved to be helpful in determining the cause of symptoms and complaints except where there are strong or unusual sources, or a proven relationship between contaminants and specific building-related illnesses. The low-level concentrations of particles and variable mixtures of organic materials usually found are difficult to interpret and usually impossible to causally link to observed and reported health symptoms. However, measuring ventilation and comfort indicators such as CO_2, temperature and relative humidity, has proven useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems.

NIOSH and the Environmental Protection Agency (EPA) jointly published a manual on building air quality, written to help prevent environmental problems in buildings and solve problems when they occur.[27] This manual suggests that IEQ is a constantly-changing interaction of a complex set of factors. Four of the most

important elements involved in the development of IEQ problems are: 1) a source of odors or contaminants; 2) a problem with the design or operation of the HVAC system; 3) a pathway between the contaminant source and the location of the complaint; 4) and the building occupants. A basic understanding of these factors is critical to preventing, investigating, and resolving IEQ problems.

The basis for measurements made during this evaluation are listed below.

1. Carbon Dioxide

   CO_2 is a normal constituent of exhaled breath and, if monitored, may be useful as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. The ANSI/ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, 15 cfm/person for reception areas, and 60 cfm/person for smoking lounges, and provides estimated maximum occupancy figures for each area.[24]

   Indoor CO_2 concentrations are normally higher than the generally-constant ambient CO_2 concentration (range 300-350 ppm). When indoor CO_2 concentrations exceed 1000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased.

2. Temperature and Relative Humidity

   The perception of comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. ANSI/ASHRAE Standard 55-1981 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally comfortable.[25]

3. Asbestos

   NIOSH recommends as a goal the elimination of asbestos exposure in the workplace; where it cannot be eliminated, the occupational exposure should be limited to the lowest possible concentration.[28] This recommendation is based on the proven carcinogenicity of asbestos in humans and on the absence of a known safe threshold concentration.

   NIOSH contends that there is no safe concentration for asbestos exposure. Virtually all studies of workers exposed to asbestos have demonstrated an excess of asbestos-related disease. NIOSH investigators therefore believe that any detectable concentration of asbestos in the workplace warrants further evaluation and, if necessary, the implementation of measures to reduce exposures. The OSHA PEL for asbestos limits exposure to 0.2 fibers/cc as an 8-hour TWA.[22]

VI. RESULTS

A. Environmental

The results of the environmental evaluation are presented in Table 1. All of the indoor CO_2 concentrations (range: 450 to 650 ppm) were lower than 1000 ppm, a guideline suggested by ASHRAE. Outdoor CO_2 concentrations ranged between 350 to 425 ppm. Indoor temperatures ranged from 70.5 to 74.8°F across all areas measured throughout the day. Outside temperatures were approximately 33°F (with snow flurries). Relative humidities inside the building ranged from 25.2 to 28.2%. Outside relative humidities ranged from 48 to 56.6%. Particle counts inside ranged from approximately 12,000 to 71,000 particles per 0.1 cubic foot (ft^3) of air in the $\geq$ 0.3 micron range and outdoor particle counts outside ranged from approximately 13,000 to 21,000 particles per 0.1 ft^3 of air in the $\geq$ 0.3 micron range.

The temperature and relative humidity pairings were just outside the acceptable ranges of operative temperature and humidity suggested by ASHRAE, as shown in Figure 2.[25] In general, the range of humidity levels recommended in the guidelines are 30% to 60%. Relative humidities below 30% may produce discomfort from dryness but low humidities also help restrict microbiological growth, therefore, the concerns over discomfort should be balanced against the risk of increased microbiological growth associated with humidification. In general, if temperatures are maintained between 68 to 70°F during the heating seasons, the relative humidity will be approximately 30%.[27] The temperature and relative humidity remained stable during the workday throughout the work areas.

The particle counts were similar inside and outside the building, except in the office where smoking was allowed and in the adjoining spaces to that office. Higher particle counts are typically found in smoking areas.

The air handling units appeared to be well maintained. However, the third floor HVAC system had exposed fiberglass insulation material. The outside air dampers were open and there was no visible water or microbial growth in the condensate pans. During the walkthrough, it was observed that one of the water drains on the roof was open, creating a potential safety hazard. It was also observed that the ceiling tiles around the supply grills were dirty and the curtains hanging over the perimeter units were discolored along the edges. The artificial and dried flower planters and wall and floor carpeting were potential sources of dust due to the visible dust accumulation which may be disturbed by occupant activities.

Review of industrial hygiene sampling data provided by GSA showed the presence of 3-10% chyrsotile (a form of asbestos fiber) in bulk samples of insulation material [1990 data] and no detectable levels of asbestos fibers in the office areas at the analytical limit of detection of 0.004 fibers per cubic centimeter of air [according to NIOSH analytical method 7400[1]] (1992 data).

B. Questionnaires

Twenty out of 22 questionnaires (91%) were returned and analyzed. The average age of the respondents was 45 years (range: 28-62). The population was 45% male (9/20) and 55% female (11/20). Ten individuals (50%) had never smoked; seven (35%) were former smokers; and three (15%) were current smokers. Nineteen individuals wore glasses and/or contacts.

A list of the self-reported symptoms that were perceived to be related to the building in the four weeks prior to the survey are given in Table 2. The most frequently reported symptoms were: stuffy or runny nose, or sinus congestion (16/20-80%); tired or strained eyes (14/20-70%); headache (12/20-60%); unusual tiredness, fatigue or drowsiness (11/20-55%); and dry, itching, or irritated eyes (10/20-50%). One individual reported their stuffy nose/sinus congestion had worsened in the last four weeks. The other respondents reported that their symptoms either stayed the same or improved during the four week time frame.

On the day of the survey, the following symptoms were reported by the respondents: stuffy or runny nose, or sinus congestion (10/20-50%); dry, itching, or irritated eyes (7/20-35%); headache (6/20-30%); tired or strained eyes (6/20-30%); cough (3/20-15%); dry throat (3/20-15%); unusual tiredness, fatigue, or drowsiness (2/20-10%); chest tightness (2/20-10%); difficulty remembering things or concentrating (1/20-5%); and sore throat (1/20-5%).

Occupant perceptions of environmental conditions over the past four weeks were solicited (Table 3). The most common problems reported were: temperature too cold (19/20-95%); air too dry (15/20-75%); temperature too hot (11/20-55%); and too little air movement (9/20-45%). Photocopiers, laser printers, and facsimile (FAX) machines were frequently used by staff. Employees reported a solar heat loading problem on the east side.

VII. DISCUSSION/CONCLUSIONS

Environmental tobacco smoke (ETS) was identified as a health hazard at this facility. Smoking was allowed in the manager's office, in the restrooms on the even numbered floors of the building, and in the cafeteria. NIOSH considers ETS to be a potential occupational carcinogen and recommends exposure be reduced to the lowest feasible concentration, either by eliminating smoking or restricting it to dedicated rooms ventilated directly to the outside. Recent epidemiologic studies have found that ETS can cause lung cancer and suggest a possible association between ETS and an increased risk of heart disease in non-smokers.[28]

All of the indoor CO_2 concentrations were lower than 1000 ppm, a guideline suggested by ASHRAE. The CO_2 measurements suggested that the work areas were receiving adequate amounts of outside air on the day of the survey. The temperature and relative humidity measurements taken during the site visit were just outside the acceptable ranges of operative temperature and humidity suggested by ASHRAE. Relative humidities below 30% may produce discomfort from dryness but low humidities also help restrict microbiological growth, an issue which should be taken into consideration.

Higher qualitative particle counts were obtained in the office and surrounding area where smoking was permitted than in the other office spaces or outdoors, the most probable source was tobacco smoke. The HVAC systems that were examined were clean of visible microbiological contamination and standing water, and appeared to be well maintained. The GSA environmental sampling data for asbestos indicated that no asbestos fibers were entering the office areas at the time of the sampling.

The most common occupant concerns regarding indoor environmental quality were temperature extremes, lack of humidity, and lack of air movement. The four most-frequently self-reported symptoms were stuffy or runny nose, or sinus congestion; tired or strained eyes; headache; and unusual tiredness, fatigue or drowsiness.

VIII. RECOMMENDATIONS

1) Smoking should not be allowed in the work environment. If that is not possible, a separate smoking area should be designed to meet the current ASHRAE guidelines of negative pressure to the rest of the building, 60 cfm of supply air per person, and direct exhaust to the outside to prevent smoke from entering the ventilation system.[24] Suggestions to eliminate or restrict smoking in the workplace are found in the NIOSH "Current Intelligence Bulletin 54: Environmental Tobacco Smoke in the Workplace: Lung Cancer and Other Health Effects."[29]

2) To remove fine dust particles from the air supplied to offices (as seen from visible accumulation of material on the ceiling tiles near supply diffusers and curtains), the possibility of increasing filter efficiency for the ventilation system should be explored. It should be noted that the static pressure drop across the filters should be matched to system fan requirements. A firm specializing in HVAC units should be consulted to determine the maximum filter efficiency the system can handle.

3) To reduce the dust level in the office areas, more efficient cleaning of the carpeting on the floor and walls should be undertaken with a more powerful vacuum and the artificial and dried planters should be either cleaned or removed. The draperies and carpeting should be dry cleaned on a regular basis.

4) Dirty ceiling tiles should be replaced to prevent possible microbial growth, using appropriate asbestos containment techniques.[30]

5) The asbestos management program should continue with routine monitoring to make sure airborne asbestos fibers are not entering the workspace.

6) The open drain hole on the roof should be covered.

7) The missing grill work on the diffusers should be replaced.

8) The exposed fiberglass in the third floor HVAC system should be covered to prevent fraying.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. IRS - Appeals Office, Zorinsky Federal Building
2. National Treasury Employees Union
3. GSA Office, Zorinsky Federal Building
4. OSHA, Region II

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

Table 2

Symptoms Associated with Workplace
IRS - Appeals Office, Zorinsky Federal Building
Omaha, Nebraska
November 5, 1992

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Symptoms	Experienced in the Past 4 Weeks	
	YES	NO
Dry, Itching, or Irritated Eyes	10 (50%)	9 (45%)
Wheezing	1 (5%)	19 (95%)
Headache	12 (60%)	6 (30%)
Sore Throat	6 (30%)	12 (60%)
Unusual Tiredness, Fatigue, or Drowsiness	11 (55%)	8 (40%)
Chest Tightness	4 (20%)	15 (75%)
Stuffy or Runny Nose, or Sinus Congestion	16 (80%)	4 (20%)
Cough	7 (35%)	12 (60%)
Tired or Strained Eyes	14 (70%)	5 (25%)
Difficulty Remembering Things or Concentrating	8 (40%)	11 (55%)
Dry Throat	5 (25%)	14 (70%)
Dizziness or Lightheadedness	6 (30%)	13 (65%)
Shortness of Breath	1 (5%)	18 (90%)

Table 3

Workplace Conditions
IRS - Appeals Office, Zorinsky Federal Building
Omaha, Nebraska
November 5, 1992

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Workplace Conditions	Experienced in the Past 4 Weeks	
	YES	NO
Too much air movement	1 (5%)	19 (95%)
Too little air movement	9 (45%)	11 (55%)
Temperature too hot	11 (55%)	9 (45%)
Temperature too cold	19 (95%)	1 (5%)
Air too humid	1 (5%)	19 (95%)
Air too dry	15 (75%)	5 (25%)
Tobacco smoke odors	4 (20%)	15 (75%)
Chemical odors	2 (10%)	17 (85%)
Other unpleasant odors	5 (25%)	15 (75%)

Table 1

Indoor Air Quality Data
IRS - Appeals Office, Zorinsky Federal Building
Omaha, Nebraska
November 5, 1992

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Location	Time	CO_2 (ppm)	Temp (°F)	RH (%)	Particle Count (≥0.3 µm)*	No. of Occupants
Third Floor:						
Manager's	7:14	575	73.7	26.0	71000	0
Office	11:10	575	73.1	27.3	52000	2
SE Corner - 1	4:45	525	72.3	26.1	18000	1
First Office - 2	7:17	525	72.1	26.6	34000	0
	11:11	575	71.5	28.2	25000	0
	4:14	525	72.0	26.2	25000	0
Second Office - 3	7:15	525	73.5	25.9	42000	0
	11:12	575	71.5	28.2	19000	1
	4:16	575	70.8	27.1	17000	1
Secretarial	7:20	575	71.7	27.0	27000	0
Office - 4	11:14	575	72.2	27.6	18000	1
	4:12	525	73.7	25.6	62000	0
Open Reception	7:22	525	73.4	27.0	25000	1
Area - 5	11:16	550	73.9	26.8	15000	2
	4:17	525	72.1	26.3	16000	2
Window	7:25	575	73.3	27.0	23000	1
Cubicle - 6	11:18	525	73.5	26.7	15000	0
	4:18	525	72.4	26.0	15000	0
Window	7:26	550	72.4	27.4	18000	0
Cubicle - 7	11:20	550	72.4	27.2	14000	1
	4:19	500	72.0	26.1	14000	0
Window	7:28	550	72.1	27.3	18000	1
Cubicle - 8	11:21	575	72.1	27.2	15000	1
	4:23	500	71.0	26.6	14000	1
Window	7:30	575	71.8	29.4	18000	1
Cubicle - 9	11:22	550	71.6	27.4	14000	1

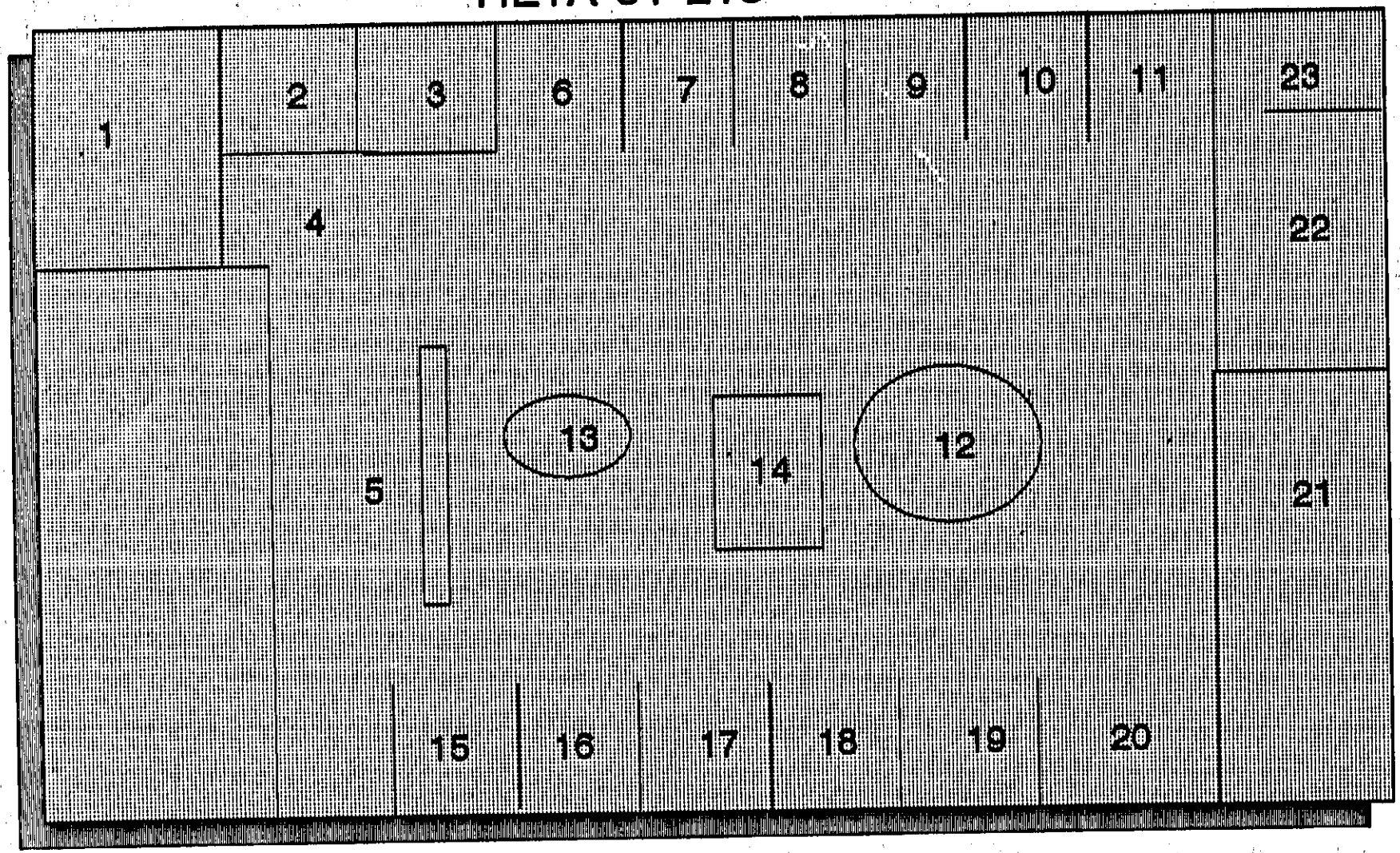
	4:21	500	71.1	26.4	16000	0Table 1 (continued) Indoor Air Quality Data IRS - Appeals Office, Zorinsky Federal Building Omaha, Nebraska November 5, 1992 HETA 91-215
Location	Time	CO_2 (ppm)	Temp (°F)	RH (%)	Particle Count (≥0.3 µm)*	No. of Occupants
Third Floor:						
Window	7:31	575	71.7	26.9	16000	1
Cubicle - 10	11:24	550	71.0	27.8	17000	1
	4:25	500	70.9	26.6	12000	0
Window	7:32	550	71.7	27.4	28000	0
Cubicle - 11	11:25	550	71.2	27.6	15000	0
	4:27	500	70.5	26.9	12000	0
Large Conference	7:34	575	72.0	27.2	16000	0
Room - 12	11:26	550	71.4	27.4	14000	0
	4:28	500	70.9	26.6	12000	0
Small Conference	7:36	550	72.6	26.8	15000	0
Room - 13	11:30	550	72.8	27.1	14000	0
	4:31	500	72.4	26.4	13000	0
Central Clerk	7:38	525	72.7	26.6	16000	0
Area -14	11:28	575	72.4	26.9	13000	0
	4:29	500	71.7	26.0	14000	0
Wall Cubicle - 15	7:40	550	73.2	26.4	16000	0
	11:32	550	73.5	26.6	13000	1
	4:33	475	72.9	26.1	14000	0
Wall Cubicle - 16	7:42	575	73.5	26.3	16000	0
	11:34	550	74.0	26.2	12000	0
	4:34	475	73.6	26.0	14000	0
Wall Cubicle - 17	7:44	650	73.4	26.9	16000	2
	11:50	600	74.2	25.9	18000	2
	4:35	475	73.6	25.2	13000	0
Wall Cubicle - 18	7:45	575	73.7	26.5	18000	1
	11:59	525	73.6	26.3	-----	1

	4:36	475	73.8	25.5	14000	0Table 1 (continued) Indoor Air Quality Data IRS - Appeals Office, Zorinsky Federal Building Omaha, Nebraska November 5, 1992 HETA 91-215
Location	Time	CO_2 (ppm)	Temp (°F)	RH (%)	Particle Count (≥0.3 µm)*	No. of Occupants
Third Floor:						
Wall Cubicle - 19	7:46	600	73.9	26.3	16000	1
	11:52	525	74.4	25.7	13000	0
	4:38	475	74.0	25.9	15000	0
Double Office - 20	7:48	575	74.2	26.6	16000	1
	11:54	525	74.3	26.0	13000	0
	4:40	500	74.0	25.7	13000	0
Supply Area - 21	7:50	575	74.4	27.7	17000	3
	11:55	525	74.5	26.4	19000	0
	4:41	450	74.3	25.2	13000	0
Central	7:51	550	74.4	25.7	19000	0
Records - 22	11:56	525	74.8	25.7	13000	2
	4:42	475	74.7	24.7	13000	0
Central Records-	7:53	575	73.7	26.5	16000	0
Office - 23	11:58	525	74.0	26.2	11000	1
	4:45	475	73.4	25.7	14000	0
Outside	7:59	425	33.7	56.6	21000	0
	12:04	350	33.9	48.0	13000	0
	4:57	350	33.4	52.0	--------	0

* - µm - microns per 0.1 cubic foot of air

Figure 1

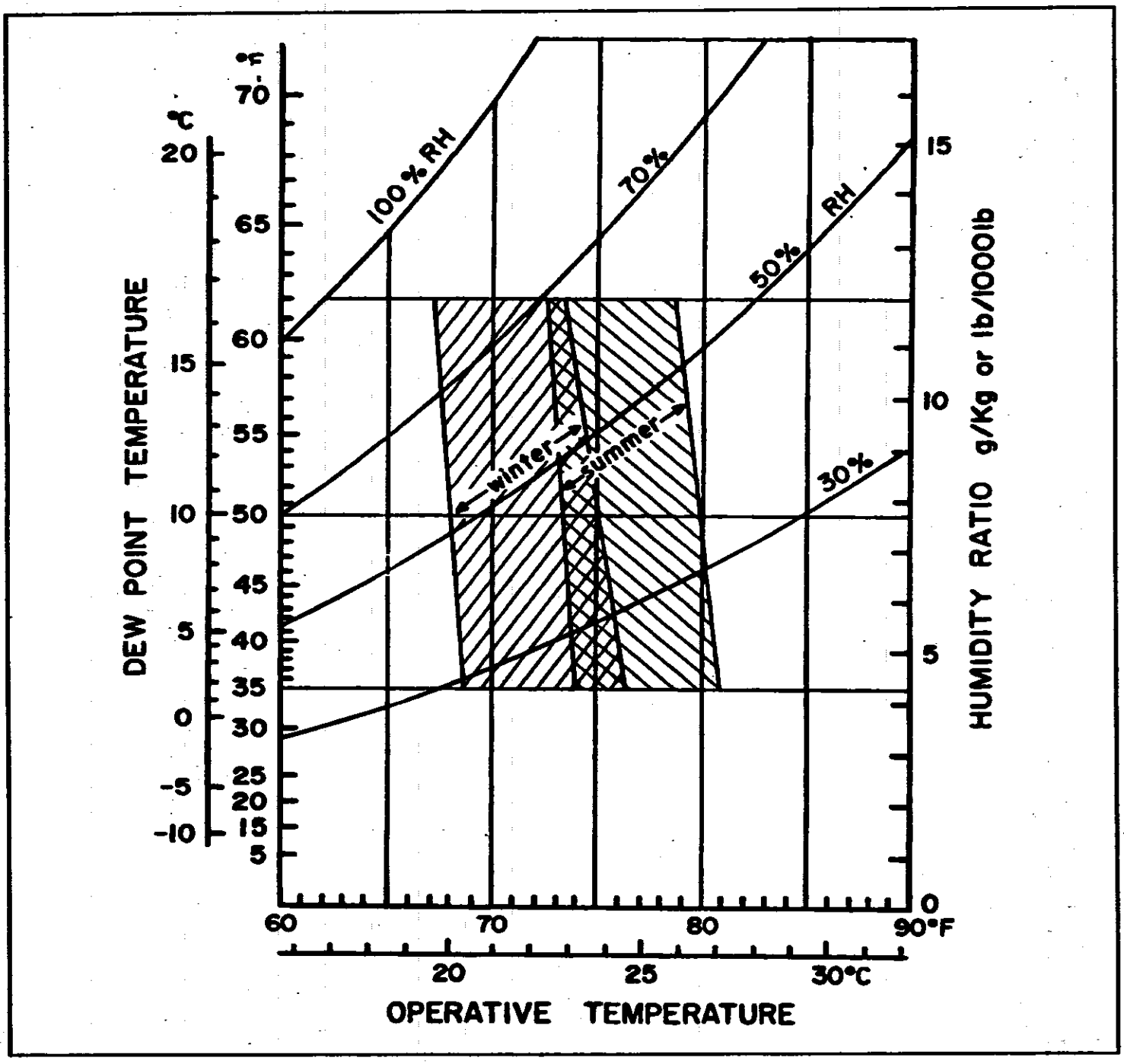
IRS Appeals Floor Plan
Omaha, NE
HETA 91-215



Sampling Sites

Figure 2

IRS Appeals
Omaha, NE
HETA 91-215



Acceptable ranges of operative temperature and humidity for persons clothed in typical summer and winter clothing, at light, mainly sedentary, activity.

Figure courtesy of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Thermal Environmental Conditions for Human Occupancy (55-1981).

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