HETA 96-0120-2608
Acton Post Office
Acton, Massachusetts

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PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, 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 the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by David C. Sylvain, M.S., CIH, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing by Pat Lovell.

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Health Hazard Evaluation Report 96-0120-2608
Acton Post Office
Acton, Massachusetts
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SUMMARY

In March 1996, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request to evaluate exposure to airborne formaldehyde at the U.S. Post Office in Acton, Massachusetts. The request indicated that employees reported eye and upper respiratory irritation while in the building. Air sampling conducted by an environmental consultant on August 23, 1995, revealed formaldehyde concentrations of 0.2 and 0.38 parts per million (ppm) in two offices. The consultant's report provided no indication of the source of formaldehyde.

NIOSH conducted an initial site visit on April 23, 1996, which included a walk-through inspection, and an opening conference with management and union representatives. Air sampling for formaldehyde was conducted during a subsequent site visit on June 20, 1996. Bulk samples of floor wax and hand cleaner were also obtained at this time.

The results of personal breathing zone (PBZ) air sampling revealed formaldehyde concentrations below 0.02 parts per million (ppm). Area sampling, using a more sensitive sampling and analytical method, indicated formaldehyde concentrations of approximately 0.01 ppm in all area samples. Analysis of the floor wax bulk sample indicated a formaldehyde content of 0.41%. The hand cleaner could not be successfully analyzed due to a color interference.

Although air sampling conducted during the HHE revealed formaldehyde concentrations that were well below levels which commonly result in irritation, the floor wax appears to be a possible source of airborne formaldehyde

Formaldehyde concentrations on the sampling date were well below levels which commonly cause eye and upper respiratory irritation. However, previous use of the formaldehyde-containing floor wax in the workroom was a likely source of formaldehyde, and may have been the source of formaldehyde measured by a consultant in August 1995. Concentrations measured at that time (0.2 and 0.38 ppm) would be sufficient to cause eye and upper respiratory irritation in some individuals.

Keywords: SIC 4311 (United States Postal Service), cleaning products, eye and upper respiratory irritation, floor finish compound, formaldehyde, indoor environmental quality.

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INTRODUCTION

In March 1996, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from management at the U.S. Postal Service Middlesex-Central District Office, to evaluate exposure to airborne formaldehyde at the U.S. Post Office in Acton, Massachusetts. The request indicated that employees reported eye and upper respiratory irritation while in the building. Air sampling conducted by a consultant on August 23, 1995, revealed formaldehyde concentrations of 0.2 and 0.38 parts per million (ppm) in two offices. The consultant's report provided no indication of the source of the formaldehyde.

NIOSH conducted an initial site visit on April 23, 1996, which included an opening conference with management and union representatives, and a walk-through inspection of the building. Air sampling for formaldehyde was conducted during a subsequent site visit on June 20, 1996.

BACKGROUND

The Acton Post Office was constructed approximately six years ago in a suburban area. It consists of a large, open work area where mail is sorted for delivery (the "workroom"); several small (one or two person) offices, and a lobby with customer service windows. The main workroom area is approximately 116 feet long by 58 feet wide, with a 21 foot high ceiling. An 18 by 52 foot section of the workroom is partially separated from the main area by the postal inspectors' viewing gallery which extends down from the ceiling. The workroom is adjacent to the customer service area and offices.

Mail is manually sorted in "cases," which are two or three sided metal units with vertically divided shelves. The cases measure approximately 5½ feet wide, 5½ deep, and 6 feet in height. Newsprint and other bulk mail is kept on the workroom floor until it is sorted and delivered. The amount of mail that moves through the post office was reported to vary throughout the week, with lightest volumes on Wednesday, and heaviest on Friday. Postal staff reported that newsprint comprises the largest part of the mail stream. Of the approximately 60 clerks and carriers who are employed at the post office, 15 to 20 remain in the building throughout the day. Carriers typically remain in the building for several hours in the morning while preparing mail for delivery.

METHODS

On April 23, 1996, a walk-through inspection of the building was conducted to assess potential sources of formaldehyde or other contaminants which could contribute to reports of eye and upper respiratory irritation. The walk-through inspection included all building areas, as well as the rooftop heating, ventilating, and air conditioning (HVAC) units.

On June 20, 1996, four personal breathing zone (PBZ), and four area air samples were collected to evaluate employee exposures to formaldehyde. Each PBZ sample was collected using a battery-powered sampling pump to draw air through a midget impinger containing 20 milliliters of one percent sodium bisulfite solution. The pumps were operated at a nominal flow rate of 0.275 liters per minute (lpm), and were calibrated before and after sampling to ensure that the desired flow rate was maintained throughout the sampling period. PBZ samples were analyzed for formaldehyde by visible spectroscopy according to NIOSH Method 3500 (NIOSH Manual of Analytic Methods, Fourth Edition, August 15, 1994).

Each of the four area air samples was collected using a battery-powered sampling pump to draw air through a solid sorbent tube (treated XAD-2) at a nominal flow rate of 0.075 lpm. Area samples were analyzed for formaldehyde by gas chromatography according to NIOSH Method 2541 (modified).

Material safety data sheets (MSDSs) were reviewed, and cleaning supplies were inspected to determine if any of the products used in the post office contained formaldehyde. Bulk samples of products which contained formaldehyde (floor wax and hand cleaner) were collected. The samples were analyzed for formaldehyde by visible spectroscopy according to NIOSH Method 3500, modified for analysis of bulk samples.

In addition to air and bulk sampling, indicators of occupant comfort were measured: carbon dioxide (CO_2), temperature (T), and relative humidity (RH). Real-time measurements of CO_2 were obtained using a Gastech Model RI-411A, portable CO_2 indicator. This portable, battery-operated instrument uses a non-dispersive infrared absorption detector to measure CO_2 in the range of 0-4975 ppm, with a sensitivity of ±25 ppm. Instrument zeroing and calibration were performed prior to use with zero air and a known concentration of CO_2 span gas (800 ppm). Real-time temperature and humidity measurements were made using a Model 8360 VelociCalc® Plus Air Velocity Meter. The VelociCalc® meter provides relative humidity and dry bulb readings ranging within an operational range of 40°F to 113°F, and 20% to 95% RH.

EVALUATION CRITERIA

Workplace Exposures

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment 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. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

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, OSHA Permissible Exposure Limits (PELs)[3]. In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards; however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8-to-10-hour workday. Some substances have recommended short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Formaldehyde

Formaldehyde and other aldehydes may be released from foam plastics, carbonless copy paper, particle board, and plywood. Formaldehyde is a constituent of tobacco smoke and of combustion gases from heating stoves and gas appliances. This chemical has also been used in the fabric and clothing industry to impart permanent press characteristics, in the manufacturer of some cosmetics, and in disinfectants and fumigants. Formaldehyde in ambient air can result from diverse sources such as automobile exhaust, combustion processes, and certain industrial activities such as the production of resins.

Exposure to low concentrations of formaldehyde may result in irritation of the eyes, nose, and throat; headaches, nausea, nasal congestion, skin rashes, and asthma-like symptoms. It is often difficult to ascribe reports of symptoms to specific concentrations of formaldehyde because people vary in their subjective responses and complaints. For example, eye irritation may occur in people exposed to formaldehyde at concentrations below 0.1 ppm. Upper airway irritation may occur at 0.1 ppm, but more typically begins at exposures of 1.0 ppm and greater.[4] Some children or elderly persons, those with pre-existing allergies or respiratory disease, and persons who have become sensitized from prior exposure may have symptoms from exposure to concentrations of formaldehyde between 0.05 and 0.10 ppm. Cases of formaldehyde-induced asthma and bronchial hyperreactivity developed specially to formaldehyde are uncommon.[5]

In two studies, formaldehyde induced a rare form of nasal cancer in rodents. Formaldehyde exposure has been identified as a possible causative factor in cancer of the upper respiratory tract in a proportionate mortality study of workers in the garment industry.[6] NIOSH and ACGIH have designated formaldehyde as a suspected human carcinogen and recommend that exposure be reduced to the lowest feasible concentration.[1,4] NIOSH has established the REL for formaldehyde at the lowest concentrations that can be reliably quantified: 0.016 ppm for up to a 10-hour TWA exposure, and 0.1 ppm as a 15-minute ceiling concentration. ACGIH has set the TLV for formaldehyde at 0.3 ppm as ceiling limit. The TLV is intended to reduce worker reports of sensory irritation.[4]

The OSHA general industry formaldehyde standard (29 CFR 1910.1048), sets the PEL for airborne exposure to formaldehyde at 0.75 ppm as an 8-hour TWA and 2 ppm as a STEL. The standard specifies requirements for exposure monitoring, medical surveillance, hazard communication, housekeeping, and recordkeeping. In addition, the OSHA standard requires that workers be informed that formaldehyde is a potential cancer hazard.

Indoor Environmental Quality

A number of published studies have reported a high prevalence of symptoms among occupants of office buildings.[7,8,9] NIOSH investigators have completed over 1200 investigations of the indoor environment in a wide variety of settings. The majority of these investigations have been conducted since 1979.

The symptoms reported 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.

Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building–related occupant complaints.[10,11] 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.[7,8,9,10] Reports are not conclusive as to whether increases of outdoor air above currently recommended amounts ($\geq$15 cubic feet per minute per person) are beneficial.[12] However, rates lower than these amounts appear to increase the rates of complaints and symptoms in some studies.[13] 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 outdoor or indoor sources.[14]

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.[15] Some studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and comfort complaints.[16,17]

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 that 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 office 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, no cause of the reported health effects could be determined.

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.[18,19,20] With few exceptions, pollutant concentrations observed in the office work environment fall well below these published occupational standards or recommended exposure limits. The ASHRAE has published recommended building ventilation design criteria and thermal comfort guidelines.[21,22] 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.[23]

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 relative humidity (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 62-1989, 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 15 cfm/person for reception areas, classrooms, libraries, auditoriums, and corridors.[22] 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 ppm). Carbon dioxide concentration is used as an indicator of the adequacy of outside air supplied to occupied areas. 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. 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.[21] 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 ranges is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained between 30 and 60% RH.[21] Excessive humidities can support the growth of microorganisms, some of which may be pathogenic or allergenic.

RESULTS

The results of personal breathing zone (PBZ) air sampling conducted on June 20, 1996, are presented in Table 1. The results of PBZ sampling were below the minimum detectable concentration (MDC). The MDC for personal samples collected in the bulk mail room and customer service window was 0.01 parts of formaldehyde per million parts air (ppm). The MDC for personal sampling conducted in the Administrative Office and on the workroom floor was 0.02 ppm.

A more sensitive sampling and analytical method was used to collect area air samples. However, due to low airborne formaldehyde concentration, only a semi-quantitative estimate of formaldehyde concentration could be made. Approximately 0.01 ppm was detected in all area samples (Table 2).

Analysis of a floor wax bulk sample indicated that this product contains 0.41% formaldehyde. Formaldehyde in the bulk sample of "Tuf-Scrub" hand cleaner could not be determined due to a color interference.

Environmental measurements of temperature, relative humidity, and carbon dioxide are presented in Table 3. Twelve measurements were made at six locations throughout the post office. Carbon dioxide concentrations ranged from 475 to 725 ppm. The highest indoor concentration was measured during the morning in the workroom while carriers were preparing mail for delivery. Temperatures ranged from 68.5°F in the Carrier Supervisor's Office, to 73°F in the Administrative Office and bulk mail room. Relative humidity readings were between 56% and 61%. The ambient (outdoor) CO_2 concentration was 350 to 375 ppm, with an ambient temperature range of 64°F to 72 °F. The relative humidity was 64% at the time of the morning and afternoon measurements.

DISCUSSION

Air sampling revealed formaldehyde concentrations that were well below levels expected to result in irritation. However, floor wax used in the workroom is a possible source of the formaldehyde measured during a previous evaluation by an environmental consultant. Analysis determined that this particular wax contains 0.41% formaldehyde, which is the equivalent of approximately 0.52 ounces of formaldehyde per gallon of wax. At this concentration, each gallon of floor wax contains sufficient formaldehyde to generate more than 2 ppm in an enclosure having the approximate volume of the workroom (estimated at 160,000 ft^3). The actual airborne formaldehyde concentration resulting from the use of this product would depend on a number of variables, including the extent of the surface area (workroom floor area) where the product is used, the quantity applied, the time of use relative to building occupancy, the air exchange rate in the workroom, etc. Nevertheless, it appears that the use of this product could generate significant airborne concentrations of formaldehyde. In addition, floor finish compounds may release other volatile organic compounds that can contribute to occupant discomfort.

Formaldehyde levels of 0.2 and 0.38 ppm, which were measured by the consultant, are high enough to cause irritative symptoms in some individuals. The consultant's report misleadingly states that the sampling results "were found to be within acceptable ranges for a work environment." The report assessed formaldehyde levels in terms of the OSHA PEL, which is not an appropriate criteria for evaluating indoor air quality complaints in a non-industrial workplace. (The report incorrectly noted the OSHA PEL for formaldehyde as 1 ppm.) As discussed above, air sampling for specific contaminants is not usually an effective means of evaluating indoor air quality; however, when air sampling is performed, results must be compared to appropriate evaluation criteria. In this case, sampling was conducted for a wide range of possible contaminants, and none of the results proved useful in identifying the possible source of employee complaints.

Formaldehyde was listed as an ingredient on containers of "Tuf-Scrub" hand cleaner located in the storage room. Although formaldehyde was listed on the containers, the MSDS for this product did not identify formaldehyde as a constituent. Since formaldehyde is used as a preservative in shampoos and, presumably, other similar products, it is likely that low concentrations of formaldehyde are present in the hand cleaner.

Figure 1 presents acceptable thermal environmental conditions as prescribed in ANSI/ASHRAE Standard 55-1992. The temperature, relative humidity, and CO_2 measurements that were recorded during the sampling visit did not reveal any environmental deficiencies with respect to ANSI/ASHRAE guidelines. As expected, the CO_2 readings were higher in the morning when mail carriers were in the building preparing deliveries. The lower afternoon readings, and readings taken in unoccupied offices, reflect a decrease in the number of building occupants, and do not reflect conditions that exist when the building is fully occupied.

The location of ventilation diffusers and return air grills in high ceilings, such as in the post office, may result in "short-circuiting," whereby supply air does not reach building occupants before it is exhausted via the return air system. The use of the ceiling fans (paddle fans) in the workroom should help to move supply air down to floor level.

CONCLUSIONS

Formaldehyde concentrations on the sampling date were well below levels which commonly cause eye and upper respiratory irritation. Air sampling results indicate that a health hazard due to formaldehyde exposure did not exist at the time of the sampling visit. However, use of the formaldehyde-containing floor wax in the workroom is a possible source of formaldehyde exposure, and may have been the source of airborne formaldehyde measured by a consultant in August 1995. Concentrations measured at that time (0.2 and 0.38 ppm) would have been sufficient to cause eye and upper respiratory irritation in some individuals. No other apparent sources of airborne formaldehyde were identified. Measurements of temperature, relative humidity, and CO_2 indicated satisfactory indoor air quality on the sampling date.

RECOMMENDATIONS

1. The health effects of using cleaning and maintenance products should be evaluated. The first step is to obtain and evaluate material safety data sheets (MSDSs) prior to purchase. This information can be used to select occupant-friendly products, and to determine ways to use products which will have minimal impact on building occupants.

2. The floor wax should be replaced by a wax which does not contain formaldehyde. According to the manufacturer of the wax, this product line is no longer formulated with formaldehyde.

3. The supplier of Tuf-Scrub should be notified of the discrepancy between the container label and the MSDS so that a correction can be made. (The OSHA formaldehyde standard (29 CFR 1910.1048) requires that formaldehyde be identified on the MSDS if the product contains greater than 0.1% formaldehyde.)

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Table 1. Personal Air Sampling. USPO, Acton, Massachusetts (HETA 96-0120), June 20, 1996.

Job Title	Location	Sample Number	Sample Period (minutes)	Sample Volume (liters)	Formaldehyde (ppm)
Administrative Clerk	Admin Office	6	366	26.5	<0.02
Bulk Mail Clerk	Bulk Mail Room	7	383	29.2	<0.01
Clerk	Workroom	8	302	24.6	<0.02
Window Distribution	Customer Window	9	355	28.4	<0.01

< Less than. The formaldehyde concentration was below the minimum detectable concentration (MDC). The MDC is determined by the analytical limit of detection (0.5 micrograms per sample) and the volume of the air sample.

ppm Parts per million.

Table 2. Area Air Sampling. USPO, Acton, Massachusetts (HETA 96-0120), June 20, 1996.

Location	Sample Number	Sample Period (minutes)	Sample Volume (liters)	Formaldehyde (ppm)
Carrier Supervisor’s Office	1	431	119.	(0.010)
Workroom, RR24 Carrier Case	2	429	120.	(0.0082)
Administrative Office	3	426	117.	(0.011)
Customer Window	4	420	115.	(0.0087)

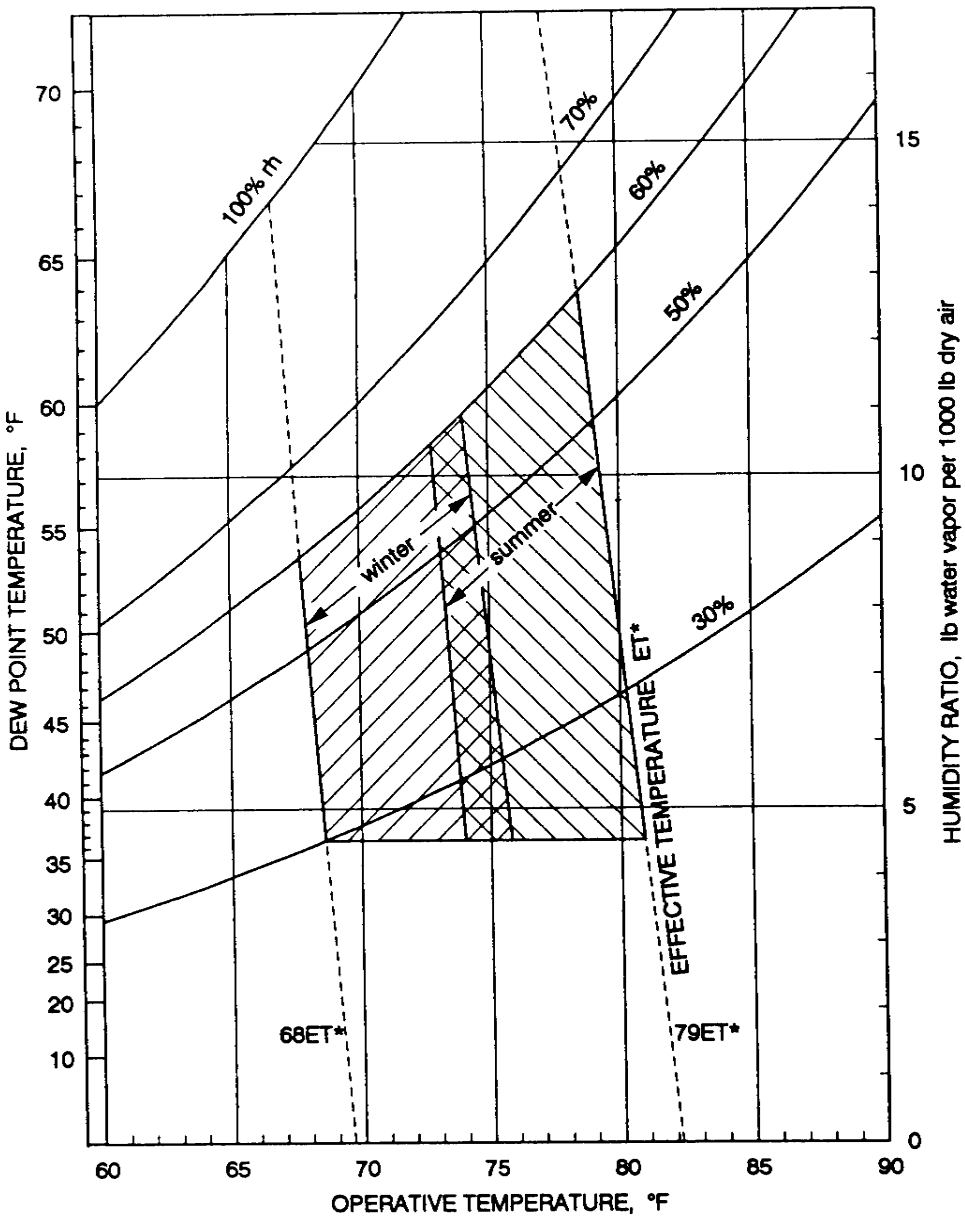
( ) Value is between the MDC and the minimum quantifiable concentration (MQC). Values in this range are semi-quantitative.

ppm Parts per million.

Table 3. USPO, Acton, Massachusetts (HETA 96-0120), June 20, 1996.

Location	Time	CO_2 (ppm)	Temperature (ºF)	Relative Humidity (%)
Administrative Office	0955	700	73	57
	1349	525	73	60
Workroom, carrier case 24	0946	700	72	56
	1339	475	70.5	61
Customer Window	0953	700	71	56
	1347	575	71.5	61
Carrier Supervisor Office	0945	625	69	58
	1337	550	68.5	60
Workroom, center	0950	725	70.5	58
	1345	500	70.5	61
Bulk Mail Room	0957	600	71.5	61
	1352	525	73	61
Ambient	1000	375	64	78
	1355	350	72	64

Figure 1
ANSI/ASHRAE Standard 55-1992
Thermal Environmental Conditions
for Human Occupancy



Acceptable ranges of operative temperature and humidity for people in typical summer and winter clothing during light, primarily sedentary activity.

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