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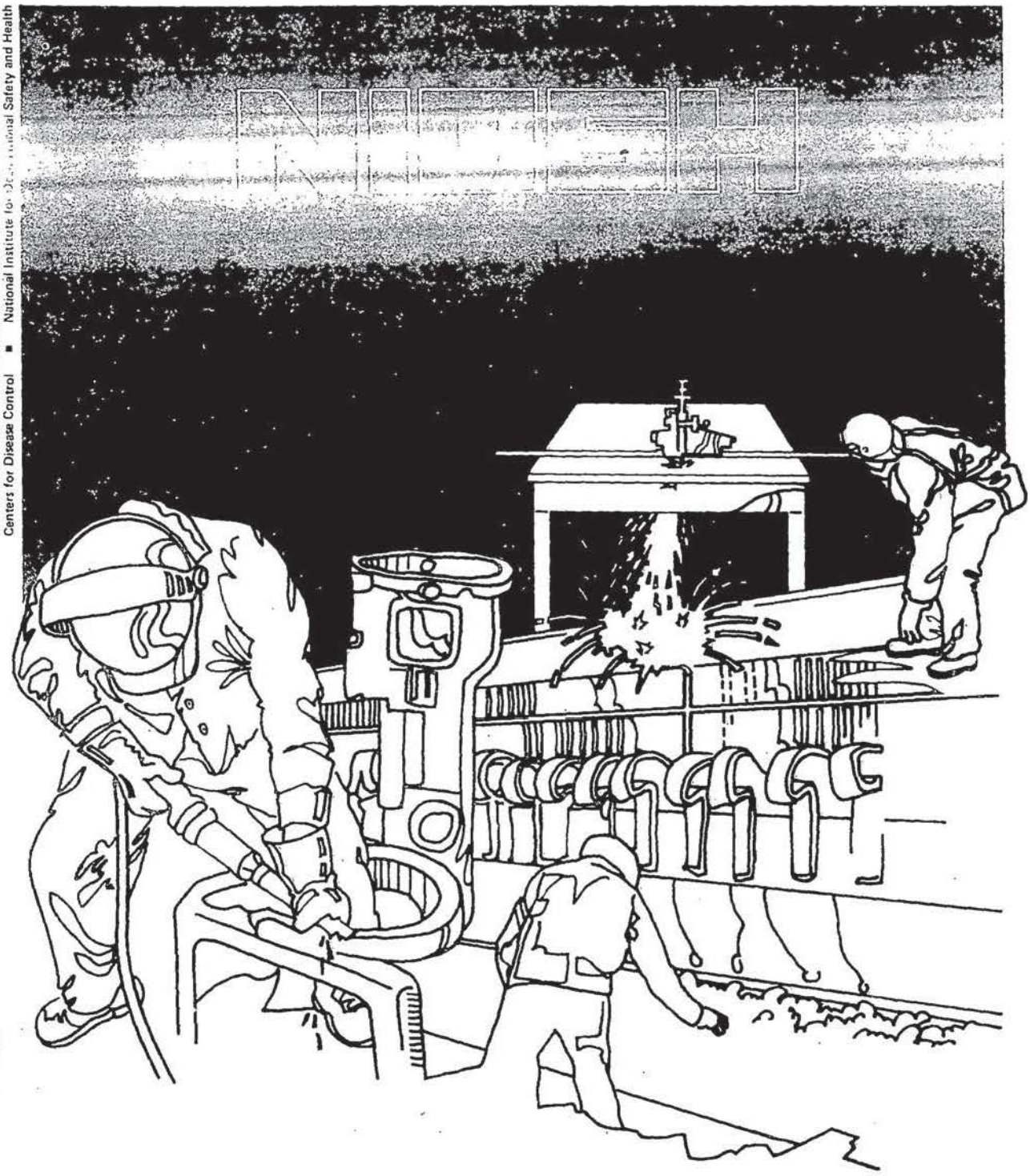

Health Hazard Evaluation Report

HETA 84-065-1519
SOUTHERN OREGON STATE COLLEGE
ASHLAND, OREGON

PREFACE

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

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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SOUTHERN OREGON STATE COLLEGE
ASHLAND, OREGON

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I. SUMMARY

In December 1983 the National Institute for Occupational Safety and Health (NIOSH) received a request to determine the cause of skin rashes experienced by several bookstore employees at the Southern Oregon State College, Ashland, Oregon.

NIOSH conducted an initial survey in December 1983 and environmental sampling in April and May 1984. The medical records of the workers were reviewed by a NIOSH physician and two of the three currently affected workers were patch tested by a local dermatologist.

Eight of thirteen No-Carbon-Required paper forms used in the bookstore contained from 100 to 880 ppm latent formaldehyde; formaldehyde was not detected in the other 5 forms. Airborne formaldehyde concentrations ranged from 0.01 to 0.02 ppm. Measurements of the ventilation system indicated that the supply air volumes were adequate. Due to the lack of a humidifier in the HVAC, the room humidity could be very low in the colder winter months when the skin rashes tend to occur.

Two of the affected workers were patch tested for sensitivity to a variety of potential allergens, including wipe samples of dust from the door jamb, filing cabinet, and supply air vents. One worker who was patch tested, exhibited a 3-plus reaction to 2% formaldehyde at 72 hours. The affected workers were seen by a dermatologist during the time they were experiencing a skin rash. The diagnosis made by the dermatologist was acne rosacea.

On the basis of this investigation, NIOSH investigators could not conclusively identify the cause of the skin rashes experienced by seven former and current Southern State College bookstore employees. Handling NCR paper containing formaldehyde and exposure to low humidity in the winter may have caused and/or contributed to the rash in one or more of the individuals. Recommendations are presented in Section VII of this report.

Keywords: SIC 8221 (College Universities) Asbestos, Formaldehyde, Indoor air quality, No Carbon Required paper, skin rash.

II. Introduction

In December 1983 the National Institute for Occupational Safety and Health (NIOSH) received a request to determine the cause of skin rashes experienced by several bookstore employees at the Southern Oregon State College, Ashland, Oregon. NIOSH conducted an initial survey in December 1983. Follow-up surveys were conducted in April and May 1984. An interim report was sent to the requestor on May 7, 1984.

III. BACKGROUND

The bookstore is located in Britt Center. Britt Center, built around 1930, was originally a gymnasium. Wings were added to both sides in 1956 and the gymnasium was divided into two floors. The building now had three floors (the basement, the old gym floor and a new floor constructed at the balcony level). About 1973 it was again remodeled and the bookstore was put in on the old gymnasium floor.

The bookstore covers the entire floor area of the old gymnasium and has an eight foot ceiling. On the west side are two offices, a coffee room and another small room next to it. The offices are 12' x 13' with an 8' ceiling. The coffee room and the small room next to it are together about 12' x 13' in size. These offices and coffee area have no outside windows or doors.

The bookstore sells books, paper and other educational supplies, clothing items, cards, souvenirs, etc. In one office a considerable number of purchase orders and company invoices are handled that are of the no carbon required (NCR) variety. There are two drawers in the file cabinet near the desk where the invoices are filed. A small portable copy machine was placed in this office about January 1984.

The heating, ventilation, and air conditioning system (HVAC) is a forced air system. The heat is provided by hot water from a central campus boiler and the air conditioning is a refrigeration system.

There have been seven workers who have experience adverse health effects over the past six years. Six of the workers worked in the bookstore and one in the ceramic shop. The main effect has been a rash over a portion or all of the person's exposed skin area.

IV. EVALUATION DESIGN

A. Environmental

Environmental air samples were collected for formaldehyde in the bookstore and office area. Various no-carbon-required paper forms used by the bookstore were analyzed for latent formaldehyde. The ventilation rates were measured along with temperature, humidity and carbon dioxide concentrations. Materials used on the old bookstore ceiling and on top of the kilns in the ceramic shop were collected to determine if they contained asbestos. The results of air samples collected previously by the State Accident Insurance Fund were reviewed.

Listed below are the sampling and analytical methods used in the evaluation.

Substance	Collection Method	NIOSH Analytical Method
Asbestos	Bulk	Polarized light microscopy and dispersion staining techniques
Carbon Dioxide	Detector Tube	Direct reading
Formaldehyde	1% sodium bisulfite in impinger at 1 lpm	P&CAM 125
Latent Formaldehyde	Bulk NCR paper forms	Burlington Industries standard test for latent formaldehyde

B. MEDICAL

The affected workers were interviewed to elicit what symptoms they experienced and when they occurred. A NIOSH physician reviewed the medical records of the affected employees. Two of these workers were patch tested to determine if they were sensitive to a variety of potential allergens and to the dust found in the bookstore and office area.

V. EVALUATION CRITERIA

Building-Related Illness Episodes

Building-related illness episodes have been reported more frequently in recent years as buildings have been made more air-tight in order to reduce heating and air conditioning expenses, and to conserve energy. Symptoms most often reported are eye, nose, and throat irritation, headache, fatigue, and sinus congestion. Occasionally upper respiratory irritation and skin rashes are also reported. In some cases, the cause of the symptoms has been ascribed to an airborne contaminant, such as formaldehyde, tobacco smoke, or insulation particles, but most commonly a single cause cannot be pinpointed.

In the absence of other apparent or viable theories of causation these building-related illnesses are generally assumed to be caused either by poor indoor air quality or by HVAC system problems.

Indoor Air Pollution

In 1981 the National Research Council (National Academy of Sciences) issued a report urging a major national effort be mounted to study the subject of indoor air pollution. The Environmental Protection Agency recently initiated an indoor air pollution research program. Some of the major types of contaminants found in indoor air are:

1. Products of combustions

   Carbon monoxide and nitrogen dioxide are generally considered the most important toxic products of the combustion of fossil fuels and other organic materials. Carbon monoxide is an asphyxiant, and nitrogen dioxide a pulmonary irritant.

2. Formaldehyde

   Formaldehyde and other aldehydes may be released from foam plastics, carbonless paper, particle board, plywood, and textile fabrics. Formaldehyde is an irritant to the eyes, nose, mouth, and throat. It is also a suspected carcinogen, based on its ability to produce nasal cancer in rats.

3. Sprayed-on insulation materials

   Asbestos, fibrous glass, and mineral wool fibers have been used in some buildings in sprayed-on fireproofing insulation for walls, ceilings and structural steel beams. Fibers and dust particles may be dislodged from the insulation and become airborne. Asbestos fibers can cause pulmonary disease and cancer. Mineral wool and fibrous glass particles are irritants.

4. Tobacco Smoke

   Tobacco smoke contains several hundred toxic substances, the more important of which are: carbon monoxide, nitrogen dioxide, hydrogen cyanide, formaldehyde, hydrocarbons, ammonia, benzene hydrogen sulfide, benzo(a)pyrene, tars and nicotine. The American Medical Association estimates that at least 34 million Americans are sensitive to cigarette smoke. The smoke can irritate the respiratory system, and in allergic or asthmatic persons, often results in eye and nasal irritation, coughing, wheezing, sneezing, headache, and other related sinus problems. People who wear contact lenses complain of burning, itching and tearing eyes when exposed to cigarette smoke.

5. Microorganisms and allergens

   Microorganisms have been found to be spread through ventilation systems in buildings where air filters had become wet and moldy, where pools of stagnant water had collected under air conditioning cooling coils, and where decaying organic matter was found near air conditioning intakes. Health results may be infections, irritation, or allergic symptoms.

6. Hydrocarbon vapors

   Hydrocarbon vapors are released from dispersents and toners used in photocopying machines, telecopier machines, from printing processes, and from certain cleaning compounds. The hydrocarbons can be irritants, and are central nervous system depressants at high concentrations.

A. Toxicology of Formaldehyde (1,2)

Formaldehyde had induced a rare form of nasal cancer in both Fisher 344 rats and in B6C3F1 mice as reported in an ongoing study by the CIIT. In a second study by NYU, formaldehyde appears to have induced the same type of cancer in Sprague-Dawley rats. Although humans and animals may differ in their susceptibility to specific chemical compounds, any substance that produces cancer in experimental animals should be considered a risk to humans. Formaldehyde has also demonstrated mutagenic activity in several test systems. Although a substance cannot as yet be designated a potential occupational carcinogen based solely on results of mutagenicity tests, positive results in mutagenicity tests should be used as supporting evidence for identifying a potential occupational carcinogen.

Based on these results, NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen. Safe levels of exposure to carcinogens have not been demonstrated, but the probability of developing cancer should be reduced by decreasing exposure. An estimate of the extent of the cancer risk to workers exposed to various levels of formaldehyde at or below the current 3 ppm (US Department of Labor, OSHA Standard) standard has not yet been determined. In the interim, NIOSH recommends that, as a prudent public health measure, engineering controls and stringent work practices be employed to reduce occupational exposure to the lowest feasible limit.

Other Health Effects

The first signs or symptoms noticed on exposure to formaldehyde at concentrations ranging from 0.1 to 5 ppm are burning of the eyes, tearing (lacrimation), and general irritation to upper respiratory passages. Higher exposures (10 to 20 ppm) may produce coughing, tightening in the chest, a sense of pressure in the head, and a palpitation of the heart. Exposures at 50 to 100 ppm and above can cause serious injury such as collection of fluid in the lungs (pulmonary edema), inflammation of the lungs (pneumonitis), or death.

Dermatitis due to formaldehyde solutions or formaldehyde-containing resins is a well-recognized problem. After a few days of exposure, a worker may develop a sudden inflamatory (eczematous) reaction of the skin of the eyelids, face neck, scrotum, and flexor surfaces of the arms. An eczematous reaction may also appear on the fingers, back of the hands, wrists, forearms, and parts of the body that are exposed to the rubbing of clothing. This sometimes occurs after years of repeated exposure.

IV. RESULTS AND DISCUSSION

A. ENVIRONMENTAL

Thirteen sheets from several different NCR purchase order, book return and invoice forms were analyzed for latent formaldehyde (Table 1). Eight sheets contained formaldehyde in concentrations from 100 to 880 ppm. Formaldehyde was not detected in the other five. Air samples collected for formaldehyde (Table 2) showed concentrations of 0.01, 0.02 and 0.014 ppm in the areas where the 3 affected employees worked. These concentrations are very low and unless an individual is sensitized they should not experience any adverse health effects. However, individuals who handle NCR paper that contain formaldehyde may develop skin rashes. Small particles of the paper are released at the perforated joint when they are separated. Exposure to these formaldehyde containing particles would occur during the separation or later when the sheets are again handled. These particles could contact the exposed skin (hand, face, top of head) and produce a skin rash while clothing would protect the other skin areas.

The heating, ventilation, and air conditioning system (HVAC) is a forced air system. The heat is provided by hot water from a central campus boiler and the air conditioning is a refrigeration system. A corrosion inhibitor (sodium nitrite) is added to the boiler water. No water leaks were observed in the system which, if present, could put a mist or aerosol of the boiler water through the ventilation system. Also no water or wet areas were observed in the HVAC system which could provide breeding grounds for biological agents. The last few feet of each supply air duct is a glass fiber duct. Settled dust examined microscopically by the Oregon State Accident Insurance Fund hygienist showed only several glass fibers in the sample and is not considered to be present in sufficient quantities to produce the rash.

There are no humidifiers in the HVAC units. Depending on the outside temperatures, the fresh make up air will range from 10 to 90%. The HVAC unit for the west wing, which includes the bookstore offices, consists of three zones with one zone for the bookstore offices. The air conditioning system is not turned on until the outdoor temperature reaches 90°F. With a heat load in the office from lights, humans, etc., the temperature in the office area may exceed 90°F before the air conditioner is activated.

Environmental measurements were taken on April 2, 1984, for temperature, humidity and carbon dioxide; however, due to a power failure in the morning, the ventilation remained off and the conditions were not considered representative. On April 3, the temperature in the office area remained a steady 73-74°F with a relative humidity of 30%. The carbon dioxide levels were a constant

400 ppm which is close to the normal concentration of 300-350 ppm. A level of 700 or more would indicate a lack of fresh make-up air. The ventilation rate was measured, but due to the shape of the diffuser, the measurements are considered estimates. It is estimated that the air flow rate into each office is about 200 cubic feet per minute. This gives approximately 10 air changes per hour and with a minimum of 10% fresh make-up air, the air volume is considered adequate. There is a concern that during the cold months of December, January and February, the humidity may be quite low due to a lack of a humidifier in the ventilation system.

There is a ceramic workshop in the basement of the west wing which contains three kilns. The exhaust from these kilns terminates on the roof and side of building. It is possible, but not very probable, for some of the exhausted air to enter the air intake of the HVAC. The kilns are used after three weeks into each school quarter and are fired about once a week. They were not fired in January 1984 when the people in the bookstore experienced a rash. The floor of the ceramic shop used to be swept daily; however, since a year ago, the floor has been washed with water once a week.

The negative allergy test from dust in the office area tends to rule out any dust or aerosol that could be coming through the ventilation system. This would also rule out reentry of the kiln exhaust through the HVAC system. The old ceiling material above the new suspended ceiling and the material on top of the kilns were analyzed for asbestos. The ceiling material did not contain any asbestos. The material on top of the kilns contained 40% asbestos.

B. MEDICAL

There have been seven workers who have been affected over the past six years. The main effect has been a rash over a portion or all of a person's exposed skin area. The symptoms are periodic, appearing irregularly several times a year lasting over several weeks, often being severe in the fall and winter. Six workers have worked in the bookstore and one in the ceramic shop. Three of the affected workers are no longer employed by the bookstore. One worked in the office; one worked in the bookstore area with about 1 1/2 hours each day in the office area; and the third was a part-time employee who worked only for several weeks in the bookstore before quitting. Three current bookstore employees have experienced occasional rashes. One works in the bookstore area. The rash has occurred about four times and it is located on the cheeks below the eye. This worker handles some of the NCR paper. A second person works in the office and has had several occurrences which began one year ago. It also is confined to the cheek area just below the eye. Allergy tests were performed on this individual and all were negative. The third employee works in the office and handles the NCR paper. The rash on this person covered all her exposed skin area. Frequent hand washing was reported to reduce the redness and discomfort to some extent and clothing protected against the rash.

It occurs sporadically; however, it is more frequent in January, February and March. This person was tested for allergies using the patch test method by a dermatologist and exhibited a 3-plus reaction to 2% formaldehyde at 72 hours. This was the only positive reaction of the substances tested. The substances included dust taken from the top of the cabinets and the door jamb and supply air vents in her office. The diagnosis made by the dermatologist in these two cases was acne rosacea (a chronic disease affecting the skin of the nose, forehead and cheeks, marked by flushing, followed by red colorations due to the dilatation of the capillaries, with appearance papules and acne-like pustules). The last person works in the ceramics shop. In 1981 he had a skin problem that was cancerous. The skin problems have not occurred since that time.

VII SUMMARY

The cause of the sporadic rash experienced by the employees could not be definitely determined. One employee tested for allergies exhibited a reaction to formaldehyde. The employee also handled NCR paper which was tested and found to contain formaldehyde and therefore it could be the causative agent for the skin rash. The rashes tend to occur more during the cold winter months. Since there is no humidifier in the ventilation system, the humidity in the bookstore during this time period may be low, causing excessive skin dryness which may be a partial factor in the skin rashes. Also the paper products in the bookstore may act as a desicant causing a lower humidity in the bookstore than in other parts of the building.

VII RECOMMENDATIONS

1. Increase the volume of supply air to the bookstore and office areas. Increased air volumes have reduced symptoms in similar office environments that have been investigated.

2. Provide a portable room air humidifier to the offices and maintain the humidity at 45 to 50%. This may alleviate the rash.

3. The offices in the bookstore do not have doors or windows to the outside and in the summer these rooms can become uncomfortably hot before the air conditioners are activated. Try to keep the temperature in the bookstore and offices lower in the summer by having the air conditioner activated when a predetermined temperature is reached in the bookstore office rather than when the outside temperature reaches 90°F.

4. The portable copy machine was placed in one of the offices about January 1984. Although the rashes have been present for several years, the substances used in the copy machine may contribute to the rash. It should be moved to an area of the bookstore where workers are not assigned for prolonged periods of time. Note: The copy machine was removed in August of 1984, prior to completion of this report.

5. Replace the asbestos containing material that is on top of the kiln with a non-asbestos material.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to formaldehyde. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-126)

2. NIOSH Current Intelligence Bulletin #34
April 15, 1981 Formaldehyde: Evidence of Carcinogenicity

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Southern Oregon State College, Ashland, Oregon.

2. State of Oregon Accident Prevention Division, Salem, Oregon.

3. U. S. Department of Labor, Occupational Safety and Health Agency (OSHA), Region X, Seattle, Washington.

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

TABLE 1
FORMALDEHYDE CONCENTRATIONS IN
NO CARBON REQUIRED (NCR) PAPER
USED IN SOSC BOOKSTORE

SOUTHERN OREGON STATE COLLEGE
ASHLAND, OREGON
HHE 84-065

SAMPLE NUMBER	DESCRIPTION OF PAPER	TOTAL LATENT FORMALDEHYDE PPM*
1	SOSC Bookstore purchase order form - white	880
2	Second sheet of sample #1 - yellow	740
3	Third sheet of sample #1 - pink	180
4	SOSC bookstore "Request for Permission to Return" - white	N.D.**
5	Second sheet of sample #4 - green	N.D.**
6	Third sheet of sample #4 - pink	N.D.**
7	Fourth sheet of sample #4 - gold	N.D.**
8	Invoice for from a book company - pink	250
9	Invoice for from another book company - pink	N.D.**
10	Book return for from book company - yellow	620
11	Packing slip of book company - yellow	290
12	SOSC bookstore general purpose forms - white	170
13	Second sheet sample #12 - pink	100

* PPM - Parts per million on a weight to weight basis

** N.D. - Non Detected

TABLE 2
FORMALDEHYDE AIR CONCENTRATIONS
IN SOSC BOOKSTORE
May 12, 1984

SOUTHERN OREGON STATE COLLEGE
ASHLAND, OREGON
HHE 84-065

SAMPLE NUMBER	LOCATION	SAMPLE VOLUME LITERS	FORMALDEHYDE CONCENTRATION PPM
1	Southwest Office	330	0.01
2	Northwest Office	330	0.02
3	Book Store Area Near Book Return Desk	330	0.014