HETA 91-181-2307
APRIL 1993
HADDON CRAFTSMEN, INC.
SCRANTON, PENNSYLVANIA

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I. Summary

In May 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) at the Haddon Craftsmen book bindery in Scranton, Pennsylvania. The request concerned worker exposures associated with hot-melt glue, shrinkwrap, and foil stamping operations. Concerns were also expressed about worker exposures to carbon monoxide (CO), noise, and paper dust.

An initial plant visit, completed in August 1991, included noise and ventilation surveys, bulk air sampling for hydrocarbons, collecting bulk samples of the hot-melt glues used, and a review of medical records.

NIOSH conducted full-shift personal (breathing zone) and area sampling for total airborne particulate, CO, 1,1,1-trichloroethane, and aldehydes at the facility April 7-9, 1992. None of these measurements indicated exposures above the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). Exposures to acetaldehyde and formaldehyde, both potential occupational carcinogens, were found above the NIOSH Recommended Exposure Limit (REL) which is established at the lowest feasible level (LFL). The range of concentrations corresponding to personal exposures at the End Paper Combiner, Compact 45, UB4 and UB5 binders, and Kolbus Liners were: formaldehyde none detected (ND) - 0.09 parts per million parts of air (ppm); acetaldehyde ND - 0.10 ppm. The ranges of concentrations for personal exposure to other air contaminants were: 1,1,1-trichloroethane ND - 0.51 ppm; carbon monoxide ND - 6 ppm; and airborne particulate ND - 5.8 mg/m^3 (milligrams per cubic meter).

Noise level measurements indicated that workers are potentially exposed to levels in excess of the NIOSH REL and OSHA Action Level of 85 dBA (decibels of noise as measured on the A-weighted scale). Hearing protection and annual audiometric testing are available to all employees.

A review of medical records of 10 employees and interviews with some of the workers revealed symptoms of upper respiratory irritant exposures. There were also numerous notations in the OSHA logs of strains, sprains, and other repetitive motion trauma.

Full-shift, personal time-weighted average (TWA) sampling for acetaldehyde and formaldehyde indicated exposures above the NIOSH Recommended Exposure Limit (REL). These levels ranged from ND to .10 ppm (parts analyte per million parts of air). NIOSH considers these aldehydes to be potential occupational carcinogens and recommends that exposure be controlled to the lowest feasible level. Recommendations for improving work practice and engineering controls for reducing these exposures are presented in Section VIII of this report.

KEYWORDS: SIC 2789 (book binding and related activity), hot-melt glues, foil stamping, 1,1,1-trichloroethane, formaldehyde, acetaldehyde, carbon monoxide, total airborne particulate, book bindery, vapor/hazard ratio, noise.

II. Introduction

In May 1991, NIOSH received a request for a HHE at the Haddon Craftsmen book bindery in Scranton, Pennsylvania. The request concerned worker exposures associated with hot-melt glue, shrinkwrap, and foil stamping operations. Concerns were also expressed about worker exposures to carbon monoxide (CO), noise, and paper dust. A physician's report accompanying the request listed employees with abnormal spirometry, carboxyhemoglobin (CO-Hb), and chest x-rays -- which were attributed to plant working conditions.

During an initial site visit on August 4, 1991, the NIOSH medical officer reviewed OSHA logs, spoke with the company nurse about employee health complaints, conducted employee medical interviews, and visited a local physician who had examined several Haddon employees. The NIOSH industrial hygienist conducted qualitative bulk air sampling for hydrocarbons, surveyed the local exhaust ventilation systems, spoke with employees to learn of their health concerns, performed a plant-wide noise survey, and collected bulk samples of the six hot-melt glues used in the bindery operations.

On April 7-9, 1992, personal and area sampling was conducted to characterize worker exposures to total airborne particulate, CO, 1,1,1-trichloroethane, and aldehydes.

III. Process Description

The Haddon Craftsmen book bindery is a three-story building complex, and former educational facility, built in 1901. It has served as production facility and home office, for the company since the early 1940's. About 265 employees work in the office and 235 production employees work 3 shifts per day, 5 days per week.

The printing of the pages is accomplished off-site. Signatures (the printed page sections) arrive at the facility from the printers. Six varieties of hot-melt glues are used in nine machines on three floors of the main facility to produce finished volumes. About 1,000 pounds of hot-melt glues are used to produce 100,000 hard cover and 25,000 paperback books each day. The hot-melt glues arrive in solid pellet form and are preheated in gas-fired, pre-melt pots near the points of application. The liquified hot-melt glues are then piped to the respective points of application, where they are heated further and applied at approximately 350^{o}F. Hot-melt glues are used in these machines: Kolbus Tipper, UB4 and UB5 binders, Compact 45, 3 Kolbus Liners, End Paper Combiner, and Crathern Casemaker.

On the second floor, the Kolbus Tipper places end leaf pages onto the first and last signatures. One operator and one helper work this Tipper machine. The signatures are then loaded into gathering machines on the first floor which assembles them into sequential order. The ordered signatures pass through the UB4 or UB5 binder, where hot-melt glue is applied to bind them together. Combustion of natural gas is used to speed the drying of the hot-melt glues between operations. Trimmers at the ends of these lines trim the bound signatures to book size. Three operators and 8-11 helpers operate each binder.

At the trimmers, a vacuum system picks up the scrap paper at the point of liberation and carries it to the baler area where the scrap is deposited into either one of two large rooms (about 300 yd^3 each) above the baler. An attendant on each shift diverts the flow to the empty room and then pushes the accumulated scrap paper into an unguarded vacuum duct (floor opening) and down into the baler. Dust respirators (3M-8710) are provided to these baling area employees.

Other processes throughout the facility are involved with producing various types of covers. In the

basement, two Cloth Cutter machine operators prepare cloth to selected widths; the Crathern Casemaker operator produces laminated cloth hardcovers; four Kolbus and Chandler-Price Stamper machine operators use heated plates (300°F) to apply metal foil designs onto covers; and one operator and one helper at the Dexter machine produce laminated paper covers.

On the ground floor, three Kolbus Liner machines employing 10 workers add reinforcement to hard covers. At the End Paper Combiner, an operator cuts liners for hard covers. The Compact 45 machine places these covers and single-sheet "dust covers" onto the trimmed signature bundles as the final step in producing the finished volume. Operation of the Compact 45 requires an operator and up to five helpers. The finished books are stacked onto pallets for packaging and shipment.

The pre-melt pots' local exhaust ventilation hoods are set 2-3 feet above the pots to allow clearance for adding hot-melt glue pellets. Some of these pots incorporate strip curtains to direct the atmosphere above the pots into the hoods. Some of the various points of glue application are also fitted with an exhaust ventilation hood a few feet above the application point. Other points of application do not incorporate local exhaust ventilation.

A shrinkwrap operation wraps clear plastic sheeting around pallets stacked with books, book boards (stiffeners which separate and reinforce signature bundles during shipment to the facility), and other materials before shipment from the facility. The operator then uses a propane torch to shrink the sheeting. The shrinkwrap operation is only performed on the day shift and requires about 20-30 minutes per day.

The combustion of natural gas is the only likely source of CO within the facility. Natural gas fuels the pre-melt pots and is also burned at the binding machines (UB4 and UB5) to speed the drying of the hot-melt glue between operations.

IV. Methods

During the initial walk-through, a plantwide noise survey was conducted. Noise levels (A-weighted, slow response) were measured and recorded plantwide using a General Radio 1565 noise survey meter.

The effectiveness of the local exhaust ventilation hoods (over pre-melt pots and application points) was evaluated using a Almer Model 8525 Compuflow hot-wire velometer and smoke tubes.

Air samples and bulk hot-melt glue samples were collected in August 1991, to provide information useful in developing the environmental survey protocol. Laboratory analysis of the bulk hot-melt glue samples and air samples indicated potential exposure existed to a wide variety of hydrocarbons. The decision as to which hydrocarbons to include in the personal and area exposure monitoring was made by vapor/hazard ratio comparison. This number is the ratio of the equilibrium vapor concentration of the chemical at room temperature to the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) - the lower the ratio, the lower the relative potential hazard.[1]

In April 1992, NIOSH conducted full-shift TWA personal and area monitoring for total airborne particulate, CO, 1,1,1-trichloroethane, acetaldehyde and formaldehyde. Sampling was conducted on the day shift, which is the busiest production shift.

Airborne particulate

Personal (breathing zone) and workplace area samples for total airborne particulate were collected in accordance with NIOSH Method 0500[2] at the Cloth Cutter, Kolbus Stamper, signature gathering,

and baling operations. Seven personal and 12 area samples were collected on tared 37mm polyvinyl chloride filters in three-piece cassettes using DuPont Model P2500 Constant Flow pumps calibrated to 2 liters/minute flow, with pre- and post-sampling calibration.

Carbon Monoxide

Carbon monoxide levels were monitored using passive and short-term detector tubes at all machines which burn natural gas fuel: the Stamper, Crathern Casemaker, Kolbus Liner, Dexter, UB5 Binder, and UB4 Binder operations. Fourteen area samples were collected using Drager 67-33191 CO passive diffusion tubes with a range of measurement between 6-75 ppm TWA.

1,1,1-Trichloroethane

Trichloroethane levels were monitored at the Stamper, Kolbus Liner, UB4 and UB5 Binder, Compact 45, End Liner, End Paper Combiner, and Kolbus Tipper operations using NIOSH Method 1003[2]. Sixteen personal and seven area samples were collected on charcoal media using the Gil-Air pumps and a dual manifold sampling arrangement, as described below, with pre- and post-calibration to 25 cubic centimeters of air per minute (cc/minute).

Aldehydes

Acetaldehyde and formaldehyde levels were monitored at the Dexter, Crathern Casemaker, Stamper, Kolbus Liner, UB4 and UB5 Binders, Compact 45, End Paper Combiner, and Kolbus Tipper operations. Twenty-seven area and 45 personal samples were collected and analyzed using NIOSH Methods 2538 and 2541[2]. Gilian Gil-Air Constant Flow pumps with dual manifold samplers were used. This allowed each pump to monitor for both aldehyde and 1,1,1-trichloroethane exposures. The pumps were pre- and post-calibrated to a flow rate of 25 cc/minute. ORBO-23 solid sorbent tubes containing treated XAD-2 sorbent were used as the sampling media.

Formaldehyde levels were also monitored using the more sensitive impinger solution method, NIOSH Method 3500[2]. One personal sample and 23 area samples were collected from the Kolbus Tipper, End Paper Combiner, UB4 and UB5 Binder. Compact 45, Stamper, Kolbus Liner, and Crathern Casemaker operations. The DuPont Model P2500 Constant Flow pumps were employed, pre- and post-calibrated to 400 cc/minute. The impinger solution was 20 cc of 1% sodium bisulfite solution. A back-up impinger was included into the sampling train and analyzed.

Each laboratory analysis has a limit of detection (LOD) and a LOQ. The LOD is a decision point used to decide whether to report a significant analyte signal from a sample. The LOQ is the smallest amount of analyte which can be measured with precision.[3]

V. Evaluation Criteria

Evaluation criteria are used as guidelines to assess the potential adverse health effects of occupational exposures to substances and conditions found in the workplace. These criteria are generally established at levels that can be tolerated by most healthy workers occupationally exposed day after day for a working lifetime without detrimental effects. Because of the variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria. Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure. Evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

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 evaluation criteria. 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.

The primary sources of environmental criteria considered in this report are: (1) NIOSH RELs, (2) ACGIH TLVs, and (3) the OSHA PELs. The OSHA PELs have been established with consideration for economic feasibility and represent the maximum legal limits to which employees may be occupationally exposed. The NIOSH RELs and ACGIH TLVs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. The exposure criteria are reported as: TWA exposure recommendations averaged over the full work shift; short-term exposure limit (STEL) recommendations for 10-15 minute exposure periods; and ceiling exposure levels (C) not to be exceeded for any length of time. These exposure criteria and standards are commonly reported as parts contaminant per million parts of air (ppm) or milligrams of contaminant per cubic meter of air (mg/m^3).

The evaluation criteria for the substances monitored during this survey are listed in Table I.

VI. Toxicology

This section describes the possible toxicological and physiological effects in workers exposed to the substances monitored during this survey. These effects are described so workers will be familiar with the symptoms and health consequences of exposure.

NOISE: Exposure to excessive noise causes hearing loss (which may be temporary or permanent) depending on the level and frequency characteristics of the noise, duration of exposure, and the susceptibility of the individual.[4] Noise can startle, annoy, and disrupt concentration, sleep, and relaxation. Noise can interfere with speech communication and consequently interfere with job performance and safety. Effects of acute high exposures include pain and possible permanent noise-induced hearing loss.

Noise-induced hearing loss as a rule, develops over a long period of time and the loss of hearing may not be apparent until a considerable amount of damage has been done.[4,5]

AIRBORNE PARTICULATE (not otherwise classified) does not produce significant organic disease or toxic effects. Exposures to paper dust are measured in terms of total airborne particulate. These dusts are biologically inert in that when inhaled, the architecture of the alveoli remains intact; little or no scar tissue is formed; and any reaction provoked is potentially reversible[4]. An excessive concentration in workroom air may reduce visibility, and cause unpleasant accumulations in the eyes, ears, and nose.

CARBON MONOXIDE (CO) is a colorless, odorless gas, slightly lighter than air. It is produced whenever incomplete combustion of carbon-containing compounds occurs. The danger of this gas derives from its affinity for the hemoglobin of red blood cells, which is 300 times that of oxygen.

Inhalation of CO may cause headache, nausea, dizziness, weakness, rapid breathing, unconsciousness, and death. High concentrations may be rapidly fatal without producing significant

warning symptoms. Exposure to this gas may cause chest pain in those with pre-existing heart disease. Pregnancy presents particular risks to the effects of CO exposure. The effects are also more severe in people who are exercising hard and in people who are working in places where the temperature is high or at altitudes above 2,000 feet.[6]

1,1,1-TRICHLOROETHANE (also called methyl chloroform) can affect the body if it is inhaled, ingested, or comes in contact with the eyes or skin. Acute exposure to the vapor may cause headache, dizziness, drowsiness, unconsciousness, irregular heart beat, and death. Prolonged or repeated skin contact with liquid trichloroethane may cause irritation of the skin. Reproductive abnormalities have been noted in studies of animals exposed to high concentrations. At high concentrations, 1,1,1-trichloroethane causes liver changes in animals.[6]

FORMALDEHYDE may cause adverse health effects following exposure via inhalation, ingestion, dermal or eye contact. Acute inhalation of high concentrations of formaldehyde has caused bronchitis (inflammation of the upper airways), pulmonary edema (accumulation of fluid in the lungs), pneumonitis (inflammation of lung tissue), pneumonia, and death due to respiratory failure. Acute exposure to formaldehyde gas can cause irritation of the eyes and respiratory tract, tearing, coughing, dry throat, tightening of the chest, headache, sensation of pressure in the head, and palpitations of the heart. Irritation symptoms may occur in people exposed to formaldehyde at concentrations as low as 0.10 ppm, but more frequently in exposures of 1.0 ppm and greater[7]. Ingestion can cause irritation of the mouth, throat, and stomach, nausea, vomiting, convulsions, and coma. Chronic exposure can cause dermatitis and sensitization of the skin and respiratory tract.[6]

Currently, NIOSH recommends that formaldehyde be considered as a potential occupational carcinogen based on studies in which laboratory rats exposed to formaldehyde vapor developed nasal cancer. Based on these studies and formaldehyde's demonstrated mutagenic capabilities, NIOSH recommends the reduction of occupational exposure to the lowest feasible level.[8]

ACETALDEHYDE can affect the body if it is inhaled, ingested, or if it comes in contact with the eyes or skin. NIOSH considers acetaldehyde to be a potential occupational carcinogen. Acetaldehyde vapors may cause irritation of the eyes, nose, and throat. Inhalation of high concentrations of acetaldehyde vapor may cause drowsiness, dizziness, and unconsciousness. Ingestion may cause drowsiness, dizziness, unconsciousness, kidney damage, and severe breathing difficulties which may be delayed in onset.[6]

VII. Results and Discussion

A. Environmental

Noise Measurements

Short-term noise level measurements were conducted and recorded plantwide. As shown in Table II, noise levels ranged between 75-96 decibels measured on the A-scale (dBA) and slow response, with most machine noise in the 80-90 dBA range. These levels are assumed to be representative of the full-shift TWAs for these machine operators and helpers, since the sources of the noise - the machines - operate nearly constantly during the shift and workers are present except for brief periods. The noise exposure of these workers are likely to be in excess of the 85 dBA, the NIOSH REL and the "action level" as defined in the OSHA Noise Standard - 29 CFR 1910.95[9]. Hazard warning signs were noted in-place at the machines with noise levels 90 decibels and above, and employees were observed wearing hearing protection devices in these areas. Hearing protection and annual audiometric testing are available to all employees.

Air sampling

Total airborne particulate sampling results are shown in Table III. Full-shift total airborne particulate levels were monitored at the Cloth Cutter, Stamper, signature gathering, and baling operations. Seven personal and 12 area samples were collected. Personal exposures in the baling area ranged from 3.8 to 5.8 mg/m^3. Personal exposures in the other areas were all less than 0.5 mg/m^3. All exposures were below the OSHA PEL (15 mg/m^3), and the ACGIH TLV (10 mg/m^3). A single area sample at the baler stair cover exceeded the ACGIH TLV.

It should be noted that these criteria for total airborne particulate may not be protective enough since the particulate may contain substances, such as adsorbed aldehydes, that may result in an increase in toxicity.

Total airborne particulate samples from the Stampers operation was further analyzed to check for the levels of 30 elements using NIOSH Method 7300[(2)]. The following elements were found to exceed the limit of detection of the analytical method: aluminum, barium, chromium, copper, magnesium, zinc, calcium, iron, and sodium. However, no personal exposure levels approached relevant evaluation criteria.

Carbon monoxide levels were monitored through collection of area samples at the Stamper, Crathern Casemaker, Kolbus Liner, Dexter, UB5 and UB4 Binder operations. Of the 14 full-shift area samples collected, all levels were found well below the NIOSH REL (35 ppm), OSHA PEL (35 ppm), and ACGIH TLV (25 ppm). The highest TWA found was
6 ppm.

1,1,1-Trichloroethane levels were monitored at the shrinkwrap, Stamper, Kolbus Liner, UB4 and UB5 binder, Compact 45, End Liner, End Paper Combiner, and Kolbus Tipper operations. Eighteen full-shift personal and five area samples were collected. No concentrations were found above the LOQ, which is 0.51 ppm and well below the relevant evaluation criteria.

The **aldehyde sampling** results are shown in Table IV. Aldehyde levels were monitored at the shrinkwrap, Dexter, Crathern Casemaker, Stamper, Kolbus Liners, UB4 and UB5 Binders, Compact 45, End Paper Combiner, and Kolbus Tipper operations. Fifteen area samples and 57 personal samples were collected. Twelve of the formaldehyde and four of the acetaldehyde personal exposures were measured above the NIOSH REL. The operations which had personal exposures above the NIOSH REL for these contaminants were: Kolbus liner, UB4 and UB5 binders, Compact 45, and End Paper Combiner. All personal and area formaldehyde measurements were below the OSHA PEL (0.75 ppm TWA). All personal and area acetaldehyde measurements were well below OSHA and ACGIH criteria (100 ppm TWA). NIOSH considers formaldehyde and acetaldehyde to be potential occupational carcinogens and recommends that exposures be kept to the lowest feasible level. The NIOSH REL is set at the LOQ for these potential carcinogens, therefore many workers were exposed to levels above the NIOSH REL.

Formaldehyde levels were also measured using the more sensitive impinger solution method, NIOSH Method 3500[(2)]. One personal sample and 23 area samples were collected from the End Paper Combiner, Kolbus Tipper, UB4 and UB5 binder, Compact 45, Stamper, Kolbus Liners, and Crathern Casemaker operations. Similar to the aldehyde sampling results presented above, measured concentrations ranged up to 0.09 ppm. These sampling results are shown in Table V. These sampling results reinforce the conclusion that workers at the following operations are potentially overexposed (with respect to NIOSH criteria) to formaldehyde concentrations: Kolbus Liners, UB4 and UB5 binders, Compact 45, and End Paper Combiner. Additionally, a single personal sample collected on the Kolbus Tipper operator exceeded the NIOSH REL. As mentioned above, NIOSH considers formaldehyde to be a potential occupational carcinogen and recommends that exposure

be kept to the lowest feasible level.

Ventilation evaluation: The pre-melt pots' local exhaust ventilation hoods are 2-3 feet above the pots to allow clearance for adding hot-melt glue pellets. The average face velocity of the local exhaust ventilation hoods at the UB4, UB5, and End Paper Combiner above pre-melt pots and points of application was approximately 50 feet per minute (fpm). Some of these pre-melt pots incorporate strip curtains to direct the hot-melt glue vapors into the local exhaust ventilation hoods. Some curtains had strips missing, and some pots were not equipped with curtains. The 1-inch slotted-hoods mounted above the Kolbus Liner and Compact 45 showed average slot face velocities of 225 and 750 fpm respectively. No strip curtains were in place at these machines.

A smoke tube survey demonstrated that vapors from the hot-melt glues often escape capture by the local exhaust ventilation hoods. The local exhaust ventilation hoods are located too far above the liquid hot-melt glues to be effective in capturing the vapors. The mixing of in-plant air by the pedestal fans further reduces the effectiveness of these local exhaust ventilation systems in use.

The Compact 45 exhaust ventilation system releases its effluent above the first floor roof, 10 feet outside second floor windows. These windows are often open in warm weather to allow additional ventilation. Thus, hot-melt glue vapors may be drawn into the second floor, resulting in potential exposure to workers.

B. Medical

Attached to the HHE request was a letter from a local physician who had evaluated 10 workers from Haddon Craftsmen. These individuals had worked in various areas of the plant and were selected for their long tenures at the facility. During the initial visit, interviews were conducted with six of these employees. These interviews revealed symptoms such as nose and throat dryness and irritation, but no specific respiratory problem other than shortness of breath on exertion in one worker. The most frequent complaint was headaches.

Several complained about the dust and vapors, particularly in the winter months when plant windows were not allowed open. (The windows were closed at the time of the NIOSH sampling survey.) Formaldehyde, acetaldehyde, and 1,1,1-trichloroethane are known upper respiratory irritants, and exposures to CO can produce headache, dizziness, fatigue and nausea.[6,7,10]

Medical records were obtained for the 10 workers and reviewed by a NIOSH physician. The medical records revealed complaints of symptoms suggesting an irritant exposure. The chest x-rays did not suggest an occupational fibrotic lung disorder. The local physician had suggested that five of the employees, showed abnormal spirometry and that two were borderline abnormal. However, the quality of the spirometry tracings did not meet American Thoracic Society (ATS) standards[11], thus making the interpretations questionable. The local physician reported that one individual (identified as a smoker during NIOSH interviews) had an abnormal CO-Hb of 4.70%. It is not uncommon however, for CO-Hb to be elevated in smokers. In non-smokers, it is normally less than 2.00 %, but can be as high as 5% in an urban environment. Smokers can have up to 12% CO-Hb without exposures other than cigarettes and ambient air.

Discussions with the company nurse and a review of the OSHA log sheets revealed problems with repetitive motion trauma, sprains and strains, but no respiratory complaints were reported. The OSHA 200 log did show one entry out of 48 entries in 1991 and five entries out of 80 entries in 1990 reporting burns to hands and forearms which resulted from contact with hot-melt glue.

VIII. Conclusion and Recommendations

A. Environmental

The noise survey demonstrated potential noise exposures above the NIOSH REL and OSHA's designated "Action Level". The employer should continue the annual audiometric testing program begun in 1983 for all employees exposed to noise above the REL of 85 dBA, 8-hour TWA. Legal requirements for an effective hearing conservation program are contained in 29 CFR 1910.95[9] - Occupational Noise Exposure. Recommendations for improving the employee hearing conservation program may be found in the NIOSH publication entitled *A Practical Guide to Effective Hearing Conservation Programs in the Workplace*[12].

The employer should establish an industrial hygiene program to monitor airborne particulate levels of baler area employees, and implement standard operating procedures for a respirator program if warranted. Legal requirements for an effective respiratory protection program are contained in 29 CFR 1910.134[9] - Respiratory Protection.

Several employees had formaldehyde and acetaldehyde exposures above the NIOSH REL. All concentrations measured were below the legal OSHA PELs. NIOSH considers formaldehyde and acetaldehyde to be potential occupational carcinogens and recommends that exposure be kept to the lowest feasible level. The following changes should be instituted to reduce potential aldehyde exposures at the Haddon Craftsmen book bindery:

1. Modify the existing local exhaust systems over the pre-melt pots to improve the effectiveness of local exhaust ventilation by completely enclosing the hot-melt glue pots.

   Establish effective local exhaust ventilation at all application points where hot-melt glues are applied to capture and remove vapors at their source, so that these vapors do not enter the general workplace environment. Improvements in local exhaust systems should be implemented by a firm specializing in this type of work.

2. While the above is being implemented, assure that all pre-melt pots for the hot-melt glues incorporate strip curtains to direct the atmosphere immediately above the surface of the pots into the local exhaust ventilation hoods, uninterrupted by the circulation of in-plant air. Assure that all elements of strip curtains are present and properly positioned at all times. This will help to contain the vapors within the exhaust ventilation system, and slow the spread of vapors into the work environment.

3. Monitor employee exposures to aldehydes as engineering controls are established to track the improvement in air quality.

Other recommendations include:

a. Furnish employees with (and require the use of) appropriate personal protective equipment while working/cleaning in close proximity to the liquid hot-melt glues to avoid burns from skin contact.

b. The rooftop exhaust vent from the first-floor Compact 45, should be extended to a point above the second-floor roof line to minimize introduction of exhaust vapors into the second-floor work areas.

c. In the baler area, handrail guarding should be set at the floor openings above the baler duct entries to prevent employee injuries from falling into the floor openings.

d. Implement the requirements of 29 CFR 1910.1200(h)[9] - Hazard Communication, Employee Information and Training - so that the workers will better understand the potential health risks of chemical exposure and effective ways to reduce these risks.

B. Medical

From the review of medical records, there did not appear to be respiratory problems other than irritant symptoms. Workers were found to be exposed to formaldehyde and acetaldehyde, which can cause respiratory irritation. Spirometry done as part of the pre-employment screening could serve as a baseline for future testing on these individuals.

There were numerous notations in the OSHA logs of strains, sprains, and other repetitive motion trauma. Though levels of most of the chemicals used in this facility were found to be below current OSHA standards, the combination of repetitive motion and low level neurotoxin exposure may have a synergistic or multiplied effect resulting in disease.[13] The company should either solicit outside help in identifying and correcting the cause of these problems or institute their own plan to eliminate these injuries.

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XI. Distribution and Availability

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Copies of this report have been sent to:
1. Haddon Craftsmen, Incorporated
2. Local 97B, Graphic Communications Union
3. Graphic Communications Union
4. OSHA Region III Offices

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 I
Evaluation Criteria
Haddon Craftsmen
Scranton, PA
April 7-9, 1992
HETA 91-181

ANALYTE	NIOSH REL[15]	OSHA PEL[9]	ACGIH TLV[16]
airborne particulate, total	none	15 mg/m³ TWA	10 mg/m³ TWA
1,1,1-trichloroethane	350 ppm C*	350 ppm TWA 450 ppm STEL	350 ppm TWA 450 ppm STEL
carbon monoxide	35 ppm TWA 200 ppm C	35 ppm TWA 200 ppm C	25 ppm TWA
acetaldehyde	LFL, CA	100 ppm TWA 150 ppm STEL	100 ppm TWA 150 ppm STEL
formaldehyde	LFL, CA	0.75 ppm TWA 2 ppm STEL	0.3 ppm C, CA
noise	85 dBA TWA 115 dBA C	85 dBA TWA - action level, 90 dBA TWA - hearing protection required	85 dBA TWA

TWA - 8-hour time-weighted average
STEL - 15-minute short-term exposure limit
CA - potential occupational carcinogen
LFL - lowest feasible limit
mg/m³ - milligrams analyte per cubic meter of air
ppm - parts analyte per million parts of air
C - ceiling exposure limit
dBA - decibels of noise (A-weighted scale)
* - this is a 15-minute ceiling value

Table II
Short Term Noise Survey Measurements
Haddon Craftsmen
Scranton, PA
August 5, 1991
HETA 91-181

Job/Location		Sound Level Measured (dBA)
Basement:	Sheridan	83-86
	Cloth Cutters	92-96
	Kolbus Stampers	81-84
	Flatbed Cutter	81-89
First Floor:	Kolbus Liners	82-88
	VT Trimmer	89-92
	UB5 Binder	84-90
	End Paper Combiner	84-88
	UB4 Binder	84-90
	Compact 45	82-85
	Gathering Machines	82-87
Second Floor:	Kolbus Tipper	81-83
	Simplex Tipper	75-78
	Rapid Trimmer	82-87
	Baum Folder	83-88
	Arm Gatherer	79-81
	Bracket Stripper	79-81
	Sewing area	82-84

dBA - decibels measured on the A-weighted scale, slow response

Table III
Airborne Particulate Sampling
Haddon Craftsmen
Scranton, PA
April 7-9, 1992
HETA 91-181

Job/Location	Sample Type	Concentration (mg/m^3)	Weight Gained (mg)	Minutes Sampled
Baler Attendant	personal	5.2	5.06	480
Baler Attendant	personal	5.8	5.61	480
Baler Attendant	personal	3.8	3.18	420
Baler stair cover	area	9.6	8.06	422
Baler stair cover	area	11.5	9.98	429
Baler stair cover	area	2.3	1.93	425
Cloth Cutter	personal	0.3	0.29	425
Cloth Cutter	personal	0.1	0.10	334
Cloth Cutter	personal	0.3	0.29	471
Cloth Cutter	personal	0.4	0.35	447
Chandler Price Stamper	area	0.2	0.17	460
Stamper #2	area	ND	ND	506
Stamper #3	area	0.2	0.19	513
UB4 Gatherer	area	0.2	0.23	490
UB4	area	0.1	0.10	520
UB4	area	0.2	0.19	477
UB5	area	0.1	0.04	369
UB5 Gatherer	area	0.2	0.16	444
UB5 Gatherer	area	0.4	0.42	471

EVALUATION CRITERIA

ACGIH TLV	**10.0 mg/m^3 TWA**
OSHA PEL	**15.0 mg/m^3 TWA**
LOD - limit of detection	**0.01 milligrams per sample**

mg/m^3 - milligrams airborne particulate per cubic meter of air
ND - none detected

Table IV
Total Aldehyde and Trichloroethane Sampling Results
Haddon Craftsmen
Scranton, PA
April 7-9, 1992
HETA 91-181

Job/ Location	Sample Type	Formaldehyde Concentration (ppm)	Acetaldehyde Concentration (ppm)	Minutes Sampled
Crathern Casemaker	area	ND	ND	472
Crathern Casemaker	area	<LOQ	ND	509
Crathern Casemaker	area	ND	ND	514
Crathern Casemaker Helper	personal	<LOQ	<LOQ	476
Crathern Casemaker Operator	personal	ND	<LOQ	479
Crathern Casemaker Operator	personal	<LOQ	<LOQ	461
Compact 45 Apprentice	personal	0.08	0.10	468
Compact 45 Apprentice	personal	<LOQ	<LOQ	471
Compact 45 B-worker	personal	0.07	<LOQ	445
Compact 45 Helper	personal	<LOQ	<LOQ	480
Compact 45 Journeyman	personal	0.07	0.07	477
Compact 45 Journeyman	personal	<LOQ	<LOQ	441
Compact 45 Operator	personal	<LOQ	<LOQ	484
Compact 45 Operator	personal	<LOQ	<LOQ	488
Compact 45 Operator	personal	<LOQ	<LOQ	479
Compact 45 Operator	personal	<LOQ	<LOQ	484
Dexter	area	ND	ND	523
End Liner	area	<LOQ	ND	473
End Liner Journeyman	personal	0.06	<LOQ	479
End Liner Operator	personal	<LOQ	<LOQ	484
End Paper Combiner Journeyman	personal	0.09	<LOQ	535
End Paper Combiner Operator	personal	0.06	0.08	471
End Paper Combiner Operator	personal	<LOQ	<LOQ	460
End Paper Combiner Operator	personal	<LOQ	ND	81
End Paper Combiner Operator	personal	<LOQ	<LOQ	470
End Paper Combiner Trainee	personal	0.07	<LOQ	486
Kolbus Cassing-In	area	0.06	<LOQ	453
Kolbus Liner	area	<LOQ	<LOQ	486
Kolbus Liner	area	<LOQ	<LOQ	506
Kolbus Liner	area	<LOQ	<LOQ	450
Kolbus Liner	area	<LOQ	ND	515
Kolbus Liner Feeder	personal	0.07	<LOQ	465
Kolbus Liner Journeyman	personal	<LOQ	<LOQ	452
Kolbus Liner Journeyman	personal	0.08	0.07	455
Kolbus Liner Operator	personal	<LOQ	ND	464

Table V
Formaldehyde Impinger Sampling Results
Haddon Craftsmen
Scranton, PA
April 7-9, 1992
HETA 91-181

Job/Location	Formaldehyde Concentration (ppm)	Liters Sampled	Minutes Sampled	Sample Numbers
Crathern Casemaker	< LOQ	208.4	511	684 / 682
Crathern Casemaker	< LOQ	209.2	513	678 / 648
Crathern Casemaker	< LOQ	214.1	525	657 / 690
End Paper Combiner	0.09	194.5	493	687 / 679
End Paper Combiner	0.07	190.6	483	647 / 650
End Paper Combiner	0.07	203.2	515	644 / 602
Compact 45	0.04	192.0	471	677 / 683
Compact 45	0.07	198.3	472	674 / 662
Compact 45	0.07	209.2	513	616 / 618
Compact 45	0.06	208.4	496	688 / 617
Compact 45	0.06	205.1	503	686 / 654
Kolbus Liner	0.06	213.7	506	658 / 661
Kolbus Liner	0.07	217.4	515	645 / 666
Kolbus Tipper	void	122.6	252	607 /
Kolbus Tipper	0.01	207.6	493	680 / 663
Kolbus Tipper	0.03	250.5	515	668 / 642
Kolbus Tipper Operator	0.01	223.7	460	653 / 665
Remote at breakroom	< LOQ	212.7	522	632 / 664
Remote at breakroom	0.03	215.1	538	685 / 649
Stamper	< LOQ	200.0	476	629 / 610
Stamper	< LOQ	207.0	517	672 / 671
UB4	0.07	201.4	506	612 / 646
UB5	0.05	195.4	491	651 / 655
UB5	0.07	206.2	518	636 / 613
Limit of Quantitation (LOQ)	0.017 ppm			
Evaluation Criteria				
NIOSH REL	LFL			
OSHA PEL	0.75 ppm			
ACGIH TLV	0.3 ppm ceiling			

LFL - lowest feasible limit
ppm - parts analyte per million parts air
STEL - short term exposure limit
<LOQ - below the NIOSH Method's Limit of Quantification
ND - none detected
CA - potential human carcinogen
TWA - Time-weighted Average exposure