HETA 87-369-1929
SEPTEMBER 1988
THE BOSTON HERALD
BOSTON, MASSACHUSETTS

NIOSH INVESTIGATORS:
Teresa A. Seitz, M.P.H.
Scott Deitchman, M.D., M.P.H.

I. SUMMARY

In July, 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from Local 600 of the Graphic Communications International Union to evaluate exposure to Y-Polymer in the photoengraving department at the Boston Herald, Boston Massachusetts. The request concerned complaints of skin sensitization and irritation, shortness of breath, dizziness, and headaches. The Boston Herald produces a daily newspaper which utilizes Y-Polymer and the W.R. Grace & Company Letterflex* photographic system to create relief printing plates. Y-Polymer is a proprietary product containing a urethane-based polyene, a methacrylate monomer, a photoinitiator, and a polythiol, as the major components. Two of the components, the methacrylate and the polythiol, are known skin sensitizers.

On November 16-17, 1987, personal breathing zone and general area air samples were collected to assess potential exposures to Y-Polymer vapor and mist. Because a sampling and analytical method was not available for these substances, several analytical techniques were evaluated. Exposure monitoring was also performed for isopropyl alcohol, which is used to clean the Letterflex equipment, and for formaldehyde, which was previously reported as a byproduct of the photocuring process.

A NIOSH medical officer interviewed thirteen of the fifteen photoengraving department employees who had occupational contact with the Letterflex process. Workers were questioned about past or present signs and symptoms of skin disorders; skin disorders described by the employees were examined at the time of the interview. Company medical logs and and OSHA 200 forms were reviewed.

The methacrylate compound was detected in area air samples as well as in all personal breathing zone air samples. Due to incomplete desorption of this substance from the sampling media, the methacrylate component could not be quantitated. One of the area air samples showed the presence of the photoinitiator component as well. Presently, there are no established environmental evaluation criteria for Y-Polymer or the major components of this product. Isopropyl alcohol exposures of the plate operators and the crimper ranged from 15 to 67 parts per million (ppm), with all values falling below the NIOSH, OSHA, and ACGIH evaluation criteria. Formaldehyde was not detected on any of the personal breathing zone air samples and was found in concentrations less that 0.01 ppm in general area air samples.

Several employees described a mild feeling of irritation of the skin at the time of skin contact with Y-Polymer, but this was immediately relieved by washing the skin. Only one case of skin irritation was seen during the site visit, and this reportedly resolved spontaneously. It was not possible to demonstrate or refute the possibility of allergic sensitization in other workers.

The data collected during this evaluation indicate that photoengraving department employees have potential airborne exposure to Y-Polymer vapor and mist, and dermal exposure to Y-Polymer from contact with contaminated equipment surfaces. Although no exposure criteria exist for this product, nor for its major components, exposures should be kept to the lowest feasible level, as two of the components are known skin sensitizers. Recommendations are made in Section VII of the report, with the goal of minimizing employee exposure to Y-Polymer and isopropyl alcohol.

KEYWORDS: SIC 2753 (Engraving and plate printing), 2711 (newspaper publishing and printing), Y-Polymer, Letterflex*, skin sensitization, methacrylates, isopropyl alcohol.

II. INTRODUCTION

In July, 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from Local 600 of the Graphic Communications International Union to evaluate exposures to Y-Polymer in the photoengraving department at the Boston Herald, Boston, Massachusetts. NIOSH was asked to evaluate health effects including skin irritation and sensitization, shortness of breath, dizziness, and headaches, and their association with workplace exposures to Y-Polymer. In response to this request, two NIOSH Industrial Hygienists conducted an environmental survey in the photoengraving department on November 16-17, 1987. A NIOSH Medical Officer conducted personal interviews with employees in the department and reviewed medical records. Preliminary findings and recommendations were presented to union and management representatives at the conclusion of the survey on November 17, 1987, and again in a letter dated December 14, 1987.

III. BACKGROUND

The Boston Herald produces a daily newspaper, with a circulation of approximately 420,000 on weekdays and 300,000 on Sundays. Printed copies of the newspaper are reproduced using relief plates which are created in the photoengraving department. Each plate represents a single page of the newspaper and is capable of producing several hundred thousand copies of printed material.

The Boston Herald's printing plate manufacturing process utilizes the W.R. Grace & Company Letterflex* photographic system and the photoprepolymer, Y-Polymer. Y-Polymer contains a urethane-based polyene, a methacrylate monomer, a photoinitiator, and a polythiol, as the major components .[1,2] Specific components are not identified in this report, as this information is considered proprietary.

There are three Letterflex 290 machines in operation at the Boston Herald. Each machine has six main sections: plate loading, forming, main exposure, air knife, blotter, and post exposure. The platebacking, which is made out of aluminum, is mounted onto a conveyor in the plate loading section and then moved to the forming area, where Y-Polymer is spread over the surface with a moving blade. Y-Polymer is mechanically dispensed to the Letterflex equipment from storage drums located beside each machine. As Y-Polymer is spread out, a light ultraviolet (UV) irradiation is provided to begin the hardening process. Photographic negatives of the newspaper pages (prepared previously) are wiped with an alcohol mixture to clean the surfaces and minimize static. The negatives are then manually loaded into the main exposure chamber, directly above the formed plate. The plates are then further irradiated, causing the exposed areas to harden. In the air knife section, hot compressed air is blown over the plate to remove unreacted polymer. Blotting paper is then applied to remove residual polymer. In the post exposure chamber, a high intensity xenon lamp provides the final cure. The printing plates are then split in two, where they exit to the plate drop bin. The air knife section and the post exposure chamber are provided with local exhaust ventilation.

The Letterflex machines are typically operated in the automatic mode, however, they can be operated manually if necessary. There is one plate operator for each machine. This individual is responsible for loading and unloading the negatives, and for monitoring the overall operation and cleaning of the equipment. Trimming and bending of the finished plates, to prepare the plates for use in the presses, is performed by the crimper. Although these individuals have the greatest potential for Y-Polymer exposure, other

photoengraving department employees assist in plate-making activities during busier times, and therefore, also have

potential exposure to this product.

IV. METHODS AND MATERIALS

A. Environmental Evaluation

The environmental evaluation consisted of exposure monitoring for Y-Polymer, formaldehyde, and isopropyl alcohol, during the evening shift on November 16-17, 1987. The evening shift was selected for the evaluation, as this is when the majority of the plates are made. Although measurements were made for UV radiation around the Letterflex equipment, these data are not presented due to problems encountered with the UV detection meter.

Y-Polymer

Because specific sampling and analytical methods were not available for Y-Polymer or its major components, several analytical techniques were evaluated. In addition, due to the possibility that Y-Polymer may have been present as a vapor as well as a mist (from the air knife operation), air samples were collected on several different media, including activated charcoal, ORBO-42 sorbent tubes (porous styrene-divinylbenzene polymer), and polytetrafluoroethylene (PTFE) filters. Charcoal and ORBO-42 sorbent tubes were later spiked with the methacrylate ingredient (obtained from the manufacturer) to determine which substrate, if any, had a better desorption efficiency - an indication of the suitability of the collection media. Four spikes each at two concentration levels, were analyzed.
Eight general area air samples were collected on activated charcoal and on ORBO-42 tubes for qualitative analysis (identification only) of organic contaminants; that is, components or reaction products of Y-Polymer. Full shift air samples were collected using battery-operated sampling pumps at flowrates ranging from 0.2 to 0.4 liters per minute (l/min). Air samples were collected by the air knife section, at the main exposure units, by the plate drop, and in the headspace of a Y-Polymer container. Charcoal tube samples were desorbed with carbon disulfide; ORBO-42 tubes with methanol, in an ultrasonic bath for 30 minutes. The solutions were first screened with a gas chromatograph equipped with a flame ionization detector (GC-FID) and a 30 meter DB-1 fused silica capillary column. Representative samples were further analyzed by the more sensitive gas chromatographic/mass spectrometric technique (GC-MS) for peak identification.

Personal breathing zone air samples were collected on activated charcoal, and based on the GC-MS results, the major contaminants were quantitated. Air samples were collected from the three plate operators and the crimper.

To assess potential exposures to Y-Polymer mist, four full-shift area air samples were collected behind the main exposure units of machines #1 and #3, by machine #1 plate drop, and at the air knife section of machine #2. Exposure to Y-Polymer mist was of particular concern, due to the fact that operators would periodically remove the protective cover above the air knife to visually inspect the newly formed plates, allowing the escape of Y-Polymer mist. Samples collected behind the main exposure units were taken to assess whether mist from the air knife was contaminating these areas, potentially exposing the operator of the Letterflex machine directly behind. The sampling train consisted of a 37-millimeter (mm) cassette with a 37-mm PTFE membrane filter (1- to 3-micron pore size) and a sampling pump operating at a flowrate of

approximately 2 l/min. Samples were analyzed by extracting the filters with 5.0 milliliters (ml) of methanol for 3 hours, after which time the filters were removed. The methanol was allowed to evaporate, and the remaining portion was incorporated into a potassium bromide pellet for infrared analysis. Using Fourier Transform-Infrared Spectroscopy (FT-IR) an infrared spectrum was obtained on each residue. Comparisons were then made with Y-Polymer reference spectra.

Isopropyl Alcohol

Isopropyl alcohol is used to clean the Letterflex equipment at the end of the shift and in preparing the surface of the photographic negatives. Personal breathing zone air samples were obtained for the three plate operators and the crimper. Air samples were collected on activated charcoal using personal sampling pumps calibrated between 175 and 200 ml/min. Analysis was performed using gas chromatography, in accordance with NIOSH Method 1400.[3]

Formaldehyde

To address a concern regarding the possible release of formaldehyde during the photocuring process, personal breathing zone and general area air samples were collected. Personal breathing zone air samples were collected from each of the three plate operators and the crimper, using ORBO-22 solid sorbent tubes [Chromosorb 102 coated with 2-(benzylamino)ethanol] and personal sampling pumps calibrated at 80 ml/min. Samples were analyzed by gas chromatography in accordance with NIOSH Method 2502.[3] General area air samples were collected by the post exposure chamber and in the middle of the workroom. Area air samples were collected and analyzed in accordance with NIOSH Method 3500.[3] In addition, three short term measurements were made around the Letterflex machines using direct-reading detector tubes specific for formaldehyde.

Isocyanates

Diisocyanates comprise the monomeric subunits in urethane polymerization.[4] Because free monomeric diisocyanate may still be present in urethane-based polymers or prepolymers, a bulk sample of Y-Polymer was analyzed for the presence of isocyanates. Portions of the bulk were disolved in toluene and added to toluene solutions of 1-(2-methoxyphenyl) piperazine. Solutions were then analyzed for loss of reagent and presence of isocyanate ureas by high pressure liquid chromatography (HPLC), with electrochemical and UV detection.

B. Medical Evaluation

Thirteen employees were interviewed by a NIOSH medical officer on November 16-17, 1987. Employees interviewed included all those working the evening shift on November 16-17 who were potentially exposed to Y-Polymer, as well as one employee who had been on leave for several months. Each employee interviewed was asked if they had health problems related to their work. Specific questions were asked to elicit any history of skin irritation or skin disease. Employees reporting skin disease at the time of the interview were examined by the medical officer. Employees were later contacted by telephone, as needed, for additional followup.

During the site visit the OSHA 200 logs and the medical log books were reviewed.

V. EVALUATION CRITERIA

A. Environmental

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 if 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 evaluation 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 Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs*), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLVs usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

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 exposurelimits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Table 1 presents the evaluation criteria and a brief summary of the primary health effects of the airborne

contaminants measured during this evaluation. As indicated in the table, there are presently no environmental evaluation criteria for Y-Polymer, nor for the major components of this product.

B. Medical

Dermatitis, or skin irritation, can arise in the workplace by several mechanisms. A substance may induce an allergic reaction in the skin, in which case it is a contact sensitizer (because the skin becomes immunologically sensitized to the substance, and an allergic reaction occurs when the substance contacts the skin). Contact sensitization can occur after as little as a week of exposure or not until years of exposure have occurred; whether or not it occurs at all may depend on the substance, the condition of the skin, environmental factors, the extent and duration of exposure, and/or health factors unique to each individual.

Some of the chemicals used in the Letterflex process have been reported to induce contact sensitization in workers. In 1977, Malten published case reports of Dutch printers who became sensitized to the Letterflex photopolymers in use at that time.[5] Three patients patch tested with the American and English Letterflex photopolymer mixtures reacted positively. Although there have been some changes in the composition of the photopolymer mixture over the years, two of the ingredients (the methacrylate and the polythiol) in Y-Polymer, the Letterflex product in current use, are known sensitizers.[1]

Skin contact with isopropyl alcohol can result in loss of protective oils and fats in the skin; this loss leads to skin drying and cracking. Dry skin is also more susceptible to irritation from other substances.

VI. RESULTS

A. Environmental

Y-Polymer

Results from the area air monitoring are presented first, as this information was used in the analysis of personal breathing zone air samples.
The chromatograms from the GC-FID analyses of area air samples collected on charcoal gave nearly identical results for samples collected by the main exposure unit of machine #1, air knife section of machine #3, and in the headspace of a Y-Polymer container. Further analysis of the latter sample by GC-MS identified the methacrylate component of Y-Polymer, a substituted phenol, isopropyl alcohol, toluene, xylene, and various C6 - C12 alkanes (aliphatic hydrocarbons). The air sample collected by the plate drop area of machine #1 showed only isopropyl alcohol and toluene.

When ORBO-42 sorbent tubes were used as the collection media, the methacrylate component and a substituted phenol were the major substances identified in air samples collected by the air knife section of machine #3 and in the headspace of a Y-Polymer container. Another component of Y-Polymer, the photoinitiator, was identified in the air sample collected by the air knife section of Letterflex machine #3.

The infrared spectra of residues from PTFE filter samples did not show the presence of Y-Polymer. Although weak IR spectra were obtained on each residue, comparison with IR spectra of methanol extracts of a Y-Polymer bulk and major components of this product obtained from the manufacturer (the methacrylate, polythiol, and the photoinitiator) indicated that these substances were not present on the filter samples.

The methacrylate component was present in small amounts in all four personal breathing zone air samples. The methacrylate component could not be quantitated, however, because a desorption efficiency study indicated that there was a stability or reactivity problem with this substance on charcoal. The desorption efficiency study revealed that charcoal and ORBO-42 tubes spiked with known concentrations of the methacrylate ingredient gave variable desorption. Other substances present on the personal air samples were hexane, toluene, xylenes, and various (other) hydrocarbons. Although these substances were present in all four breathing zone samples, their concentrations were less than one-one hundredth (1 %) of the most stringent exposure criteria for the respective substances. Isopropyl alcohol, also present on the personal samples, was analyzed separately as discussed below.

Isopropyl alcohol

Results from the exposure monitoring for isopropyl alcohol are listed in Table 2. Isopropyl alcohol concentrations ranged from 15 to 48 ppm for the crimper and plate operators #2 and #3. The concentration of isopropyl alcohol in the breathing zone of plate operator #1 was estimated as 67 ppm. Because the quantity of isopropyl alcohol found on the back-up section of this sample was more then 25% of the front section, the possibility of breakthrough and sample loss exists. The TWA concentration for plate operator #1 may, therefore, be underestimated.

Formaldehyde

Personal breathing zone and area air sampling results for formaldehyde are summarized in Table 3. No formaldehyde was detected in any of the breathing zone air samples. The limit of detection for this method was 2 micrograms per sample, which corresponds with a formaldehyde concentration of less than 0.06 ppm. Area air sampling results indicate that formaldehyde was present in concentrations less than 0.01 ppm. Based on a sample volume of 300 liters, the limit of detection for this method is approximately 0.001 ppm. No formaldehyde was detected in three grab air samples collected around the Letterflex units using direct-reading detector tubes, to a limit of detection of 0.2 ppm.

Isocyanates

No free isocyanate was detected in a bulk sample of Y-Polymer. Based on the quantity of sample analyzed, the limit of detection was estimated as less than 0.001% isocyanate.

B. Medical

Of the thirteen workers interviewed, seven worked as platemakers and were directly exposed to the Letterflex process; the remaining six were employed in the photo room as photographers or strippers. Although the photo room employees are physically separated from the platemaking area, some of these employees assist in platemaking during busy times. None of the employees interviewed at work reported any of the symptoms listed in the health hazard evaluation request (headaches, dizziness, etc). Eight workers said they had not experienced any skin disorders as a result of their contact with the platemaking process or with Y-Polymer. Three other workers stated that when they inadvertently had skin contact with Y-Polymer, they immediately felt mild irritation at the site of contact. This irritation was quickly relieved by washing off the Y-Polymer. Employees frequently described the use of isopropanol to wash Y-Polymer off their skin. None

of these employees had any signs of skin disorders at the time of the interview. Several workers said they did not wear gloves at all times during the operation of the Letterflex machines; the reason commonly given was that the gloves interfered with their job performance, particularly mounting and removing the negatives. One employee described a history possibly compatible with skin sensitization. Another employee had a small area of dermatitis at the time of the visit, but in a telephone conversation later reported it had cleared completely, without any change in work practices.

The OSHA 200 forms and the medical log book did not identify any additional cases of dermatitis. We noted several cases of cut fingers or hands incurred while handling the Letterflex plates. We also noted several cases of eye irritation from alcohol splashes to the eyes.

VII. DISCUSSION AND CONCLUSIONS

Because there were no established sampling and analytical methods for components of Y-Polymer, several techniques were evaluated during this investigation. The environmental monitoring results indicate that charcoal and ORBO-42 tubes had collected the methacrylate component; however, due to inconsistent desorption from both collection media, this substance could not be accurately quantitated. Additional research is needed in this area to identify either more efficient sampling media or better desorbing solvents for this substance. The photoinitiator was found on an area air sample collected on ORBO-42, yet not on a paired charcoal tube sample, thus indicating that ORBO-42 was a better substrate for this particular substance. Despite the analytical limitations encountered, this evaluation was successful in documenting the presence of components of Y-Polymer in personal breathing zone and area air samples, where previous surveys conducted at this plant were not.[6,7]

It is clear from this work that at least some of the components of Y-Polymer have sufficient volatility that they can be present as vapors in the workroom air. The source of the vapors appears to be the forming area (which is not enclosed) and the air knife section. Air samples collected at the plate drop bin did not show the presence of Y-Polymer. This is most likely due to the fact that by the time the plates reach the plate drop bin, the polymer is fully cured.

Although the PTFE filter samples did not show the presence of Y-Polymer, observations made during this investigation indicate that Y-Polymer misting does occur when the protective cover above the air knife is opened, as evidenced by visible mist and surface contamination in this area. We observed that some operators would routinely open the protective cover above the air knife to visually inspect the newly formed plates. This practice is not recommended because it creates unnecessary exposure to aerosolized Y-Polymer and compromises the effectiveness of the local exhaust ventilation. It is possible that the filter samples did not show evidence of Y-Polymer because the sample locations were too far from the misting area and settling had already occurred. It is also possible that some of the components had volatilized off the filters. To further evaluate sample volatilization from PTFE (or other) filter media, future sampling could utilize a modified sampling train consisting of a PTFE prefilter followed by solid sorbent media.

Isopropyl alcohol exposures were below the applicable NIOSH, OSHA, and ACGIH occupational exposure criteria for this substance. The greatest potential for isopropyl alcohol exposure occurs during clean-up of the Letterflex machines at the end of the shift.

In August, 1985, an environmental survey conducted by the U.S. Department of Labor, OSHA, reported

instantaneous airborne concentrations of formaldehyde around the Letterflex machines (as measured by a Miran 1B Infrared Gas Analyzer) ranging from 0.2 to 2.2 ppm.[6] In this investigation, however, no formaldehyde was detected in full-shift air samples collected in the breathing zone of the three plate operators, to a limit of detection of 0.06 ppm. In addition, direct-reading detector tubes failed to document the presence of formaldehyde in the area immediately surrounding the equipment. Because the infrared spectroscopy method used by the OSHA investigator is not specific for formaldehyde, it is subject to posititve interference from other substances.

During the NIOSH site visit we identified one possible cause of skin sensitization. In the absence of additional evidence of allergic contact dermatitis among exposed workers, further medical investigation of the employees by NIOSH does not seem warranted. However, published investigations at other sites clearly show the potential for chemicals used in the Letterflex process to induce contact sensitization. It is therefore important that skin contact with these substances be reduced as much as possible through the use of protective equipment and appropriate work practices, as detailed in the following recommendations. Individuals with persistent health complaints may require evaluation or treatment by their physicians. Skin patch testing (which can be performed by a dermatologist or other qualified physician) would be the appropriate procedure to help determine whether contact sensitization has occurred in an individual.

VIII. RECOMMENDATIONS

Based on the results of our evaluation, the following recommendations are made, with the goal of minimizing exposure of the photoengraving department employees to Y-Polymer and isopropyl alcohol.Recommendations 1 through 5 have already been presented to The Boston Herald, in a letter dated December 14, 1987.

1. The practice of lifting the cover to view the plates in the air knife section should be discontinued, as this can result in exposure to Y-Polymer mist. It can also result in surface contamination and potential skin exposure from contact with equipment surfaces. We observed that some operators would routinely open the protective cover above the air knife to view the newly formed plates, while others did this infrequently. If viewing the plates is, in fact, necessary, a clear cover can be installed so that operators could view the plates without lifting the cover. Although this new cover may require frequently cleaning (manual or automatic), this is preferable to a situation where employees are exposing themselves unnecessarily to a product which can cause skin sensitization and irritation.

2. Gloves and long-sleeved garments should be worn by employees while operating and cleaning the Letterflex machines, as the potential exists for skin contact with Y-Polymer, isopropyl alcohol, and Neutro-Stat, all of which can result in skin irritation. The manufacturer of Y-Polymer recommends the use of either nitrile or butyl rubber gloves. Either glove material would be suitable protection against isopropyl alcohol and Neutro-Stat as well. In selecting a suitable glove material, consideration should be given to providing protection from chemicals used in the plateroom as well as allowing the employee to perform routine tasks such as loading and unloading negatives and plates. Failure to do so will result in employees not wearing the prescribed hand protection.

3. Safety glasses or goggles should be worn by machine operators when handling isopropyl alcohol, as the medical records indicated that splashing with isopropyl alcohol has resulted in eye irritation for several individuals.

4 Isopropyl alcohol should not be used for cleaning skin surfaces because it can cause skin drying and irritation, and can alter skin permeability, making the skin more susceptible to irritation and penetration by other substances. Skin which has been contaminated with Y-Polymer should be cleaned immediately with soap and water. In addition, contaminated equipment surfaces should be promptly cleaned to prevent skin contact with Y-Polymer.

5. The isopropyl alcohol and Neutro-Stat containers should be labelled with the identity of the hazardous substances contained within them, and with appropriate hazard warning labels. The Y-Polymer storage tanks located by each machine also should be labelled accordingly.
6. The Letterflex machines should be inspected periodically to ensure adequate protection against UV radiation. The inspection should include measurement of UV radiation in the actinic region, around all Letterflex units, with particular attention being given to the areas immediately surrounding the UV sources.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:	Teresa A. Seitz, M.P.H. Industrial Hygienist Industrial Hygiene Section
	Scott Deitchman, M.D., M.P.H. Medical Officer Medical Section
Field Assistance:	Bruce Hills Industrial Hygienist Industrial Hygiene Section
Analytical Support:	Ardith A. Grote Chemist Measurements Support Section, Measurements Research Support Branch Division of Physical Science and Engineering
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Hazard Evaluations, and Field Studies
Report Typed by:	Linda Morris Clerk Typist Industrial Hygiene Section

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1. The Boston Herald, Boston, Massachusetts
2. Local 600, Graphics Communication International Union, Revere, Massachusetts
3. NIOSH, Boston Region
4. OSHA, Region I

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
Environmental Evaluation Criteria
Boston Herald
Boston, Massachusetts
HETA 87-369

Substance	Evaluation Criteria (ppm)[a] NIOSH	OSHA	ACGIH	Primary Health Effects
Y-Polymer	NE	NE	NE	The methacrylate monomer and polythiol components are considered sensitizers. Skin irritation and sensitization may result from repeated contact, with symptoms of erythema and edema. Shortness of breath, nausea, headaches and fainting may result from overexposure.[b]
Isopropyl Alcohol (Isopropanol, IPA)	400	400	400	May cause irritation of the eyes, nose and throat. Skin contact can result in dry, cracking skin.
Formaldehyde	LFL	1	1	May cause eye, nose, and throat irritation. Imitative symptoms have been documented as low as 0.1 ppm; however, symptoms are more Commonly reported at levels of 0.5 ppm and higher. Skin contact can cause allergic contact dermatitis. NIOSH recommends that exposure be kept to the lowest feasible level, as formaldehyde is considered a potential carcinogen.
Diisocyanates	*	*	*	May cause skin, eye, and respiratory tract irritation. Diisocyanate sensitization may occur in some individuals with repeated exposures. Sensitization may manifest as skin disorders and as an asthma-like response to diisocyanates at very low concentrations.

[a] Evaluation criteria are expressed as time-weighted average concentrations in parts per million (ppm). NE = not established. LFL = lowest feasible level. * = evaluation criteria are dependent on the specific diisocyanate substance.

[b.] Information obtained from the manufacturer's material safety data sheets of September 19, 1985 and March 13, 1987.

Table 2
Isopropyl Alcohol Exposure Data
Boston Herald
Boston, Massachusetts
HETA 87-369
November 16-17, 1987

Job Classification	Sample Type[a]	Sampling Method[b]	Sampling Time (minutes)	Sample Volume (liters)	Isopropyl Alcohol Concentration (ppm)[c]
Plate #1 Operator	BZ	CT	332	64.3	(67)[d]
Plate #2 Operator	BZ	CT	330	57.3	18
Plate #3 Operator	BZ	CT	352	68.5	48
Crimper	BZ	CT	324	40.9	15
NIOSH Recommended Exposure Limit (REL)					400 800 (15 min ceiling)
OSHA Permissible Exposure Limit (PEL)					400
ACGIH Threshold Limit Value (TLV*)					400 500 (STEL)

[a] BZ = breathing zone air sample
[b] CT = charcoal tube
[c] concentration in parts per million (ppm), as a time-weighted average over the sampling period; limit of detection = 0.01 mg per sample; limit of quantitation = 0.03 mg per sample.
[d] The quantity of isopropyl alcohol found on the backup section of this sample was more than 25% of the front section, therefore, the possibility of breakthrough and sample loss exists.

Table 3

Formaldehyde Exposure Data
Boston Herald
Boston, Massachusetts
HETA 87-369
November 16-17, 1987

Sample Description	Sample Type[a]	Sampling Method[b] (minutes)	Sampling Time (liters)	Sample Volume (ppm)[c]	Formaldehyde Concentration
Plate #1 Operator	BZ	ST	332	25.5	ND
Plate #2 Operator	BZ	ST	328	25.9	ND
Plate #3 Operator	BZ	ST	352	27.3	ND
Crimper	BZ	ST	325	25.6	ND
Plate #1 Post Exposure	P	IMP	300	300	<0.01
Middle of Room	GA	IMP	300	300	<0.01
NIOSH Recommended Exposure Limit (REL)					Lowest Feasible Level
OSHA Permissible Exposure Limit (PEL)					1.0 2.0 (STEL)
ACGIH Threshold Limit Value (TLV*)					1.0 2.0 (STEL)

[a] BZ = breathing zone air sample; P = process sample; GA = general area air sample.
[b] ST = solid sorbent tube (ORBO-22); IMP = impinger solution (1% sodium bisulfite).
[c] concentration in parts per million (ppm), as a time-weighted average over the sampling period; ND = none detected; limit of detection is 2 micrograms per sample for the sorbent tube; limit of detection is 0.3 micrograms per sample for impinger method and limit of quantitation is 0.94 micrograms per sample.