HEALTH HAZARD EVALUATION REPORT 72-104-39
HAZARD EVALUATION SERVICES BRANCH
DIVISION OF TECHNICAL SERVICES

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Establishment : Wehmeier Reproduction Service
Cincinnati, Ohio

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

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I. SUMMARY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from the owner of the Wehmeier Reproduction Service, 4609 Fehr Road, Cincinnati, Ohio regarding exposures to ammonia and ozone during operation of a blueprint machine.

Occupational health standards which have been promulgated by the U.S. Department of Labor (Federal Register, Part II, Subpart G, §1910.93, Table G-1) applicable to the substances of this evaluation are:

Substance	8-Hour Time Weighted Average Exposure
Ammonia	50 ppm
Ozone	0.1 ppm

NIOSH investigators conducted an initial survey of the Wehmeier Reproduction Service on November 21, 1972 at which time detector tubes were used to measure ammonia and ozone levels in the work area. Ammonia levels were found to be in the range of less than 5 ppm to 11 ppm while ozone could not be detected. A follow-up environmental/medical investigation was conducted on February 23, 1972 at which time continuous samples for ammonia and ozone detector tube samples were used for environmental evaluation. The personal continuous sample for ammonia resulted

in a measurement of 0.91 ppm concentration in the operator's breathing zone. Ozone was not detected in the work area (<0.05 ppm). Complete medical interviews with the concerned individuals were obtained. It is concluded that the subject substances, ammonia and ozone, are not toxic at the concentrations found in this work environment. Nonetheless, if appropriate conditions prevail, there is a possibility the exposed individual may suffer minimal discomfort arising from the irritative nature of ammonia. The environmental results are consistent with the negative medical findings since the continuous personal exposure to 0.91 ppm of ammonia is much lower than recommended levels to protect against irritation to the eyes and respiratory tract and ozone was not detected in the work area.

Copies of this Summary Determination as well as the Full Report of the evaluation are available from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202 Copies of both have been sent to:

a) Wehmeier Reproduction Service, Cincinnati, Ohio

b) U.S. Department of Labor - Region V

For purposes of informing "affected employees", the employer will promptly "post" the Summary Determination in a prominent place(s) near where affected employees work for a period of 30 calendar days.

II. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from the employer of the Wehmeier Reproduction Service, 4609 Fehr Road, Cincinnati, Ohio.

The operation which caused initiation of the request is performed by a Pease Zephyr blueprint machine which imprints a sepia image onto sensitive paper with a high pressure mercury vapor lamp. The print is then developed by an ammonia solution.

The evaluation of ammonia vapors, ozone, and radiation was requested by the employer. Since ultraviolet radiation is a physical agent and does not meet the definition of a substance under Section 20(a)(6), it was explained to the requester that an evaluation of potentially toxic effects of ultraviolet radiation from the blueprint machine could not be included in the hazard evaluation.

III. BACKGROUND HAZARD INFORMATION

A. Standards

The occupational health standards applicable to the substance of this request promulgated by the U.S. Department of Labor (Federal Register, Part II, Subpart G, §1910.93, Table G-1) are:

Substance	8-Hour Time Weighted Average Exposure
Ammonia	50 ppm*
Ozone	0.1 ppm*

Occupational health standards are established at levels designed to protect workers occupationally exposed to a substance on a 8-hour per day, 40-hour per week basis over a normal working lifetime.

Additionally the American Conference of Governmental Industrial Hygienists (ACGIH)[1] has recommended a Threshold Limit Value (TLV) of 25 ppm for ammonia.

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* ppm - parts of vapor or gas per million parts of contaminated air by volume.

B. Toxic Effects

In the reproduction of architectural tracings, there are two agents which have the potential to cause occupational illness:

1. Ammonia--(NH_3) is a colorless, easily liquified gas with a very sharp characteristic odor. An odor threshold for ammonia is reportedly from 1 to 50 ppm, but consensus appears to be about 5 ppm. The following pertinent information is quoted from the Manufacturing Chemist's Association Inc. Manual Sheet SE-13:[2]

> "Since ammonia has a penetrating, intensely pungent, suffocating odor, and is strongly irritant, there is little likelihood that one will remain dangerously long in an atmosphere seriously contaminated with ammonia if one is conscious and able to escape."

Ammonia - Aqueous Solution (Ammonia Water)

> "Aqueous ammonia exerts a local irritant action; strong solutions cause tissue destruction on contact, whether acting on eyes, skin, mucous membrane, gastrointestinal mucosa, or pulmonary tissue.
>
> Concentrated solutions of ammonia remaining in contact with the eye for even a short time may cause serious ocular damage, which may result in prolonged, severe visual disturbances or permanent scarring of the cornea.
>
> The consequences of skin contact with ammonia water vary from a relatively mild dermatitis to severe burns, depending upon the strength of the solution length of contact, and individual skin sensitivity.
>
> Ammonia gas, readily given off by aqueous solutions of ammonia, may cause severe irritation of the skin, eyes and respiratory mucosa."

Ammonia - Gas

> "Irritation of the eyes, respiratory tract, and throat results from concentrations as low as 50 ppm; a concentration of 2000 ppm produces convulsive coughing and may be fatal after a short exposure, i.e., less than half an hour. The following signs and symptoms result from exposure to gaseous ammonia; burning of the eyes, conjunctivitis, skin irritation; swelling of the eyelids and lips; dry, red mouth and tongue; burning of the throat; coughing; and, in more severe cases of exposure, difficult breathing

(due, in part, to a reflex laryngeal spasm); tenacious, blood-stained sputum; signs and symptoms of pulmonary congestion (pulmonary edema); and ultimate death from suffocation (asphyxia), due primarily to the congestion of all tissues of the respiratory tract. Inadequately treated cases of severe exposure who have developed pulmonary edema may occasionally contract a secondary bronchopneumonia, which may be fatal."

A TLV of 25 ppm has been selected to protect against irritation to eyes and the respiratory tract and minimize widespread complaints of discomfort among office workers and similar individuals who have not developed a tolerance.

2. Ozone--(O_3) Ozone is a highly injurious and lethal gas at relatively low concentrations (a few parts per million) for short exposure periods (a few hours).[1] The federal standard for Ozone is 0.1 parts per million which is also the threshold limit value established by the ACGIH. Ozone is an extremely irritant gas to all mucous membranes and the primary site of acute injury is the lung damage which is characterized by pulmonary congestion, edema and hemorrhage. The work of Flury and Zernik[3] notes that men when exposed to significant concentrations of Ozone will suffer eye, nose and throat irritations, cramps in the chest, frontal headaches and dizziness, severe fatigue, lowering of blood pressure.

EFFECTS OF OZONE IN VARIOUS CONCENTRATIONS[4]

Observed Effect	Concentration, p.p.m.
Threshold of odor, normal person	0.01 - 0.015
Maximum allowable concentration	0.04
Objectionable to all normal persons, irritates the nose and throat of most persons	0.10
Disorders breathing, reduces oxygen consumption, and shortens lives of guinea pigs	0.05 - 1.0
Inhibits fungus and mold growth in cold storage rooms	0.3 - 1.5
Headache, respiratory irritation and possible coma	1 - 10
Lethal to small animals within 2 hours	15 - 20
Lethal in a few minutes	>1700
Germicidal for air-borne organisms	6500

As noted in the TLV Documentation Book,[1] Ozone is radiomimetric--(similar to ionizing radiation) which has the effect of shortening life and causing premature aging. It is also suggested that the radiomimetric effect may occur with exposure to Ozone in a continual daily repeated 8-hour exposure. Furthermore, it's pointed out that Ozone "when inhaled in concentrations not acutely injurious per se may initiate, excelerate, or exacerbate respiratory tract disease of bacterial or viral origin." To summarize the Threshold Limit Value Documentation Book experience, "In view of the above studies the TLV of 0.1 part per million represents a limit which, although it results in no ostensible or manifest injury, may result in premature aging in the manner similar to that from continued exposure to ionizing radiation if exposure is significantly prolonged."

IV. HEALTH HAZARD EVALUATION

A. Initial Visit - Observational Survey

An initial visit was conducted at Wehmeier Reproduction Service located at 4609 Fehr Road in Cincinnati, Ohio on November 21, 1972 by Messrs. Melvin T. Eddleston and Robert E. Rosensteel, Industrial Hygienist. [redacted], owner, was interviewed at which time copies of the "Official Notice of Health Hazard Evaluation", the Occupational Safety and Health Act of 1970, and the request were presented to [redacted]. After an explanation of the Health Hazard Evaluation Program, the NSN questionnaire was completed with [redacted] assistance.

The process which potentially causes the alleged hazard is as follows. An architectual tracing is placed on top of a piece of yellow Deazo Paper (manufactured by either the Blue Print Paper Company, Detroit, Michigan or the Cushing Company, Chicago, Illinois). This combination of architectural tracing and Deazo paper is then placed into the Pease-Zephyr white printer. While in the printer two processes occur. First the Deazo Paper turns to white while a 4000 Watt Quartz Radiation Lamp is exposing all of the paper except tracing lines. Then the print is developed with a 26 Degree Baume Ammonia (manufactured by the Herbert-Verkamp Calvert Chemical Co., Cincinnati, Ohio) giving a final print of black lines on a white background. Ammonia is consumed in this operation at the rate of 40-60 drops/minute (3 ml/minute) or 100-120 gallons per year. The finished prints then are spread out on a table to dry prior to being trimmed and wrapped for consumer delivery.

The above process is performed in the basement of a residential house. Mechanical ventilation has been added in the form of an exhaust fan. In this shop there is one window and two exit ways; one a flight of stairs to the first level of the house and the other a foyer to the garage.

The operation causes the release of some ammonia vapors into the room from the reservoir in the machine or from finished prints, and there was concern by the requester about possible ozone production from the mercury vapor lamp.

At the time of the visit, [redacted] was operating the machine by himself although in the past his wife as well as part-time employees have worked in the blueprint operation. The machine is located in the basement of a private residence, but the machine has an exhaust duct to the outside and general room ventilation is provided by a squirrel cage blower located behind the blueprint machine. Ammonia and ozone detector tubes were used to determine concentrations at various locations in the room. The results of these determinations which were made during the initial visit are contained in Table I. Although the characteristic ammonia odor was quite obvious at several locations, the odor associated with ozone was not noticed at any room location.

[redacted] was questioned concerning possible effects of exposure to ammonia during machine operation, but he did not register any strong complaints other than noticing some nose and throat irritation in the morning after operating the machine. Since appreciable levels of ammonia were present, it was explained a more meaningful sample could be obtained with an impinger during normal operation. A physician could also obtain information about possible health effects at the same time. It was agreed a future visit would be made at a mutually convenient time.

B. Environmental Evaluation

A follow-up environmental/medical evaluation was conducted at Wehmeier Reproduction Service on February 23, 1972 by Dr. Phillip Polakoff, Medical Officer and Mr. Robert Rosensteel, accompanied by Dr. Julio Rivera as an observer. The purpose of this visit was to collect continuous ammonia samples and to make intermittent checks of ozone levels in conjunction with the medical evaluation. The ammonia samples were collected in a midget impinger containing 15 milliliters of 0.1 N sulfuric acid with a two liter per minute flowrate aspirated through the impinger with a Model G, MSA personal sample pump. Ozone

levels were monitored with MSA detector tubes at the operator's station. The ammonia concentrations in the impingers were determined with a specific ion electrode, and the corresponding air concentration was calculated from the air volume and amount of ammonia in the impinger.

The results obtained during the environmental/medical follow-up survey are contained in Table II. The environmental measurements of the ammonia were found to be quite low. As shown in Table II, all ammonia measurements were found to be slightly lower than one (1) ppm, and ozone could not be detected on the most sensitive scale of the MSA detector tubes used (<0.05 ppm). The machine local exhaust and general room ventilation from the squirrel cage blower provide adequate ventilation based upon the low ammonia levels found in the evnironmental test results. A window located to the left front of the blueprint machine is normally left open during operation as it was during the environmental survey and helps provide ventilation away from the operator's breathing zone during operation. This procedure should be continued in the future during operation of the machine. Since it would be possible to spill the concentrated ammonia solution during refill, care should be taken to protect the skin and eyes against inadvertent contact with the solution during refill.

Recommendations:

1. Rubber gloves and eye protection should be worn to protect the hands and eyes against contact with concentrated ammonia solution during refill of the machine.

2. Any liquid ammonia solution which accidentally comes into contact with unprotected skin or eyes should be immediately flushed off the skin with copious quantities of water.

C. Medical Evaluation

To ascertain the severity of the ammonia fume problem in this basement shop operation, two separate approaches were utilized. The first was to make a thorough observation of the blue printing process. The second was to interview the two individuals who work in this shop.

On the day of our shop visitation the alleged hazardous process, "blue printing" had been in operation for about an hour and a half. [redacted], the owner and sole production worker, states that it was an average work day for him. He stated that he works 3-4 hours a day, five days a week. For the past four years he has worked alone in reproducing architectural tracings.

[redacted] then demonstrated and explained the complete production process, as has been described earlier. During this demonstration it was difficult for any one of us in the evaluating party to personally detect the well-known harsh ammonia odor. [redacted] mentioned that the odor is only preceptible when he is producing many prints and the finish prints accumulate on the drying table. The odor is further heightened on these days when the air "hangs heavy" and there is little air dispersion.

The ammonia is stored in plastic containers and kept in a wash tub. The ammonia, when being used by the printer is automatically pumped. Thus the only time the operator comes into any possible contact with the liquid ammonia is when he opens the plastic container, inserts it into the printer, and attaches a tube from the printer's pump.

The operator is protected from the ozone generated by the 4000 Watt Quartz tube by an ozone shield. No odor of ozone was detected by the investigators.

The following medical information was ascertained from the two individuals whom are engaged in work activities in this shop.

1. F.W. - A 75 year old male self-employed in making "blue" prints for 20 years. Past medical history - (a) abcess removed from back in 1955, (b) appendectomy - 1955, (c) operation for enlarged testicle and prostrate - 1966. Present medical history - currently being treated by his personal physician for: (2) Spastic colon, taking Librax three times daily, (b) hypertension - dyazide bid, (c) Sinus problem. Occupational history - for the past 20 years has been self-employed in the business of reproducing architectural tracings. Prior to this he was employed as a saleman.. Has a smoking history of one-half pack per day of cigarettes for 12 years followed by history of pipe smoking - one-half pound per week for 10 years. Currently working between 15-20 hours/week. Never has missed any time from work due to any occupational illness. Has never complained of shortness of breath although his physician has informed this individual that he has a "small amount of emphysema". Never has had any occupational dermatitis. On occasion he has felt that odor of ammonia was present in amounts causing minor personal discomfort.

2. H.W. - a 76 year old female. Past medical history - in generally good health - never hospitalized. Present medical history - currently being treated for hypertension and hypercholesterolemia by her personal physician. Has never smoked. Occupational history - has worked as a housewife and as a part-time assistant in the reproduction shop. Works approximately five hours a week as the shop's bookkeeper. Rarely comes into contact with the ammonia. Never has had any of its associated symptomatology.

D. Conclusions

Based upon the results of the environmental and medical investigations reported above, it is judged that the subject substances, ammonia and ozone, are not toxic at the concentrations used or found in this working environment. Nonetheless, if appropriate conditions prevail, there is a possibility the exposed individual may suffer minimal discomfort arising from the irritative nature of ammonia.

V. RECOMMENDATIONS

1. Rubber gloves and eye protection should be worn to protect the hands and eyes against contact with concentrated ammonia solution during refill of the machine.

2. Any liquid ammonia solution which accidently comes into contact with unprotected skin should be immediately flushed off the skin with copious quantities of water.

3. It is suggested good ventilation practices presently being followed be continued, i.e. windows should be kept open and local and general room exhaust fans operated when the blueprint machine is run.

VI. REFERENCES

1. Documentation of the Threshold Limit Values for Substances in Workroom Air, ACGIH, 3rd Edition, Cincinnati, Ohio (1971).

2. Chemical Safety Data Sheet SD-13, Manufacturing Chemists Association Incorporated, Washington, D.C. (1947).

3. F. Flury and F. Zernik, Schädliche Gase, Springer, Berlin (1931).

4. Patty, F.A.: Industrial Hygiene and Toxicology, Vol. II, 2nd Edition, Interscience, New York, p. 917 (1963).

TABLE I

OBSERVATIONAL SURVEY RESULTS

1. Ammonia Measurement Results

Location	Concentration (ppm)
Operator's station, right side machine	<5
Operator's station, left side machine	<5
Beside print storage table	<5
Directly over print storage table	5
Breathing zone operator at machine	8
Breathing zone operator at machine	11

2. Ozone Measurement Results

Three detector tubes were used to take samples in the operator's breathing zone during normal work procedures. Ozone is detected by the length of color change which occurs in the tube, but no color change could be observed during any of the tests. The minimum concentration which can be measured with this detector tube is 0.05 ppm.

TABLE II

ENVIRONMENTAL SURVEY RESULTS

1. Ammonia Measurement Results

Location	Concentration (ppm)
Personal sample, breathing zone of operator	0.91
Center work table behind operator	0.82
Left side work table behind operator	0.94

2. Ozone Measurement Results

Three detector tubes were used to take ozone measurements at equal time intervals of twenty minutes in the operator's breathing zone during normal work procedures. Ozone is detected by the length of color change which occurs in the tube, but not color change could be observed during any of the tests. The minimum concentration which can be measured with this detector tube is 0.05 ppm.

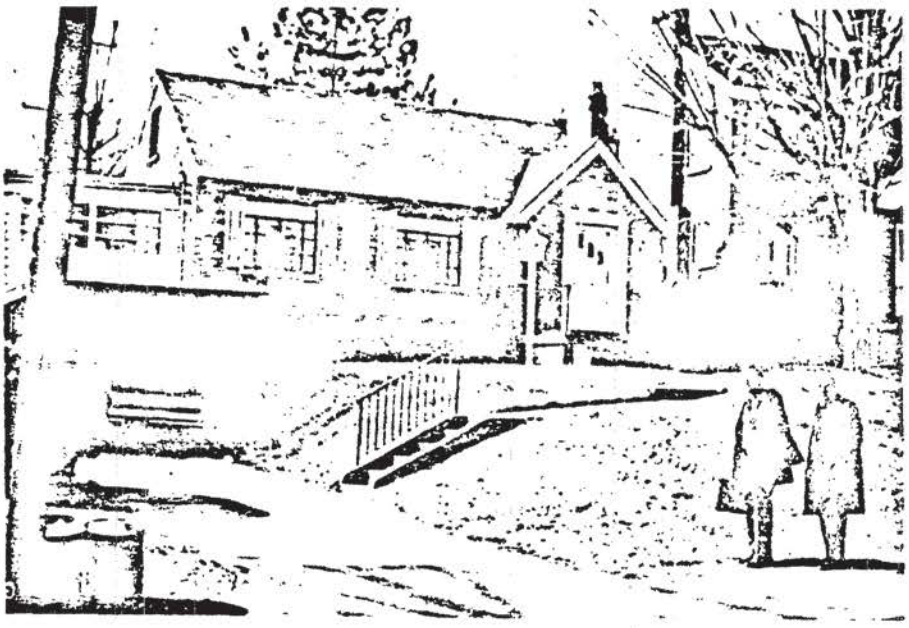

PHOTO #1 - NIOSH Investigators Arrive for Follow-Up Medical/Environmental Evaluation.

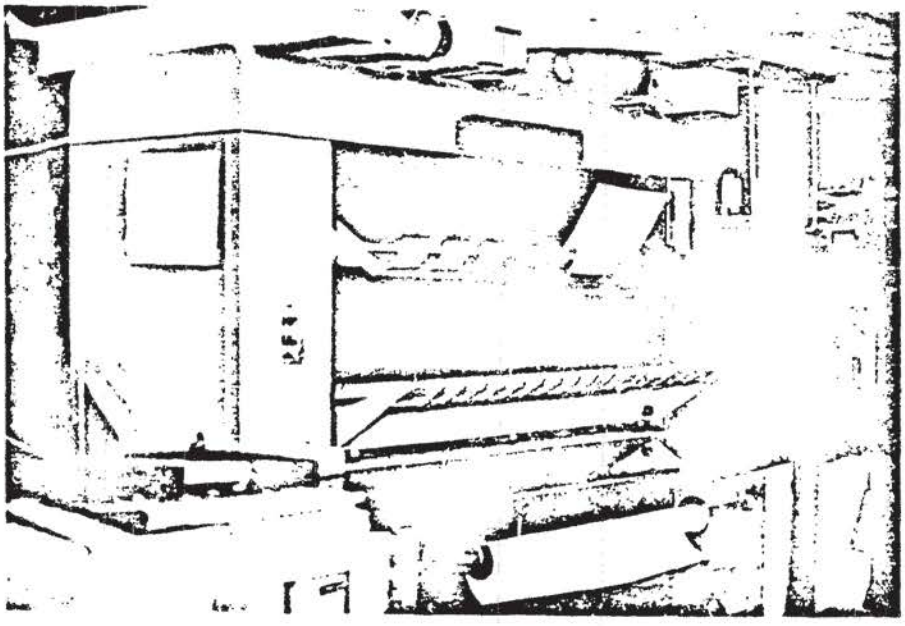

PHOTO #2 - Closeup of Pease Zephyr Blueprint Machine. NOTE: Squirrel cage at right side of machine for general room ventilation.

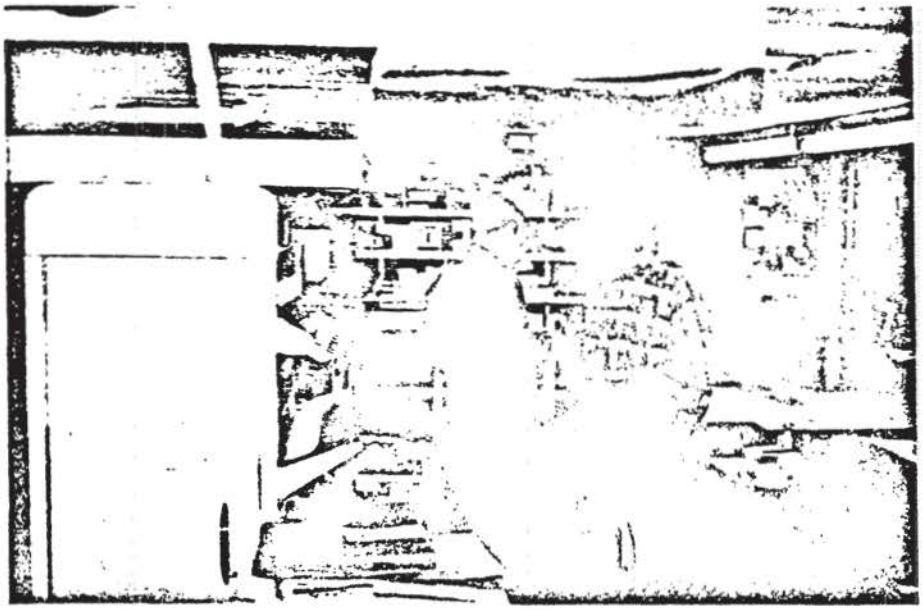

PHOTO #3 - Industrial Hygienist attaches impinger to monitor ammonia level in operator's breathing zone.

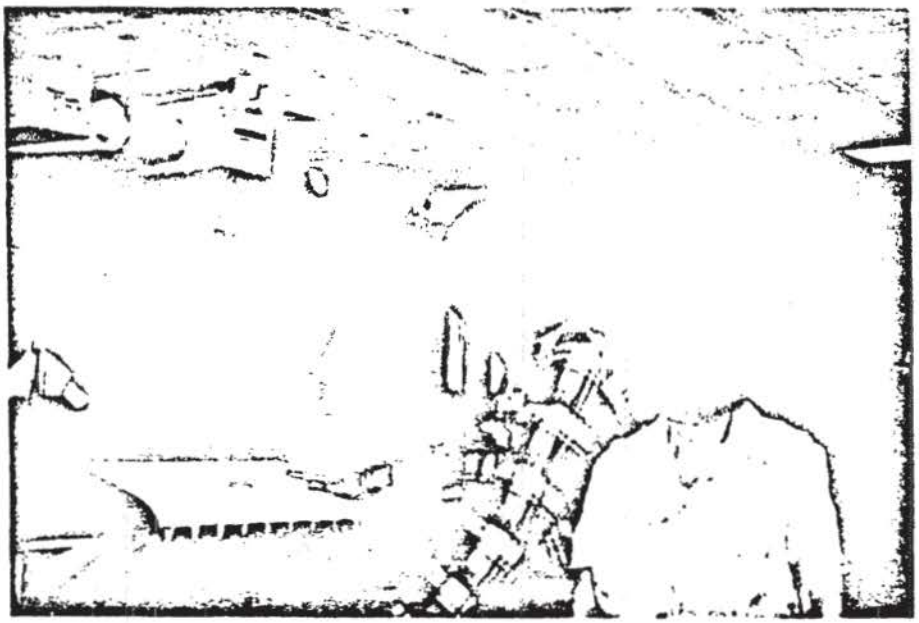

PHOTO #4 - Operator at normal work station when producing prints.

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