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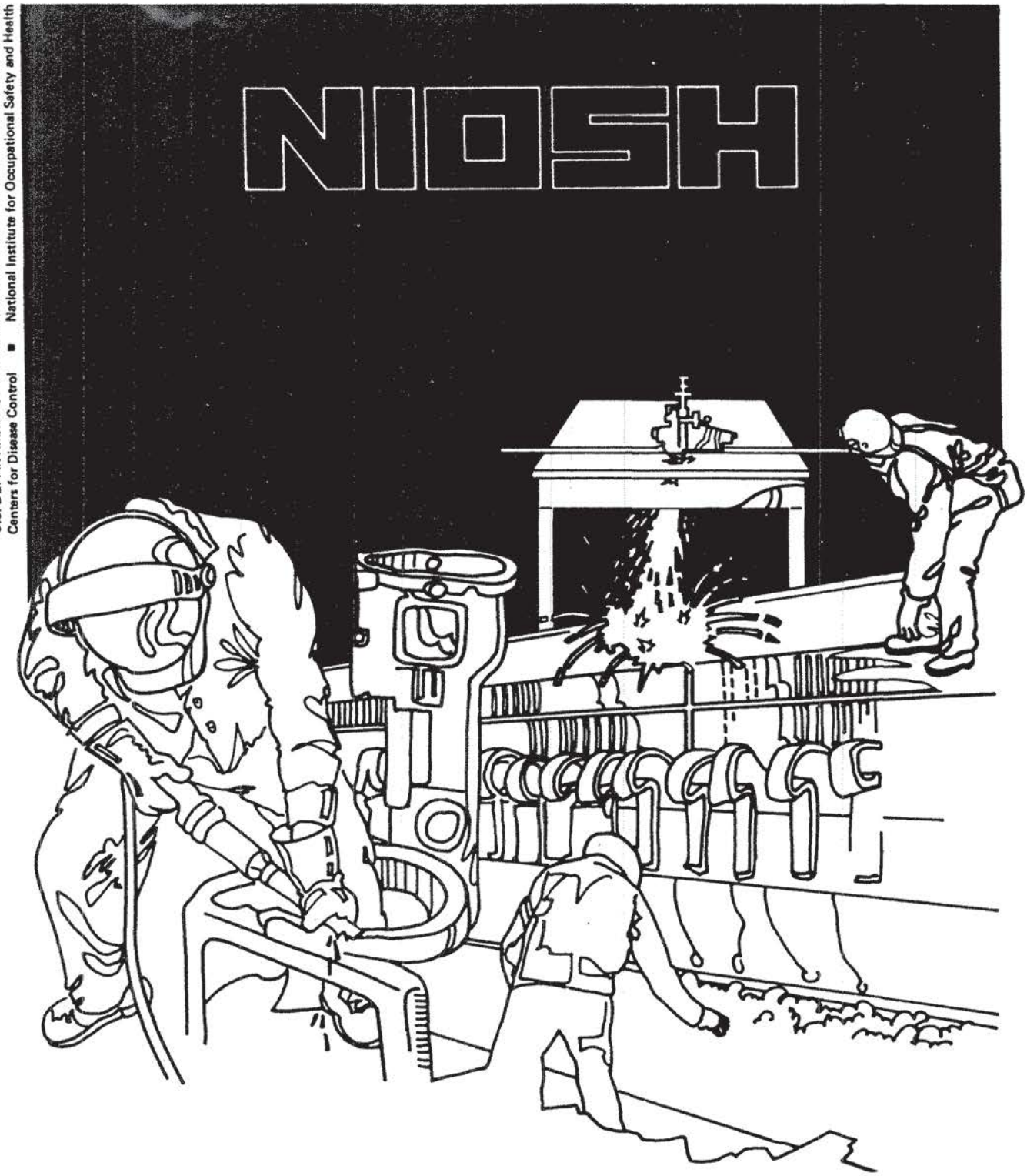

Health Hazard Evaluation Report

HETA 83-233-1410
PELTON AND CRANE COMPANY
CHARLOTTE, NORTH CAROLINA

PREFACE

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

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

HETA 83-233-1410
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Pelton and Crane Company
Charlotte, North Carolina

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I. SUMMARY

On March 29, 1983, the Pelton and Crane Company requested the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation of the Polishing Department in its manufacturing facility at Charlotte, North Carolina. The request: a) stated that due to increased production, manpower shortage and improper equipment, there were numerous complaints from production employees in this Department of back strains and general aches and pains; and b) requested an ergonomics study of these employees and their work environment to help identify changes needed to eliminate or reduce this health problem. In addition, a dirty work environment was depicted by the requestor as being a factor in the number of complaints of the employees.

The complaints assert that the heavy weight of manufactured items plus the manual manipulation required in the finishing are leading to hand and back problems among operators. The complaints about the products being manipulated during grinding and polishing were their weight, size, and the awkward positions required to carry out the finishing operations.

On-site surveys of the facility were conducted June 8 and July 14, 1983 by two industrial hygienists and a human factors engineer. The polishing department conducts grinding, buffing and polishing operations on a variety of products manufactured from aluminum, stainless steel, steel, and brass. The department currently employs approximately 15 males, of these 5 or 6 employees handle the heavy items. Smaller parts are finished by machine operators while sitting; other parts can be finished only from a standing position. All parts require manual materials handling (MMH) to accomplish the finishing (grinding, buffing, or polishing) operations.

Handling of two heavier items, which results in the center of gravity being 1 to 2 feet from the backbone, can be seen to exceed the NIOSH acceptable conditions for manual lifting. Since the NIOSH lifting tolerance limits are for "infrequent" lifts, the limits are further exceeded when the frequency and duration of lifts, transporting the load, holding the load, forcing the load against the wheel, contorting the body to get the load in position against the wheel, the occasional high temperature during certain portions of the year and the added stress of noise are considered. Thermometers in the finishing room indicated 101°F during the survey on July 14, 1983. Chairs provided for workers finishing small items were neither selected to fit the job nor structured ergonomically to provide support or comfort. Two personal dust samples showed total particulate concentrations in air of 6.4 and 1.1 mg/m^3.

Since each operator has developed his own techniques for obtaining the work quality required for each item and the maintenance of production rates is of concern not only to the company but to the operators as well, possible solutions to the MMH problem are limited. However, consideration should be given to designing a jig to hold the product being finished to reduce the need for the operator to grip the product tightly with the fingers. With heaver items, use a movable overhead crane unit to assist with manipulation of the product and provide a horizontal support surface for manual finishing. Additionally, temperatures in the department should be reduced, adjustable chairs should be procured that provide support and comfort and cushioning floor mats and raised platforms should be provided where needed to reduce fatigue and accommodate work position.

KEYWORDS: SIC 3843, ergonomics, back strains

II. INTRODUCTION

On March 29, 1983, the Pelton and Crane Company requested the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation of the Polishing Department (236) in its manufacturing facility at Charlotte, North Carolina. The request: a) stated that due to increased production, manpower shortage and improper equipment, there were numerous complaints from production employees in this Department of back strains and general aches and pains; and b) requested an ergonomics study of these employees and their work environment to help identify changes needed to eliminate or reduce this health problem. In addition, a dirty environment was depicted by the requestor as being a factor in the number of complaints of the employees. The University of North Carolina under a Cooperative Agreement with NIOSH was assigned the health hazard evaluation on May 12, 1983.

On-site surveys of the facility were conducted June 8 and July 14, 1983 by two industrial hygienists and a human factors engineer. The goals of the surveys were to evaluate the environmental conditions including possible injuries from overexertion associated with manual materials handling, and to develop appropriate recommendations to management to alleviate any problems found. No NIOSH interim letter or report was distributed prior to this report.

III. BACKGROUND

The following information was obtained in initial discussions with management personnel. The Pelton and Crane Company in Charlotte, North Carolina is a major producer of dental equipment. The polishing department conducts grinding, buffing and polishing operations on parts destined for incorporation into products manufactured by the company. The parts represent a variety of products manufactured from aluminum, stainless steel, steel, and brass. Smaller parts are finished by machine operators while sitting; other parts can be finished only from a standing position. All parts require manual materials handling (MMH) to accomplish the finishing (grinding, buffing, or polishing) operations. Figures 1 through 8 illustrate various postures used by operators during finishing of parts.

Recently, complaints have been expressed by employees relative to problems being experienced during handling of certain products. These complaints have centered on three specific products.

1. Sterilizer doors (Figures 2 and 4)
2. Lift tube assembly (Figure 1)
3. Coachman seat base (Figures 5-8)

The complaints assert that the heavy weight of these items plus the manual manipulation required in the finishing are leading to hand and back problems among operators.

Figures 1-4 Grinding and Polishing Work Sites

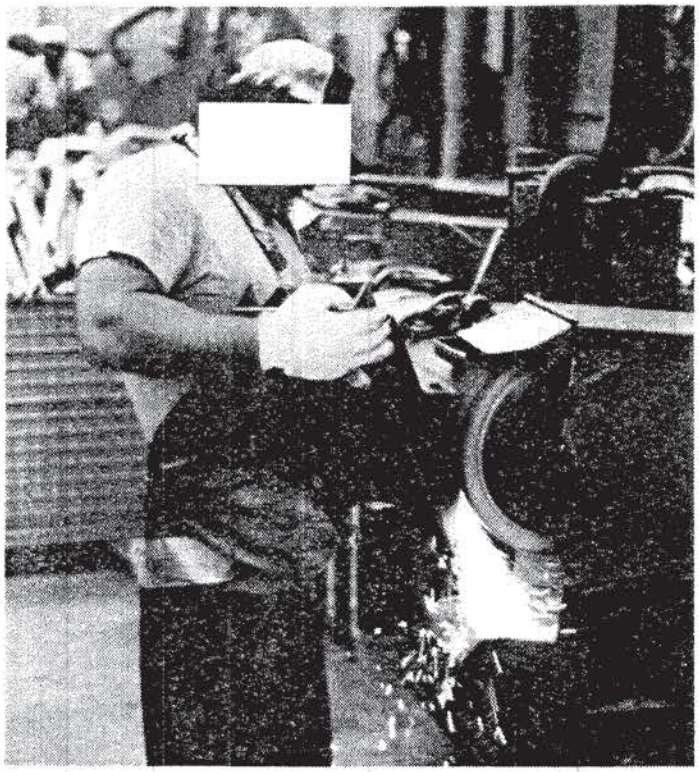

Fig. 1 - Grinding lift tube assembly, 25 lbs. Note body used to apply pressure on grinding wheel.

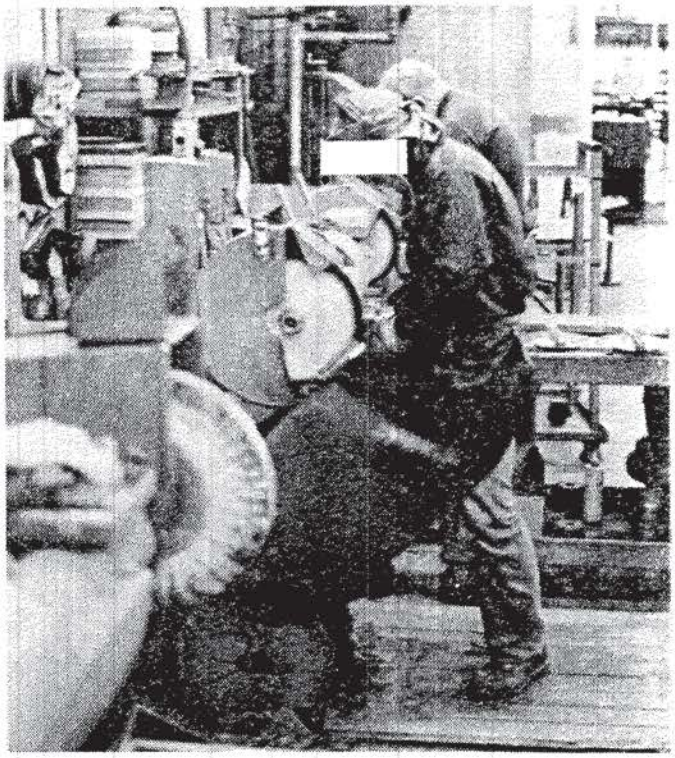

Fig. 2 - Polishing brass sterilizer door. Note footstand and wood platform.

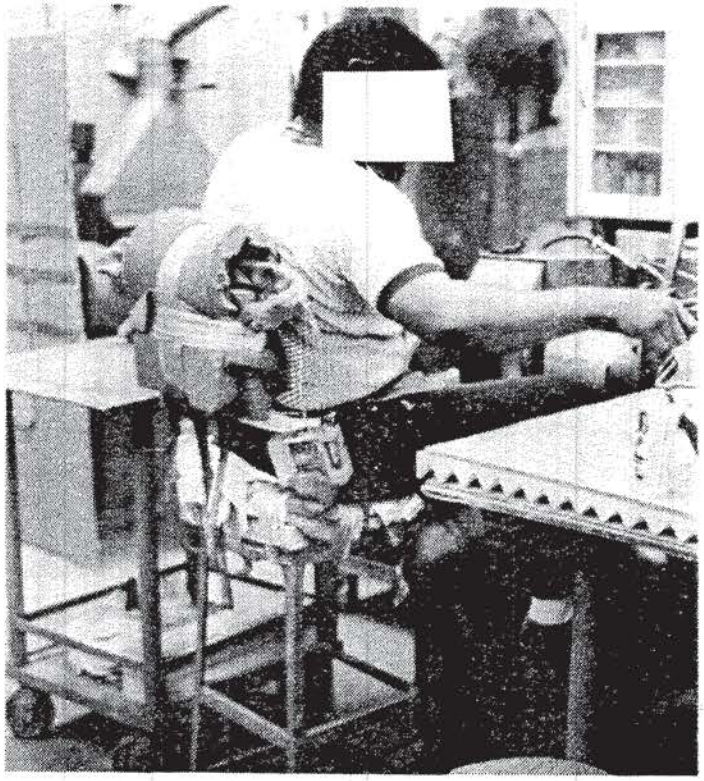

Fig. 3 - Finishing small metal parts. Note chair and its adaptation.

Fig. 4 - Polishing sterilizing door. Note abdomen used to apply pressure against wheel.

Figures 5-8 Grinding Coachman Seat Base. Weight 35.25 lbs.

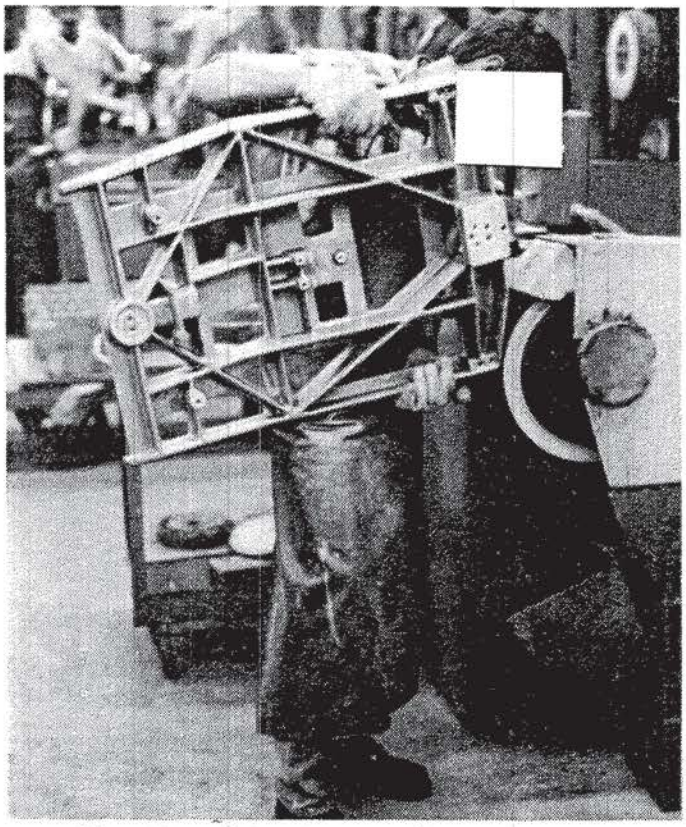

Fig. 5 - Note arm used to support seat base.

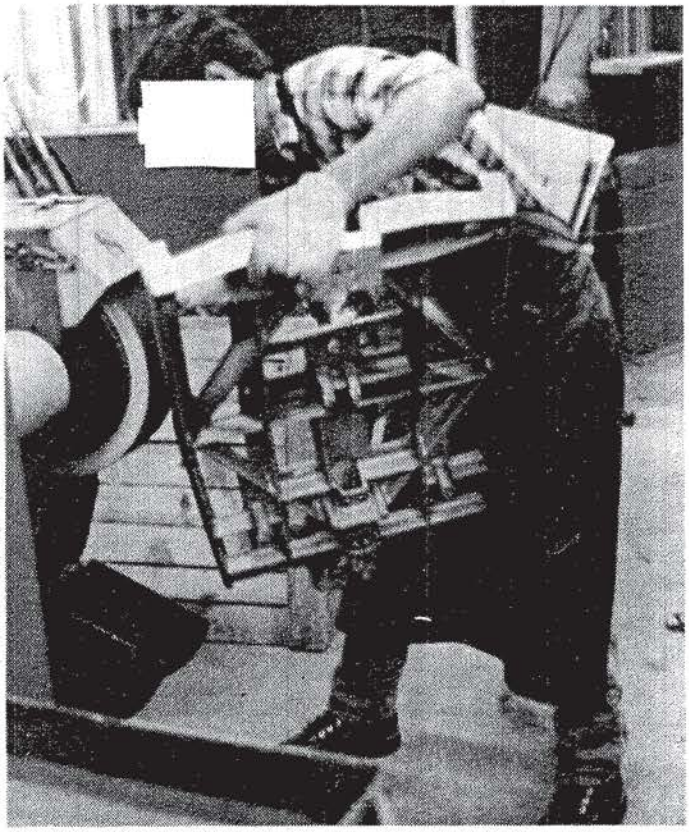

Fig. 6 - Note hip and thigh used to support seat base.

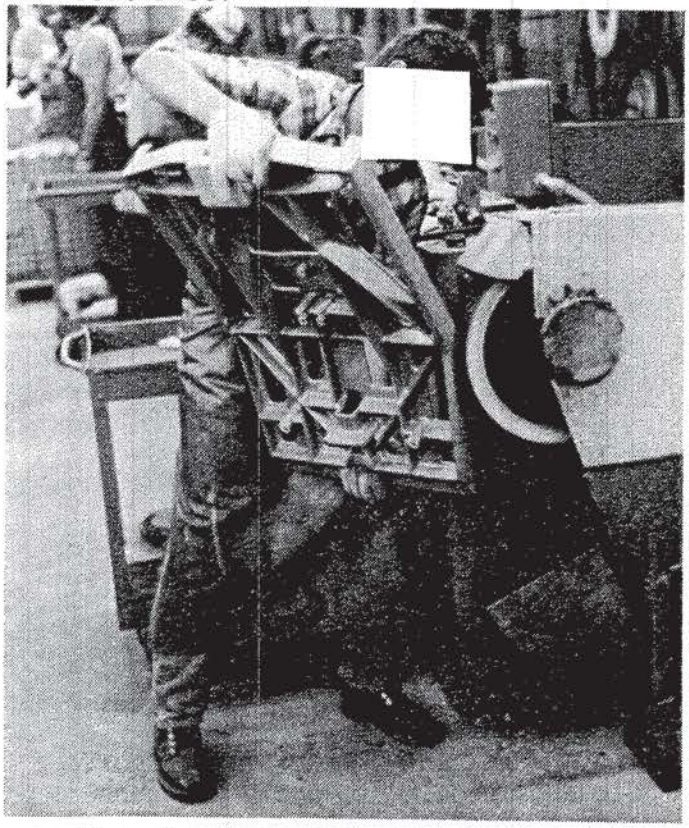

Fig. 7 - Note arched back to position seat base for grinding.

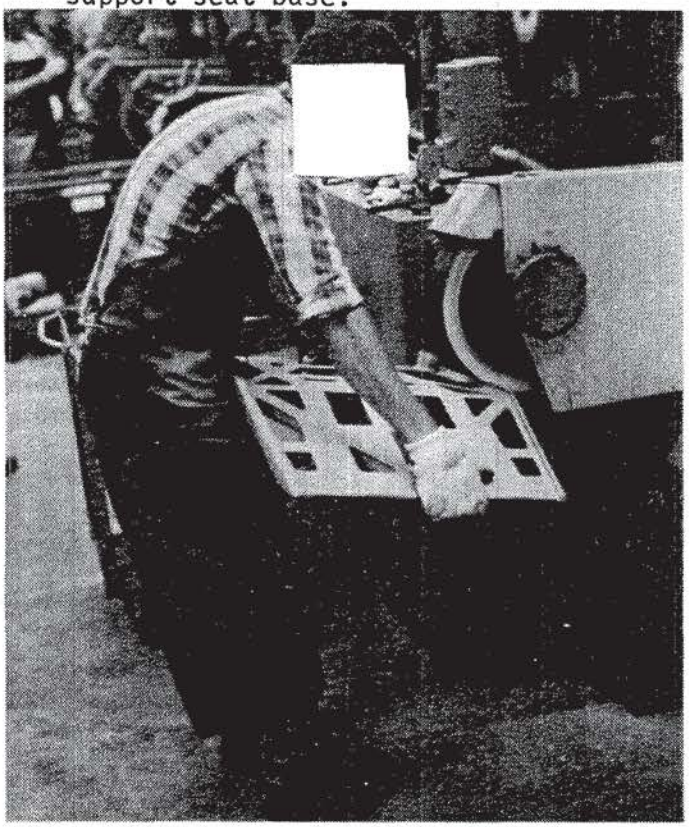

Fig. 8 - Note extension of arms to support seat base and apply pressure against wheel.

The department currently employs approximately 15 males, who work one shift per day. Of these, 5 or 6 employees handle the heavy items. Over 90% of the employees are long-term and are rated as skilled. People with documented back problems working in the department are limited to light duty involving light parts. Two employees have recently had back surgery, paid for by the company group insurance policy. One employee is rated 10% disability for back injury. Of the others working in the department at the time of this survey, three are deaf.

The department operates on a schedule of:

7-9 AM - work
9-9:10 - 10 minute break
9:10-11 - work
11:11:30 - lunch
11:30-1:30 PM - work
1:30-1:40 - 10 minute break
1:40-3:30 - work

During the work periods, production is steady at the rate sustainable by individual employees.

New employees receive a company-paid physical examination by the Mercy Medical Clinic, including chest x-ray and blood and pulmonary tests. Results are sent to the Company and made a part of each employee's personnel record. If there are indications that an employee is in some manner restricted in work capacity, the personnel department sends a memo to the department supervisor. If the employee is to be involved in heavy lifting, the examining physician also administers some physical stress tests and investigates into previous history of back problems.

A change in an existing employee's work assignment results in a review by the personnel department of the employee's personnel record. In some cases, the company safety department is queried prior to the reassignment of personnel.

IV. METHODS AND MATERIALS

Environmental evaluations consisted of interviews with management and operating personnel about environmental conditions, a walk-through industrial hygiene survey, examination of the work techniques, review of materials being handled, and collection of air samples for particulates. Noise levels were not suspected of being above regulatory limits of 85 dBA based on the surveyor's speech being able to be heard at various distances and previous experiences with noise surveys, therefore, no noise level measurements were made. Questionnaires were not used; the buffing, grinding, and polishing operators and the supervisor provided such information as they were able in the interviews.

Because grinding and buffing operations generate airborne particulates, an exploratory evaluation of dust exposure was conducted. Two personal and two area air samples were collected and analyzed for total dust concentration in air. Particulate samples were collected in open face mode on 37 mm-diameter, 5μ pore size vinyl metricel filters at a rate of 1.7 liters/minute.

V. EVALUATION CRITERIA

Overexertion injuries associated with manual materials handling (MMH) jobs (unaided lifting, lowering, etc.) have been a major concern of responsible criteria-setting bodies for many years. Past attempts to deal with this complex problem have focused upon adopting rather arbitrary weight limits for lifting loads or using training procedures to emphasize "correct" lifting techniques. Neither approach seems to have reduced overexertion injuries.

Aspects of lifting a load which have been identified as physically hazardous to the musculoskeletal system include:

1. Weight of the item lifted.
2. Location of the center of gravity of the load with respect to the worker.
3. Frequency/duration of the task.
4. Stability of the location of the center of gravity of the item.
5. Workplace geometry in terms of movement, distance, direction, and postural constraints.
6. Environmental factors such as temperature, humidity, illumination, noise, and vibration.

NIOSH's Work Practices Guide for Manual Lifting (1) provides a broad examination of the problem and presents procedures to gauge the risk of overexertion hazards in MMH jobs and for risk control. These evaluation procedures were of limited use in evaluating conditions at Pelton and Crane, as the report defined "lifting tasks" as the act of manually grasping and raising an object of definable size without mechanical aids. The time duration of such an act was considered as normally less than two seconds and requiring little sustained exertion such as holding or carrying would entail. Specifically, the criteria were intended to apply only for:

1. smooth lifting (no jerking)
2. two-handed, symmetrical lifting directly in front of the body with no twisting during lifting
3. moderate width of load (30 inches or less)

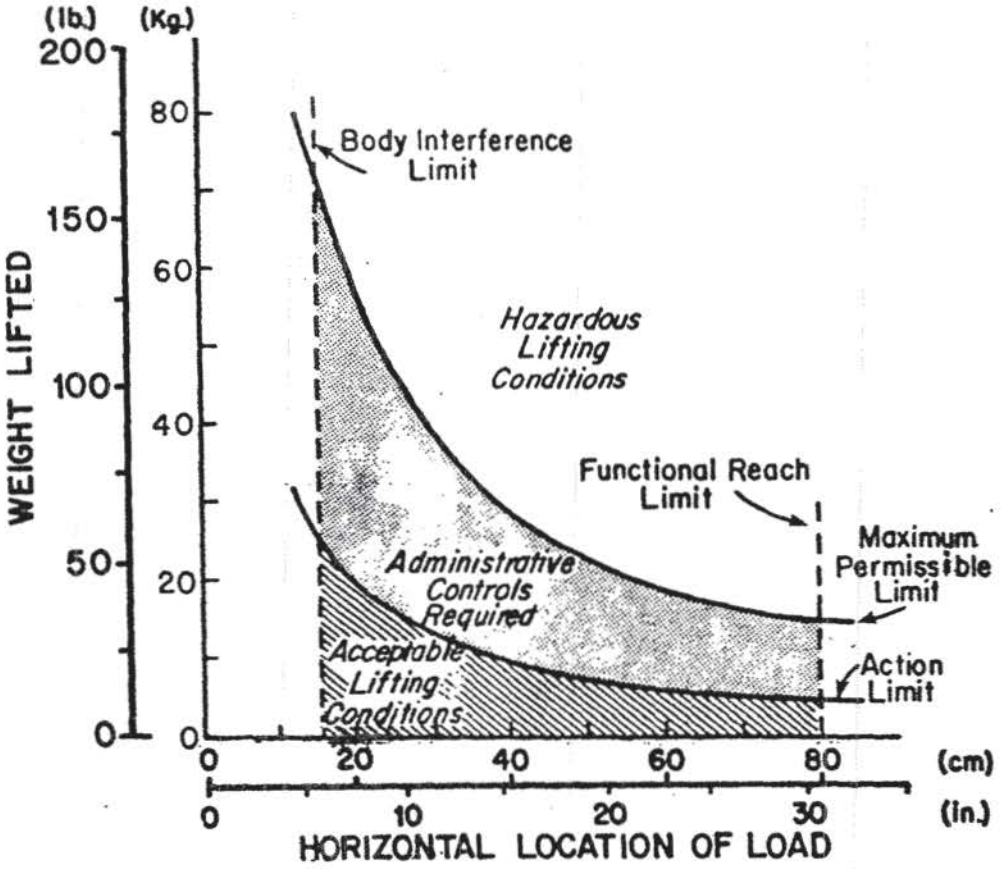

Figure 9: Maximum Weight versus Horizontal Location for Infrequent Lifts from Floor to Knuckle Height (Ref. 1)

4. unrestricted lifting posture

5. firm footing for lifter

6. favorable ambient environment.

Thus, the criteria in the NIOSH document are not directly applicable to the situation existing at the Pelton and Crane facility. Under the existing work conditions, only items 4 and 5 are met.

The criterion for evaluating total dust concentration in air is the ACGIH recommended limit for nuisance dust of 10 milligrams per cubic meter (mg/m^3)(2). The OSHA limit is 15 mg/m^3(3).

Other criteria for evaluation of the environmental conditions, apparatus, operator work technique, employee stress and assessment of any relationship between these factors, was based primarily on the judgment of the survey investigators.

VI. RESULTS AND DISCUSSION

Of the parts finished in the department, the following were identified by finishing operators as being difficult to handle due to weight and size.

Item	Weight (lbs.)	Production Rate (Units/mo)
Sterilizer OCM door	7.5	250
OCR door	16	300-350
MC door	29.5	15-20
Lift tube assembly	25	300
Coachman seat base	35.25	300

The complaint about the doors centered around two factors. First, the MC door is heavy. Second, finishing of all doors requires that the operator's hands grip the door tightly while pressing the door against the wheel. Most operators observed used their legs for leverage while pressing the door against the wheel and their abdomens for applying pressure to the back of the door to press the door against the wheel (See Figures 2,4). Operators had placed wood slat platforms in front of some machines to add height and to avoid standing directly on the concrete floor which does not provide resiliency and can contribute to fatigue of the feet and legs. Also, wooden boxes, approximately 9" high, were being used to support a leg raised so that it could be used for holding sterilizer doors against the wheel (See Figure 2).

The complaints about the lift tube assembly and the Coachman seat base were their weight, size, and the awkward positions required to carry out the finishing operations (See Figures 1, 5 through 8).

Using criteria in Figure 9, from the NIOSH report (1), the handling of the two heavier items, which results in the center of gravity being 1 to 2 feet from the backbone, can be seen to exceed the acceptable conditions for manual lifting. Since the NIOSH lifting tolerance limits are for "infrequent" lifts, the limits are further exceeded when the frequency and duration of lifts, transporting the load, holding the load, forcing the load against the wheel, contorting the body to get the load in position against the wheel, the occasional high temperature during certain portions of the year and the added stress of noise are considered. Thermometers in the finishing room indicated 101°F during the survey on July 14, 1983.

Hot Environments

In hot environments the added metabolic heat produced by MMH activities adds to the risk of overstrain and introduces the possibility of heat illness. During the visits to the facility, the effect of the work load and the thermal stress were observed in the heavy sweating of the operators when working with the heavier items. In addition, operators were observed to take short rest periods every two or three units. Although it may appear that the work load has a built-in self limitation, i.e., the operator will adjust his work output to include rest periods, such response cannot be depended upon to limit either back injury or excess thermal stress.

Chairs

Some of the tasks involving small items can be accomplished from the sitting position. In general, these items are light in weight and do not represent conditions exceeding the NIOSH lifting criteria. Chairs are provided for use of the operators. However, as can be seen in Figure 3, the chairs were neither selected to fit the job nor structured ergonomically to provide support or comfort.

Noise

Operations in the polishing department are noisy. Although noise levels were not considered sufficient to be hazardous to hearing, the constant noise represents an added stress to employees. Research has shown that constant noise can produce elevated blood pressure levels, increased heart rate, and tensing of the muscles. Although these phenomena have not been demonstrated as detrimental within themselves, they represent stress that the body must accommodate. They are worthy of note in cases such as this where the manual labor is, in some work situations, stressing the operators to the level of requiring self-imposed rest periods.

Particulates

Two area particulate samples were collected June 8, 1983 at central points near both ends of the finishing room during buffing and grinding operations. These indicated total dust concentrations in air of 1.27 and 1.13 milligrams per cubic meter (mg/m^3). Personal samples were collected at the same time in the breathing zones of two buffing operators, and indicated total dust concentrations of 6.40 and 1.12 mg/m^3. Due to the nature of the buffing operation, perhaps large cloth fibers or threads from the buffing wheel may account for the increased total dust concentration in one of the personal samples.

Fire Hazard

The use of the same exhaust ventilation ducts for dust control from fabric buffing wheels and emery grinding wheels has reportedly resulted in several duct and baghouse fires, caused by sparks from the grinding wheels igniting lint from the fabric wheels which had snagged inside the ducts. The company is aware of the problem and is in the process of correcting it, so is not treated further in this report.

VII. CONCLUSIONS

1. Manual handling of three items weighing over 25 lbs. exceeds the NIOSH criteria even for "infrequent" lifting, and conditions further are made less tolerable by the frequency and duration of tasks, the postures required and the heat and noise of the ambient working environment.

2. The finishing of some parts requires operators to grip the parts tightly, causing excessive hand and finger strain and reduced work efficiency.

3. Chairs provided for work in the sitting position were unsuitable for existing conditions.

4. Environmental conditions are at times unsatisfactory and may add to the risk of employee stress and heat illness. Noise levels in the department add to the environmental stress of the workers (although they are considered below the regulatory limits designed to prevent hearing loss).

5. The bare concrete floor of the work room may be conducive to operator leg-fatigue; operators have placed wooden platforms at some machines.

VIII. RECOMMENDATIONS

1. Since each operator has developed his own techniques for obtaining the work quality required for each item and the maintenance of production rates is of concern not only to the company but to the operators as well, possible solutions to the MMH problem are limited. Discussions with the operators and their supervisor indicated that attempts to finish some of the items in jigs and hand-held machinery had not been successful to date. However, the following steps should be considered.

   a. If a jig to hold the doors could be designed that would allow the necessary manipulation against the finishing wheel and also provide some form of handle, this would reduce the need for the operator to grip the door tightly with the fingers. However, such a device must not add significantly to the already heavy load of the doors, particularly the MC door.

   b. Some form of material handling assist, such as a movable overhead crane unit, would appear usable with the lift tube assembly and the Coachman seat base. Such a device would reduce the load on the operator during lifting the unit, transporting to the wheel, movement back to the storage position, and lowering into the release position. Such a unit would have to be properly located relative to the appropriate grinding, buffing, or polishing equipment and provide a pick-up attachment that allows rotation of the part into various positions relative to the wheel.

   c. Consideration should be given to providing a horizontal support surface for manual finishing of the lift-tube assembly.

2. The temperature in the department should be reduced during the summer months to reduce the thermal stress on the workers. This would reduce the likelihood of potential heat illness as well as thermal contribution to possible muscle injury.

3. Chairs should be procured that provide a) adjustment to accommodate individual heights relative to the work position, and b) ergonomically correct support and comfort.

4. Each of the machines in the department was observed to have the same basic work height - 38 inches from floor to wheel shaft. This required the various-sized operators to stretch or bend to adapt the body to the position necessary to place the item in the appropriate work position. It is recognized that machinery from a supplier cannot be economically procured in varying heights. Some provision should be made to accommodate the varying body sizes of operators, in order to alleviate both the potential for injury and reduction in work efficiency.

5. The tiring effect of standing on a concrete floor for long periods of time is well recognized. Cushioning mats should be provided at the standing positions of the various machines. Also, if a means of lifting a leg is required, it should be a device designed to accommodate the requirements of the individual operator and not just a convenient empty box.

IX. REFERENCES

1. Work Practices Guide for Manual Lifting, National Institute for Occupational Safety and Health, DHHS(NIOSH) Publication No. 81-122 (1981).

2. Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment with Intended Changes for 1983-84, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1983.

3. General Industry Standards, Occupational Safety and Health Administration, Publication OSHA 2206 (November 1978).

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

The cooperation of Mr. Douglas Wilson, Safety Manager, Pelton and Crane, and other company employees in the environmental evaluation is hereby acknowledged.

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