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SCOTT MOLDERS, INC.
KENT, OHIO

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I. SUMMARY

In October 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Allied Industrial Workers of America to conduct a health hazard evaluation at Scott Molders in Kent, Ohio. NIOSH was asked to address ergonomic concerns and to investigate potential employee exposures to ammonia, fibrous glass, formaldehyde, phenol, and styrene. A site visit was conducted on February 25-26, 1991.

The ergonomic analysis consisted of observing and videotaping workers in the molding and finishing areas, interviewing workers and reviewing the OSHA 200 logs. The video analysis indicated that the major upper extremity (ergonomic) stressors of these jobs are postural and muscular force demands which occur while performing the following task elements: (1) unloading parts from molding machines; (2) breaking or cutting off the excess plastic from parts; (3) filing, reaming, and sanding flashing from parts; (4) reaching (forward, overhead, or to the side) to activate press control buttons; and (5) reaching to dispense completed parts into boxes or barrels. Prolonged standing was considered to be a general ergonomic risk factor for all workers.

All of the twenty-one mold operators and finishers (16 mold press operators and five finishers) were informally interviewed for symptoms of cumulative trauma disorders (CTDs); eight workers gave histories consistent with CTDs, including elbow tendinitis, and hand, arm and wrist discomfort. Four of the twenty-one (19%) had undergone surgery for chronic carpal tunnel syndrome. In three cases, the surgery was bilateral, which brought the total number of carpal tunnel events to seven. Review of OSHA 200 logs for the years 1985-1990 confirmed these findings. The logs also indicated that between 15-50% of the injuries listed each year were musculoskeletal (average = 30%). Lost time related to CTDs ranged from three to over 100 days.

Personal breathing zone and area air samples were collected for styrene and fibrous glass at the presses that used fibrous glass molding material at the time of the site visit. Direct reading measurements for screening purposes were made throughout the operating press area for ammonia, phenol, and formaldehyde, using Draeger colormetric detection tubes. Ammonia and phenol concentrations were below the limit of quantitation (LOQ) and current evaluation criteria. No formaldehyde or fibrous glass was detected. The styrene concentrations were within current evaluation criteria.

Ergonomic evaluation in this plastic molding plant found exposure to several postural and muscular force stressors. The air sampling results indicated that at the time of the site visit there were no overexposures to formaldehyde, phenol, ammonia, fibrous glass, or styrene. Recommendations for redesign of several work areas to minimize ergonomic stressors and reduction of exposure to chemical substances are contained in Section VI of this report.

KEYWORDS: SIC 3089 (Plastics Products, Not Elsewhere Classified), ergonomics, formaldehyde, phenol, ammonia, fibrous glass, styrene.

II. INTRODUCTION

In October 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Allied Industrial Workers of America to conduct a health hazard evaluation at Scott Molders in Kent, Ohio. NIOSH was asked to address ergonomic concerns and to investigate potential employee exposures to ammonia, fibrous glass, formaldehyde, phenol, and styrene. A site visit was conducted on February 25-26, 1991.

Scott Molders, Inc. is a family-owned, press molding firm that employs approximately 70 production workers distributed over three work shifts. The company molds plastic and fibrous glass parts for automotive, military, and custom-order clients.

The building was one-story with concrete floors. There were rows of windows near the ceiling. There were three types of molds in use - compression and transfer, injection, and insert. The presses weighed between 50-400 tons. According to company personnel, all presses have exhaust vents and there is a complete room air change every three and one-half minutes in the area that contains only presses. Two types of fibrous glass material were in use at the time of the site visit. Several different phenolic molding compounds were used. According to the material safety data sheets (MSDSs) for the molding compounds used, ammonia and phenol could be released if heated to product temperatures greater than 90°F and all of the compounds contained less than 1.5% phenol.

The length of the average work day was seven hours, with additional time for two 10-minute rest-breaks, a 30-minute lunch, and five minutes at the end of the day for clean-up. The company has no piece-rate standards, and press workers were rotated through jobs so that no worker spent more than two days in succession at a particular press operation. There is no job rotation among the five workers in the finishing department because they all work on the same parts.

III. EVALUATION CRITERIA

A. **Ergonomic**

Cumulative trauma disorders (CTDs) of the musculoskeletal system occur in workers whose jobs require repetitive movements and forceful exertions. These injuries frequently affect the tendons, tendon sheaths, muscles and nerves of the upper extremities. Common CTDs include tendinitis, synovitis, tenosynovitis, bursitis, ganglionic cysts, strains, DeQuervain's disease, and carpal tunnel syndrome (CTS). Studies have shown that CTDs can be precipitated or aggravated by activities that require repeated or stereotyped movements, large applications of force in awkward postures, or exposure to hand/arm vibration.[1-3] Postures often associated with upper extremity (UE) CTDs are extension, flexion, and ulnar and radial deviation of the wrist, open-hand pinching, twisting movements of the wrist and elbow, shoulder abduction, and reaching over shoulder height. Activities associated with UE CTDs are frequently observed in many manufacturing and assembly jobs in industry. Occupations associated with a high incidence of CTDs include electronic components assembly, garment manufacturing, small appliance manufacturing and assembly, and meat and poultry processing.[4-6]

One of the most disabling CTDs is CTS. CTS was first reported as a clinical entity as early as 1854; however, it was not fully described in the medical literature until 1927.[7] CTS is caused by compression of the median nerve inside the carpal tunnel at the wrist. Clinical manifestations include pain, numbness, and burning and/or tingling sensations in the hand and fingers in the distribution of the median nerve. At advanced stages, atrophy of the thenar muscle may occur.[8-9]

CTDs can be associated with non-occupational activities or preexisting conditions. For example, individuals with diabetes, rheumatoid arthritis, certain thyroid conditions, and kidney dysfunction appear to be at an increased risk for CTS.[10] However, the association between work-related factors and CTDs has been documented extensively. Previous investigations have focused on the role of forceful and repetitive hand motions, awkward postures, mechanical stress at the base of the palm, and vibration in CTD development. One study found that workers performing jobs with force levels of 4 kg or more were four times as likely to develop hand/wrist CTDs as those workers with jobs requiring muscular exertions of 1 kg or less. Job tasks with cycle times of 30 seconds or less were associated with a three times greater incidence of UE CTDs than jobs where cycle time was more than 30 seconds.[3]

Nevertheless, because of the complexity of repetitive motion patterns it has been difficult to establish specific exposure limits for minimizing CTD risk. Previous reports have used various definitions of repetitiveness to distinguish between different jobs.[5] According to these definitions, low repetitive jobs require less than 10,000 movements per day; medium repetitive jobs require from 10,000 to 20,000 movements per day; and high repetitive jobs require 20,000 or more movements per day. These definitions are intended merely to assist in judging the relative risk of hand intensive jobs. Other factors, such as posture and level of muscular force exerted during work activity, can exacerbate the CTD risk.

B. Industrial Hygiene

In order to assess the hazards posed by workplace exposures, industrial hygienists use a variety of environmental evaluation criteria. These criteria are intended as exposure levels to which most employees may be exposed for a normal working lifetime without adverse health effects. The criteria are often expressed as 8 or 10-hour time-weighted averages (TWAs). For compounds with irritant effects, evaluation criteria may include a short-term exposure limit (STEL), a concentration not to be exceeded during a 15-minute period of the workshift. These levels do not take into consideration individual susceptibility such as pre-existing medical conditions or possible interactions with other agents or environmental conditions. Evaluation criteria change over time with the availability of new toxicologic data.

There are three primary sources of environmental evaluation criteria for the workplace: 1) NIOSH Recommended Exposure Limits (RELs),[11] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[12] and 3) the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs.)[13] The OSHA PELs may reflect the feasibility of controlling exposure in various industries where the agents are used: the NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted while reviewing this report that industries are legally required to meet those levels specified by an OSHA standard.

1. Ammonia

Ammonia is a severe irritant of the eyes, respiratory tract and skin. It may cause coughing, burning, and tearing of the eyes; runny nose; chest pain; cessation of respiration; and death. Symptoms may be delayed in onset. Exposure of the eyes to high gas concentrations may produce temporary blindness and severe eye damage. Exposure of the skin to high concentrations of the gas may cause burning and blistering of the skin. Repeated exposure to ammonia gas may cause chronic irritation of the eyes and upper respiratory tract.[14,15] The NIOSH REL for ammonia is 25 ppm as a 10-hour TWA. NIOSH and OSHA have set short-term exposure limits (STELs) of 35 ppm. ACGIH has set limits of 25 ppm or as an 8-hour TWA and a STEL of 35 ppm.

2. Fibrous glass

Fibrous glass is a skin, eye, and respiratory tract irritant. It has been associated with intense pruritus (itching) of the skin in the presence or absence of pinpoint-sized papules. Tumor development in animals has been related to the physical characteristics of the glass fibers and the length of time the fibers are present in the animals. Tumor development in animals is typical of a non-specific foreign body response. In 1977, NIOSH proposed a REL of 5 mg/m^3 (TWA) for total fibrous glass dust and a 3 fiber/cubic centimeter (cc) limit for fibers having a diameter equal to or less than 3.5 µm and a length equal to or greater than 10 µm, based on evidence that small diameter fibers produce fibrosis in animals and respiratory tract irritation in humans. In 1988, as part of the proposed rules on air contaminants, OSHA proposed to adopt the NIOSH recommendation of 5 $\mu g/m^3$ for total fibrous dust, but not the 3 fiber/cc limit for small diameter fibers. In its testimony to OSHA, NIOSH identified several studies that suggested a carcinogenic risk in workers exposed to certain types of man made mineral fibers, including glass wool. NIOSH concluded that the proposed OSHA PEL of 5 $\mu g/m^3$ for total fibrous dust is unlikely to be protective and that a 3 fiber/cc limit for small diameter fibers is a significantly better alternative.[16] OSHA temporarily delayed a final decision regarding the establishment of a separate PEL for fibrous glass because of the complexity of the issues raised by the extensive evidence submitted to the record.[13] ACGIH has a TLV of 10 mg/m^3 as an 8-hour TWA.

3. Formaldehyde

Formaldehyde is a colorless gas with a strong odor. Exposure can occur through inhalation and skin absorption. The acute effects associated with formaldehyde are irritation of the eyes and respiratory tract and sensitization of the skin. The first symptoms associated with formaldehyde exposure, at concentrations of 0.1 to 5 parts per million (ppm), are burning of the eyes, tearing, and general irritation of the upper respiratory tract. There is variation among individuals, in terms of their tolerance and susceptibility to acute exposures of the compound.[17] In two separate studies, formaldehyde has induced a rare form of nasal cancer in rodents. Formaldehyde exposure has been identified as a possible causative factor in cancer of the upper respiratory tract in a proportionate mortality study of workers in the garment industry.[18] Statistically significant excesses in mortality from cancers of the buccal cavity and connective tissue were found among exposed workers.[18,19] NIOSH has identified formaldehyde as a suspected human carcinogen and recommended that exposures be reduced to the lowest feasible concentration. The OSHA PEL is 0.75 ppm as an 8-hour TWA and 2 ppm as a STEL.[26] ACGIH has designated formaldehyde to be a suspected human carcinogen and therefore, recommends that worker exposure by all routes should be carefully controlled to levels "as low as reasonably achievable" below the

TLV.[12] The current ACGIH TLV is 1 ppm as an 8-hour TWA and 2 ppm as a STEL. ACGIH has proposed a ceiling limit of 0.3 ppm in their notice of intended changes.

4. Phenol

Phenol is an irritant of the eyes, mucous membranes, and skin. Systemic absorption can cause convulsions as well as liver and kidney disease. The skin is a route of entry for the vapor and liquid phases. Phenol has a marked corrosive effect on any tissue. Symptoms of chronic phenol poisoning may include difficulty in swallowing, diarrhea, vomiting, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly a skin rash.[14] The NIOSH REL, ACGIH TLV, and OSHA PEL for phenol are 25 ppm as an 8-hour TWA. NIOSH has set a ceiling limit of 15.6 ppm. All standards include a skin notation, which indicates that skin absorption may be a significant route of exposure.

5. Styrene

Styrene is an irritant of the eyes and respiratory tract and a central nervous system depressant. Exposure to styrene has produced health effects such as headache, fatigue, drowsiness, nausea, malaise, difficulty in concentrating, and a feeling of intoxication.[20] Decrements in balance, coordination, manual dexterity, and reaction time have also been associated with styrene exposure. High concentrations may cause a person to become sleepy or unconscious. Long term skin exposure may produce a rash from defatting.[14,21] The NIOSH REL and OSHA PEL for styrene are 215 mg/m^3 as an 8-hour TWA and 425 mg/m^3 as a STEL. The ACGIH TLV is 213 mg/m^3 as an 8-hour TWA and 426 mg/m^3 as a STEL with a skin notation.

IV. METHODS

A. Ergonomic Evaluation

The ergonomics evaluation at Scott Molders, Inc. consisted of observing the jobs that were running, informally interviewing all the workers at those jobs, videotaping several cycles of each operation, and reviewing the OSHA 200 logs for cases of musculoskeletal disorders. Ideally, during an ergonomic evaluation of production tasks, the day-to-day exposure of workers to ergonomic hazards (repetitive movements, high muscular forces, awkward postures, and vibration) is determined quantitatively. This type of calculation is possible even when workers rotate through several jobs, provided all the jobs in the rotational scheme can be evaluated. However, because Scott Molders runs fewer than 20 out of a possible 600 molding jobs at a time, it is not possible to calculate a traditional daily exposure of workers to ergonomic hazards. Therefore, the ergonomics evaluation in this case was limited to studying the videotapes of the available jobs for purposes of identifying job elements containing ergonomic hazards which may increase the risk of workers developing CTDs. The final step in this ergonomics evaluation is to offer recommendations for minimizing the level of hazard observed in the jobs that were studied.

B. Industrial Hygiene

Personal breathing zone and area air samples were collected for styrene and fibrous glass at the two presses that were using fibrous glass molding material at the time of the site visit. The styrene samples were analyzed using gas chromatography-flame ionization detector

(NIOSH Method No. 1501).[22] The laboratory assigned limit of detection (LOD) for styrene was 0.002 milligrams per sample and the limit of quantitation (LOQ) was 0.04 milligrams per sample. The samples for fibrous glass were analyzed using phase contrast light microscopy (NIOSH Method No. 7400).[23] The LOD for fibrous glass was 3000 fibers per filter. For screening purposes, direct reading measurements were made throughout the operating press area for ammonia, phenol and formaldehyde, using Draeger colormetric detection tubes. According to the manufacturer, the LOD for ammonia and phenol was 5 parts per million (ppm); the LOD for formaldehyde was 1.6 ppm. The MSDSs were examined for products used at the facility. Air flow patterns were evaluated using smoke tubes. Work practices were observed.

V. RESULTS

A. Ergonomic

At the time of the plant visit, 16 workers were molding parts and five were performing finishing operations. All of these workers were observed and videotaped while performing their jobs.

Most of the press operator jobs are similar, regardless of the type of molding process. In general, press operators stand at wooden benches, 37-39 inches in height. The standing surface is a wooden platform two inches in height, resulting in a working height of about 36 inches. In some cases, the press operators stand on elevated wooden platforms, and work at tables that are comparably elevated.

Except for injection molding, the main activities of a press operator are to place preformed plastic disks or fibrous glass links into a press, close the press with hand controls, perform inspection and/or finishing tasks during the mold cycle, and retrieve molded parts from the press at the end of the mold cycle. Injection molding differs in that the plastic is automatically fed into the press, and workers slide glass doors back and forth to gain access to the molded parts instead of pressing control buttons.

Each press molding station is also equipped with a high-pressure air wand which operators use to clear the press of excess plastic and flashing after each molding sequence. For the 16 press jobs observed, the mold time ranged from 36 seconds to just over four minutes.

Most of the press operators wear cotton gloves (some wear two pairs) primarily due to the temperature of the plastic (300-320°F) and fibrous glass (280-290°F) parts which are handled after they are molded.

The workers in the finishing department sit at a bench (60-70% of the time) while performing the final filing and sanding operations on various molded parts. A batch polishing operation precedes the final finish, which consists of rotating parts in a tumbler filled with abrasives made from crushed peach and apricot pits or crushed walnut shells. Other tasks performed by finishers include making boxes for finished parts and tapping holes in selected parts with a drill press, an operation which is often done while standing.

The video analysis indicated that the major upper extremity ergonomic stressors of these jobs are postural and muscular force demands which occur while performing the following task elements:

(1) Unloading parts from molding machines.

(2) Breaking or cutting off the excess plastic from parts.

(3) Filing, reaming, and sanding flashing from parts.

(4) Reaching (forward, overhead, or to the side) to activate press control buttons.

(5) Reaching to dispense completed parts into boxes or barrels. Repetition rate was not judged to be a significant risk factor in any of the jobs evaluated. Risk due to repetition was considered to be low because the overall pace of the jobs is moderate, and the workers are allowed to rest each cycle during the mold close time of the press machines.

Having to stand during the work day was judged to be a general ergonomic risk factor for the press operators. For the most part, it is recognized that prolonged standing increases heart rate and diastolic blood pressure, and may result in fatigue to lower extremity and back muscles which maintain erect posture.[24] Leg swelling and varicose veins also are reported to result from prolonged standing due to insufficient flow of venous blood and static muscular effort.[25] Other studies have reported increased problems with the feet in worker populations who stand during the work day.[26]

All 21 workers (16 mold press operators and 5 finishers) were informally interviewed for symptoms of cumulative trauma disorders (CTDs); 8 workers gave histories consistent with symptoms of CTDs, including elbow tendinitis, and hand, arm and wrist discomfort. Four of the 21 (19%) had undergone surgery for chronic carpal tunnel syndrome. In three cases, the surgery was bilateral, which brought the total number of carpal tunnel events to seven. Review of OSHA 200 logs for the years 1985-1990 confirmed these findings. The logs also indicated that between 15-50% of the injuries listed each year were musculoskeletal (average = 30%). Lost time related to CTDs ranged from 3 to over 100 days.

B. <u>Industrial Hygiene</u>

The results of grab air sampling with direct reading instruments for ammonia, phenol, and formaldehyde are shown in Table 1. Ammonia and phenol concentrations were below the LOQs and current short-term evaluation criteria. No formaldehyde was detected using the screening method.

The results for the styrene sampling are located in Table 2. Both personal breathing zone concentrations were 17 mg/m^3, which is below the current evaluation criterion of 213-215 mg/m^3 as a TWA. Area air concentrations of styrene ranged from 6.2-45.5 mg/m^3.

The concentrations for area air and personal breathing zone samples for fibrous glass are shown in Table 3. None of the four samples had detectable amounts of fibrous glass.

Work practices were observed throughout the facility. Several workers had open containers of food and drink at their work stations. Several employees used gloves for protection from heat and abrasions. Employees stated that long-sleeve shirts were worn to protect their skin from fibrous glass material and to prevent itching.

Airflow patterns were evaluated throughout the two areas where the presses were located. A make-up air system was in place in the larger area that contained the majority of presses. There was air movement away from the presses in the large area. There was very little air movement in the second area where the additional fibrous glass presses had been added and there was no make-up air system in this portion of the facility.

VI. DISCUSSION AND RECOMMENDATIONS

A. Ergonomic

As noted in the job descriptions above, many task elements of the various molding operations are similar, regardless of the type of part being molded. Therefore, two types of recommendations will be offered: general recommendations that apply to all jobs (including ones that were not running at the time of the evaluation), and specific recommendations that apply only to a certain work station.

General Recommendations - Press Operators

1. **All Press Machines**

    a. For standing press operators, provide a stool or sit/stand bar so the worker can relax during the portion of the mold close time that exceeds the time needed to finish and/or inspect parts from the previous mold cycle.

    b. Provide a foot rail that workers can rest one foot on while waiting for the mold cycle to end. The rail should be 4-6 inches above floor height and span the width of the work table. Workers should be encouraged to alternate legs often to alleviate back stress and minimize foot fatigue. Some workers were observed to be resting their feet on the horizontal strap connecting the legs of the work table, but it was situated too high to provide the leg and back rest that a lower rail can provide.

c. Install cushioned mats at each press work station to minimize foot and leg fatigue. The wooden platforms currently in use at each work station provide some cushioning for workers, but they are not as effective as mats.

2. **Injection Mold Press Machines**

   a. Ensure that the doors on the mold machines are working properly, and that appropriate maintenance measures that minimize the amount of force needed to open and close the doors are routinely performed.

<u>Specific Recommendations and Comments - Press Operators</u>

1. Work Station 25, Resistor Cord (injection mold) - none.

2. Work Station 18, On/Off Switch for an electric motor (injection mold)

   a. Provide a handle for the file used to remove flashing from the part. The handle should be round or bulbous, made of wood or plastic, and sized to fit comfortably in the palm so that applied forces are distributed over a large area of the hand.

3. Work Station 20, Carrier Ignition Switch (injection mold)

   a. Provide a handle for the file used (see number 2a above).

4. Work Station 17A, Electrical Co. Tops and Bottoms (injection mold) - none.

5. Work Station 26, RV Pump Body

   a. Replace the "speed handle" socket wrench used to remove a threaded mold piece from the part with a ratchet wrench. This substitution would reduce the amount of muscular force needed to remove the mold from the part by improving the worker's position and mechanical advantage.

   b. Provide a handle for the file used to finish parts (see recommendation 2a, above). On this job, the worker used the pointed end of the file to clean out small holes on the part. Either a small boring tool would need to be added to the worker's tool supply, or the handle could be designed so that the tip of the file remained uncovered.

   c. Raise the wooden platform on which the worker stands, or add an adjustable platform to the work station so that the worker does not have to reach above shoulder height to retrieve plastic disks from the oven or to remove the molded part from the press.

   d. Lower or relocate the press control buttons so that the worker does not have to reach above shoulder height to activate the buttons. The need to move the control buttons may depend on the option chosen to elevate the worker in relation to the press height (see letter c, above).

   In general, the press control buttons on all work stations were situated too high, particularly for short workers. Conveniently-located control buttons are important at Scott Molders because on operations, workers maintained pressure on the buttons until the mold was completely opened (or closed), which constitutes astatic muscle loading condition in addition to an awkward posture.

e. Tilt the box of plastic disks toward the worker to reduce the reach height and distance required to remove disks, or provide a gravity feed bin which allows the worker to remove the plastic disks at table top height.

6. Work Station 29, K Brush Holder

   a. Reposition the press controls so that they are not so far apart, and the left button is not above shoulder height of the worker. A control panel containing both buttons, located safely away from the press at about waist level, is recommended for this work station.

   b. Elevate the oven so that the worker can insert and remove plastic disks from the oven door without bending over.

7. Work Station 30, MSHA Flashlight

   a. Raise the height of the oven so that the worker does not have to bend over when opening the door to insert and remove plastic disks. Note: at the time of the NIOSH visit, the oven in use was temporary; nonetheless, the oven should be raised, and if the normally-used oven is returned to the work station, it should be permanently located at a convenient height for the worker, with adjustability for others who may work at Station 30.

   b. Relocate the hand controls for the machine which removes the ends of the mold from the flashlight housing so that the worker does not have to reach across the width of the work table (30 inches) to activate them. These controls should be located near the front edge of the work table.

   c. Reposition the controls on the press machine so that they are lower (particularly the left button) and closer together (see recommendation 6a, above).

8. Work Station 24, Automotive 87 Case (injection mold) - none.

9. Work Station 22, 77 Case (injection mold) - none.

10. Work Station 14, 8472 Pump Body

    a. Provide a handle for the file used to shave off scrap material and bore holes (see recommendation 5b, above).

       The worker on this job held the file by the shank, not by the handle. This was due to the greater width of the file portion of the tool, but it also was an indication that the file could have been shorter. A shorter file with a good handle would be easier for the worker to use.

    b. Tilt the box of plastic disks toward the worker or provide a bin which allows disk retrieval at table top height to avoid shoulder and wrist flexion (see recommendation 5e, above).

11. Work Station 13, ITT 97 Ring

   a. Relocate press control buttons to reduce reach height, particularly the left button (see recommendation 6a, above).

   b. Provide a handle for the file used to remove flashing and bore holes (see recommendation 5b, above). Because each part has six holes to bore out, a slow turning power tool could be considered as an alternative to the pointed end of the file for use in cleaning out small holes.

   c. Provide a bin within easy reach of the worker to eliminate having to reach over the width of the table to dispense the finished parts.

12. Work Station 31, OB Bracket

   a. Provide a height adjustable platform in the work place so that short workers can improve their position with respect to the mold and the top press control button.

13. Work Station 11, SAD-4 Part

   a. Lower the press control buttons so that the worker can activate them without reaching above shoulder height (see recommendation 6a, above).

   b. Provide an adjustable platform in the work place to improve the worker's position with respect to the work table. The height of the table caused the worker to flex and deviate the wrist in the ulnar direction while filing parts.

      The work height of most of the tables in the plant was between 35 and 37 inches. The table height should be adjustable allowing work to be performed approximately four inches below elbow height, which for women can be as low as 27.5 inches.[25] Therefore, the adjustability range of a platform should be about 10 inches.

   c. Tilt the box of plastic disks toward the worker, or provide a bin which allows disk retrieval at table top height to avoid shoulder and wrist flexion (see recommendation 5e, above).

14. Work Station 5, Fibrous glass Switch Plate

   In this job, the mold, press control buttons, and work table were all too high. As a result, the worker reached overhead to operate the press controls that transfer fibrous glass into the mold, and above shoulder height to load the press with fibrous glass and remove finished parts from the mold. The table height caused ulnar deviation of the wrist during the cutting of parts from the branches of the mold tree.

   a. To control for the mold height and the table height, an adjustable platform as discussed previously (13b, above) is recommended.

   b. Relocate the press control buttons to avoid reaching above shoulder height to activate them (see recommendation 6a, above).

c. To control for ulnar deviation while cutting parts, a tool handle bent about 45 degrees could be considered. A better solution is to devise a jig onto which the tree of parts is mounted, equipped with a center plunger (mechanical or pneumatic) that will remove all eight parts from the hub with one activation.

15. Work Station 4, SAT-11 Part

a. Tilt the box of plastic disks toward the worker, or provide a bin which allows disk retrieval at table top height to avoid shoulder and wrist flexion (see recommendation 5e, above).

b. Provide a bin at table height or below to eliminate wrist flexion when dispensing finished parts. A bin, mounted flush at table height so that parts can be slid in directly after filing, is recommended.

Note: The press control buttons at this work station are located at the proper height, and serve as a model for all work stations.

16. Work Station 2, R Brush Holder

This job differs from many in the plant in that there is a secondary press operation where a metal sleeve is inserted into the molded part. The press is located on the work table. The worker loosely engages the two parts, and the action of the press plunges the two together. The hand controls are located in a vertical plane about six inches above the height of the table. This hand control orientation results in the elbows being elevated (and unsupported) while the buttons are pushed with the thumbs.

Another unusual aspect of this job is that the molded part is threaded and must be removed from the mold with an air-driven nut runner. The worker holds the tool upside down, while the parts are removed from the top portion of the mold. While performing this task for seven pieces per mold, the worker must support the weight of the tool in the right hand, with the wrist extended and the forearm supinated.

a. Relocate the mold press control buttons to avoid reaching above shoulder to activate them (see recommendation 6a, above).

b. Provide support for the elbows while the worker is performing the secondary press operation. These supports could be attached to the surface of the work table. Because of the need for elbow support, performing this task while seated should be considered. The elbows could be supported by the arms of the chair, and leverage to activate the control buttons could be supplied by the back support of the chair. A foot support should also be provided, which could be mounted on the chair or on the table legs. Other considerations are to substitute the hand controls with a foot pedal (point-of-operation guarding may be necessary), or to horizontally-orient the buttons flush with the table top to allow for activation by the fingers with the wrist in a neutral position. Sinking the pan containing the metal sleeves into the table so it is flush with the table top surface would minimize wrist flexion while removing parts from the pan.

c. If technically possible, invert the mold so that the molded parts project upward from the bottom of the mold, rather than downward from the top half of the mold. This arrangement would allow the worker to use the air tool with the wrist and elbow in a neutral position, and would not require the worker to support the weight of the tool. The worker's ability to see the part on the mold would also be improved.

Recommendations - Finishers

1. Provide finishers with the option of using files with handles, as described above for press operators. At the time of the NIOSH visit, most of the finishing work was light-duty, and there was frequent use of the rough end of the file for smoothing edges and the pointed end of the file for boring out small holes. However, for other molded parts (not seen), the effort required to smooth the edges may be greater, making a comfortable handle on the files a desirable feature.

2. Provide all finishers with height adjustable chairs equipped with padded back supports and foot support.

3. Pad the edge of the work tables in the finishing area. The finishers perform a lot of close up, precision work with their wrists and forearms in contact with the table top edge.

B. Industrial Hygiene

The air sampling results indicate that at the time of the site visit, there were no overexposures to formaldehyde, phenol, ammonia, fibrous glass, or styrene.

Based on observations made during this site visit, the following recommendations are offered.

1. General ventilation should be added to the second area of the plant where the fibrous glass presses had been added. There was little air movement in that vicinity based on smoke evaluation, and this portion of the facility had not originally been set up to house presses.

2. To prevent potential ingestion of contaminants, no eating, drinking, or smoking should be allowed in the production area. These activities should be restricted to designated clean areas away from production.

3. Gloves, to protect the skin from heat and abrasions, should continued to be used.

4. Guards, to protect the forearms from fibrous glass, should be made available for employee use.

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1. Scott Molders, Inc.
2. Allied Industrial Workers Union
3. OSHA, Region V

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

Results of Direct Reading Survey for
Ammonia, Phenol, and Formaldehyde

Scott Molders, Inc.
Kent, Ohio
HETA 91-003

February 26, 1991

Location	Time	Concentration (ppm)* Ammonia	Phenol	Formaldehyde
Vicinity of Press #16	9:40	Trace	ND**	ND
	11:00	Trace	Trace	ND
	2:05	Trace	ND	ND
Vicinity of Press #23	9:45	Trace	ND	ND
	2:15	Trace	Trace	ND
Vicinity of Press #19	9:50	Trace	ND	ND
	2:20	Trace	Trace	ND
Evaluation Criteria:				
OSHA Permissible Exposure Limit (PEL)		35(STEL)	25	0.75
NIOSH Recommended Exposure Limit (REL)		25	25	LFC#
ACGIH Threshold Limit Value (TLV)		25	25	1

* - parts per million
** ND - none detected
# - Lowest Feasible Concentration

Table 2

Results of Personal and Area Air Samples for Styrene

Scott Molders, Inc.
Kent, Ohio
HETA 91-003

February 26, 1991

Job/Location	Sample Time (mins)	Sample Volume (liters)	Concentration (TWA - mg/m^3)*
Personal:			
Press Operator #31	402	80.5	17.4
Press Operator #5	410	82.1	17.1
Area:			
Press #31	439	87.8	45.5
Press #5	443	88.7	6.2

Evaluation Criteria:	
OSHA Permissible Exposure Limit (PEL)	215
NIOSH Recommended Exposure Limit (REL)	215
ACGIH Threshold Limit Value (TLV)	213

* TWA-mg/m^3 - Time-weighted average - milligrams per cubic meter

Limit of Detection (LOD): 0.02 milligrams per sample
Limit of Quantitation (LOQ): 0.04 milligrams per sample

Table 3

Results of Personal and Area Air Samples for Fibrous glass

Scott Molders, Inc.
Kent, Ohio
HETA 91-003

February 26, 1991

Job/Location	Sample Time (mins)	Sample Volume (liters)	Concentration (TWA - mg/m^3)*
<u>Personal:</u>			
Press Operator #31	400	400	<0.007#
Press Operator #5	412	412	<0.007#
<u>Area:</u>			
Press #31	436	436	<0.007#
Press #5	445	445	<0.007#
Evaluation Criteria:			
NIOSH Recommended Exposure Limit (REL)		5	
ACGIH Threshold Limit Value (TLV)			10

* TWA-mg/m^3 - Time-weighted average - milligrams per cubic meter

- Below LOD

Limit of Detection (LOD): 3000 fibers per filter or 0.007 mg/m^3