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HETA 96-0062-2588
Weyerhaeuser Paper Company
Belleville, Illinois

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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.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Katharyn A. Grant, Ph.D., C.P.E., and Daniel J. Habes, M.S.E., C.P.E., of the Applied Psychology and Ergonomics Branch, Division of Biomedical and Behavioral Science (DBBS). Desktop publishing by Pat Lovell.

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SUMMARY

In January 1996, the National Institute for Occupational Safety and Health (NIOSH) received a joint labor-management request for a health hazard evaluation at the Weyerhaeuser Paper Company, in Belleville, Illinois. The request cited problems resulting in cumulative trauma disorders (CTDs) and specified the need for assistance in developing engineering controls and implementing improved methods of medical assessment. On March 4-6, 1996, NIOSH investigators conducted a site visit at the facility. During this visit, NIOSH investigators reviewed the company's Occupational Safety and Health Administration (OSHA) 200 logs, spoke with labor and management representatives, and observed and videotaped work activities within the production areas.

Between 1993-1995, 13 musculoskeletal disorders (back and upper extremity) were recorded on the plant's OSHA 200 logs. The incidence rate of OSHA recordable musculoskeletal disorders ranged from 2.5 to 3.2 per 100 full time workers per year. Most of these disorders (>90%) affected workers in the Finishing Department. Thirty percent of these injuries resulted in lost work days (mean = 26 days); 46% resulted in restricted work activity (mean = 44 days). From 1993 to 1995, the direct costs to the company due to work-related musculoskeletal injuries (i.e., cost of compensation, rehabilitation services, medical services, and litigation) totaled $99,765. The estimated future liability to the company resulting from these injuries is $88,441 (direct costs only).

Following the site visit, NIOSH investigators reviewed videotapes of work activities to identify factors related to musculoskeletal disorder onset. The Strain Index was applied to estimate the risk of upper extremity musculoskeletal disorders associated with specific box forming tasks. Although recent improvements in workstation design (e.g., introduction of air tables) have reduced workers' exposures to ergonomic hazards, some jobs in the Finishing Department continue to expose workers to stressors commonly associated with the development of musculoskeletal disorders. These risk factors include repetitive and forceful hand/wrist movements, localized contact stresses, and awkward back and upper extremity postures.

Based on the information and data obtained during this Health Hazard Evaluation, NIOSH investigators conclude that while efforts to reduce hazards in the Finishing Department have been successful, some risk factors for work-related musculoskeletal illness and injury remain. Recommendations to further reduce ergonomic hazards and improve safety conditions are included in this report.

KEYWORDS: SIC 2653 (corrugated and solid fiber boxes), ergonomics, musculoskeletal disorders.

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INTRODUCTION

In January 1996, the National Institute for Occupational Safety and Health (NIOSH) received a joint request from the management of Weyerhaeuser Paper Company and the International Brotherhood of Boilermakers Union, Local S-185, to evaluate potential hazards resulting in cumulative trauma disorders (CTDs) at its container board manufacturing facility in Belleville, Illinois. In the request, the company expressed frustration at a recent increase in the number of lost-time injuries, which followed a thirty-three month period without a lost-time incident. On March 4-6, 1996, NIOSH representatives conducted a site visit to the Weyerhaeuser facility in Belleville, Illinois. During the opening meeting, plant management communicated the opinion that most of the jobs in the Finishing Department had been configured for maximum safety and that recent injuries were not consistent with these job design/redesign efforts. Therefore, NIOSH ergonomists were asked to determine if the potential for injury had been minimized to the extent possible and, if not, what the company had overlooked in the design of its jobs. A stated goal of the company is to reduce the injury rate to zero.

BACKGROUND

Plant and Job Description

The Weyerhaeuser Paper Company operates more than 40 container board manufacturing facilities across the U.S. The Belleville, Illinois, plant produces cardboard packaging for various consumer products. The facility employs approximately 110 workers, distributed over three shifts. Workers are represented by the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers, AFL-CIO, CFL, Lodge S-185. The workforce is predominantly male and is relatively stable, with an average turnover rate of less than 10%. Approximately 65% of workers are age 30 or older, and approximately 20% are age 50 or older. Workers are paid on an hourly basis (average wage is between $11.50 and $12.00 per hour) and receive medical and dental benefits. Although the plant has production standards, they do not affect wages. Employees work an average of 8% overtime weekly, although overtime is rarely mandatory.

The process of manufacturing corrugated boxes takes place in two steps. In the first step, sheets of corrugated cardboard are manufactured from paper stock brought in from a supplier (mill). The machine used to perform this process is known as a corrugator. The corrugator is staffed by 5 workers -- 3 at the "wet end," where paper stock and starch are supplied to the machine; and 2 at the "dry end," where the finished cardboard is cut into sheets and stacked. In the second step, the cardboard sheets are cut, scored, folded and glued to form boxes. Printing may be added to the exterior of the box. These processes are largely automated and are performed in the finishing area. The Finishing Department contains approximately 10 different machines, each used to produce one or more types of box. Each machine is staffed by 2 or 3 operators. Most machines are equipped with automatic feeding mechanisms which provide cardboard sheets to the machine without worker involvement; however, some machines are not equipped with this feature, and workers feed stacks of cardboard to these machines by hand. Likewise, while one machine has an automatic stacking mechanism, most machines require an operator to transfer and stack boxes by hand. Workers are encouraged to rotate between stacking and feeding positions once every thirty minutes. When the manufacturing process is completed, boxes are sent via conveyor to a "unitizer," which compresses the boxes and places a band around the stack. The unitizer is usually operated by a single worker. Once banded, boxes are shipped or sent to storage.

Safety Committee

The Weyerhaeuser safety program uses the DuPont STOP process, and is modeled after the program developed by Quaker Oats. The structure of the safety committee was altered in the summer of 1995. Formerly, the safety committee consisted of 20-25 people, representing all plant functions, who

met monthly. Under the current program, all employees have safety responsibilities. Safety is a topic at all weekly crew meetings, and one meeting each month is devoted specifically to safety. Each shift also has a job safety analysis team. Although there is interest in ergonomics among the workers, ergonomics is not a current emphasis of the safety program, and workers are not provided regular training in ergonomics.

Discussions with management revealed that Weyerhaeuser has very high safety expectations, and that safety performance is considered in the company's Continuous Improvement Incentive Plan (CIIP). Management expressed the view that workers' behaviors are frequently responsible for injuries that occur within the plant, and that workers' compensation laws provide financial incentives for workers to report injuries. Alternatively, the union believes that management tries to discourage injury/illness reporting by litigating valid workers' compensation claims. Management is currently evaluating whether employee injuries should be considered in employees' performance evaluations.

METHODS

Incidence Rates

Incidence rates for work-related musculoskeletal disorders were calculated based on entries in the Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses (OSHA 200 log) for the years 1993-1995. For this study, we defined "musculoskeletal disorders" as injuries to the neck, shoulder, elbow, arm, hand, wrist, or back, resulting from overexertion or repetitive trauma. Fractures, lacerations, burns, or contusions were excluded from this definition. The total number of musculoskeletal disorders entered onto the OSHA 200 logs was multiplied by 200,000 work hours, and divided by the total number of employee hours worked for the year, to derive the number of injuries per 100 full time workers per year, assuming that employees work 40 hours per week and 50 weeks per year.

Employee injury and illness cost data was provided by the company. Expenditures for workers' compensation, rehabilitation, medical care, and attorney/investigation fees were described on a case-by-case basis. Investigators did not attempt to estimate the indirect costs (i.e., cost due to lost productivity, additional training for replacement workers, etc.) resulting from each claim. However, an estimate of the future financial liability to the company resulting from each case was provided.

Job Analyses

Activities performed in the corrugating and finishing areas of the plant on the day of the site visit were observed and videotaped. Eleven different activities/operations were evaluated. Information about the number of workers employed in each job, the size and shape of objects handled, and the dimensions of each workstation was collected. Jobs were also examined to identify the extent to which they were comprised of task factors and attributes that are associated with the development of upper extremity and low back disorders. Specifically, the Strain Index, a job analysis methodology that provides a numerical indication of the risk of developing distal upper extremity disorders, was applied to a sample of the job examined (Moore and Garg, 1995). Recommendations to eliminate or reduce workers' exposures to these risk factors are provided at the end of this report.

EVALUATION CRITERIA

Overexertion injuries, such as low back pain, tendinitis, and carpal tunnel syndrome, are often associated with job tasks that include: (1) repetitive, stereotyped movement about the joints; (2) forceful exertions; (3) awkward work postures; (4) direct pressure on nerves and soft tissues; and (5) work in cold environments or (6) exposure to whole-body or segmental vibration (Keyserling, Armstrong and Punnett, 1991; Gerr, Letz and Landrigan, 1991; Rempel, Harrison and Barnhart, 1992). The risk of injury appears to be enhanced as the intensity and duration of exposures to these factors are increased and the duration of recovery time is reduced (Moore

and Garg, 1995). Although personal factors (age, gender, weight, fitness) can affect an individual's susceptibility to these disorders, studies conducted in high-risk industries show that the risk associated with personal factors is small when compared to that associated with occupational exposures (Armstrong *et al*., 1993).

Because of the multifactorial nature of work-related musculoskeletal disorders, there are no completely validated models for predicting the risk of injury associated with specific jobs or job tasks. However, the Strain Index (SI) has been proposed as one possible method for discriminating between jobs associated with elbow, forearm, wrist and hand disorders versus jobs that are not. The SI represents the product of six multipliers that correspond to (1) intensity of exertion, (2) duration of exertion, (3) exertions per minute, (4) hand/wrist posture, (5) speed of work, and (6) duration of task per day. Preliminary tests indicate that jobs with SI scores less than or equal to 3 are probably safe, while jobs with scores greater than or equal to 7 are probably hazardous (Moore and Garg, 1995).

In all cases, the preferred method for controlling/preventing work-related musculoskeletal disorders is to design jobs, workstations, tools, and other equipment items to match the physiological, anatomical, and psychological characteristics and capabilities of the worker. Under these conditions, exposures to task factors considered potentially hazardous will be reduced or eliminated to the extent feasible.

RESULTS

Medical

In the three-year period from 1993 to 1995, 13 musculoskeletal disorders affecting the back, neck, and upper extremity were recorded in the OSHA 200 logs. The average incidence of recordable musculoskeletal disorders was 2.8 per 100 full time workers per year (range = 2.5 to 3.2). Twelve of the 13 injuries involved workers in the Finishing Department; only one of the injured workers was employed in the corrugating area. Three of the 13 injuries (23%) resulted in lost work days (mean = 26 days); 6 of the 13 (46%) resulted in restricted work days (mean = 44 days). "Repeated trauma" was cited as the cause of 6 injuries, including 3 cases of carpal tunnel syndrome. The average incidence of "disorders associated with repetitive trauma" was 1.3 injuries per 100 full time workers per year. This compares to an average incidence rate of 0.38 repetitive trauma disorders per 100 full time workers per year in private industry, and 0.32 repetitive trauma disorders per 100 full time workers per year for the 2653 Standard Industrial Code (SIC) (BLS, 1995). According to accounting statistics provided by the company, the direct costs of work-related musculoskeletal injuries from 1993 to 1995 (i.e., the cost of compensation, rehabilitation services, medical care, litigation, and investigative services) totaled $99,765. The company estimated its future liability as a result of these injuries to be $88,441 (direct costs only).

Ergonomic

Corrugator - Wet End

The wet end of the corrugator is staffed by 2 or 3 operators. The corrugating machine is extremely loud, and hearing protection is mandatory. Operators are primarily responsible for keeping the machine supplied with the raw materials (paper and starch) needed for making corrugated cardboard. The machine uses between three and five rolls of paper simultaneously at all times. According to records maintained by the employees, operators are required to change paper rolls approximately 70 times per shift. The frequency of roll changes is affected by the length of product runs - if several short runs are made, more frequent roll changes are required. Changing a roll of paper takes approximately five minutes; the procedure used for changing rolls of paper is described in Table 1.

Potential hazards: Although the work is not highly repetitive (cycle time is approximately 5 minutes), some steps in the procedure require moderately forceful hand exertions, awkward bends and

overhead reaches. In addition, the work requires extensive walking and provides little or no time for rest.

Corrugator - Dry End

Since the cardboard is cut, stacked and released from the machine automatically, work at the dry end of the corrugator largely consists of paperwork and monitoring the operation of the machine.

Potential hazards: The operator performs two activities requiring a moderately forceful exertion. First, as stacks of cardboard exit the machine via conveyor, the operator folds long pieces of cardboard and lifts the top portion of the stack to insert them between adjacent layers of cardboard. This practice prevents the stacks of cardboard from toppling over. Secondly, the operator pushes the stacks to an adjacent conveyor, which carries them to an area where they can be removed by a forklift.

Finishing Department

Work in the Finishing Department generally consists of feeding cardboard sheets into a machine or building stacks of finished boxes. These tasks tend to be moderately to highly repetitive. The forces and postures associated with these tasks are influenced by the particular machine and the workstation layout. Each machine is staffed by two or three workers.

2444 Rotary Diecutter

The 2444 Rotary Diecutter is unique in that it has both autofeeding and autostacking mechanisms. The 2444 is run by two workers who rotate between positions. One worker is primarily responsible for monitoring the operation of the machine. The other operator is responsible for building a base for the folded boxes as they are output from the machine. The operator performs this task by laying several pieces of cardboard on the floor beneath the location where boxes are delivered to the autostacker. This operator also inserts labels and other pieces of paper into the stacks before they are released to the unitizer. (The operator indicated that boxes are sometimes stacked by hand, but we did not observe this.)

Potential hazards: Although the stacking task is not highly repetitive (one double-stacked pallet is completed every 3.5 minutes), the operator is required to stoop/bend under the machine to set the cardboard foundation in place. While repeated stooping/bending can increase the likelihood of low back pain, a more likely outcome of this practice is an increased rate of traumatic injury (worker strikes head against the bottom of the machine).

5054 3-Color Flexo Folder Gluer/5104 2-Color Flexo Folder/5114 Koppers Flexo Folder Gluer

The 5054, 5104, and 5114 are operated in a similar manner. Each machine is equipped with an autofeed mechanism, and each is staffed by two workers. Operators rotate between monitoring the machine operation and forming piles of completed boxes. Pile height is adjusted automatically -- each successive layer of boxes is built on a smooth metal surface (34 inches high) which retracts, depositing the boxes on the preceding layer below. An air table is provided at each transfer station to facilitate the lateral movement of the boxes from the conveyor to the metal surface. The operator is also responsible for removing defective boxes from the stack, placing cardboard sheets below the bottom layer of each pile, and folding a box to place on top of each completed stack.

Potential hazards: Although the stacking task is not highly forceful, it is repetitive (4-5 transfers/minute) and the operator is under some pressure to keep up with the machine. Also, building the stack and placing tags in the appropriate location can require long reaches (up to 40 inches). An SI between 1.5 and 2.3 was calculated for this task (see Table 2).

2531 Platen Diecutter

The 2531 Platen Diecutter is commonly used to make smaller boxes, e.g., boxes for processed cheese. The machine is not equipped with an autofeeder, and cardboard sheets (approximately 3' x 3' square) must be placed in the machine by hand. One or two operators are stationed at the other end of the machine where finished products are delivered. Operators separate and stack the boxes before placing them on a pallet. Interviews with the operators indicated that they generally do not rotate between positions on this machine.

Potential hazards: Both feeding and stacking positions require repetitive hand motions and exertions, although stacking is the more difficult of the two tasks. To feed the machine, the operator lifts a stack of cardboard approximately 2-3 inches thick from a larger stack located directly behind the machine and positions it into the machine's feeding area. This task is repeated approximately 3-4 times/minute. A stack of sheets emerges from the other side of the machine approximately once/minute. Stackers fold and tear the sheets into smaller stacks of boxes. Although the risk of upper extremity disorders is probably low (SI is 3, see Table 2), this task has potential to cause low back pain or fatigue. The output conveyor of the machine, which delivers the boxes to the workers, is only 29 inches high, and the workers bend as much as 45 degrees during the folding and tearing portion of the task. After brushing all sides of the boxes with the hands and fingers to remove loose cardboard and square the stack, operators place the boxes on a work surface located directly opposite the conveyor. The work surface height is located 12 inches above the floor and is not adjustable; therefore, stacking can also require low bending and long reaches.

3410 Tray Press

Like the 2531, an operator feeds raw materials to the 3410 by hand. The worker transfers piles of cardboard (flats) from a supply stack to the machine at a rate of 2 piles/minute. Each pile is approximately 4-5 inches thick and contains 40+ sheets of cardboard. At the output end of the machine, a standing worker grabs stacks of tray flats from the delivery conveyor, squares them against a board mounted on the work table, and stacks them on a roll conveyor located across from the delivery conveyor. There is a load leveling device under the stack which allows the worker to adjust the height to which the flats are placed, but long reaches are required to build the far edge of the double row of stacked flats.

Potential hazards: The height of the supply stack is not adjustable, which causes the feeder to reach above the shoulder to access the top of the stack and to bend at the waist when reaching to the bottom of the stack. The feeding job is made somewhat more difficult by the requirement that the worker remove and flip some of the sheets to prevent the cardboard from warping. An SI between 2 and 3 was calculated for the stacking job, indicating that the risk of upper extremity disorders is likely small.

5072 Mini-Martin Flexo Folder Gluer

The 5072 is staffed by two or three workers, and like the 2531 and 3410, is hand fed.

Potential hazards: Feeding and stacking tasks are highly repetitive, requiring 7-8 transfers/minute. The feeder cannot adjust the height of the supply stack, meaning that low bends and lifts are required to retrieve the cardboard at the bottom of the stack. The finished boxes are stacked on a load-leveling roll conveyor. The workers reported that at the beginning of a stack when the conveyor is positioned at its highest level, the metal edge contacts the mid thigh when reaches are made to the far row.

Langston Flexo Folder Gluer

The Langston Flexo Folder Gluer is equipped with an autofeeding mechanism and is similar to the 5054, 5104, and 5114 machines, although it is used less frequently. Unlike the other machines, boxes are transferred to a stack across a Teflon coated table instead of an air table.

Potential hazards: Use of the Teflon table instead of the air table results in a minor increase in the force required to perform the stacking task. This task is fairly repetitive (transfer rate is slightly greater than 4/minute, and can require extended reaches of 42" or more to position the boxes at the back of the stacking

surface.)

5204 S&S Folder Gluer

Unlike other Folder Gluer machines in the plant, the 5204 tends to run high volumes of the same product with little changeover during the day. The machine is expected to run a minimum of 6700 sheets/hour, although operators indicated that the machine can run up to 10,000 sheets per hour. The machine is fed by hand, from a stack of cardboard on an adjacent conveyor. Because material quality is sometimes poor, the feeder "fans" each stack to remove loose pieces of cardboard before placing it in the machine. As boxes are completed, another worker at the other end of the machine transfers stacks of boxes from a conveyor to a metal surface overlaying the stack. A ball-bearing table (as opposed to a Teflon or air table) is provided to facilitate transfer of boxes between the conveyor and the stack.

Potential hazards: Although the SI is relatively low (2 to 3), the feeding task is somewhat repetitive and requires some above-shoulder reaching and bending (the height of the supply stack ranges from 72 to 12 inches above the floor). The need to fan the cardboard before placing it in the feeder increases the frequency of manual exertions. The machine also has sharp edges which the worker may contact. The stacking task is much more repetitive than stacking tasks at other machines, having a transfer rate of approximately 11 loads/minute, even when the machine is running slightly under minimum speed (6500 sheets/hour). The SI for this task is between 4.5 to 6.8 (Table 2).

Shrink Wrapping Operation

Although not required for most products, the bottom two feet of corrugated cardboard products manufactured for one company (Gilster) are wrapped with a layer of plastic wrap material before shipping. According to the workers, this prevents the stack from toppling over, but it is not clear why this wrap is not used on similar stacks that are also banded at the unitizer. The wrapping process is performed by two workers, one of whom lays a bed of cardboard on the conveyor for the forklift operator to set the stack on, and the other of whom uses a hand-held roll of clear plastic to wrap the bottom portion of the stack.

Potential hazards: Wrapping the stack requires the operator to walk around the perimeter of the stack (on the conveyor rollers) while bending at the waist. Requiring the operator to walk around the stack on the conveyor increases the likelihood that the operator could lose his/her balance during the task. The stooped posture that the worker is forced to assume can also lead to back pain and fatigue if maintained for prolonged periods of time.

DISCUSSION AND CONCLUSIONS

The automatic machine loading and unloading mechanisms, the air tables, and the adjustable-height roll conveyors found in the Finishing Department are examples of improvements which have significantly reduced the physical demands of job tasks performed in this facility. The risk of upper extremity disorders, as indicated by the Strain Index, appears relatively low for most jobs. However, employees in some jobs perform activities that may increase the risk of back and upper extremity musculoskeletal disorders. These include low bends and long reaches, forceful lifts and pushes involving stacks of boxes, and repetitive motions to feed machines and fold boxes.

While the Company's desire to achieve a perfect injury/illness record is laudable, it is probably unrealistic given the hand-intensive nature of the work performed in the plant. For this reason, the use of injuries/illness statistics as a consideration in employee performance evaluations is strongly discouraged. Systems which penalize employees for work-related injuries/illnesses frequently have little effect on behavior, while creating a strong incentive for employees not to report.

In the judgement of the investigators, conditions in the plant are *not* such that the injury and illness rate should far exceed the average for similar plants/operations. While additional job

modifications may provide benefit in terms of improving the health and safety of the workers, making substantial reductions in the plant's injury/illness rate may well depend on the arrival of management and union upon an appreciation and mutual understanding of each other's health, safety, and productivity goals.

RECOMMENDATIONS

It will be difficult to fully *eliminate* all risk factors for upper extremity musculoskeletal injury as long as workers continue to feed cardboard and stack boxes manually. The following recommendations are offered to *reduce* the risk of chronic and acute injuries among workers in the Finishing Department.

Engineering Controls

General

1. *Provide padding for edges and sharp corners at all work stations.* Specific locations where sharp edges were seen to be a hazard include the stacking end of the Mini Marten (the edge of the conveyor comes in contact with the worker's legs during reaches to the back of the stack) and the feed position of the 5204 S&S Folder Gluer (a metal arm protrudes from the feed mechanism).

2. *Provide workers performing feeding and stacking tasks with a means of adjusting the height of sheets/boxes.* Machines in need of lift tables or other load-leveling systems include the 3410 (feeder), the 5072 (feeder), the 5204 (feeder), and the 2531 (stacker).

3. *Use one-piece slip sheets as a base for stacking cardboard sheets and boxes.* Laying multiple sheets of cardboard under each stack of boxes appears to waste materials (although we assume scrap materials are used) and requires more of the operator's time and effort. Providing stackers with larger sheets of cardboard or plastic to place under each stack would eliminate the task of building an appropriate base. This recommendation, would largely eliminate the need for the stacker to duck under the machine when operating the 2444 with an auto-stacker (see below).

Corrugator - Wet End

Examine the facility layout for opportunities to consolidate materials and supplies near their point of use. From a fatigue standpoint, occasional walking is superior to constant standing. However, prolonged periods of whole-body activity can also cause fatigue and an increased likelihood of mentals errors. Much of the operators' time is spent traveling between locations to retrieve materials or dispose of scrap. Reducing the travel distance to these locations should increase the efficiency of the operators while reducing the potential for fatigue.

2444 Rotary Die Cutter

Allow the worker to place a cardboard base under the stack without standing under the machine. One alternative would be to provide the worker with a long-handled tool equipped with a pinch mechanism that would allow a single sheet to be placed under the stack while the worker stands next to the auto-stacker.

2531 Platen Die Cutter

Raise the height of the conveyor leading from the diecutter. A more appropriate height for the conveyor leading from the die cutter would be approximately 36 inches above floor level (Eastman Kodak, 1983).

5204 S&S Folder Gluer

Implement improved production methods/quality control procedures to eliminate the need to fan boxes before feeding them into the machine. In addition to reducing the number of times sheets are handled, improvements in technology (substitution of lasers for metallic blades in cutting machines) or machine maintenance could also result in the production of less scrap material/waste.

Shrink Wrapping Operation

Develop an alternative method for preventing the stack from toppling over on its way to the Unitizer, or apply the shrink wrap at some other point in the operation. A possibility would be to set the stack on a raised surface immediately before it is delivered to the roll conveyor, apply the shrink wrap, and *then* move the stack to the conveyor.

Administrative

Continue efforts to collect and monitor injury/illness data for surveillance purposes. On-going analysis of injury/illness data can be extremely useful for identifying problem areas and determining job analysis and intervention priorities. In addition to records analyses, worker surveys also help in identifying hazardous jobs and processes before injuries or illnesses occur. Information on surveillance methods for work-related musculoskeletal disorders can be obtained from a number of sources (OSHA, 1995; ANSI, 1996).

Training

Training is an essential element for any effective safety and health program. Providing training ensures that employees are well-informed about the hazards to which they may be exposed and can participate effectively in identifying and controlling these hazards (OSHA, 1995). Although workers at Weyerhaeuser currently receive training in proper lifting techniques, all workers should receive additional training in ergonomics. At a minimum, this training should include information on the signs and symptoms of work-related musculoskeletal disorders and how to report them, risk factors associated with their development, and ways to reduce exposure. In addition, at least one person on each shift should be given specific responsibility for ergonomics (just as other workers are responsible for other safety issues, e.g., lock-out/tag-out compliance). This individual should receive additional training in identifying risk factors, performing job analyses, and implementing/evaluating control measures.

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TABLE 1
Process Chart - Dry End Corrugator
WEYERHAEUSER PAPER COMPANY
BELLEVILLE, ILLINOIS
HETA 96-0062-2588

Symbol	Time (min)	Activity Description	Notes
F	0.5	Remove fixture from machine.	
F	0.1	Remove empty roll from fixture.	Requires bending and lifting.
⇨	0.1	Dispose of scrap paper.	
D	0.7	Get lift truck.	
⇨	0.2	Move new roll into position.	
F	0.1	Cut paper with knife.	
F	0.7	Position roll in fixture.	Requires some pushing, pulling and bending
F	0.4	Manipulate controls to secure roll in fixture.	
F	0.2	Cut paper with knife.	Requires low bending (to floor)
F	0.3	Turn roll to position edge in proper location.	Requires push/pull force exertion.
F	0.7	Tape edge to top of fixture.	Requires manual force exertion with palm and fingertips, over shoulder reaching
F	0.5	Gather scrap paper.	Requires stooping and bending to floor level.
⇨	0.2	Dispose of scrap paper.	
F	0.4	Move fixture into machine.	
⇨	0.4	Pick up and dispose of remaining scrap.	Requires low bending.
	5.5	**TOTAL**	

Legend: F Operation
⇨ Transportation
D Delay

TABLE 2
Strain Index Calculations
WEYERHAEUSER PAPER COMPANY
BELLEVILLE, ILLINOIS
HETA 96-0062-2588

Task (Machine number)	Intensity of Exertion	Duration of Exertion	Efforts per Minute	Hand/Wrist Posture	Speed of Work	Duration of Task	**SI Score**
Stack (5054, 5104, 5114)	Light	30-45%	4-8	Good or	Fair	4-8 hrs.	**1.5**
	"	"	"	Fair	"	"	**2.3**
Stack (2531)	Somewhat hard	10-29%	< 4	Bad	Slow	4-8 hrs.	**3**
Stack (3410)	Light or	50-79% or	< 4	Bad	Slow	4-8 hrs	**2**
	Somewhat hard	10-29%	"	"	"	"	**3**
Feed (5204)	Light or	50-79% or	< 4	Bad	Fair	4-8 hrs	**2**
	Somewhat hard	10-29%	"	"	"	"	**3**
Stack (5204)	Light	50-79%	9-14	Good or	Fast	4-8 hrs	**4.5**
	"	"	"	Fair	"	"	**6.8**

According to Moore and Garg (1995), tasks with SI Scores less than or equal to 3 are probably safe, and tasks with SI Scores greater than or equal to 7 are probably hazardous. Tasks with scores less than 7 but greater than 3 fall into a "gray area" and may be safe or hazardous.

Delivering on the Nation's promise:
Safety and health at work for all people
Through research and prevention