**HETA 95-0335-2566**
**Schrock Cabinet Company**
**Arthur, Illinois**

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# PREFACE

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# ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Katharyn A. Grant, Ph.D., C.P.E., Daniel J. Habes, M.S.E., C.P.E., of the Applied Psychology and Ergonomics Branch, Division of Biomedical and Behavioral Science (DBBS), and by Patricia K. Bertsche, M.P.H., R.N., C.O.H.N. of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies. Field assistance was provided by Bruce P. Bernard, M.D., M.P.H. Desktop publishing by Patricia C. McGraw.

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# Schrock Cabinet Company
# Arthur, Illinois
# March 1996

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## SUMMARY

On September 20-21, 1995, the National Institute for Occupational Safety and Health (NIOSH) responded to a health hazard evaluation request from the management of the Schrock Cabinet Company in Arthur, Illinois, to evaluate potential lifting hazards in the shipping department. The request was prompted by an increase in musculoskeletal disorders among workers in this department in the last two years, and the introduction of a new and heavier line of cabinets. NIOSH investigators reviewed the company's Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses (OSHA 200), interviewed employees, and administered a symptom questionnaire to all current employees in the shipping department to assess the extent of the musculoskeletal problems. The investigators also observed and videotaped the activities of eight workers performing lifting activities in the loading dock and staging area. Measurements of box sizes, lifting heights and cabinet weights were obtained. Representative lifts were analyzed using the Revised NIOSH Lifting Equation.

The medical evaluation revealed that 26% (5 of 19) of the shipping department employees were reported to have an OSHA recordable musculoskeletal disorder in the first 8 months of 1995 and 79% (15 out of 19) of the employees reported work-related musculoskeletal pain or discomfort in the past year. The lifting analyses showed that more than half of lifts executed by trailer loaders exceed the NIOSH Recommended Weight Limit (RWL), and that some exceed the RWL by more than three times. Using a multi-task analysis approach and various assumptions about the job, composite lifting indices ranging from 3.9 to 8.2 were calculated for the trailer loading job. Based on this analysis, it is possible that this job will place even a highly select group of workers at substantial risk for low back injury.

Based on the data obtained during this Health Hazard Evaluation, NIOSH investigators conclude that work in the shipping department imposes a high level of physical demand, which may increase the risk of work-related musculoskeletal injury. The medical survey found a high prevalence of self-reported work-related back pain or discomfort in the year prior to the survey, confirmed by the OSHA Illness and Injury Logs. Efforts should be made to reduce these demands by redesigning the job. Recommendations for changes in work organization, more frequent rotation, and additional worker training are also provided in this report.

**KEYWORDS**: SIC 2434 (Wood Kitchen Cabinets), ergonomics, musculoskeletal disorders, repetitive lifting, trailer loading, lower back pain.

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# INTRODUCTION

On September 20-21, 1995, representatives from the National Institute for Occupational Safety and Health (NIOSH) visited the Schrock Cabinet Company in Arthur, Illinois, in response to a management request for a health hazard evaluation (HHE). The request was prompted by concerns about potential hazards due to repetitive lifting by workers employed in the shipping department. Specifically, the company reported an increase in the number of musculoskeletal disorders in the last two years. Furthermore, the company had recently introduced a new and heavier line of cabinets to its product mix, prompting concerns from the shipping department employees. During an opening conference, NIOSH staff met with management and worker representatives to discuss the HHE objectives:

1. Determining the prevalence of musculoskeletal complaints associated with the material handling activities of workers in the shipping department.

2. Assessing potential lifting hazards due to manual material handling activities in the shipping department.

3. Developing recommendations for reducing or eliminating the physical stresses associated with manual material handling activities in the shipping department.

# BACKGROUND

**Plant and Job Description**

Schrock Cabinet Company, a subsidiary of White Consolidated, Inc., is a manufacturer of handcrafted wooden cabinets located in Arthur, Illinois. The company employs 600 people; 460 of these are employed in the cabinet making shop. The plant operates in two shifts and is non-unionized.

The focus of this investigation was limited to workers employed in the shipping department. At the time of this study, 19 workers (10 on day shift, 9 on night shift) were employed in this department. Almost all of these workers are employed as "trailer loaders." As the title implies, these workers are responsible for loading cabinets into one of 22 trailers for

distribution. In addition, one worker on each shift is employed as a "truck driver." Although truck drivers were not observed extensively during this investigation, they do perform some loading tasks at loading docks located elsewhere in the plant.

Trailers are loaded manually, without mechanical assist devices. In addition to moving cabinets into trailers, trailer loaders manage a 9300-foot$^2$ staging area located behind the loading dock. The staging area serves as a temporary storage area for cabinets waiting to be shipped. The company uses a "just-in-time" (JIT) inventory system whereby cabinets are made as needed and shipped immediately afterward. When this system breaks down, parts of an order are stored in the staging area until the entire order (also known as a "drop") is completed and can be loaded together on the trailer. The two shifts are organized somewhat differently with regard to how this work is carried out. The day shift uses a team approach, whereby loaders work in groups of 2 or 3 to load individual trailers in order of their scheduled departure. The night shift uses a more individual approach, whereby each loader is assigned to a number of different trailers (usually 5) for which he alone is responsible. On both shifts, there is some daily rotation; i.e., workers who load trailers one day may work in the staging area the next. The only worker who does not rotate is the truck driver.

Cabinets arrive in the staging and shipping areas individually packed in cardboard boxes, via conveyor belt. Cabinets range in weight from less than 10 lbs. to more than 200 lbs. (exclusive of packing materials), depending on their size and construction. The average weight of Schrock's top-selling cabinets (those that comprise 67% of sales) is approximately 47 lbs. When all the cabinets in an order (or drop) are assembled, the cabinets are released to the shipping area via conveyor belt. A drop may contain as many as 50-60 cabinets; a full-size trailer (3200-foot$^2$) typically holds between 6 and 9 drops. To maximize space usage, loaders are encouraged to "pack tightly," i.e., to stack cabinets to the ceiling of the trailer, leaving as little space between boxes as possible. It is important for loaders to keep cabinets in the same drop together in the trailer. As cabinets are moved onto trailers, they are checked off against a "pick ticket," i.e., a list of cabinets contained in the drop. During loading sequences, lift rates range from 2 to 3 lifts/minute. Between drops, loaders usually get short breaks from lifting, usually to provide information to a computer that schedules the next drop to be delivered to the shipping dock. Although work load can vary, loaders (overall) move an average of 1800 cabinets daily. Most trailers are completely loaded in 2 days. Trailers which are missing components after 2 days are moved to a separate set of docks, where loading is completed by the truck driver. There is little or no overtime work in the shipping department. Loaders perform virtually all lifts unassisted. In 1992, a training program was instituted to provide workers training in proper lifting techniques. Loaders are also provided with back belts, which are widely used. In July 1995, Schrock introduced a new line of cabinets known as the Gallery line. Although similar to cabinets in the Schrock cabinet line, Gallery cabinets feature metal-reinforced drawer boxes, which increase the overall weight of the cabinet by up to 100%. As of September 1995, Gallery cabinets comprised less than 10% of the company's sales.

**Safety Committee**

A safety committee was formed by the company in April of 1995. The company's contract "Medical Administrator," who is an emergency medical technician (EMT) by training, is in charge of the safety committee. The committee

includes 8 volunteers: 5 employees from the cabinet making shop and 3 employees from the office area. During the single meeting the committee has held since it was formed and the time of our evaluation, all members received 8 hours of safety training from an outside consultant. The training materials included some information related to ergonomics. This is the only training related to ergonomics the safety committee members and the Medical Administrator received.

# METHODS

**Medical Evaluation Methods**

The medical evaluation included: (1) a review of the Occupational Safety and Health Administration Log and Summary of Occupational Injuries and Illnesses (OSHA 200) from 1992-1995, (2) discussions with the contract Medical Administrator, who is the health care provider at the plant and the person who is responsible for maintaining the OSHA 200 logs; and (3) a self-administered symptom questionnaire that was distributed in small groups to all 19 employees in the shipping department. The questionnaire inquired about age, gender, job tenure and whether the employee had any work-related musculoskeletal pain or discomfort in the past year. Employees experiencing pain or discomfort were asked whether the problem interfered with their ability to do their job, caused them to miss days of work or be placed on restricted work duty. Employees were also asked to identify the location of pain or discomfort (i.e., shoulder, neck, upper extremities, back, or lower extremities.)

**Ergonomic Evaluation Methods**

During the site visit, NIOSH investigators observed the activities of employees working in the staging and shipping areas. To capture information about lifting postures and the frequency of manual lifts, work activities were recorded on videotape. NIOSH researchers also measured the sizes of different boxes and the heights of various lifts. Because of difficulties in making the measurement inside a trailer, the horizontal distance between the center of the box and the midpoint of the worker's ankles was measured (for various box sizes) in the staging area. Information about box sizes and cabinet weights was provided to NIOSH by the Schrock health and safety representative. This information was subsequently used as input to the revised NIOSH Lifting Equation. The NIOSH equation is a tool for assessing the physical demands of two-handed lifting tasks (Waters et al., 1993). A full description of the NIOSH Lifting Equation is provided in Appendix A. In brief, the equation provides a Recommended Weight Limit (RWL) and a Lifting Index (LI) for a lifting task, given certain lifting conditions. The RWL is the weight that can be handled safely by almost all healthy workers in similar circumstances; the LI is the ratio of the actual load lifted to the RWL. Lifting tasks with an LI $\leq$ 1.0 likely pose little risk of low back injury for the majority of workers. Tasks with an LI > 1.0 may place an increasing number of individuals at risk of low back injury. Many researchers believe that tasks with an LI > 3.0 pose a risk of back injury for most workers (Waters et al., 1993).

# RESULTS/DISCUSSION

**Medical**

OSHA 200 logs revealed no recorded musculoskeletal disorders in the shipping

department for 1992 and 1993. Four (1 back, 1 neck, 1 wrist, 1 knee) musculoskeletal disorders were recorded in 1994, resulting in a total of 56 restricted duty days and 32 lost work days. Five (3 back, 1 neck, 1 arm) musculoskeletal disorders were recorded on the OSHA 200 logs from January 1 - August 31, 1995. These disorders resulted in a total of 13 restricted duty days and 12 lost work days. According to the Medical Administrator, the direct medical costs for treating work-related musculoskeletal disorders in the shipping department for the period March 3, 1994 - May 18, 1995 totaled $23,000.00.

All 19 employees assigned to the shipping department completed the questionnaire. All workers were male, between the ages of 21 and 46 years (mean age = 32 years). All but one had been employed in their current job for more than a year, and 11 of the 19 had been employed in their current job for more than 5 years.

Seventy-nine percent (15 of 19) of shipping department employees reported work-related musculoskeletal pain or discomfort during the past year. There were 9 reports of work-related back pain or discomfort, 8 neck, 7 shoulder, 6 upper extremity (elbow/forearm, hand/wrist, or fingers), and 6 lower extremity (hip, knee, or ankle/foot).

Five employees who reported work-related musculoskeletal pain or discomfort in the past year also reported that their problem interfered with their ability to do their job. Four employees reported missing days of work in the past year due to work-related musculoskeletal pain. Two employees stated that they had been assigned to restricted or light duty work in the last year because of work-related musculoskeletal problems.

**Ergonomic**

Table 1 displays the results of an evaluation of 15 lifts using the revised NIOSH Lifting Equation. Lifts were selected for analysis using sales data provided by Schrock. The 15 cabinets were chosen to represent the variety of cabinets handled by workers in the staging and shipping areas during an average work day. Lifting indices (LIs) were computed for the same cabinets in both the Schrock and Gallery cabinet lines. Assumptions regarding the way these cabinets are handled were derived from observations of lifts involving the same or similarly-sized cabinets. For this analysis, researchers assumed that each lift was performed less than once every 5 minutes for periods of less than an hour, that each lift covered a distance of 12 inches, and that coupling was poor. As shown, the LI for individual lifts ranged from 0.7 to 6.0. More than half of lifts examined had an LI > 1.0, indicating that the lift could increase the risk of back injury to some portion of the working population.

Because the energy demands of repetitive lifting are significantly higher than that for a single lift, a multi-task analysis approach was also applied to the trailer loading job. Based on observations of workers in the shipping area, an overall lifting frequency of 3 lifts/minute was assumed. A composite lifting index (CLI) for the overall job was computed from the single-task, frequency independent lifting indices (FILIs) for each of the 15 cabinets. Assuming that loaders lift only Schrock line cabinets for durations of less than one hour, a CLI of 3.9 was computed for the job. Table 1 shows that as workers lift for longer durations, or as the percentage of Gallery cabinets increases, the CLI for the job also increases. For example, if workers spend more than 2 hours continuously handling Gallery cabinets, the CLI for the job increases to 8.2.

The CLIs calculated for the trailer loading job

should be viewed as conservative assessments of the lifting demands of this job for several reasons. First, cabinets included in our sample were somewhat lighter (mean = 44 lbs.) than the average Schrock cabinet, and no cabinet weighed more than 119 lbs. Company records indicate that some Gallery cabinets weigh more than 200 lbs.; it is likely that even a one-time lift of this magnitude would substantially increase the risk of back injury to these workers. Furthermore, many lifts cover distances greater than 12 inches; in several instances, loaders were observed lifting objects overhead to heights of 80 inches or more (distances of at least 50 inches). Therefore, it is likely that our sample calculations using the Lifting Equation underestimate the risk of back injury associated with this job.

Nonetheless, the results of this investigation indicate that nearly all workers in the shipping department are at elevated risk of work-related injury when performing lifting activities, even for short time periods. This risk increases as (1) the lifting duration increases, (2) the opportunity for rest is reduced, and/or (3) cabinet weight increases. For example, if Gallery cabinet sales were to rise substantially, and shipping department workload and practices remain the same, the company could expect an additional increase in reports of low back pain and musculoskeletal injury among workers in this department.

Although lifting is believed to be the major contributor to the potential for back injury, another hazard unique to the truck driver's work deserves mention. The truck driver is responsible for retrieving cabinets from the assembly area to complete orders which are awaiting shipping. To achieve this, the truck driver pushes a cart loaded with cabinets up an incline to the area where the nearly-filled trucks are located. The truck driver said that powered means of moving the cabinets (i.e., fork lifts or pallet jacks) were not available for this task.

# CONCLUSIONS AND RECOMMENDATIONS

Even under ideal conditions, the maximum recommended weight for manual lifting tasks is 51 lbs (Waters et al., 1993). Approximately 40% of cabinets produced by the Schrock Cabinet Company exceed this weight, and because cabinets are inherently large and bulky, optimal lifting conditions cannot be achieved. *Therefore, workers in the shipping department will likely be at increased risk of back injury as long as cabinets are handled manually, without assistance.*

The preferred method of controlling overexertion hazards is to provide engineering controls, i.e., to redesign tools, workstations, and jobs to eliminate hazardous work conditions. Administrative controls or policies designed to limit workers' exposures to hazardous conditions can be used temporarily until engineering controls can be implemented. In addition, training is recommended to allow employees to participate in the process of identifying hazards and making job modifications.

**Engineering Controls**

Recommendations that would eliminate or significantly reduce manual lifting requirements in the shipping department include the following:

1. **Consider implementing an automatic truck loading (slug loading) system.** Automatic truck loading (ATL) technology has been in

existence for about 20 years. It is a system of quickly and efficiently loading trailers that is often used in conjunction with JIT inventory processes. With ATL, a pre-assembled load is automatically moved into a trailer as a unit, instead of one package at a time. Using ATL, workers could build the load outside the trailer using pneumatic, vacuum or mechanical handling equipment, and move the unit into the truck when complete. Implementing this type of system would require additional space inside the shipping area (for building loads outside the trailer) and a method for moving the necessary lifting equipment between different trailers/docks. Although some ATL systems necessitate use of a dedicated trailer fleet (because the load mechanism becomes an integral part of the trailer bed), other types of loading systems are dock-mounted and can service any conventional trailer.

2. **Consider implementing an automated palletizing system.** Using automated palletizing equipment has two potential benefits. First, machines are used to stack materials on the pallets, eliminating manual handling. Second, software is available for determining the optimum method of stacking items on a pallet to maximize space usage. Loaders would no longer be responsible for trying to figure out how to make a load fit on the truck. Once palletized, loads could be moved into the trailers using forklifts, pallet jacks, or ATL equipment. This alternative would require the company to purchase pallets and forklifts; also, this option may slightly reduce the amount of shipping space available inside the trailer (since the pallets will take up some room). However, if some loads are transferred to slip sheets before loading occurs, the number of pallets needed and the loss of shipping space will be minimized. The existing system of conveyors would also require modification to allow forklifts access to the lifting docks.

3. **Consider implementing assistive devices for lifting in the staging area.** The staging area is not subject to the same constraints that limit the utility of assistive equipment in the shipping area; i.e., the staging area is smaller and there are no overhead space limitations, which may permit installation of stationary lifting devices. Therefore, implementing a pneumatic, vacuum or mechanical lifting system may be feasible. Devices with articulated handles (to permit high stacking) are currently available from a number of manufacturers. Installation of an overhead bridge crane (to allow lateral movement of the system) may be necessary.

4. **Provide the truck driver with a powered means of moving cabinets within the plant.** Because there is no conveyor for transporting cabinets to the loading docks used by the truck driver, a powered means of moving cabinets (i.e., fork truck or pallet jack) should be provided to reduce potential hazards associated with pushing or pulling heavy loads.

**Administrative Controls**

The effectiveness of administrative changes in work practices for controlling musculoskeletal disorders is dependent on management commitment and employee acceptance. Regular monitoring and reinforcement is necessary to ensure that control policies and procedures are not circumvented in the name of convenience, schedule, or production. An advantage of administrative controls is that they can be implemented quickly and easily without capital expense. However, because administrative controls do not eliminate the hazard, they should be considered temporary solutions for

controlling exposure until engineering controls can be implemented. Administrative control recommendations include the following:

1. **Encourage two-man lifting**. Although workers on the day shift already work in teams, the current procedure has evolved into one where one worker marks cabinets off the pick ticket and the other does the majority of the lifting. Although workers rotate between these roles on a daily basis, the end result is a situation where one worker is subjected to heavy physical demands for an entire eight hour workday, while the other performs paperwork and virtually no lifting. Encouraging workers to work in pairs when lifting heavier boxes would balance the demand between the workers, and hopefully reduce the risk of overexertion injury for both. Modifying larger boxes to include handles or cutouts would enable each worker to grasp one side of the box as the lift is performed. Experimentation may be necessary to determine the proper placement of hand holds on the various types of boxes.

2. **Consider more frequent rotation schemes.** Although analyses using the NIOSH lifting equation show that decreasing the lifting duration only slightly reduces the risk of low back injury, there may be some benefit (from the standpoint of preventing systemic and local muscle fatigue) in rotating workers from lifting tasks to lighter work assignments on a more frequent basis (e.g., hourly).

3. **Limit the need for staging.** One area where improvements will result in reductions in material handling is in the management of inventory and the sequencing of assembly operations. Currently, the company is undertaking efforts to implement a just-in-time (JIT) production system, whereby cabinets will proceed directly to a truck after leaving the assembly area. The present status of the JIT system is such that only 30% of cabinets go directly to the loading docks; 70% of cabinets are removed from the conveyors and stacked in the staging area due to production or sequencing problems. As a result, cabinets are lifted and/or lowered multiple times in staging before they are sent to shipping and loaded into a truck. By increasing the percentage of cabinets which are ready for immediate shipping, manual lifting in the staging area will be greatly reduced.

4. **Ship certain components in separate boxes.** The heavier cabinet components should be packaged and shipped in separate boxes. NIOSH lifting indices less than 1.0 cannot be achieved if box weights exceed 51 lbs. One way to reduce load weights would be to ship cabinet components (tops, shelves, etc.) in boxes separate from the cabinet frame. Limited assembly of these cabinets will be required upon arrival at their destination.

**Back Belts**

In August of 1992, NIOSH formed a Working Group to review the scientific literature addressing the use of back belts to reduce work-related back injuries in healthy, previously uninjured workers. At the completion of this review, the working group concluded that, because of limitations of the studies that have analyzed the workplace use of back belts, there is insufficient evidence to either support or refute the effectiveness of back belts in injury reduction. **As a result NIOSH does not recommend the use of back belts to prevent injuries among workers who have never been injured.** "Back belts do not mitigate the hazards

to workers posed by repeated lifting, pushing, pulling, twisting or bending." (NIOSH, 1994) The most effective means of minimizing hazards is to redesign jobs and workstations to ensure that workers can perform required activities without exceeding their physical capabilities and capacities. Employers should not make back belt use mandatory, and they should not be used instead of appropriate engineering and administrative controls.

**Safety Committee**

Effective control of worker safety and health requires management commitment and employee involvement. Although Schrock has been successful in developing an employee safety committee, the following recommendations are offered to improve the efficacy of the committee:

1. Appoint a management representative to the safety committee, as a way of ensuring that adequate authority and resources are made available to the committee to fulfill its objectives.

2. The committee should develop procedures and mechanisms to evaluate safety goals and monitor progress. These goals and objectives should be organized into a written safety program that is endorsed by management and communicated to all employees. Safety committee meetings should be held on a regular basis, to evaluate progress, assign responsibilities, and identify potential problem areas.

3. Provide additional training in ergonomics for the members of the safety committee to complement the limited training that has already taken place. If all safety committee members cannot receive more comprehensive training, the Medical Administrator should receive additional training since he is responsible for the committee.

4. Provide periodic training to all employees in the shipping department regardless of membership on the safety committee. This training should include information on the signs and symptoms of work-related musculoskeletal disorders, their prevention, and the proper use of control methods.

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