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NIOSH HEALTH HAZARD EVALUATION REPORT

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United States Postal Service
O'Hare Airport

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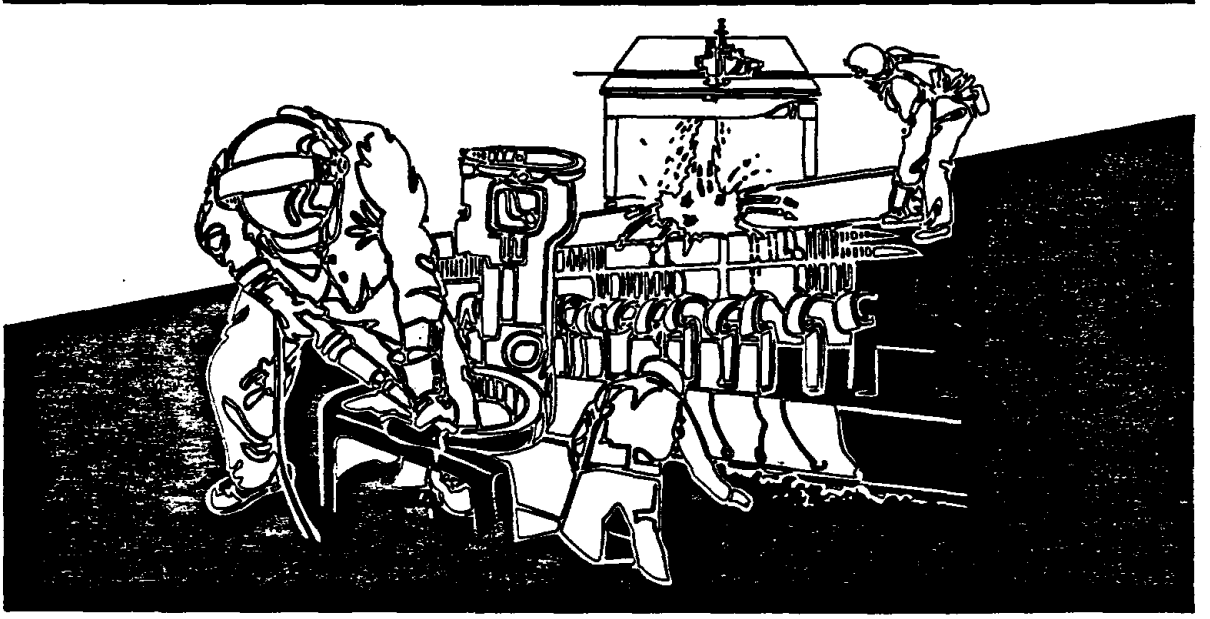

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluations and Technical Assistance Branch of the National Institute for Occupational Safety and Health 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 an employer or authorized representative of the employees, to determine whether any substance normally found in the place of employment has potential toxic effects in such concentrations as used or found.

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

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OCTOBER 1995
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I. SUMMARY

In September 1993, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the American Postal Workers Union (APWU) O'Hare-Midway "T" Local to evaluate the potential ergonomic hazards associated with two operations at the O'Hare Airport Mail Facility: 1) the sack sorting, and 2) small parcel bundle sorting (SPBS). In February 1994, NIOSH investigators visited the O'Hare Airport Mail Facility and held an opening conference with labor and management, videotaped employees performing the designated operations, took physical measurements of workstations and related components, conducted confidential employee interviews, and reviewed available employer-maintained illness and injury records.

NIOSH ergonomists reviewed the videotape and workplace measurements and identified several potential ergonomic hazards. The main sources of biomechanical stress to the workers were the need for the sorter to stand for prolonged periods in the SPBS area, and the requirement of the loader in this area to lean over the lip of a bulk mail container to retrieve sacks of mail. The loaders also had the potential to lift loads which were excessively heavy. Sweepers in the SPBS area also had the potential to lift excessive loads while filling various types of bulk mail containers with sorted mail. The main sources of biomechanical stressors in the sack sorting area were attributed to long reaches to retrieve bundles and boxes of mail and when using workstation components such as the label dispenser and the scale reset button. Employees in this area were also at risk of getting hit by bulk mail as it slid down the metal delivery chute. Employees interviewed consistently reported leg and back discomfort from prolonged standing.

From the videotape and workstation measurements, NIOSH investigators identified several potential ergonomic hazards associated with the work in the SPBS and sack sorting areas. These potential hazards pose a risk for low back, upper extremity, and lower extremity musculoskeletal disorders. Recommendations to further evaluate and correct these hazards are included in this report.

KEYWORDS: SIC code 4311 (United States Postal Service), ergonomics, biomechanical hazards, postal employees musculoskeletal disorders, lifting hazards, cumulative trauma disorders (CTDs), lower extremity discomfort, static lower extremity posture, standing postures

II. INTRODUCTION

In September 1993, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the American Postal Workers Union, O'Hare-Midway "T" Local, to evaluate potential ergonomic hazards associated with the Sack Sorter Coding Stations and the Small Parcel Bundle Sorter (SPBS) workstations at the AMC O'Hare Processing and Distribution Center (AMC) located in Chicago, Illinois. SPBS issues included unnecessary standing; excessive bending, stooping, and lifting; and the need for armrests on the keyboard stations. Concerns at the sack sorting location included the build-up of sacks, tubs, and trays; the need for armrests; and scanner height.

On February 17 and 18, 1994, NIOSH investigators conducted a site visit at the facility. An opening conference was held with national and local postal service management personnel and the O'Hare-Midway "T" Local Safety and Health representative. The meeting topics included an overview of the NIOSH HHE program and a review of the issues which prompted the HHE request. After the meeting, a walk-through survey of the AMC was conducted. At the conclusion of the site visit a closing conference was held providing initial findings to labor and management.

III. BACKGROUND AND JOB DESCRIPTION

The AMC became operational August 3, 1987, and currently employs over 1,000 workers. This facility operates seven days a week, 24 hours a day, and processes approximately one million pounds of mail daily.

AMC employees are either full-time regular, part-time regular, part-time flexible, transitional, or casual. All except casual employees are represented by one of three unions, the American Postal Workers Union O'Hare-Midway "T" Local, the National Association of Letter Carriers, or the Mail Handlers Union.

Initial job safety training for all postal workers consists of two sessions: two hours at the main office specific to the worker's craft followed by on-line job-specific training. Training includes such topics as fire and evacuation procedures, laser safety, and blood borne pathogens for workers handling biological specimens. It was reported by management that since October 1992 the AMC injury rate had fallen by 90%.

The only major equipment change since the building opened was the installation of the Verbex (voice activated coding) on each of the SPBS coding stations. Verbex allows mail to be sorted by voice signal.

IV. JOB DESCRIPTIONS

The Small Parcel Bunmdle Sorter (SPBS)

a. Load and Sort Positions

At the SPBS, small packages received via air mail are sorted and rerouted to specific mailing locations, including foreign destinations. The incoming mail is delivered to the SPBS in a variety of containers designed to carry large quantities of bulk mail. Table 1 describes the types of carts that were observed at the mail facility. The mail in these containers can either be loose or stuffed into cloth sacks. The total weight of packages bound in sacks is usually under 70 pounds.

The packages are dumped by mail handlers onto an ascending belt conveyor which delivers them piece-by-piece to a mail sorter standing on an elevated platform. The mail handlers must lift the individual packages or dump the sacks of mail over a front lip on the conveyor that can vary in height from 26-29 inches, depending on the workstation. There are four conveyors delivering mail to four mail sorters. Each mail sorter picks up and/or aligns a package, which is measured by the "code belt" (a notched template built into the conveyor work surface), and then weighed by a scale, also built into the conveyor. Parcels that are too small or too light (called "flats") or packages exceeding 20 pounds are removed by the mail sorter and placed into a nearby tray or thrown into a bin located on the main floor where the ascending conveyor originates. If the package is acceptable, the mail sorter enters the first three digits of the affixed zip code. After the key-entry operation, the package is swept away by another conveyor which delivers it to one of 100 possible locations of the sweeping portion of the machine.

The keypad used by the mail sorters is adjustable in height (39-49 inches), angle, and rotational orientation, and has a wrist support which is independently adjustable for angle. A pad can be attached to the surface of the wrist support for added support and comfort. At the time of the NIOSH site visit, only one such pad was available for the four sorting workstations. In addition, the keypad is mounted on an articulating arm which allows some flexibility in the standing position of the mail sorter.

The mail sorters stand on a thin mat at a work surface height of 35 inches, processing up to 1,100 packages per hour. At the time of the site visit, mail sorters spent four hours of the shift performing the keying or sorting aspect of the job, and four hours sweeping the sorted mail into secondary trays and sacks. Packages can also be sorted using a voice-recognition system called the Verbex. The system was new and not fully-operational at the time of the site visit. The Verbex eliminates the need for the mail sorter to enter the package zip code manually. Rather, the sorter verbally enters the code via a microphone attached to a headset.

b. Sweep Position

Packages are diverted off the main belt conveyor by means of metal chutes to 100 locations oriented perpendicular to the direction of the conveyor. There are 50 of these "sweep" sites on each side of the conveyor. Each sweep station can be configured to accommodate either a rigid tray (empty weight = 3.1 pounds) or a cloth sack. When trays are used, they are perched on a 13-inch platform which raises the top edge of the tray to 26 inches (handle height = 24"). The trays are designed (20 x 18 ½ inches) so that they fit on the platform only one way, ensuring that the initial grasp is in front of the worker (sagittal plane lift). Sacks are hung on the delivery chutes by a metal frame (32 inch height) in such a way that when full, they rest on the floor. The process can be programmed to deliver specified amounts of mail to each location. The maximum amount of weight is generally set at 35 pounds for trays and 70 pounds for sacks. If a package is meant to be delivered to a location where the tray or sack is already full, the package will stay on the main conveyor and go to a reject area. Occasionally, packages fail to get delivered to the reject are and fall onto the floor at the end of the line at a place called the "waterfall." Packages that fall onto the floor at the "waterfall" must be returned to the system of conveyors by hand.

The normal sweeping procedure entails removing full trays or sacks and placing them into one of the many types of large-capacity mail carts, or onto a flat bed utility cart. These containers are located across the aisle from the sweep locations, the number of which is determined by the volume and type of mail. To prevent packages from being delivered to a vacant sweep position, the sweeper presses a button on a panel above the tray or sack, which "closes" the position, and thereafter any mail headed for that position goes directly to the reject location. After an empty sack or tray is returned to the dormant sweep position, the sweeper reactivates the machine and the mail delivery system continues in the typical manner. In general, trays of mail are stacked in a bulk mail carrier (BMC) or an over-the-road carrier (OTR). Both of these metal containers feature a door on one side of the container which opens fully via a hinge at the top edge (70 inches) and a door on the opposite side which slides half way down the side of the cart. The fully open (or "walk-in") door allows trays to be easily stacked on the floor of the cart, but the open door (more than 60 inches) takes up considerable room in front of the cart. In cases where loading is done from the other side of the cart, workers must lift over an edge about 35 inches in height. The openings of the mail sacks must be bound before they are placed in a container or on a cart. This is accomplished with a sliding fastener much like those used to close household garbage bags, only larger and more rigid.

At the time of the site visit, there were three sweepers on each side of the main conveyor, and at no time were all 100 positions receiving mail. In one instance, small packages were being delivered exclusively to five or six trays grouped together in the

middle of the row of 50 sweep positions, on one side of the machine. The volume of mail seemed to be light, and rather than wait for the trays to fill up, workers removed packages by hand and tossed them over the top edge of a mail container. Further inspection revealed that the mail carts were situated side-by-side (doors facing doors) which made opening or lowering the sides impossible. Orienting the carts in this fashion takes up less floor space because the carts are more wide than long.

c. Sack Sorter

The Sack Sorter is an operation where large pieces of mail are routed to standing workers by means of a steep metal slide located below an overhead belt conveyor system. An angled diverter on the conveyor that can be set to a fixed position, moving at a constant speed, or governed in a distant computerized control room, ensures that the cascade of packages is distributed equally among the five sack sorters located at the bottom of the slide. Each workstation is separated by a cone-like divider that serves to funnel the packages to the individual workers. At each workstation, there is a piece of angle iron welded across the opening leading to the worker for purposes of slowing down incoming packages. Prior to this retrofit, packages could slide into the work area before the sack sorter was ready to process another package.

The package delivery system seemed to operate most smoothly when the accumulation of packages on the slide never exceeded half-way between the bottom and the top. If packages collect too far up the slide, an infra-red detector stops the belt conveyor from delivering packages to the slide. This situation is called going past "red line."

The observed package mix was either full or partially-full cloth sacks, bound trays of mail, or sleeved cardboard trays. Maximum weight is supposed to be 70 pounds. At the time of the site visit, it appeared that most packages were in the 30-35 pound range.

A horizontal chute located near the steep slide delivers packages to the worker. This chute, plus the scale located at its end, constitute the work surface area for the sack sorter. The 45" wide chute is slightly tilted to facilitate package movement (41 inches high at the beginning and 35 inches high at the end). The diagonal distance from the middle of the workplace (where the sack sorter usually stands, height = 38 inches) to the furthest point across the width of the chute is 51 inches. This represents a typical maximum reach for dislodging packages caught between the opening of the delivery chute and the angle iron that spans the chute opening. The maximum reach across the chute could be reduced to a 45 inch width, but would require the sack sorter to move up the chute and reach across the point where the chute is 41 inches high.

After receiving the package via the chute, the sack sorter moves it laterally to the scale (34 ½ inches high), aligns the package so that the bar code tag can be read by the

overhead scanner, removes the destination tag from the label dispenser, affixes it to the package, and pushes the package onto a conveyor below, which in turn delivers it to a continuously moving transport conveyor perpendicular to the workstation. Packages weighing more than 70 pounds will not scan and are pushed onto the conveyor by the worker. Occasionally, a package of 70 pounds or more is sent through the system to clear the metal slide of stuck packages.

There are several key components in the workplace that affect the motions and postures of the worker. These are the keypad, the label dispenser, the Class II laser scanner, and the reset button for the scale. The keypad is located conveniently to the right of the worker, and is height-adjustable. A common use of the keypad is to generate a destination label for a package that cannot be scanned. Also, the sack sorter generally hits one or two keys after processing packages in the normal manner. The label dispenser is located above the scale, forward from the scanner, at about the same height (60 ½ inches). One of the positions in the sack sorting area had the label dispenser relocated to just above the keypad. This location was being evaluated for its utility at the time of the site visit. Because it was lower and closer to the worker, it appeared that the relocated label dispenser was an improvement. Occasionally, the scale must be "rezeroed" by the sack sorter. The button on the scale controller was located on a shelf above the scale, 82 inches high. The scanner is located above the scale and aimed toward it. The mechanism had previously been located at a height of 74 inches above the scale but was recently lowered to 68 ½ inches to improve the scanner readability.

Production goal per worker is 300 packages per hour. There were two sack sorting areas in the mail facility (ten total employees per shift), but all observations took place at the one located on the north side of the building.

V. EVALUATION METHODS

Medical Evaluation

Confidential interviews were conducted with six sack sorters and eight SPBS workers. The interviewers solicited information on work (e.g., length of employment, department) and health (e.g., musculoskeletal symptoms). In addition, summaries of all Postal Service Forms 1769, Accident Report, from January 1, 1990, to February 10, 1994, and occupational illnesses for the same period were examined.

Ergonomic Evaluation

The primary purpose of the ergonomic exposure assessment was to identify risk factors for musculoskeletal discomfort or injury associated with the SPBS and sack sorter

workstations. The ergonomic assessment was accomplished via walk-though inspection and videotape analysis. NIOSH staff videotaped a representative work segment of each of these areas. The video was later reviewed by the NIOSH ergonomist to identify risks for lower extremity musculoskeletal disorders from long-term standing, upper extremity disorder risks from repetitive motions, and low back injury risks from lifting.

VI. EVALUATION CRITERIA

It is widely accepted that musculoskeletal disorders such as strains, sprains, and other regional impairments involving the muscles, ligaments, tendons, and nerves of the upper extremity and trunk can be caused or aggravated by repetitive hand work and excessive lifting loads.[1,2,3,4] Based on this body of literature, guidelines for the prevention and control of these disorders have been compiled, and can be found in ergonomics texts and design books.[5,6,7] A further evaluation of risk levels for manual lifting tasks can be found in the revised NIOSH lifting equation.[8] An assessment of the apparent and potential hazards to the musculoskeletal system from performing the manual work observed in the SPBS and the Sack Sorting areas (and subsequent recommendations for prevention and control) will be based on criteria found in the above-mentioned literature.

There is also accepted literature linking lower extremity musculoskeletal disorders with prolonged standing and static postures that was used as criteria to evaluate the work tasks in the mail facility. In 1983, the American Podiatric Association reported that 83% of industrial workers had foot or lower leg problems such as discomfort, pain, or orthopedic deformities.[9] Standing tasks increase heart rate and diastolic blood pressure, and require static contraction of the lower extremity and back muscles to maintain an erect position.[10] In the absence of leg movement, blood and other tissue fluids can accumulate in the legs, causing increased venous pressure and possibly varicose veins.[11] Fatigue and discomfort associated with prolonged standing tasks could be attributable to insufficient venous blood return and static muscular effort.[12]

In a recent study of painful feet among saleswomen, department store clerks, and supermarket staff, the prevalence was found to be approximately 48-50%.[13] The prevalence increased as these women maintained a standing rather than walking position, and as the "time on their feet" increased. Those who reported foot discomfort reported spending a greater time standing, walking, and kneeling, and less time sitting, than did those without foot discomfort. The prevalence of pain or discomfort was 48.2% among those spending more than 30% of their working day on their feet, while for those spending less than 30% on their feet, the prevalence was 7%.

In regard to providing accommodation for standing workers, Redfern and Chaffin found that workers reported 3/8-inch rubber mats, trilaminate mats, and shoe inserts to be more comfortable to stand on than concrete floors or hard mats.[9]

VII. RESULTS

DESCRIPTION OF ERGONOMICS HAZARDS AND DISCUSSION

Small Parcel Bundle Sorter (SPBS)

a. Load and Sort Positions

The keypad, with all of its adjustability features, seems well-suited for the sorting portion of this operation. At 1,100 packages an hour, the keying rate computes to about 3,300 keystrokes per hour. This is below the average of 11,263 for data entry workers in general[14] and fewer than the hourly rate of 8,100 for letter sorter machine operators.[15] Furthermore, it is likely that the keyboard used by the sorters is better designed than what was available to the above two groups of workers.

The main source of biomechanical stress for the sorters appears to be the need to stand while performing the task. Four hours of continuous standing, which was the work schedule at the time, can be fatiguing to the legs, feet, and back.[13] Reach distances to retrieve parcels from the far edge of the delivery conveyor (26-28 inches maximum) are not excessive for standing workers who can bend at the hip to reach forward.

Because the position of the keypad can be customized to the height and desired orientation of the worker, and is easily adjustable, a support for the elbow would probably not improve the job dramatically, and could restrict the ability of the sorter to move about the workplace while coding packages. However, other workplace accommodations such as a comfortable pad on which to stand, a stool or lean bar to relieve lower extremity and back fatigue, and a rail on which to rest one foot, would be beneficial to the worker.

The main source of biomechanical stress to the package loader is the requirement to lean over the side of a BMC or a canvas hamper to remove loads which could weigh up to 70 pounds. The full or "walk-in" door on a BMC can be used for unloading, but it typically isn't because when the door is opened, loose mail at the bottom of the BMC falls out onto the floor. The BMC would also have to be repositioned so that there would be enough room in the work area to allow clearance for the large door. The actual exposure to biomechanical stress by workers performing the loading portion of the SPBS job is difficult to quantitate and assess because of the variety of mail that is received and the many types of containers in which packages are delivered. Extensive sampling would be required to ascertain the distribution of mail received in each type of container, and in each form, i.e., loose packages, full sacks, partially full sacks, or trays. The following combinations of mail and container type (see Table 1) were observed:

1. sacks of mail unloaded from an aluminum BMC-OTR
2. loose packages unloaded from an aluminum BMC-OTR
3. loose packages unloaded from a GPMC
4. loose packages unloaded from a large hamper

One of the few constants of the loading task is that each of the four loaders will, on average, have to supply each mail sorter with about 1,100 parcels per hour. This can be accomplished in a variety of ways given that a single sack of mail could conceivably contain 50 or more small parcels. There are also many opportunities for rest because the loader can fill up the conveyor and get substantially ahead of the sorter. As such, the average weight of a single lift, and the average rate of lifting appears not to be a serious hazard for the loader. However, because all of the containers in which mail is delivered to the loaders are large, and have sill heights ranging from 35 to 38 inches, and loads can weigh up to 70 lbs, there are occasional lifting situations that can require above-normal strength capabilities, and pose a risk of injury to the shoulders and low back. An example of a common lifting situation for the loaders is having to retrieve a full sack of mail from the bottom of a BMC-OTR, a GPMC, or a large hamper. In evaluating this lifting situation, the following assumptions are made:

1. the bottom of the container is three inches above the floor
2. the sack (orange type) is at the near edge of the container, lying flat and sideways in the container and is 30 inches wide
3. the load is stood up straight before it is lifted, two hands are used, there is no twisting, and it is lifted to a height of 29 inches to clear the lip of the ascending conveyor
4. the loader gets as close to the container as possible, with feet under the cart and only the width of the container sill between the body and the sack
5. the frequency of lifting is low, and could be as little as once per day
6. hand to load coupling is good

According to the NIOSH lifting equation, the recommended weight limit (RWL) is 51 x horizontal multiplier (HM) x vertical multiplier (VM) x distance multiplier (DM) x asymmetric multiplier x frequency multiplier (FM) x coupling multiplier (CM) = 51 x .44 x .98 x 1 x 1 x 1 x 1 = 22 lb.

TABLE 1

CONTAINER NAME	DIMENSIONS	DESCRIPTION	USES
General Purpose Mail Carrier (GPMC)	42 in. long, 29 in. wide 69 in. high 230 lbs.	made of square tubing, retractable doors	bulk mail, trays
Eastern Region Mail Container (ERMC)	Same as GPMC	equipped with full height nylon web door; fully open, half-closed three-quarter closed, fully closed	bulk mail, shelves for trays
Bulk Mail Container mail(BMC) Over-The-Road (OTR), Aluminum	63.5 in. long 43 in. wide, 70 in high 385 lb	two side doors: walk-in opens from bottom; half door, opens from top holes in upper panels to check contents	bulk mail
BMC-OTR (Steel)	Same as alum. BMC-OTR, 580 lbs.	four steel wire screens	only New York and Chicago
In-House Container (IHC)	65 in long 41.5 in. wide 36 in. load height. 342 lb.	flat bed, with side rails	in-house sacks
Platform Truck/ Trailer (1070)	74 in. long 32 in. wide 14 in. high to platform (54 in high w/pipe rack) 290 pounds	flat bed, swivel wheels at center of platform	move bulk mail in-plant
Utility Cart	35.6 in. long 21.5 in. wide, 40 in. high, 80 lb.	hinged basket, canvas liner	in-house transport: flats, letters, small parcels
1046 Hamper (large)	44 in. long 32 in. wide 38 in. high 75-85 lbs.	canvas basket steel and wood frame	move mail in bulk
1033 Hamper (small)	36 in. long 26 in. wide 28 in. high 48 lbs.	canvas basket steel and wood frame	move mail in bulk

The lifting Index (LI) = Actual Weight/RWL =70/22 = 3.2. The LI is a rating of the relative risk of a lifting task. NIOSH believes that a LI of 1 represents a lifting task that can be performed safely by 90% of the population. The shape of the risk curve for tasks with a LI greater than 1 is not known, but the ad hoc committee of experts who reviewed the NIOSH lifting equation before it was published agree that many workers will be at elevated risk if the lifting index exceeds 3.0.[8]

The purpose of the above example is to illustrate that, because of the design of the containers, there may be manual lifts required by the loaders that should not be performed unassisted as little as once per day, even under the almost ideal lifting conditions that were assumed. It is possible that the LI could be even higher if loads were lifted from the back of the container, were difficult to grasp (overfilled), or were lifted more often than once per day, all of which would further increase the risk of injury.

There should be a more efficient procedure for transferring packages from a bulk container to the conveyors leading to the mail sorters. If the bulk containers were positioned as close as possible to the conveyors, the two could be connected by a roll or portable belt conveyor so that packages or sacks could be slid from the bulk container to the ascending conveyor. BMCs equipped with spring-loaded leveling systems that maintain the bottom of the container at about 30 inches would make transfer of packages or sacks from the container to the conveyor a simple matter. An alternative to retrofitting bulk containers in this manner would be to lower the sill height of the four conveyors. If the lips of the conveyors could be lowered to the height of the lowest levels on the BMCs or ERMCs, then packages could be unloaded with the walk-in door opened, and lifting of heavy sacks could be virtually eliminated. GPMCs would have to be unloaded with the half-door opened only, but a transfer conveyor would facilitate the removal of packages from the bottom of the container. Hampers equipped with the elastic cords that raise the level of the bottom as packages are unloaded could be effectively used by the loaders in the normal manner. The Verbex is a system that would appear to improve the mail sorting task because it eliminates the need for the worker to make keystrokes. As previously noted, the number of keystrokes required does not appear to be a serious hazard, but nonetheless, any amount of keying adds to the risk of hand, wrist, and arm injury when other hand intensive activities such as the handling and transferring of packages are taking place simultaneously. The risk of injury is further increased if the keypad is not adjusted properly for the worker. However, the Verbex has the potential to lead to other sources of discomfort which could result in fatigue and possible increased risk of injury. For example, the Verbex increases the vigilance aspects of the job because the worker has to visually inspect the package, speak the destination into a microphone, and verify that the computer recognized the inputted message via a computer monitor located across the conveyor. A limitation of the Verbex that can lead to frustration and subsequent reduction in productivity is that it occasionally does not recognize the

mail sorter's voice. This may happen due to the sorter having a cold or a destination number spoken with an unusual voice inflection. Regarding the postural aspects of using the Verbex, one of the workers was observed leaning forward and squinting to see the screen. The ambient noise in the SPBS area seemed to require increased concentration by the worker. It is also difficult to listen to a personal radio while using the Verbex, an observed practice of many of the mail sorters. Loss of voice, and dry mouth are other small perturbations that could detract from the overall effectiveness of the Verbex system. In conclusion, it seems that the Verbex is a system that reduces the workers' exposure to biomechanical stress, and should be an overall improvement, but may need refinements to be appreciated by all mail sorters.

b. Sweeper Position

There appeared to be no significant hazard in the sweep portion of SPBS job with respect to rate of lifting. Similar to the loaders, there are many ways the job can be configured and many ways in which up to 4,400 packages per hour can make their way into trays and sacks, and subsequently into a bulk container of some type.

The conveyor and chute system which delivered the parcels to either trays or sacks are well designed. Working heights and reach distances are within that which is normally recommended for such tasks. The platform that standardizes the position of the trays so that the narrow dimension (18 ½ in) faces away from the worker and ensures that trays are lifted by the hand holds and in the sagittal plane of the worker, reduces the lifting hazard as much as possible. The following is an analysis of infrequent (once per day) lifting of filled trays off the platform and into the front edge of a BMC with the door fully open, facing the worker: RWL = 51 x. 59 x .99 x .90 x 1 x 1 x 1 = 27 lbs. The Lifting Index (LI) for a tray containing 35 lbs. = 35/27 = 1.4, which is greater than what NIOSH recommends for the 90th percentile of the population. Removing trays once per minute for 4 hours would result in a RWL of about 23 lbs., and a LI of about 1.5. More frequent lifting of trays, to higher heights as the BMC gets filled, and to the middle or back of the container would decrease the recommended weight limit, and increase the risk of injury to the worker.

That sweepers were observed removing individual parcels of mail from the trays and throwing them over the top edge of a closed BMC, GPMC, or ERMC rather than lifting the trays off the platform and carrying them to an open (or half-opened) container, may be an indication that the filled trays were too heavy to lift, or too heavy to lift and place over a 35" sill and into the container. As the sweepers removed individual parcels from the trays, mail continued to flow into the trays, and on several occasions workers were hit on the head by incoming packages. When queried, workers indicated that they did not know that the delivery of mail to a particular location could be stopped by pressing the button located in the work area. They similarly stated that they did not know about the two options for opening the side of

the carts or lowering the height of the top edge. The BMCs in use at the time may have been positioned next to each other, door to door, because when turned around and opened fully, they take up too much room in the sweep area to be useful to the workers. Also, when opened, the walk-in doors present a head clearance hazard for tall workers. The fact that the workers on duty at the time were not aware of the shutoff feature on the conveyor system suggests that the observed work methods may have been due to lack of training in proper container loading procedures, or because the sweepers simply chose to perform the job in the manner easiest for them, due to some of the ungainly features of the work area set up. As noted above, the system of delivering parcels to the trays had some desirable features, but if these are not or cannot be used by the workers, the overall system is inadequately designed.

The height at which sacks are attached to the holding frame is such that a filled bag rests on the floor. The positive aspect of this design is that the sweepers do not have to lift the full bag, weighing as much as 70 pounds, off the frame and onto the floor. This design feature only marginally reduces lifting hazard because the second lift of the bag (from the floor to a mail container or to a utility cart) still has to be performed manually after the open end is fastened. At the time of the visit, filled bags were being lifted onto a platform truck, which had a bed height of 14 inches. Application of the NIOSH lifting equation for lifting a full sack (blue = 32 inches wide) from the floor (standing upright) to the front edge of a platform truck is as follows: 51 x .42 x .99 x .92 x 1 x 1 x 1 = 19.5 lb. Lifting index = 70/19.5 = **3.6**. Once again, this calculation is based on one lift of a 70 pound sack to the lowest point on a platform truck. More frequent lifts, to other containers such as a BMC or GPMC, to stacked heights (the side rails on a platform truck are 54 inches high) would substantially increase the risk of injury due to manual lifting in the sweep area of the SPBS.

A system that provides a link between the bulk container and the floor (for sacks) and the tray stand (for trays) is needed for some of the lifting situations that are commonly encountered in this area. These include lifting sacks or trays to the back of a BMC, GPMC, or ERMC when loading the half-door side, and lifting full sacks to the upper levels of a utility cart. This could be accomplished with roll conveyors or an overhead hook and pulley system.

Fastening the sack openings requires substantial pulling force by the workers. In addition, the sweepers were observed to either bend over while securing the fasteners, or squat down and close the bag as it lay on the floor. A bagging station engineered to eliminate the need to lift sacks off the frame could also have featured a method to easily close the bag while still in place on the frame.

Packages that fall off the conveyor at the waterfall cannot be easily reached by the workers. They must get close to the moving conveyor and reach into a small space to retrieve parcels and could get hit by the conveyor or a falling package.

c. Sack Sorter

Packages are delivered to the sack sorters in an unstructured manner. At times they move slowly to the opening at the bottom of the slide, and at other times packages are delivered with such speed that they jump over the angle iron stop and into the work area of the sorter. Packages also get lodged at the cone-shaped divider located behind the worker (except the sorter in the first position), or get caught between the angle iron stop and the slide in front of the worker, necessitating reaches across the full width of the work area (45 to 51 inches) to dislodge the packages. Forward reaches for standing workers who can bend forward at the hip should not exceed 34 inches (reference 6, p. 23). Packages that get stuck behind the worker can eventually fall into the workplace, possibly on top of the sorter.

The system for delivering packages to the workers, which dates back to the 1950s, is not suited to the variety of packages that are received by the mail facility. It is not reasonable to expect that a metal slide, set at a fixed angle, could deliver packages of various shapes, sizes, and weights, made of materials such as plastic, cardboard, canvas, and acrylic, in a direct and orderly fashion.

The main ergonomic (and safety) hazards presented by the sack sorting job are excessive reaching to obtain packages, possible high muscular forces to handle and dislodge packages, and getting hit by fast moving or falling packages, none of which has anything to do with the task of processing and delivering the mail.

Aspects of the sack sorting task that increase the risk of developing musculoskeletal disorders are (1) reaching above the shoulder to remove labels from the dispenser (unmodified workstations) and (2) reaching to a height of 82 inches to zero the package scale. At least one of the observed workstations contained a swivel chair, on which the worker stood to reach the button. If the worker were to lose balance while standing on the chair, a fall to the continuously moving conveyor that removes the packages from the sack sorting area could result. Another noted safety hazard is the risk of falling off foot stands that workers brought into the work area. At least two workers were standing on one empty mail tray and one stood on two empty trays. For a task like sack sorting, the work height should be between 32 and 36 inches. (reference 6, p. 26.) The location of the lowered scanner is generally out of the way of the sack sorter, but can be an overhead hazard for a tall worker or one standing on a platform.

The conveyor that the processed packages are pushed onto, and the conveyor oriented perpendicular to it that removes the packages are not ordinary smooth-surface belts. Rather, the surface of these conveyors is sectioned into individual locations intended for one package. The movement of these conveyors is controlled so that the first conveyor always has an empty location when a package is pushed onto it, and the package is subsequently always pushed into an empty location on the perpendicular conveyor. Similarly, the package from the first conveyor is always gone by the time the sack sorter has processed another package. This is how packages should be delivered to the sack sorter. Incoming packages could be kept in a holding area that feeds into a sectioned conveyor leading to the work area. Then, some action, either a sensor or an infra-red beam aimed across the scale, activation of the scanner by the sack sorter, or even a button pressed by the worker after a package is processed, releases another package into the work area for processing. The width of the delivery conveyor could be reduced and all of the hazards to which the sack sorter is exposed that are not associated with the processing of the packages are eliminated.

EMPLOYEE INTERVIEWS

Small Parcel Bundle Sorter (SPBS)

Six SPBS employees volunteered to be interviewed. Their length of employment ranged from one month to five years.

a. **Verbex**: Workers stated that extended Verbex use caused sore throats and voice loss. Headaches were also reported as a result of prolonged talking. Since liquids are not allowed in the work area, dry mouth was an additional problem. The Verbex long cord has a tendency to wrap around the workers neck as well as create a tripping hazard. The inability to listen to music while working was felt to be a disadvantage of the Verbex system.

b. **Sweeping Area**: Workers expressed concern about heavy packages hitting them on the head, arm, or foot. The sharp edges on the bag holder were seen as a potential source of injury. The inaccessibility to the waterfall at the end of the conveyer belt was another source of concern. Mail trapped in this area had to be removed by reaching in and physically removing it while the conveyer was still moving. Workers suggested that a stick or pair of tongs would be useful to remove the trapped mail.

c. **Keying Station**: Workers stated that SPBS station four was missing the reset button which makes it difficult to reset the scale. Some workers favored use of wrist pads while others did not. None felt an elbow support would be beneficial. A concern was expressed as to whether or not the large mail containers created a fire or safety hazard when blocking the aisles.

Several workers stated that after prolonged standing their backs hurt and the option to use a lean bar or step stool would potentially relieve this discomfort. One worker related a history of sore feet from standing, while another had heel spur and hip joint discomfort. To provide some relief from prolonged standing one employee reported using a mail tub to shift weight from one leg to the other.

Sack Sorter

Length of employment of workers interviewed ranged from one month to 14 years. Seven of the eight interviewed felt cushioned mats would provide relief from back or foot discomfort experienced as a result of prolonged standing. All employees said that, at times, mail moves down the ramp too fast and falls off, striking a worker. Several workers erected a physical barrier using a box to prevent errant mail from hitting and potentially injuring them. Another measure workers used to prevent such injuries was to watch out for, and warn each other of falling sacks, tubs, or trays. The plastic bag tags were reported, on occasion, to have hit workers in the face or eye.

Workers reported that when an excess of sacks, tubs, or trays builds up at the bottom of the ramp, sometimes they are packed so tight it is difficult to dislodge those at the bottom of the pile. In the case of the yellow or white bags, which can weigh over 70 pounds, removing them was more difficult for shorter employees. Most workers felt that if the ramp was never above half-full, more mail could be processed and provide a safer work environment.

Two individuals over six feet tall related occasionally hitting their heads on the laser scanner box. Shorter workers had difficulty resetting the scales to zero, an action repeated several times a day, and often resorted to standing on a chair or unplugging the machine to accomplish this task.

Dust in the work area provided a source of respiratory irritation for the majority of sack sorting employees interviewed. Another worker mentioned the fumes produced by vehicles on the floor below as unpleasant.

INJURY AND ILLNESS REVIEW

Occupational illnesses due to repetitive trauma information for the entire facility were reviewed. Occupational illnesses filed using Form CA-2 can be found in Table 2.

In 1993, the LSM had three of five claims filed for disorders due to repetitive trauma. The SPBS had one such claim, and the sack sorting had none. The department of two claims is unknown.

TABLE 2

Occupational Illnesses Claims Filed for Repetitive Trauma		
Year	**Location**	**Type of Illness**
1990		None filed
1991		None filed
1992	Unknown	Tendinitis
	Letter Sorting Machine (LSM)	Carpal tunnel syndrome
1993	Unknown	Carpal tunnel syndrome
	LSM	Carpal tunnel syndrome
	LSM	Disorder due to physical agents (repetitive motion)
	SPBS	Other disorder - repeated trauma
	LSM	Carpal tunnel syndrome
1994	Unknown	Tendinitis

A log containing injuries for the years 1989, though February 10, 1994, was reviewed. Table 3 lists the types of injuries associated with the SPBS and sack sorter work location recorded on the log by location.

TABLE 3

Injuries for Work Locations 29 and 57
January 1990 through February 1994

Type of Injury	1989 Location Code		1990 Location Code		1991 Location Code		1992 Location Code		1993 Location Code	
	29[1]	57[2]	29	57	29	57	29	57	29	57
Caught in, under or between	1		1				1	1	1	
Struck by material or equipment	1		1		2					
Pushing at the same level									2	
Lifting from/to a higher level			1							
Struck by falling objects							1	1		1
Pulling from/to a higher level							2			
Pulling at the same level									2	
Striking against material/equipment									1	
Trip on/by object										
Not elsewhere classified			1				1		1	

Of the 25 PS Forms 1769 (Accident Reports) requested, 24 were received. These reports were reviewed for injury data. Six were in a computerized format and did not contain descriptive information on the circumstances surrounding the incident; they were not included in the following analyses. Of the remaining 18, 3 described occupational illnesses (2 inhalation of paint fumes and 1 due to repetitive motion).

Three injury reports were filed by SPBS workers. Two workers reported being struck by mail exiting the chute in the sweep area, and the other reported bleeding due to an abscess. Twelve reports were filed for workers to move overweight mail, mail being pushed off the ramp, dust in eyes, a finger caught in a conveyer belt, a finger caught in a metal band surrounding a box, mail flipping over, and another employee's actions.

Location code 29 represents all injuries that occurred the sack sorting work area and may include workers not assigned to the sack sorting

Location code 57 represents all injuries that occurred in what is considered the SPBS work area and may included workers not assigned to the SPBS.

VIII. SUMMARY AND RECOMMENDATIONS

There are some aspects of the job tasks described in this report that pose a risk of fatigue or injury to the lower extremity, low back, and upper extremity of the workers at the mail facility. Many of these risks are due to the volume of mail processed (such as in the sack sorter area) and the inability of components contained therein to fully accommodate the number of task variations that are performed. In general, the facilities provided are suitable for most of the lifting tasks performed in the loading and sweeping areas of the SPBS. However, there are lifting tasks which could pose a hazard, based upon assessments using the NIOSH lifting equation. Flexibility should be added to SPBS work areas to allow these lifts to be performed more safely, either by multiple workers or with mechanical aids.

The situation is similar in the sack sorting area. As long as the slide is not overloaded, many packages are delivered satisfactorily to the workers. However, many times heavy or large packages get stuck and pose a risk to the worker for overexertion or acute injury. This area, too, should be modified to accommodate a larger variety of packages that can be processed safely by the diverse population of workers performing this job. The mail sorting aspect of the SPBS seemed to be the most routine of all the job tasks observed in the mail facility. The lower extremity and back seemed to be at most risk of fatigue or injury, due to prolonged standing.

Accordingly, the following recommendations are offered as means of reducing the risk of musculoskeletal and acute injuries to the workers.

IX. GENERAL

1. Establish a mechanism for employees to suggest work-process changes for evaluation by the joint safety and health committee.

2. Refer to the NIOSH publication entitled "Workplace Use of Back Belts"[16] for guidance in formulating a back belt policy at the Mail Facility.

3. Some employees interviewed indicated a hesitancy to report occupational injuries and illnesses. Thus, the actual number may be higher than reported. Employees should be assured that the purpose of reporting occupational injuries and illnesses is to assist in taking corrective actions to prevent future incidents. Management should identify and eliminate any disincentives to reporting.

SPBS: MAIL SORTERS (KEYERS)

1. Provide a comfortable mat (with selection input from the workers) on which to stand.
2. Provide a rail or step on which to rest one foot while performing the task. The

footrests should be 4-6 inches above standing height. Workers should alternate legs often to alleviate back stress and foot fatigue.

3. Provide sit/stand stools for workers. The sit/stand stool with the "rest bar" already available in the mail facility would be adequate for this purpose.

4. Provide a pad for the wrist support of the keypad for all workstations. A possible design could include one that attaches with a hook and loop system for easy removal and storage under the wrist support when not in use.

5. Provide a non-spill drinking container at the Verbex station which can be inserted into a mounted beverage holder when not in use.

SPBS: LOADERS

Eliminate the unassisted manual lifting of mail sacks weighing up to 70 pounds from containers filled with parcels and bulk mail. As previously discussed in this report, options include providing a conveyor link between the mail carriers and the delivery conveyor, or the modification of containers to include "load-leveling" systems that maintain the bottom of the container at a constant height of about 30 inches.

This situation could be addressed administratively by specifying that loads of a certain size and weight that fall outside safe limits based on accepted criteria, e.g., the NIOSH lifting equation, be lifted by teams of workers. An intervention of this type would require additional workers with experience in material handling, dedicated to assisting loaders in the SPBS area. This option would be the most economical, but the least desirable, due to the level of supervision required to ensure that procedures set in place are continually followed.

SPBS: SWEEPERS

1. Reconfigure the manner in which sacks and trays of mail are loaded into containers and onto utility carts, to exclude unassisted manual lifting of heavy loads. A necessary first step is to find out why existing procedures for loading containers are not followed. Other alternatives include linking the sweep area to mail containers using conveyors, installing overhead track-mounted lifting assists, providing portable boom-type lifting devices, or adding workers to the area to enable multi-person lifting. As with the loaders above, the latter alternative is the least desirable and the least likely to reduce the lifting hazard to which workers are exposed.

2. Consider alternative fastening methods for closing the open end of mail sacks. As noted in the **Discussion** the sliding fasteners used in the sweep area seemed to require considerable effort on the part of the workers. Adhesive tape or clip-type bag sealers that are equipped with a mechanical-assist attachment mechanism may be suitable for sealing the mail sacks.

3. Develop a procedure for safely returning parcels to the conveyor that fall off at the waterfall area. This may involve providing easy access for workers to get into the area of the conveyor, shutting down the conveyor to clear packages, or providing a long-handled grasping tool that workers can use for retrieving parcels from the floor without getting close to the conveyor.

SACK SORTERS

1. Improve the delivery of packages to the workers to eliminate long reaches and jammed packages. The types of approaches discussed elsewhere in this report would require extensive remodeling of the sack sorting area, and a change in the method used to direct packages to the individual workers. However, it seems that some additional diverters at the bottom of the slide that funnel packages to the workers more within their envelope of reach could be feasibly added. The recommended maximum reach distance is 34 inches. Limiting the accumulation of packages to no more than halfway up the slide would ensure that packages reach the sack sorters in a smooth manner.

2. Lower the height of the metal chute located at the bottom of the slide to between 32 and 36 inches. This work height can be achieved with adjustable-height foot stands, but care must be taken not to create falling or tripping hazards. Anti-fatigue mats, sit/stand stools, and foot rails (as recommended for the mail sorters in the SPBS area) are also recommended for the sack sorters. It is more difficult to integrate these components into a work area where adjustable foot stands are located, so the preferred intervention is the lowering of the workstation height.

3. Relocate the label dispenser to just above the keypad for all workstations in the sack sorting area.

4. Provide a reset button for the scale used to weigh packages within easy reach of the worker. The preferred method is to relocate the controller within arm's reach of the worker, but a device with a long handle could be placed in the work area to reset the scale.

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