HETA 2000-0014-2792
United States Postal Service
Dayton, Ohio

Daniel J. Habes

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

HETAB also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Daniel J. Habes of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing was performed by Robin Smith. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Ergonomics Evaluation of Bulk Mail Delivery

NIOSH was asked to determine if the manual loading and unloading of bulk mail containers presented a hazard to truck drivers employed by the Dayton, Ohio, Post Office.

What NIOSH Did

- Measured the amount of force needed to push mail containers into and out of delivery trucks.
- Measured other things that could affect how much effort is required, such as the height of the handle on the mail carts and the slope of the truck when parked at the delivery dock.

What NIOSH Found

- Loading the trucks from the main dock required less effort than unloading the same containers at the delivery locations.
- Pushing mail carts into trucks from the main dock was within the capabilities of most workers, but unloading them at destination mail facilities was not.
- Workers may be at higher risk of injury than it seems because part of the time mail containers must be pulled instead of pushed. Pulling takes more effort.

What Managers Can Do

- Make sure that mail containers are not loaded beyond Post Office limits.
- Make portable motorized material handling equipment available to truck drivers or assign another mail handler to each truck.
- Make sure mail containers are properly maintained and fix those that are broken.

What the Employees Can Do

- Only load mail containers that can be pushed easily.
- Make sure that overloaded mail containers are broken down into smaller loads that can be handled more easily.
- Report instances of damaged or overloaded mail containers to management.

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National Institute for Occupational Safety and Health
NIOSH

Health Hazard Evaluation Report 2000-0014-2792
United States Postal Service
Dayton, Ohio
May 2000

Daniel J. Habes

SUMMARY

On October 12, 1999, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation (HHE) from the Senior Safety Specialist (Cincinnati District) of the United States Postal Service (USPS). The request stated that truck drivers who load and unload bulk mail from delivery trucks in Dayton, Ohio, were experiencing back, chest, shoulder, and neck injuries from pushing, pulling, and maneuvering the containers of mail.

A NIOSH ergonomist evaluated mail delivery tasks on December 16, 1999, and January 27, 2000. The push forces needed to load trucks with mail containers at the main mail facility in Dayton, Ohio, and unloaded at six remote mail facilities in the Dayton area ranged from less than 10 pounds to over 100 pounds. The push forces were generally higher at the remote locations than at the main dock.

Medical records summaries provided by the Post Office indicated that during the first 9 months of 1999, 7 of 42 drivers sustained injuries that required assignment to light duty work until they recovered sufficiently to resume their normal work activities.

The results of the NIOSH investigation indicate that the manual maneuvering of loaded mail carts, particularly at the remote mail facilities in the Dayton area, requires forces that are beyond the capability of most workers. Adherence to Post Office guidelines regarding the proper handling and loading of mail containers would be helpful in reducing the risk of injury to the drivers who unload the trucks, but a mechanical aid is likely necessary to reduce the risk of injury to sufficient levels. Additional recommendations aimed at reducing the risk of injury to the truck drivers who load and unload the mail containers are included in this report.

Keywords: SIC 4311 (United States Postal Service), pushing and pulling forces, bulk mail delivery, ergonomics

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INTRODUCTION

On October 12, 1999, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation (HHE) from the Senior Safety Specialist (Cincinnati District) of the United States Postal Service (USPS). The request stated that truck drivers who load and unload bulk mail from delivery trucks in Dayton, Ohio, were experiencing back, chest, shoulder, and neck injuries from pushing, pulling, and maneuvering the containers of mail.

On November10, 1999, a NIOSH representative conducted an opening conference at the Dayton General Mail Facility (GMF). At this meeting, the details of the HHE request were discussed and a plan was developed to measure the push and pull forces required to maneuver various types of loaded mail containers. These measurements were made during subsequent visits on December 16, 1999, and January 27, 2000. The measurements made in January 2000 were during simulated work tasks because the time needed to make measurements on deliverable mail disrupted dispatch and delivery schedules when they were attempted in December. The January 2000 measurements were made on three types of mail containers filled to a typical level with undeliverable mail and metal weights. These containers were delivered to six remote locations chosen by drivers who operate the mail delivery trucks. At each location the push forces to unload the containers were measured, videotapes of the mail facility were taken, and relevant physical measurements were collected. A closing conference was held by telephone on February 7, 2000.

BACKGROUND

The Dayton, Ohio, GMF is the main receiving point in the Dayton area for bulk mail delivered from various locations around the country. The bulk mail is further sorted at the GMF and then delivered to other "remote" locations in the Dayton area for subsequent delivery to residences and businesses. The trucks used to transport the mail to the remote facilities are loaded in the evening, and deliveries are made by drivers during the night. The drivers can usually get help loading bulk mail from the main dock to the truck, but assistance in unloading the trucks at the remote mail locations is not always available due to the time of the delivery. The fully-loaded mail containers are heavy and difficult to move, and many factors add to the difficulty in moving them. Factors which increase the amount of force needed to push the mail containers during loading and unloading are:

1. overloaded mail containers;
2. obstructions on the main dock (out-of-use drop wells that are covered with metal plates);
3. sloped transitions between the dock and the delivery trucks;
4. the condition of the wooden floors on the delivery trucks;
5. the condition of the containers; and
6. the slope of the truck when it is parked at the loading dock.

In July 1999, the Dayton GMF was inspected by the Occupational Safety and Health Administration (OSHA). The OSHA report noted ergonomic stressors associated with the manual handling of mail containers and suggested that the Post Office voluntarily reduce the high rate of musculoskeletal disorders (MSDs) resulting from these activities. Medical records summaries provided by the Post Office indicated that during the first 9 months of 1999, 7 of 42 drivers sustained injuries that required assignment to light duty work until they recovered sufficiently to resume their normal work activities. The approach chosen by the Post Office safety manager to lower the injury rate was to request the subject NIOSH Health Hazard Evaluation.

Job and Container Descriptions

Mail is sorted and loaded into bulk containers on the second floor of the GMF. The containers are brought to the loading dock by material handlers for subsequent loading into the trucks, which are dispatched to the remote Dayton area mail facilities. The mail can be sent out of the GMF in a variety of containers, but the All Purpose Container (APC), the Bulk Mail Container (BMC), and the Wire Cage (WC) are among the most common. The APC, also known as the General Purpose Mail Container, is a tall container that weighs 230 pounds when empty and has a maximum load capacity of 1200 pounds (1430 pounds total weight). The APC is 42 inches long, 29 inches wide, and 69 inches high. The handle height is 43.5 inches. It is designed mainly for letter trays, flat trays, and white flat tubs. Post Office procedures specify the maximum number of trays to be 24 if the container has shelves and 36 if there are no shelves. White flat tubs are limited to 16 in an APC.

The BMC is a heavy duty aluminum container that weighs 385 pounds when empty and has a maximum cargo load of 1500 pounds (total of 1885 pounds). It is 63.5 inches long, 43 inches wide, and 70 inches high. The handle height on the BMC is 41.5 inches. Post office procedures limit the height of mail to no more that three-quarters full in the BMC.

The WC is a short-sided container that is 30 inches high, 48 inches long, and 40 inches wide. It has a maximum load capacity of 2000 pounds. Its use is intended primarily as a mail transport container for intra-division dispatch, handled with a fork lift or other mechanical aid. The WC is also used as a delivery container from the main GMF to the remote mail facilities, loaded and unloaded manually.

Each type of container has two fixed wheels and two swivel-type wheels. They are designed to be pushed from the swivel-wheel side (fixed wheels in front) to allow maneuverability and maximum rolling efficiency.

General Postal Service container handling guidelines specify that a container should be pushed and not pulled, should not be overloaded, and should be "red tagged" if defective. The guidelines further specify that containers can be pulled from a trailer or away from a wall, but only as far as necessary to get behind it so it can be pushed.

A typical dispatch consists of a truck driver loading the truck, driving to the designated mail facility, unloading the truck, and bringing empty containers back to the main GMF. Usually, a dispatched truck is not fully loaded. An official for the Post Office estimated that 70-75% of the time a truck is loaded to about 60% capacity. For example, during a one day period (January 25, 2000), the average of 50 dispatches from the main GMF was about 5 mail containers per truck, with a range from 1 to 15. During a typical work day, a driver on a standard 9-ton truck will handle about 60 loaded and empty mail containers. Most of the remote locations are a short distance from the main GMF, ranging from about a 5-minute to a 30-minute drive.

METHODS

A simulated mail delivery exercise was designed to evaluate the force needed to unload mail containers at several remote mail locations in the Dayton area. Three common mail containers (BMC, APC, and WC) were loaded to typical weight levels using undeliverable mail and metal weights. These containers were then delivered to six locations considered by the drivers to be typical of the locations to which mail is delivered. These were Trotwood, Wright Patterson Air Force Base (WPAFB), West Carrolton, Wright Brothers, Dabell, and Mid-City. The weight of the BMC was 1024 pounds, the APC was filled to 844 pounds, and the WC was loaded to 1,116 pounds. The force measurements were made using an Imada® PSH push-pull scale as the three containers were moved from the GMF dock floor into the truck and then unloaded at each of the six delivery locations. The forces to get the carts moving and keep them moving were noted in all cases. The forces were measured at all of the various points that comprised the particular dock-to-truck coupling situation. For example, at the main GMF, the forces were measured as the cart was pushed from the floor, over the drop well, back onto the floor, and then onto the transition between the dock and the floor of the lift table. When the load is raised to the height of the truck it must be started from stationary again and eased into the truck. Once over the transition from the elevator to the truck, the load must be held back from rolling uncontrollably into the truck, which can be sloped from 3 to 10 degrees downward, depending at which dock bay the truck is parked. The drop wells at the main dock are raised obstructions on the floor directly in the path of the truck bay. Mail used to be unloaded from the trucks and sent down the drop wells, which lead to a conveyor that transported mail trays to the basement of the building. These drop wells are no longer used, and are covered with a metal plate, which forms the raised obstruction on the floor of the loading dock. The six delivery locations were similar, comprised mostly of lifting platforms that form the transition between the dock floor and the bed of the delivery truck. Notable differences among the various delivery locations can be found on Table 3.

The equipment and procedures described above were used to measure the push forces on the containers filled with "actual" mail that was performed on the night of December 16, 1999. The results of these measurements can be found in Tables 1 and 2.

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 manual exertions; (3) lifting; (4) awkward and/or static work postures; (5) direct pressure on nerves and soft tissues; (6) work in cold environments; or (7) exposure to whole–body or segmental vibration.[1,2,3,4] The risk of injury appears to increase as the intensity and duration of exposures to these factors increases and recovery time is reduced. [5] Although personal factors (e.g., age, gender, weight, fitness) may affect an individual's susceptibility to overexertion injuries/disorders, studies conducted in high–risk industries show that the risk associated with personal factors is small compared to that associated with occupational exposures.[6]

In all cases, the preferred method for preventing/controlling work–related musculoskeletal disorders (WMSDs) is to design jobs, workstations, tools, and other equipment 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.

The criteria used to evaluate the pushing of bulk mail carts at the Dayton Post Office were the psychophysical guidelines found in Snook and Ciriello [7] and workplace and job design criteria found in the ergonomics literature.

The Snook and Ciriello tables provide acceptable pushing forces based on the handle height of the container, the frequency of the push, and the distance the container is pushed. Some of the task variables measured at the Dayton Post Office, such as the handle height and frequency of push were between successive categories in the Snook and Ciriello tables. These acceptable push forces were interpolated to improve the accuracy of applying the observed pushing tasks to the data contained in the tables. The modified tables can be found in Appendix 1.

RESULTS

The amount of push force needed to maneuver mail containers during the actual and simulated deliveries can be found in Tables 1, 2, and 3. For each pushing task there is a cell entry for the amount of push force required and the percent-capable for males and females taken from the modified Snook and Ciriello tables. As mentioned above, the Snook and Ciriello tables were modified to better reflect the working patterns of the delivery truck drivers. The choices for lifting frequency on the Snook and Ciriello tables were either one push every 5 minutes or one push every 30 minutes throughout the work period. Even though the unloading of containers from the truck can require more than one push per container (due to stopping at the lifting platform), one push every 5 minutes was too frequent, and one push every 30 minutes was too infrequent. As such, the acceptable forces from the Snook and Ciriello tables were averaged for these two frequency categories. Likewise, the handle heights for the three main containers studied were 30, 41.5, and 43.5 inches, for the WC, BMC, and APC respectively, but the pushing criteria tables have break points of 35 and 53 inches for handle height. The values in these columns were therefore averaged for application to the tasks studied. For all containers, a push distance of 7.6 meters (25 feet) was used because the truck bed was 20 feet long, and usually containers would be pushed another 25 or 30 feet from the dock into the remote mail facility.

Containers Filled with Deliverable Mail

In general, the push forces from the dock of the main GMF to the truck (Table 1) were within the capability of most males and females ($\geq$ 90% capable). In two cases, pushing the BMC into the truck from the lift platform was in the lower percentiles of capability, but loading at the dock is usually not an issue because the drivers can get help or use mechanical equipment to load the trucks at the dock of the main GMF.

The weight of the mail mattered somewhat in that the two BMCs loaded from the main dock (1400 and 807 pounds) required 80 and 70 pounds of force, respectively, to get them moving and 50 and 45 pounds, respectively, to maintain motion, both of which were acceptable for at least 50 percent of the male population. Neither of these two loads were pushed over a drop well, but in each case the force to move the load over the lip and onto the lift platform was acceptable to no more than 25 percent of the male population. The forces to move the APCs and the WCs from the docks were acceptable for most men and women, including the portion of the task when the container is pushed into the truck from the lift platform.

Containers Filled with Simulated Mail

The trend in Table 2 is similar to that of Table 1 in that many of the containers loaded from the concrete dock of the main GMF were within the capabilities of acceptable percentiles of males and females. Some of the forces for removing the simulated loads from the truck at the GMF dock exceed the capabilities for men and women, but typically, full loads are not removed from the trucks at the main dock, and if they are, there would be an opportunity for help from another worker, or from mechanical equipment. However, these truck unload forces do serve as a comparison of the main GMF to the six remote locations, at which these same simulated mail containers were unloaded. As in Table 1, the forces to push the containers into the truck from the lift platform and over obstructions such as the drop wells exceed those to start and maintain the motion on the concrete dock, and serve as the limiting factor in the percent of the population capable of completing the loading task.

Table 3 shows the forces required for unloading the simulated mail container loads from the truck at the six remote mail facilities. As can be seen, most of the push forces are in the range of 25 to 50 percent capable for men and less than 10 percent capable for women. Unlike the forces shown in Tables 1 and 2, there seems to be no single aspect of the loading task that is the limiting factor in determining the difficulty of the overall task. That is, the forces to move the containers out of the truck and onto the lift platform and onto the docks at the remote locations were comparable, and largely in excess of the capabilities of all but the strongest workers. In one instance at Trotwood, the BMC could not be pushed over the threshold between the truck and the lift platform due to a misalignment resulting from improper snow removal in front of the dock.

Discussion

The forces needed to move the containers filled with the simulated mail and steel weights are limited to the extent that they are specific to the containers used on the day of testing, to the truck, and to the bay at which they were loaded and unloaded. Also, the filled containers may or may not represent the actual weight of containers delivered by Postal Service drivers day in and day out. Nonetheless, the results show that in most cases, the amount of effort required to unload the containers from the truck at the remote locations exceeds that to load the trucks at the main dock, and is beyond the capabilities of all but the strongest workers.

There are material handling procedures in place at the Post Office intended to minimize the risk of injury to the workers, such as properly orienting the containers when maneuvering, pushing rather than pulling, and loading the mail within Post Office weight limits. However, it is not clear that following these procedures would reduce the forces to an acceptable amount or that conforming to these guidelines is advisable when unloading the trucks. For example, the 90th percentile male push force (from Table 4 in Appendix I) is 52 pounds initial and 34 pounds sustained. (The allowed initial forces are larger than the allowed sustained forces because the initial forces are bursts of effort, while the sustained forces must be maintained during the entire length of the push, which in this case was assumed to be about 25 feet.) Referring to Table 3 indicates that in some cases, the initial force to push a container over the transition between the truck and the lift platform exceeded 100 pounds. Assuming a linear relationship between applied force and container weight (which was found in a study of factors affecting push and pull forces of manual carts)[8], the weight of a container would have to be reduced by about 1/3 to result in push forces considered acceptable by the Snook and Ciriello guidelines. In most cases this would require removing more than 1/3 of the mail because the containers themselves are quite heavy. Removing mail to achieve acceptable push forces seems less practical when one considers that the simulated loads used in this study were lighter than the maximum capacities of the containers.

Acceptable pulling forces are about 15% lower than comparable pushing guidelines (see Table 5 in Appendix I), so pushing rather than pulling containers is ergonomically preferable. But to push the containers out of the trucks, the drivers have to pull them out for clearance and swing them around so that the stationary wheels face the opening of the truck bed instead of the front of the truck. Depending on how the truck is loaded, this type of maneuver may not always be possible, and could potentially require more time and effort for the driver. Excessive maneuvering of the containers in the truck presents a potential safety hazard because the driver could become trapped between containers while attempting to get positioned to push a container according to Post Office guidelines. This is a particular problem with the WC because it does not have a brake with which to stop the container if the driver loses control of the load. The end result of the difficulty in maneuvering loads in the prescribed manner at all times is that for a portion of the time (at least until the load is placed on the lift platform), drivers are pulling the containers rather than pushing them. Therefore, the risk of injury to the driver is somewhat higher than indicated in Tables 1-3 due to pulling tasks having lower acceptable force values.

It is likely that the conditions under which Post Office officials determined the maximum load capacities for the various containers are not applicable to the unloading conditions at the Dayton area remote locations. The same study of factors which affect the push and pull forces of manual carts found that compared to concrete, forces while maneuvering the same cart on tile, asphalt, and carpet were 7%, 48%, and 106% percent higher, respectively. The study did not evaluate wood, and all surfaces were flat, but it is reasonable to conclude that the forces to move a cart up a sloped wooden truck bed floor would be similar to the results the investigators found for asphalt and carpet. Other factors found to influence push and pull forces were wheel diameter and orientation of the swivel wheels. For a cart weighing 200 pounds, the push force on concrete was three times higher with 2-inch-diameter wheels than with 6-inch-diameter wheels. Similarly, the results showed that orienting the wheels in the direction of the movement rather than at 90° lowered the push forces by about 18%.

One way to more easily push containers over barriers, such as the drop wells or transitions between the dock and truck, is to push the load faster and use momentum to cross the barrier. This is more possible on the dock because it is smoother and flatter than the truck beds, and there is room enough to get the load moving faster. This tactic is not feasible in the truck due to space limitations, and perhaps it is not advisable, because a fast moving load is more difficult to control, which could be hazardous to the driver. This would be particularly true at Wright Brothers, where the lifting platform is 56 inches long instead of the 97- to 100-inch lengths observed at some of the other remote mail facilities.

The slope of the truck while parked at the dock of the remote mail locations undoubtedly accounted for some of the difference between the load and unload forces. It seems reasonable that if the trucks were level or sloped somewhat toward the dock instead of away from the dock, that unload forces would be reduced. Adjusting the slope of the trucks at the dock would require some type of hydraulic jack or leveling device, which could be time-consuming for the drivers. Such a device could present a safety hazard if the truck were inadvertently sloped toward the dock, allowing the carts to roll out when the driver removes the safety bar which maintains the position of the containers in the truck.

Consideration of the above arguments and factors which influence the force needed to maneuver containers indicates that it is not likely that following Post Office procedural and weight limitation policies could, in all cases, ensure that drivers would not be routinely unloading mail containers that require handling forces that are beyond acceptable limits for most workers. As such, other solutions should be sought in order to guarantee the safety of the drivers who unload the trucks at the remote mail facilities. Options include assigning a mail handler to each dispatched truck to help unload the mail, loading less mail into more containers, or providing some mechanical aid for the drivers. Given the existing shortage of mail containers (which leads to overloading), the first and third options seem most feasible in the short term.

CONCLUSIONS

1. The amount of force needed to unload mail containers from trucks at the remote mail locations is greater than that needed to load them at the dock of the main GMF, and these forces exceed the capabilities of all but the strongest workers. The factors most likely accounting for the differences between loading and unloading are the slope of the truck at the docks, the wood surface of the truck beds versus the smooth concrete on the main dock, and the various transition barriers between the truck and the dock at the remote mail facilities.

2. Overloading of containers accounts for some of the excessive forces required to unload them, but loading mail within Postal Service guidelines may not result in sufficient lowering of forces to match the capabilities of most workers.

3. Difficulty in adhering fully to Post Office material handling guidelines regarding wheel orientation and pushing of mail containers instead of pulling may contribute to a higher risk for injury.

4. The maximum capacity guidelines for the containers evaluated in this study seem to be based more on the design specifications of the container than on the capabilities of the workers maneuvering them.

RECOMMENDATIONS

1. Maintain the mail containers in use at the Post Office to achieve optimum mechanical performance. Containers with wheels that are damaged or that don't roll properly should be taken out of service and repaired. Consideration should be given to using the

largest replacement wheels possible to minimize the force needed to maneuver the containers.

2. Enforce existing Post Office guidelines related to the loading of mail containers.

3. Either assign another mail handler to each truck or provide drivers with mechanized devices to load and unload mail containers at the main dock and at the remote mail facilities. This would necessitate the acquisition of lightweight material handling equipment such as a motorized pallet jack or other lift mechanism that could be used on the dock, loaded on the truck, used at the destination delivery stops, and returned to the main dock. An alternative would be to store and maintain the chosen material handling equipment at the destination mail stops.

4. An alternative to recommendation # 3 would be to re-establish the loading specifications for mail containers so that push forces are within the capabilities of all the drivers. According to the Snook and Ciriello tables, the target push force would be in the range of 40-50 pounds. For each type of container used, there should be weight limits that are acceptable for unloading at the remote mail facilities as well as loading from the main dock. If loads are continued to be handled manually, all containers should be weighed before delivery to the main dock so that the drivers can assess their ability to handle the loads safely.

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Table 1: Forces (Pounds) to Load Actual Mail Containers onto a Truck at Dayton GMF Dock

Type	Weight (pounds)	Dock	Force to start			Force to sustain			Force over drop well			Force onto lip of lift platform			Force to push into truck			Slope of truck	Comment
			Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F		
BMC	1400	West	80	50	<10	50	50	<25				120	<10	<10	100	25	<10	3°	wheels 7 ½ diam.
BMC	807	West	70	75	25	45	75	25				100	25	<10	60	75	50	3°	
APC	n/a	East	7	>90	>90	7	>90	>90	12	>90	>90							2.5°	filled with 43 inches of parcels
APC	n/a	East	7	>90	>90	7	>90	>90	40	>90	90							2.5°	filled with 30 mail trays
WC	680	East	10	>90	>90	10	>90	>90	25	>90	>90	50	90	75	50	90	75	2.5°	
WC	680	West	15	>90	>90	15	>90	>90	40	>90	90	60	75	50	40	90	90	3°	

Note: %M = percent of males capable, %F = percent of females capable
BMC = Bulk Mail Container
APC = All Purpose Container
WC = Wire Cage

Table 2: Forces (Pounds) to Load and Unload Simulated Loads at West GMF Dock, Bay 19

Type	Weight (pounds)	Force to start			Force to sustain			Force over drop well			Force onto lip of lift platform			Force to push into truck			Force to push out of truck			Force over lip			Slope of truck
		Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F	Force	%M	%F	
BMC	1024	15	>90	>90	15	>90	>90	60	75	50	80	50	<10	80	50	<10	70	75	25	80	50	<10	3°
APC	844	15	>90	>90	15	>90	>90	50	75	75	50	75	75	50	75	75	60	75	50	70	50	25	3°
WC	1116	20	>90	>90	20	>90	90	60	75	50	60	75	50	60	75	50	80	50	<10	100	25	<10	3°

Note: %M = percent of males capable, %F = percent of females capable
BMC = Bulk Mail Container
APC = All Purpose Container
WC = Wire Cage

Table 3: Push Forces to Unload Mail Containers at Remote Mail Facilities

Remote Mail Location	Type	Force to get moving from truck	%M	%F	Force to sustain	%M	%F	Force over lip from truck to platform	%M	%F	Slope of truck	Comments
Trotwood	BMC	110	10	<10	65	25	<10	150	<10	<10	5°	dock and truck misaligned 4" at one edge
	APC	80	50	<10	50	50	25	80	50	<10		
	WC	150	<10	<10	100	<10	<10	unable	<10	<10		
WPAFB	APC	70	50	25	60	25	<10	110	10	<10	5°	no lift - ramp between truck and dock, slope = 13°
	hamper (410#)	50	90	75	50	50	25	90	25	<10	5°	only use APCs and hampers
W. Carrollton	APC	50	90	75	45	75	25	70	50	25	3°	
	WC	90	25	<10	50	50	25	100	25	<10		
	BMC	100	25	<10	50	50	25	90	25	<10	3°	
											3°	
Wright Bros.	APC	90	25	<10	50	50	25	80	50	<10	5°	lift platform 56" long, 52" high
	WC	100	25	<10	50	50	25	100	25	<10	5°	
	BMC	100	25	<10	60	25	<10	100	25	<10	5°	
Dabell	APC	70	50	25	50	50	25	90	25	<10	3°	platform 100 inches long
	WC	90	25	<10	60	25	<10	95	<25	<10	3°	
	BMC	90	25	<10	60	25	<10	85	<50	<10	3°	
Mid-City	APC	100	25	<10	70	25	<10	90	25	<10	4°	platform 97 inches long
	WC	100	25	<10	70	25	<10	105	10	<10	4°	
	BMC	100	25	<10	70	25	<10	105	10	<10	4°	

Note: %M = percent of males capable, %F = percent of females capable
BMC = Bulk Mail Container
APC = All Purpose Container
WC = Wire Cage

Appendix I :
Modified Tables (based on reference) for Acceptable Forces of Push and Pull (Pounds)

Table 4: Push Forces (pounds) for Males (M) and Females (F)

Initial Forces			Sustained Forces		
	Force			Force	
%	M	F	%	M	F
90	52	41	90	34	19
75	66	50	75	45	28
50	83	59	50	58	37
25	99	70	25	72	47
10	114	78	10	84	56

Note: Table entries are the average for a handle height of 35 and 53 inches and of one pull every 5 minutes and one pull every 30 minutes for a 25 foot pull distance.

Table 5: Pull Forces (pounds) for Males (M) and Females (F)

Initial Forces			Sustained Forces		
	Force			Force	
%	M	F	%	M	F
90	46	42	90	31	23
75	56	48	75	40	30
50	67	57	50	50	38
25	78	66	25	59	47
10	87	74	10	68	54

Note: Table entries are the average for a handle height of 35 and 53 inches and of one pull every 5 minutes and one pull every 30 minutes for a 25 foot pull distance.

For Information on Other Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Web site at:
www.cdc.gov/niosh