



## American Postal Workers Union, AFL-CIO

1300 L Street, NW, Washington, DC 20005

March 25, 2009

**Greg Bell**

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To: Local Presidents

Re: OSHA Complaint – Ergonomic Issues Related to DBCS Operations

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Dear Local President:

I am writing in regard to ergonomic issues related to Delivery Bar Code Sorter (DBCS) operations. The purpose of this letter is to explain the attached information and the APWU's intent to have multiple OSHA complaints simultaneously filed by locals with DBCS machines, nationwide. APWU has made many attempts to discuss and correct known ergonomic risks and hazards associated with the operations of the DBCS machines. Although we have had some success, the Postal Service continues to refuse to discuss identified ergonomic risks and hazards.

On October 22-25, 2007, OSHA conducted an assessment of the DBCS operations as part of an Ergonomics Work Group (EWG) verification review that was required under the now expired Ergonomic Strategic Partnership Agreement<sup>1</sup>. OSHA's verification review documented that ergonomic risk associated with the DBCS operations are still present and some of their findings are similar to the findings of two prior NIOSH Health Hazard Evaluations. The Postal Service has refused every attempt by APWU to discuss the ergonomic risks and hazards presented in OSHA's report.

APWU has developed the enclosed OSHA complaint package which locals are being asked to file with their OSHA area offices. Instructions on completing an OSHA-7 form are attached. Additionally, you can find your OSHA area office at [www.osha.gov/html/RAmap/html](http://www.osha.gov/html/RAmap/html).

As stated earlier, it is the APWU's intent to have multiple OSHA Complaints filed in locations throughout the country at the same time. To accomplish this, we are asking that every local file the OSHA Complaint with the completed OSHA-7, the week of April 5, 2009. Locals should file individual OSHA complaints for each facility with a DBCS within the installation.

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<sup>1</sup> Renewal of the "Ergonomic Strategic Partnership Agreement" is currently under discussion.

Local Presidents

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Following submission of the complaint, OSHA should schedule an inspection of the DBCS operations; you and/or your designee may participate fully in this inspection. OSHA should not provide any advanced notice of this inspection. OSHA may hold an opening and closing conference to outline the purpose of and the findings from their inspection. Please notify Corey Thompson, APWU Safety & Health Specialist at (202 842-4273 or email, [cthompson@apwu.org](mailto:cthompson@apwu.org)) about OSHA's visit.

Thank you in advance for your assistance.

In Union Solidarity,



Greg Bell, Director  
Industrial Relations

Enclosure

GB/CT:jm  
OPEIU #2  
AFL-CIO

## **Instruction for filing the enclosed**

### **OSHA Complaint – Ergonomics Issues related to DBCS Operations**

To: Local President:

This package and the following instructions are being provided as part of a National effort to address the ergonomic risks and hazards associated with the operation of the DBCS. We are asking that you assist by sending to OSHA one complaint package and an OSHA-7 form for each facility that has a DBCS operation. We are trying to coordinate submissions from multiple locals to arrive at the Area OSHA office the week of April 5, 2009..

We have standardized the complaint process as it only requires that you complete the attached OSHA-7 form with your local information; attach the form to the front of the complaint package; and mail or fax it to your OSHA Area office- the address can be found at <http://www.osha.gov/html/RAmap.html> .

The following are brief instructions on completing an OSHA-7 form or you may put the same information on your letterhead:

***Employer name*** -- be sure to spell out the full name of your employer, without abbreviations.

***Site location*** -- the street address, including ZIP code, of the workplace. This is the address that an OSHA inspector will come to, so give OSHA the location of the entrance the inspector should use to see the hazard.

***Mailing address (If different)*** -- in case the company doesn't get mail at the site location address.

***Management official*** -- Give OSHA the name of the site manager or highest company official who works on site. If you're not sure who to name, leave it blank and the inspector will ask for the "person in charge."

***Telephone number*** -- of the management official or the head office.

***Type of Business*** – Insert United States Postal Service

***Hazard Description/Location*** - Insert SEE THE ATTACHED “OSHA Compliant – Ergonomic Hazards related to DBCS Operations”

***Has the condition been brought to the attention of*** - check Employer

***Please check your desire*** – your choice

***The undersigned believed that a violation...*** - check Representative of the Employees

The rest of the form is self explanatory.

If you need additional information on submitting this package please contact Corey Thompson , Safety & Health Specialist 202 842-4273.

U. S. Department of Labor  
Occupational Safety and Health Administration

Notice of Alleged Safety or Health Hazards

		Complaint Number		
Establishment Name				
Site Address				
	Site Phone		Site FAX	
Mailing Address				
	Mail Phone		Mail FAX	
Management Official			Telephone	
Type of Business				
<p><b>HAZARD DESCRIPTION/LOCATION.</b> Describe briefly the hazard(s) which you believe exist. Include the approximate number of employees exposed to or threatened by each hazard. Specify the particular building or worksite where the alleged violation exists.</p>				
Has this condition been brought to the attention of:	<input type="checkbox"/> Employer <input type="checkbox"/> Other Government Agency(specify)			
Please Indicate Your Desire:	<input type="checkbox"/> Do NOT reveal my name to my Employer <input type="checkbox"/> My name may be revealed to the Employer			
The Undersigned believes that a violation of an Occupational Safety or Health standard exists which is a job safety or health hazard at the establishment named on this form.	(Mark "X" in ONE box) <input type="checkbox"/> Employee <input type="checkbox"/> Federal Safety and Health Committee <input type="checkbox"/> Representative of Employees <input type="checkbox"/> Other (specify)			
Complainant Name			Telephone	
Address(Street, City, State, Zip)				
Signature			Date	
If you are an authorized representative of employees affected by this complaint, please state the name of the organization that you represent and your title:				
Organization Name:    Your Title:				

# **OSHA Complaint – Ergonomic hazards related to DBCS**

## **Operations**

### **The Issues/Complaint**

The following information is provided as supplemental information for OSHA Form-7 and further provides notification of ergonomic hazards which postal services employees are exposed on a daily basis. More specifically, the Postal Service continues to willfully expose postal employees to ergonomic risks and hazards associated with the operation of the DBCS, even after the risks and hazards have been documented and presented to the Postal Service. In addition to ignoring OSHA and NIOSH reports the Postal Service continues to willfully ignore their own handbooks and manuals and training programs as well as the equipment manufacturer's manuals for the safe and healthful operation of the DBCS. Employees are exposed to ergonomic hazards and the risk of ergonomic related injuries due to improper equipment installation, including foot-print allocation, support equipment placement and organization, improper allocation of heavy volumes of mail to higher risk sorting bins, loading procedures, sweeping procedures and various administrative issues such as work-rest cycles/rotation, training both initial and refresher, and equipment maintenance.

The Postal Service has failed to provide proper training on the use and operation of the DBCS, specifically the Postal Service has willfully

failed to provide training, including using their own training program, to postal employees.

### **Does the Hazard Exist?**

1. NIOSH – Health Hazard Evaluation Report – HETA 92-0073-2337 – July 1993 – *“NIOSH investigators identified several ergonomic hazards associated with the Postal Service’s Automated Mail Processing Machines. These hazards put employees at potential risk for low back and upper extremity musculoskeletal disorders”*
2. NIOSH – HETA 3003-0179 & HETA 2004-0103 – March 2006 – *“The DBCS machines presently in use by the USPS (four tiers, 201 stackers) present the same or greater risk of injury to workers as the three-tiered DBCS machines evaluated by NIOSH in 1991-92”*.
3. OSHA – Verification Report Denver P&DC – Investigation conducted October 22-25, 2007 – *“The DBCS machines continue to be an area of significant concern because musculoskeletal disorder (MSD – related injuries/illnesses continue to occur”*.

4. NIOSH – April 16, 2008 – Max Kiefer MS CIH - On April 1, 2008 conducted a review of prototype 7<sup>th</sup> generation DBCS (DBCS-7) at the request of (US) Rep. DeGette. – *“Externally, the DBCS-7 is very similar to previous generation DBCS systems currently operational in USPS facilities and human interaction is not anticipated to change”*.

These reports/studies identify many of the hazards employees who work on the DBCS operations are exposed to, please note this includes not only feeding and sweeping operations but also maintenance tasks. Each of these documents clearly identifies risk and hazards associated with the operation of the DBCS machines. The APWU has on both the local and National level tried without success to jointly work with the Postal Service to identify and eliminate known ergonomic hazards associated with DBCS operations. The Postal Services has willfully resisted any discussions or actions, including the most basic, discussing the findings in an agency report (OSHA) that identify hazards and was conducted under a Partnership Agreement. Above item 4 describes a Qualitative Review of the USPS Prototype DBCS-7, although this review was limited it highlights very important facts. The new machine is essentially the same configuration presenting the same ergonomic risks as the current versions; secondly the through-put rate is substantially increased.



Any increase in volume will increase employee exposure to ergonomic risks and hazards.

Since the 1993 NIOSH report identified ergonomic hazards and risks, very few if any ergonomic changes have been implemented to correct or eliminate the risk of injury to Postal employees. This fact is supported by the findings in subsequent reports that identify the same ergonomic risks and hazards as were found in 1993 NIOSH report. Willfully, for over 16 years, the Postal Service has refused to eliminate known ergonomic hazards associated with the DBCS, and it appears that with the development of the DBCS-7 this willful disregard of safety will continue.

***Is the hazard recognized?***

In 1991 and 1992, NIOSH investigators evaluated the potential for ergonomic hazards on three types of automated mail processing machines, one of which was the first generation DBCS. These types of DBCS machines have 102 stackers arranged in three tiers at heights of 22 inches, 36.5 inches and 50.25 inches above the floor, respectively. The latest generation DBCS machines currently used by the USPS have more than 200 stackers, arranged in four rows, ranging in height from 21.5 inches to 56 inches.

In the final report (attached), NIOSH investigators concluded that the automated equipment used by the USPS “put employees at potential risk for low back and upper extremity musculoskeletal disorders” due to the awkward postures and repetitive tasks to which workers were exposed. The report noted in particular the design flaws at the DBCS sweeper position, (see NIOSH HETA 92-0073-2337, United States Postal Service General Mail Facility, Denver Colorado, July 1991) The main flaw cited in the report was the height of the three rows of stackers, the first row being too low to avoid excessive trunk flexion (bending over) while sweeping mail, and the third row being too high for most workers to avoid reaching above shoulder height to sweep mail. The report cautioned against bending the knees as an acceptable method of sweeping the bottom row of stackers due to the excessive ligament forces at the knee during deep knee flexion. Another risk factor noted in the report was the potential of highly repetitive upper extremity motions from sweeping 102 stacking locations from a machine capable of sorting 35,000 pieces of mail per hour.

The recommendations pertaining to the DBCS contained in the July 1993 NIOSH report were as follows:

1. Assign additional workers to the machines to help with sweeping.

2. Limit the time that workers spend on the DBCS machines.
3. Provide additional rest breaks for workers on the DBCS machines.
4. In the long term, automate the sweeping position of the DBCS.

NIOSH provided the Postal Service with their finding of a re-evaluation of DBCS operations in the March 16, 2006 report. In addition to the prior NIOSH report recommendations the following were additional recommendations:

1. Conduct periodic training and monitoring of worker activities to reinforce safe work practices that have been taught and developed at the USPS.
2. Rotate workers frequently between the feeder and sweeper positions. Rotation should take place at least once per hour, but more frequent rotation such as every 30 or 50 minutes may be more beneficial to workers.
3. The feeder should occasionally stop loading new mail into the DBCS and help the sweeper to ensure that the amount of mail accumulated in the stacker does not exceed desired levels.
4. Encourage workers to use sound work practices like the PowerLift while working on the DBCS machines, particularly at the feeder

position where the wide stance and lift with the legs techniques are most applicable.

5. Determine and implement a mail processing rate of work which will prevent workers from sustaining injury. This can be established either through time and motion studies or by manipulating numbers of pieces of mail processed per hour or per day until injury rates are under control. As noted in the Discussion section above, reducing the rate of work is the most effective administrative means of injury control when engineering controls are not implemented, such as in the case of the DBCS.

In October of 2007 OSHA conducted its EWG verification (as part of the Strategic Partnership Agreement) of the Denver Processing and Distribution Center to determine the current status of the facilities Ergonomic Risk Reduction Process (ERRP) and to perform an ergonomics evaluation of the DBCS operations. In their report OSHA pointed out that it should not be considered an in-depth ergonomic evaluation of these risks. But, it is clear to see from reading the conclusions of the report that the DBCS operations present ergonomic risks that are readily identifiable not requiring an in-depth evaluation

The OSHA EWG verification report presents recommendations in Appendix A - Section G:

1. Both the Feeder and Sweeper tasks may create some degree of musculoskeletal hazard to the clerks performing the task. Physical risks appear to be to the shoulder, back, and wrist. The following are some recommendations to mitigate the hazards. (these are highlighted see report for full details):

- a. Feeder methods for removing mail from the mail trays.
- b. Sweeper methods for removing mail from the stack pockets.
- c. Rotation
- d. Stacking mail trays on the 1226 Pie Carts
- e. General Suggestions – including
  - i. To determine the full extent of the musculoskeletal injuries occurring at the Sweeper and Feeder tasks on the DBCS machines, an evaluation of the Feeder and Sweeper tasks should be considered. This evaluation should assess these tasks on different DBCS machines and different tours to determine potential physical hazards due to static and dynamic postures, force, frequency, and duration risks present during various rotation schedules, sweeping patterns, mail volume, mail categories, run time, machine through-put and performance expectations. This evaluation should

include employee anthropometrics, employee work methods and operation methodology:

- Explore a method that would allow mail to be moved from the mail tray to the jogger without manually lifting it.
- Continue to assess the method for visual verification and reaching into the rear of the pockets.
- Continue to refine cost analysis data of DBCS musculoskeletal injuries.

It should be noted that these are many of the same ergonomic physical risks identified in the 1993 NIOSH report; 16 years later and the Postal Services is still exposing clerks that work on the DBCS to risks of injury to shoulders, back and wrist.

Although the Postal Service continues to flaunt the supposed fact that there has been significant reduction in the number of injuries, this line of argument raises more questions than it answers. First, there has been a significant reduction in Postal Employees with corresponding reduction in DBCS related work hours, further management has repeatedly, over

the objection of the union reduced the number of operators from two to one during heavy mail volumes. Of more concern is the fact that the Postal Service never gives the same numbers of I&I for a facility. This fact has been pointed out to OSHA in a response to OSHA's EWG verification of the Denver facility. Further, the Postal Service's callous attitude that it is alright to have injuries on the DBCS is counter to the rhetoric expressed by postal management (the safety of our employees is important). Number of injuries may show as having decreased but the rate does not show a significant reduction. Various factors have contributed to a reduction in NUMBERS including fewer workers, decrease in mail volume, changes in reporting requirements, and reluctance on the part of workers to report injuries to name a few.

The Postal Service has admitted on numerous occasions that at the facility level proper procedures and installation are not followed, that clerks are not properly trained and new installations are not following proper installation procedures with regards to spatial needs and support equipment arrangement.

The Postal Service has perpetually been missing the point when it comes to safety and ergonomic problems with the DBCS, they have focused on machine design, the APWU is more focused on the operation and work methods as they are more easily altered and amended to protect workers.

In every case in which the Postal Service has responded to an evaluation related to the DBCS they have strongly objected to and have stated that the physical equipment is not a problem. The APWU is not saying that the DBCS design is placing workers at risk, we are not saying that it isn't either, we are saying that the work operation, the manner in which the employees are required to perform their work tasks and the organization of the work environment are causing significant injury. It may also be true that the design of the equipment is ultimately flawed, after repeated requests the Postal Service has never been able to produce an ergonomic evaluation proving their position.

The Postal Service continues to ignore and avoid addressing the documented facts that employees who work on a DBCS machine are exposed to known ergonomic hazards and risks, their flawed and arrogant response is the injury numbers are low and continue to decrease. A second but equally arrogant response by the Postal Service is that it has performed ergonomic evaluations on all new equipment, and during the design and construction of the DBCS it performed ergonomic evaluations – the union has requested copies of any such evaluation, the Postal Service has been unable to produce any such studies or evaluations.



## **Conclusion – Request for on-site formal inspection.**

Postal employees that work on the DBCS are being exposed to ergonomic hazards every day. Based on the facts highlighted in this complaint and supported by NIOSH and OSHA reports APWU is requesting that OSHA perform a formal inspection of the DBCS operations at our plant/facility. We have presented facts that ergonomic hazards exist, the hazards are and have been recognized by the Postal Service, the hazards are causing and are likely to continue to cause serious physical harm to employees and there are feasible and useful methods to correct the hazards.

We formally request that OSHA evaluate the work operation of the DBCS for ergonomic risks and hazards and that if the findings reflect that postal employees are continuing to be exposed to known ergonomic risks, that OSHA cite the Postal Service for WILLFULLY violated their obligation:

- to furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees.

Attachments:

1. NIOSH Health Hazard Evaluation Report, HETA 92-0073-2337, United States Postal Service, General Mail Facility, Denver, Colorado, Investigators: Hales, Habes, Grant; Issued July 22, 1993.
2. NIOSH Report related to HETA 2003-0179 and HETA 2004-0103, Addressed to David Smith Safety Department USPS Main Office, 951 20<sup>th</sup> Street, Denver, Colorado, Author: Daniel Habes, MSE, CPE, Issued March 16, 2006.
3. OSHA Strategic Partnership Program – Ergonomic Strategic Partnership Verification Report Items; Denver Processing & Distribution Center, Verification dates October 22-25, 2007, Team: Liberatore, Baptiste, Root and Besser.

OSHA Strategic Partnership Program - Ergonomic Strategic Partnership  
Verification Report Items

**DENVER PROCESSING & DISTRIBUTION CENTER**

7500 E. 53<sup>rd</sup> Place  
Denver, CO 80266-9997

October 22 - 25, 2007

Verification Team

Larry Liberatore – OSHA National Office

Pam Baptiste – Denver Regional Office

Dana Root – Chicago Regional Office

Brett Besser – Salt Lake Technical Center

## Section I – EXECUTIVE SUMMARY

1. Date of Onsite Verification: October 22 – 25, 2007
2. Date of Launch: September 25, 2003
3. Number of Employees: 2,100
4. Type of Facility: Processing & Distribution Center
5. Quantitative Key Results:

### Injury & Illness Rate Summary:

#### 2004 – 2006 MSD Rate Comparisons

	MSDs	% Change	Handling /Lifting	% Change
2004	4.67 (94 cases)		3.43 (69 cases)	
2005	2.32 (40 cases)	50% decrease	1.62 (28 cases)	53% decrease
2006	2.39 (36 cases)	3% increase	0.53 (6 cases)	67% decrease

### MSD Cumulative Injury Compensation Costs:

Year	Workers Comp Cost	% Yearly Change
2004	\$ 703,636	
2005	\$ 339,944	52% decrease
2006	\$ 261,301	23% decrease
2007	\$ 102,159	61% decrease

This represents an overall reduction of \$ 601,477 in workers' compensation costs.

6. Process Improvements – Ergonomic Hazards Addressed:

The Denver Site Core Team was very successful in implementing ergonomic improvements:

Task Analyses Conducted:	153
Task Analyses Resolved:	108
Task Analyses Recommendations Implemented:	87

Below is a sample of ergonomic fixes implemented in a variety of plant settings:

Location/Operation	Concern	Corrective Action
DBCS Maintenance	Hand procedures used to vacuum the DBCS resulted in prolonged awkward posture	Used a flexible hose that can be cut to length
AFSM 100 –feeding	While feeding the AFSM, employees bump their shins on the tub holder	Moved tub holder 3” to improve clearance
Mail Prep – sorting mail	A tall employee sorting mail at a low table had neck pain	Provided an additional (on the sort table) tub to raise and angle the tub with mail
Letters automated – sweeping manual cases	Ropes on the back of the case were hard to pull resulting in forceful pulls with pinch grasp	Replaced ropes with bungee cords that are more flexible

7. How did the Partnership function after the Ergonomist left and how is the facility maintaining ERRP?

The Denver Processing & Distribution Center (P & DC) has consistently staffed the position of a Site Coordinator and appears to be operating under the principles established during the roll out. Since the initial launch, the facility has had two Site Coordinators. The original Site Coordinator was on-site for over a year and then was reassigned to a district safety position. The current Site Coordinator has been in this position since 2005 and is extremely effective in managing the Core Team. She is well respected by her peers and upper management. The Site Coordinator keeps the team on task and fully supports their work. The Site Coordinator and Core Team are continuously working on ergonomic related projects and implementing the goals of the partnership.

The facility has an excellent Core Team:

- Knowledgeable of ergonomic hazards and developing corrective actions
- Does excellent job of tracking ergonomic related data e.g. injury and illness charts and graphs
- Good mix of crafts, each craft well represented
- Maintenance representative on team is beneficial
- Very supportive Field Coordinator
- Site Core Team Leader very passionate, has respect of peers and upper management. Excellent “champion” for ERRP.

8. Relationship between the Site Core Team and the Joint Labor Safety and Health Committee:

There is a good working relationship between the site core team and the Joint Labor Safety and Health Committee (JLSHC). The site coordinator attends the JLSHC meetings and briefs the committee on ergonomic related activities.

## 9. Management Perspective of the OSHA Strategic Partnership (OSP):

Top management at the facility is committed to ERRP:

- Top management was extremely cooperative during the site visit
- Local funding has been provided to supplement ERRP start up funding
- Two full-time ERRP positions are being funded
- Effective corrective actions are shared with other local sites

While top management was very supportive of the ERRP Site Core Team, supervisors rarely attended “Monthly All Core Team” meetings.

Recommendation:

Increase the level of supervisory participation in the ERRP process. This could be accomplished by rotating the starting times for the monthly meetings to accommodate the supervisors’ production schedules.

## 10. Employees Perspective of the OSHA Strategic Partnership (OSP):

Employees are aware of ERPP at the facility. Employees expressed that the program has been a useful tool. Involvement by employees in ERRP occurs through their membership on the ERRP team, use of the ergonomic suggestion box, and participation in abating ergonomic hazards. Employees with a hearing impairment have been included in ERRP-sponsored training.

## 11. Hearing Impaired Services:

The Denver P & DC employs over 30 hearing-impaired employees working on all three Tours (shifts). It was clear that the programs implemented at the site provided these employees a safe work environment.

The Plant Manager assigned a Postal employee as a Coordinator (Deaf Liaison) to work with management and the unions.

The plant uses a variety of communication methods. For meetings and training events of 45 minutes or more, the USPS Deaf Liaison uses a contract service which is available 24/7.

For meetings and training events of undetermined length, Video Remote Interpreting (VRI) equipment is used (3 units). VRI is a web-based video conferencing service used for meetings and group sessions to provide real-time interpreting services between supervisors and deaf or hard-of-hearing employees. VRI equipment includes a special camera and a large-screen TV connected via a high-speed Internet connection. The interpreter uses the camera to view the deaf or hard-of-hearing employees and then interprets what they are signing and verbally communicates this to the supervisor and hearing employees.

The Deaf Liaison meets monthly with hearing-impaired workers to discuss potential problems, suggestions, and concerns on USPS issues.

For communications of a short duration (less than 45 minutes), workers communicate using hand-written notes and “sign” language.

All of the hearing-impaired workers interviewed believed the USPS was doing a good job of providing communication services for planned “events” (safety training, safety meetings) and for questions that arose on the plant floor.

## 12. Operation of the Data Bar Code Sorter (DBCS) Machines:

The DBCS machines continue to be an area of significant concern because musculoskeletal disorder (MSD) - related injuries/illnesses continue to occur. As part of the verification review, an ergonomic evaluation of the Delivery Bar Code Sorter (DBCS) machine Feeder and Sweeper tasks was performed. This evaluation was performed using industry-accepted evaluation methods to assess the potential risk for injury. This ergonomic assessment should not be considered an in-depth ergonomic evaluation of these tasks. The evaluation determined that both the Feeder and Sweeper tasks may create some degree of musculoskeletal hazard to the clerks performing the task. Principle risks appear to be to the shoulder, back, and wrist. Recommendations to assist in reducing the potential for injury to the clerk performing this task include:

1. Feeder methods for removing mail from the mail trays:
  - a. Consider using the “rolling” method to transfer mail from the trays onto the jogging table.
  - b. If a neutral wrist posture can be consistently used, “Flipping” may be appropriate for some employees. In determining if this method would be effective, it would be necessary to determine if the jogging equipment could withstand repeated jarring. (See the DBCS Standardization Mail Processing Training: Facilitator Guide, revised 5/26/2006)
  - c. Use the current jogging shelf for storage only.
  - d. Present mail to the feeder station on a height adjustable false bottom in a GPMC, ERMC, cart or container to minimize the need for low level lifting. If the Feeder position is to be used to effectively provide rest and recovery time within the rotation pattern, precautions should be taken to reduce the frequency of low level lifting or extended reaching.
2. Rotation:
  - a. To reduce the risk present to the lower back and to the shoulders, adhere to the established 30 minute rotation schedule between the Sweeper and the Feeder as recommended in the DBCS/DPS Methods and Support Equipment Guide. Additional ergonomic studies and cooperative investigations with workers may reveal other appropriate rotation schedules.
  - b. Studies should be conducted to determine the duration of time that the clerks could spend on higher volume machines.

- c. The final sweep appears to be the critical period from a frequency standpoint. If other workers in the area are at a point where they can assist, this could reduce the frequency of lifting.
  - d. Alternate body postures when sweeping the mail:
    - Change the sweeping pattern
    - Consider sweeping alternating right hand sweep versus left hand sweep
3. Stacking mail trays on the 1226 Pie Carts:
- a. Enlist the ERRP committee to conduct an ergonomic assessment to determine why the practice of stacking the loaded trays on top of the pie carts over two high occurs. Develop administrative control methods to avoid this practice and provide viable alternatives to avoid stacking loaded mail trays over two high on top of the 1226 pie cart.
4. General Suggestions:
- a. Solicit input from the nationwide ERRP committees for suggestions and implementation options for administrative, work method, or engineering controls. Suggestions should be sent to the appropriate engineering, design, or safety and health staff for consideration in future designs, modifications, or decision making activities.
  - b. To determine the full extent of the musculoskeletal injuries occurring at the Sweeper and Feeder tasks on the DBCS machines, an evaluation of the Feeder and Sweeper tasks should be considered. This evaluation should assess these tasks on different DBCS machines and different tours to determine potential physical hazards due to static and dynamic postures, force, frequency, and duration risks present during various rotation schedules, sweeping patterns, mail volume, mail categories, run time, machine through-put and performance expectations. This evaluation should include employee anthropometrics, employee work methods and operation methodology.

**Section II – OVERALL INJURY AND ILLNESS RATES**

Year	Total Injuries	TCIR Rate	DART Rate
FY 2004	103	5.12	4.33
FY 2005	100	5.84	5.32
FY 2006	104	6.9	5.84
FY 2007	93	4.95	4.10

TCIR = Total Case Incidence Rate

DART = Days Away, Restricted Work Day Rate



### Section III - GOALS, STRATEGIES, AND MEASURES:

Goal A. Improving the Safety and Health Environment: Did the worksite demonstrate improvements in the safety and health environment so that OSHA, USPS, NPMHU, and APWU could work together to reduce musculoskeletal disorders (MSDs)?

- The ERRP process at the P&DC has been effective in reducing the number of MSDs incurred since the inception of this partnership.
- In FY 2003, this facility recorded 135 MSDs and has experienced a 72% decrease over the past five years.
- The DBCS-related injuries, particularly on Tour 1, continue to be an area of concern.

Goal B. Worksite Analysis: Did the worksite demonstrate improvements in identifying tasks and conditions where MSD incidents occur and develop and implement ergonomic control processes to reduce or eliminate MSD incidents?

The ERRP Site Core Team has been successful in conducting Task Analyses (See the table of examples of ergonomic fixes in the Executive Summary.).

Goal C. Training: Did the worksite demonstrate improvements in training USPS local managers, supervisors, NPMHU and APWU representatives, and the local Joint Labor-Management Safety and Health Committees to ensure comprehension of ergonomic risks and control processes?

Training Hours:

Craft	Intro to Ergo '03 to date	DBCS (5/06&10/07)
Manager/Supervisor	211	10
Clerk	1,596	410
Mail Handler	749	0
Maintenance	226	0
Total	2,782	419

The site has trained a significant number of workers and managers at the site; however, the site has not completed the required ergo training courses. The site also has not adhered to an annual refresher training schedule.

#### **Recommendation:**

Complete required ergonomics training. Also, establish a schedule for annual refresher training.

Goal D. Reduction in Illness and Injuries Rates: Did the worksite demonstrate improvements in reducing the number of MSD related incidents thereby reducing the number of days away from work for both lost workday and restricted duty cases associated with MSD incidents?

Since the inception of the ERRP process, the facility has experienced a 67% decrease in the MSD injury and illness rate. Despite this overall success, the site needs to continue to explore ways to reduce MSD-related injuries on the DBCS machines.

Goal E. Best Practices: Did the worksite demonstrate improvements in developing and evaluating best proven practices to be implemented in other postal facilities with similar ergonomic issues, and to share best proven practices with applicable USPS operations with similar ergonomic issues?

- The site demonstrated an effective Hearing-Impaired Support program

## Section IV - SUCCESSES AND AREAS FOR IMPROVEMENT

I. Management Leadership	
<ul style="list-style-type: none"> <li>• Demonstrates support and prompt response</li> <li>• Clear program responsibilities</li> <li>• Open lines of communication</li> <li>• Attends ERRP meetings and other s/h functions</li> <li>• Appropriate resources</li> </ul>	<b><i>Needs improvement.</i></b>
<p><b>Comments:</b> The plant manager and senior MDO provide financial and human resources in support of the ERRP process. The Site Core Team Leader meets on a weekly basis with the senior MDO. One of the lead MDOs occasionally attends the All Core team meetings. However, supervisors rarely participate in the Site Core Team meetings.</p>	
II. Ergonomic Training	
<ul style="list-style-type: none"> <li>• Training of crafts and supervisors is incomplete and overdue.</li> </ul>	<b><i>Needs Improvement</i></b>
<p><b>Comments:</b> Need to get back on schedule</p>	
III. Employee Participation Process	
<ul style="list-style-type: none"> <li>• Meaningful involvement</li> <li>• Employees active in the ERRP process</li> <li>• Provide survey results if applicable</li> </ul>	<b><i>In place</i></b>
<p><b>Comments:</b> Site core members are fully involved in the Partnership. The individual tours meet weekly and the entire core team meets monthly. Core members have performed task analysis, performed job observations, interviewed concerned employees, designed ergo related fixes, conducted employee training and organized the ergo health fair. Non-Core team craft employees are involved in the ERRP process through ergonomic suggestions and some employees have been involved in the abatement of the hazard.</p>	
IV. Job Hazard Analysis and Control	
<ul style="list-style-type: none"> <li>• Task analysis conducted</li> <li>• Task analysis resolved</li> <li>• Fixes implemented</li> <li>• Quick fixes implemented</li> </ul>	<b><i>In place</i></b>
<p><b>Comments:</b> As a result of the partnership, the ERRP Core Team has conducted over 108 ergonomic tasks analyses and 87 “fixes” have been implemented.</p>	

V. MSD Management	
<ul style="list-style-type: none"> <li>• Implement an ongoing process to identify MSD's and control the risk factors.</li> <li>• Worksite builds a self sustaining ergonomic skill set and competencies within the workforce using a combination of management, labor union, and craft resources.</li> </ul>	<b><i>Needs improvement</i></b>
<b>Comments:</b> The Site Core Team has been successful in implementing some ergonomic improvements; however MSD-related injuries continue to be an issue for Tour 1 workers (when the highest volume of mail occurs).	
VI. Process Evaluation	
<ul style="list-style-type: none"> <li>• Effective evaluation of goals, strategies, and measures</li> </ul>	<b><i>Needs improvement</i></b>
<b>Comments:</b> Site coordinator, ERRP assistant and core team analyze the number of MSD-related injuries monthly and develop easy-to-read charts and graphs. The Site Core Team need to continue to focus on MSD-related injuries that occur on Tour 1.	
VII. Communications	
<ul style="list-style-type: none"> <li>• Effective lines of communication between OSHA, USPS, APWU, NPMHU, JLMSHC, and the Site Core team.</li> </ul>	<b><i>In place</i></b>
<p><b>Comments:</b> Site coordinator invites OSHA to all monthly core team meetings and provides meeting minutes to the OSHA ERRP representative. JLMSHC quarterly meetings are attended by the site coordinator. When an ergonomic/safety related issue develops, the site coordinator will address the issue immediately with JLMSHC rather than waiting for the quarterly meeting. ERRP maintains 3 bulletin boards throughout facility that contain ERRP information, stretches, MSDs injuries, fixes and success articles. Site coordinator shares monthly core meeting activities with APWU and NPMHU representatives. In addition, the Site Core Team has access the USPS ERRP Website which contains over 700 "good ideas" for improving ergonomic conditions.</p> <p>Site Core Teams have access to the national database of website "ergo fixes" and have a HQ ergonomist assigned to assist them.</p>	

# APPENDIX A

## Ergonomic Evaluation of the Delivery Bar Code Sorter Machines

A team of US Department of Labor Occupational Safety and Health Administration (OSHA) professionals performed a monitoring inspection of the U.S. Postal Service Processing and Distribution Center (USPS P&DC) in Denver Colorado as part of the partnership between OSHA and the USPS P&DC. As part of the monitoring inspection an ergonomic evaluation of the Delivery Bar Code Sorter (DBCS) machine Feeder and Sweeper tasks was performed. Interviews with management and employees were conducted to determine the various parameters of the DBCS machine operation. Measurements and video tape of selected runs were taken. An ergonomic analysis was performed using industry accepted evaluation methods to assess the potential risk for injury. Preliminary recommendations to reduce the potential for injury to the clerks performing this task are included. This ergonomic assessment should not be considered an in-depth ergonomic evaluation of these tasks.

### A. Interviews with workers on the Delivery Bar Code Sorter machines (DBCS), October 22 – 24, 2007

1. Work schedule:
  - a. Tour 1: 10: 00 or 10:30 pm to 6:30 or 7:00 am  
Tour 2: 6:00 or 7:00 am to 2:30 or 3:30 pm  
Tour 3 1:00 or 3:30 pm to 9:30 or 12:00 am
  - b. Breaks: two 15 minute breaks and 30 minute lunch break
  - c. Overtime: Employees may volunteer for time specific overtime based on peak volume (tax time, Mother's Day and Christmas rush) for four 10 hour days followed by an eight hour day. If a sixth day is needed an additional 8 hours may be worked. If there are no volunteers for overtime, then management mandates 4 hours per week of overtime.
  - d. Turnover: There is minimal employee turnover on the DBCS machines
2. DBCS Machine:
  - a. Number of employees:  
Tour 1: 160 operators  
Tour 2: 32 operators  
Tour 3: 149 operators
  - b. Machines come with three and four tier alignments and extra modules can be added to increase the number of stack pockets (sort designations) on each machine. The number of stack pockets range from 190, 198, 220 up to 288.
  - c. There are 55 four tier machines and three of the three tier machines at the Denver P & DC.
3. DBCS Process:
  - a. Mail comes in from the collector > mail is cancelled > receives the bar code > goes to the DBCS by mailhandlers in trays via General Purpose Mail Container (GPMC - cage) or the Eastern Region Mail Container (ERMC - webbing).
  - b. Tour 1 has double pass:
    - The double pass mail comes from within the area.

- First Pass: Sorts to the zone and the mail is placed into trays on the 1226 pie carts, then the pie carts are pushed to the Feeder station in preparation for the second pass.
  - Second pass: Each zone is sorted to the stops in each individual route into the Delivery Point Sequencing (DPS)
  - The mail is “clean” mail
  - This pass may require up to 288 stacker pockets.
- c. Tour 2 and Tour 3 has a single pass:
- A single pass is performed when the mail comes in from outside the area. This pass requires 60 to 85 stacker pockets.
  - This mail is “not clean” with rubber bands that need to be removed
- d. DBCS Productivity standards:
- The target is 25,000 pieces of mail per hour however; the actual Base Production Index is 18,000 to 20,000 pieces of mail per hour.
4. Work Methods:
- a. A team consisting of one Feeder and one Sweeper run the DBCS machine
- Feeder:
 

The Feeder lifts and empties full mail trays from GPMCs, ERMCS or other containers and emptied onto the jogger table. The mail is culled and “tapped down,” so that the stamped ends of the envelopes create an even edge along the base of the jogger. There are three methods to remove the mail from the tray, “flipping,” “rolling,” and manually transferring from the mail tray on the jogging shelf.

**Flipping** the mail out of the tray onto the jogging table involves tossing the mail out of the mail tray and removing the tray so that the mail lands onto the jogging table. Flipping the mail is not recommended by the Postal Service since this may damage the jogging equipment as documented in the revised “DBCS Standardization Mail Processing Training: Facilitator Guide.”

**Rolling** the mail out of the mail tray involves tipping the mail tray up against the back of the jogger, removing the tray leaving the mail vertically on the jogging table. The clerk “rolls” the mail into proper feeding alignment.

The third method involves placing the tray of mail on the jogger shelf. The mail is **manually lifted** from the tray onto the jogging table using both hands. The Feeder slides the mail from the jogger onto the feed table. Empty mail trays are replaced in the GPMC for storage until the next shift. The tray stand next to the jogging table is used as storage of slugs, rejects or sequence errors.
  - Sweeper:
 

A pie cart (1226), a wheeled metal rack which holds mail trays, is placed parallel to the DBCS machine stack pockets. The sweeper pulls out the drawer containing a mail tray that corresponds to the pocket to be swept. Both hands are used to remove the accumulated mail in the pockets and place it into the pie cart tray. Two inches of mail is left in the pocket to

prevent finger injury from the moving parts until the final sweep at the end of the run. When trays in the drawer are full, they are removed and stacked on the top of the pie cart no more than two trays high. However, with heavy through-put, employees report that trays may be stored up to seven trays high on top of the pie cart or two to three high on the floor. There are fold down steps in front of the tiers which are only used to clear jams and not during sweeping.

- Rotation:  
Each DBCS team decides when and how often to rotate between sweeper and feeder positions. The clerks indicate that they may rotate every two hours after every break. The DBCS/DPS Method & Support Equipment Guide indicates that operators should rotate positions on a regular basis, preferably every half hour when the machine is running. Both the USPS Headquarters and Denver Plant Manager recently mandated clerks rotate every 30 minutes.
- Density analysis:  
Each sort location has a different volume of mail that comes to the stack pockets. The sort location can be more easily changed in the first pass than the second pass because the density is determined by the number of stops within the zone. This provides options to sort heavier mail volume into the middle two tiers in the stack pocket location. However, changing the stack pocket location during the second pass is reportedly not feasible since the Delivery Point Sequence must be maintained. If the clerk wants to change the density layout, they go to their supervisor who will pass this information onto the Operation Support Specialists (OSS). The density distribution does not change seasonally.

5. Training:
  - a. DBCS mail process requires yearly training using six videos
6. Pie cart maintenance:
  - a. There is no regularly scheduled maintenance for the 1226 pie cart wheels or shelf rollers. If there is a maintenance issue the 1226 pie cart is to be removed from use and “red tagged.”
  - b. Some of the 1226 pie cart drawers are difficult to slide open.
7. The Implemented Fixes Log list the following fixes on the DBCS machines since the inception of the Ergonomic Risk Reduction Process (ERRP). The ERRP committee has no authority to make engineering changes on the machine. The fixes are:
  - a. Sweeping 4<sup>th</sup> tier: brighter labels for the stacker pockets, instructed DBCS operator to treat the cart like the DBCS machine
  - b. Removing trays from the cart: request maintenance when the drawers stick
  - c. Vacuuming DBCS wimpy panels: found a flexible hose that can be used
  - d. 1226 Cart alignment: realign the 1226 carts so employees do not need to twist
  - e. Feeding the DBCS: replace the joggers with newer model with a plastic flap to cover the gap
  - f. Sweeping DBCS: replace the anti-fatigue mats

## **B. Policy and Procedures (Duties and Responsibilities)**

The “DBCS Standardization Mail Processing Training: Facilitator Guide,” revised 05/26/2006 indicates that:

1. The standardized work instructions and training are a combination of demonstrated proven “best practices” from the NY Metro Area and Pacific Area.
2. Optimum operational performance requires:
  - a. Maintaining continuous feed,
  - b. Good jogging, edging and culling and mail presentation at the feeder,
  - c. Continuous sweeping of pockets and avoiding pocket full occurrences which will stop the machine.
    - Operation set-up procedures – position 1226F tray carts 36 inches from the stacker modules. Ensure that the tray racks are in working order and designated for specific machines (if not submit a repair order). Set up should be achieved within ten minutes.
    - Jogging – place tray of mail on jogger shelf, do not flip trays. Transfer mail from shelf to jogger, gently slide mail onto feed table.
    - Feeding procedures – keep the feed table full while working primarily in front of the jogger
    - Sweeping procedures – always leave at least 2 inches of mail in the pocket being swept; push the mail forward in the trays.
3. Supervisors are accountable for:
  - a. Employees being trained and using proper work methods
  - b. Reporting machine problems to maintenance and indicate resolution of the problems
4. Operators are accountable for:
  - a. The Feeder is to correctly move the mail from tray to jogger by placing the mail tray on the shelf and using two hands to move the mail.
  - b. The mail is not to be flipped on to the jogging table or the feeder belt area. This can cause damage to the jogging equipment. Flipping trays on the feeder belt damages the transport belt. Both are very costly to repair.
  - c. The Sweeper should always leave two inches of mail in the stacker pocket when sweeping a machine that is running. This prevents exposure to and potential injury from moving parts.
  - d. The Sweeper is to rotate assignments during the tour with the Feeder
  - e. Ensure that the trays are not overstuffed which can cause delays at the sleever straper.
5. Performance indicators:
  - a. These indicators are determined based on demonstrated performance by the top quartile facilities in the respective group size. Displayed metrics on or near each machine helps drive performance with performance expectations.
  - b. Machine Target Operational Throughput
    - The actual number of mail pieces that are being run per hour from the time the machine was started until the time the run was ended (includes idle and down time). The target is:
      - Category 1: 24,000 pieces per hour
      - Category 2: 26,000 pieces per hour

- Category 3: 28,000 pieces per hour

**C. Measurements and Observations**

1. Equipment:
  - a. GPMC and ERMC
  - b. Pockets: top is tier #1, bottom is tier #4
  - c. 1226 pie cart
  - d. Step stools
  - e. Tray stand
2. DBCS machine measurements:
  - a. The jogger table is 37 inches high.
  - b. There are up to 288 stack pockets in 4 tiers.
  - c. The aisle is 27 inches wide and 935 inches long for 288 pocket machine. A step can be folded down from the machine. When the step is down, the aisle is 19 inches wide. The step is 13 inches wide and 13 inches high.
  - d. Weights:
    - Tray Tare: 0.8 pounds
    - Tray of First Class mail: 15 pounds to 17 pounds
    - Tray of Standard Third Class mail: up to 25 pounds
3. DBCS machine mail volume:
  - a. The type of mail influences the volume. The size of the letters and the volume of mail directly influence the sort plan. The mail is “cleaner” on the Tour 1.
  - b. The typical volume is 80,000 to 100,000 pieces of mail per shift on Tour 1 and Tour 3.
  - c. Heaviest volume days occur on Wednesday, Thursday, Friday and Sunday on Tour 1 during the first pass with 140,000 to 160,000 pieces of mail per shift.
  - d. The heaviest mail volume may reach 200,000 pieces of mail per shift during holidays (Christmas and Mother’s Day).
4. Musculoskeletal Disorders DART Rates:  
MSD Days Away and Restricted Time Rates on the DBCS machines from the OSHA 300 Logs:

<b>Tour/ Year</b>	<b>2005</b>	<b>2006</b>	<b>2007*</b>
<b>Tour 1</b>	4.3	4.2	5.2
<b>Tour 2</b>	0.7	0	0.3
<b>Tour 3</b>	1.0	1.0	0



DART and Severity Rates by Body Part from the OSHA 300 Logs:

DBCS (all tours)	Work Hours	Body Part	MSD DART	MSD Severity Rate
2005	606,681	Low back	2.5	156.3
		Shoulder/neck	1.6	152.0
		Distal Upper Extremity	0.3	1.0
2006	618,602	Low back	1.3	68.5
		Shoulder/neck	1.9	145.5
		Distal Upper Extremity	1.0	9.7
2007	616,764	Low back	2.6	100.2
		Shoulder/neck	2.3	25.3
		Distal Upper Extremity	1.3	96.6

5. Stature:

Feeder:

Some short stature clerks rise up on their tiptoes to lift the tray onto the jogging table. They struggle with the weight of the loaded tray to place onto the jogging table or the jogger shelf.

Sweeper:

Short stature clerks rise up onto their tiptoes to reach the top stacker tier pockets and to place mail into top pie cart drawers.

6. Frequent trunk flexion

Feeder:

The GPMC bottom shelf is about 13 inches high with loaded mail trays stacked on top of each other at approximately 5 inch increments up to 48 inches high. The 1226 pie cart lower drawers are 37 inches and 27 inches high. The lifts from the lower drawers and from the lower stack of mail trays in the GPMC are made with at least 30° of trunk flexion. Frequent bending also occurs when placing empty trays from the floor into the GPMC. When the jogging shelf is used the shorter stature clerks must reach forward with up to 30° of trunk flexion to place the loaded mail tray onto the shelf or to remove the mail from the tray.

Sweeper:

The third level DBCS tier is 39 inches high, the bottom tier is 27 inches high and the bottom drawers on the 1226 pie cart drawers are 37 inches and 27 inches high. The bottom tier pocket is 20 inches deep. All of the lifts from the pockets and placement into the drawers are made with at least 45° and up to 90° of trunk flexion. Frequent bending occurs while moving mail from the bottom two tiers to the bottom level drawers. All Sweepers stoop to visually verify that two inches of mail is left in the pocket and reach into the lower tier pockets. In addition to the repetitive bending there is prolonged static exertion of the trunk muscles.

7. Shoulder reaching

Feeder:

When the jogging shelf is used the shorter stature clerks must reach forward with up to 90° of shoulder flexion to place the loaded mail tray onto the shelf.

Sweeper:

The top DBCS tier pocket is 63 inches high and the second tier pocket is 51 inches high. The top pie cart drawer is 58.5 inches high and the second drawer is

48 inches high. The top of the 1226 pie cart is 61 inches high with storage of one loaded tray on top of the cart is 66 inches high. The observed sweep method is with the clerk standing with their right side towards the pockets. The clerks work primarily with their dominant right hand to perform the sweeping activities. The duration of exposure to the shoulders postures is dictated by the design of the stack pockets and the drawers of the 1226 pie cart. Whether reaching overhead or away from the body, the shoulders have to support the arm weight and the load in the hand against gravity. This occurs whether the trunk is erect or in a flexed posture. Using this sweep method the right shoulder is held away from the body in a flexed and/or abducted posture:

0° to 45°	16% of the cycle time
46° to 90°	52% of the cycle time
91° to above	30% of the cycle time

The left shoulder is held away from the body in a flexed and/or abducted posture:

0° to 45°	66% of the cycle time
46° to 90°	14% of the cycle time
91° to above	18% of the cycle time

The static loading component from the prolonged contraction of the shoulder muscles vary between the left and right shoulder use. The shoulder postures vary depending on the clerk's stature.

#### 8. Wrist Deviation

Feeder:

The clerk places the mail tray either on the jogging table or on the jogging shelf. There are three techniques to empty the mail tray onto the jogging table. The preferred method by many of the employees is to "flip" the tray. This method requires mid to end range bilateral wrist deviation and requires less manual handling of the mail because the mail is already in proper alignment on the table. This method reportedly can damage the jogging equipment. In the second method, the loaded mail tray is vertically placed on the jogging table emptied leaving the mail vertically standing on the jogging platform. The mail is "rolled" into the feeding position. This method requires wrist flexion to roll the mail into position. The last method requires the clerk to place the mail tray onto the jogging shelf. To remove the mail from the tray, the mail is held between the left and right hands with both wrists hyperextended and deviated. All three of these methods require force to grip the mail and awkward wrist postures to maneuver the mail from the tray to the jogging position.

### D. 3-D Biomechanical Analysis – Static Strength Prediction Program

The program estimates the biomechanical static strength capabilities of the clerk in relation to the physical work demands and provides estimates of the compressive force on the low back and the static localized muscle strength. Four different lifting tasks were analyzed. They are:

- lifting the loaded mail tray onto the jogging shelf,
- flipping tray onto jogging table,
- lifting mail from the top tier pocket, and

- lifting mail from the bottom tier pocket.

The analyses are shown in Appendix B.

The following were the estimated compressive forces on the low back:

Object	Estimated Low Back Compressive Force (lbs)
25 pound mail tray onto the jogging shelf	459 lbs
Flipping 25 pounds mail tray	471 lbs
10 pounds of mail from the top tier	254 lbs
10 pounds of mail from the bottom tier	692 lbs

Lifting 10 pounds of mail from the bottom tier pocket is potentially a greater risk for injury to the low back than the other tasks noted.

The National Institute for Occupational Safety and Health (NIOSH) recommends that most workers can tolerate a compressive force of 770 pounds (Waters et al. 1993). A force above 770 pounds is considered unsafe for some workers. The muscle strength model determines the most limiting joint strength which determines the person's whole body strength capability for performing a given task. The following was the percent capable with the shoulder strength necessary to perform the task:

Object	Estimated Shoulder Strength Capable
25 pound mail tray onto the jogging shelf	61%
Flipping 25 pounds mail tray	99%
10 pounds of mail from the top tier	65%
10 pounds of mail from the bottom tier	92%

Lifting a 25 pound loaded mail tray on the jogging shelf is potentially a greater physical strength risk to the shoulders than the other tasks noted.

#### **E. Revised NIOSH Lifting Equation Analysis**

A preliminary lifting analysis, using the Revised NIOSH Lifting Equation (Waters et al. 1993, NIOSH 1994), was performed for the sweeping task. Several field studies have shown that the Revised NIOSH Lifting Equation (RNLE) is able to identify jobs associated with a high risk for occupationally related low back pain. A Lifting Index of 1 implies that the job is hazardous to some healthy workers. At a Lifting Index of 3.00 only about 25% of healthy male workers and less than 1% of healthy female workers can perform the job safely. Back injury rates have been shown to increase significantly in populations when the work is performed at LI greater than 1.0 and will continue to increase as the lifting index becomes larger. See Appendix B.

The RNLE is used to evaluate the stress created by performing a single lifting task. This methodology evaluates lifts performed by the sweeper from the DBCS pockets to the pie cart trays. The results for this type of analysis resulted in a Frequency Independent Lifting Index of about 0.2 for all levels, well below the level that should raise concern about back injury for most workers. It must be realized that this result does not factor in the repetitive nature of these tasks and is an indicator only for back stress.

However, the frequency of lifting for sweepers can be significant and as such should be considered. The problem is that the frequency varies depending on a number of factors such as the rotation pattern, the sweeping patterns, the volume of mail, the quality of the mail, time of the run, and mechanical breakdown. Based on the limited video footage that was obtained during the evaluation, it appears that it can range from a low of a few lifts per minute early in the shift up to 13 to 14 lifts per minute when performing final sweep duties at the end of the run. Most workers should be able to perform these lifting tasks safely at the lower levels of 2 to 3 lifts per minute. But, according to the lifting equation few if any workers could safely perform this task at the faster rates observed during the final sweep.

Additionally, only the sweeper task was evaluated even though there is some lifting associated with the feeder task. This portion of the work pattern should also be considered since it is part of the DBCS rotation.

## **F. The Strain Index**

The Strain Index (SI) is a semi-quantitative job analysis tool used to determine the magnitude of risk for developing distal upper extremity musculoskeletal disorders primarily those associated with the muscle-tendon unit and carpal tunnel syndrome (Moore et al, 1995). The analyses are shown in Appendix B.

The three different methods for removing the mail from the trays were analyzed. These included “flipping” the letters out of the tray onto the jogging table, “rolling” the letters out of the mail tray, and manually lifting the letters from the mail tray on the jogging shelf. The analysis used estimates of the exertion required to move the letters and considered wrist postures. The results are:

Flipping mail	SI = 3.3 to 4.5 depending on posture used
Rolling mail	SI = 1.1
From jogging shelf	SI = 4.5

A SI of 5 distinguishes between safe and hazardous jobs. SI = 3 is almost surely safe, and SI = 7 is almost surely hazardous. The index is especially sensitive to intensity of exertion.

This suggests that the force required to grasp the letters, the wrist postures and the rest and recovery time potentially reduce the risk for injury to the hand and wrist .

## G. Recommendations:

Both the Feeder and Sweeper tasks may create some degree of musculoskeletal hazard to the clerks performing the task. Physical risks appear to be to the shoulder, back, and wrist. The following are some recommendations to mitigate the hazards.

1. Feeder methods for removing mail from the mail trays:
  - a. Consider using the “rolling” method to transfer mail from the trays onto the jogging table.
  - b. If a neutral wrist posture can be consistently used, “Flipping” may be appropriate for some employees. In determining if this method would be effective, it would be necessary to determine if the jogging equipment could withstand repeated jarring.
  - c. Use the current jogging shelf for storage only.
  - d. Present mail to the feeder station on a height adjustable false bottom in a GPMC, ERMC, cart or container to minimize the need for low level lifting. If the Feeder position is to be used to effectively provide rest and recovery time within the rotation pattern, it is critical to ensure that all precautions are taken to reduce the frequency of low level lifting or extended reaching.
2. Sweeper methods for removing mail from the stack pockets:
  - a. Alternate body postures when weeping the mail:
    1. Change the sweeping pattern
    2. Consider sweeping alternating right hand sweep versus left hand sweep
    3. Consider taller stature workers to sweep the top level tiers and the shorter stature workers to sweep the bottom level tiers.
3. Rotation:
  - a. To reduce the risk present to the lower back and to the shoulders, adhere to the established 30 minute rotation schedule between the Sweeper and the Feeder as recommended in the DBCS/DPS Methods and Support Equipment Guide. Additional ergonomic studies may reveal other appropriate rotation schedules and sweeping methods.
  - b. Studies should be conducted to determine the duration that the clerk can spend on higher volume machines.
  - c. The final sweep appears to be the critical period from a frequency standpoint. If other workers in the area are at a point where they can assist, this could reduce the frequency of lifting.
  - d. Alternate body postures when sweeping the mail:
    - Change the sweeping pattern
    - Consider sweeping alternating right hand sweep versus left hand sweep
    - Consider taller stature workers to sweep the top level tiers and the shorter stature workers to sweep the bottom level tiers
4. Stacking mail trays on the 1226 Pie Carts:
  - a. Enlist the ERRP committee to conduct an ergonomic assessment to determine why the practice of stacking the loaded trays on top of the pie carts over two high

occurs. Develop administrative control methods to avoid this practice and provide viable alternatives to avoid stacking loaded mail trays over two high on top of the 1226 pie cart.

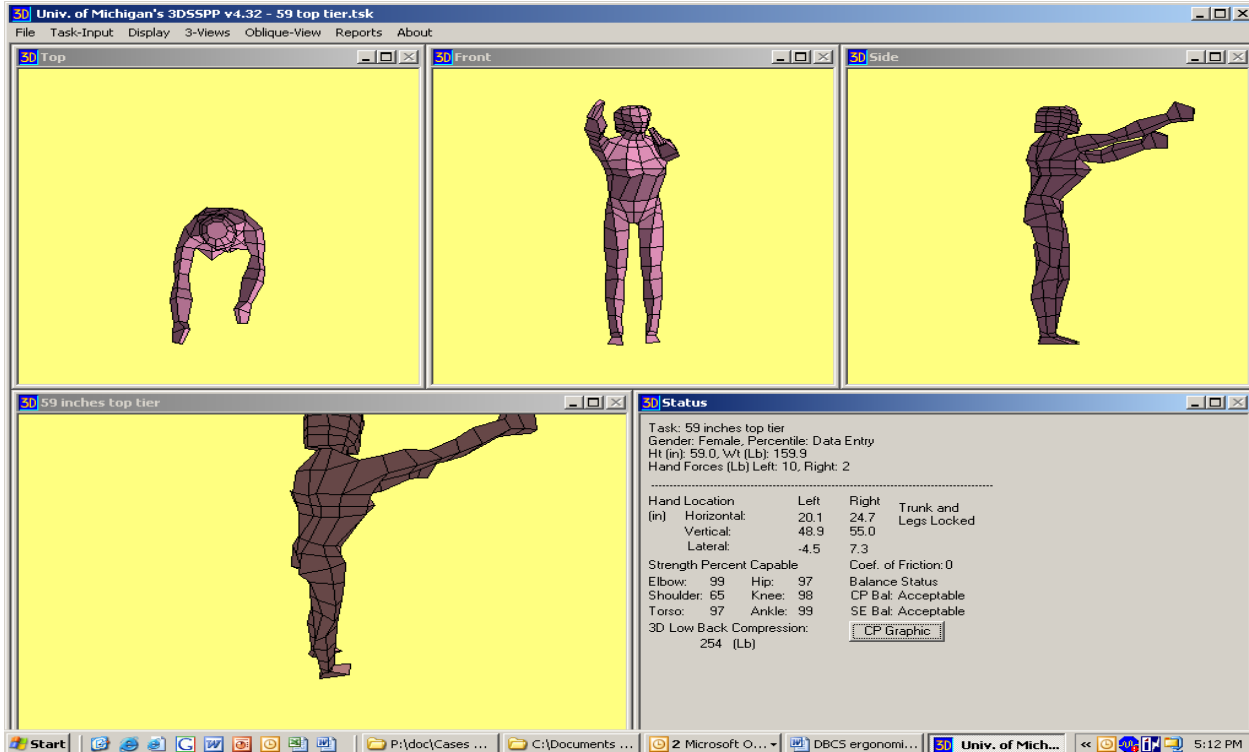
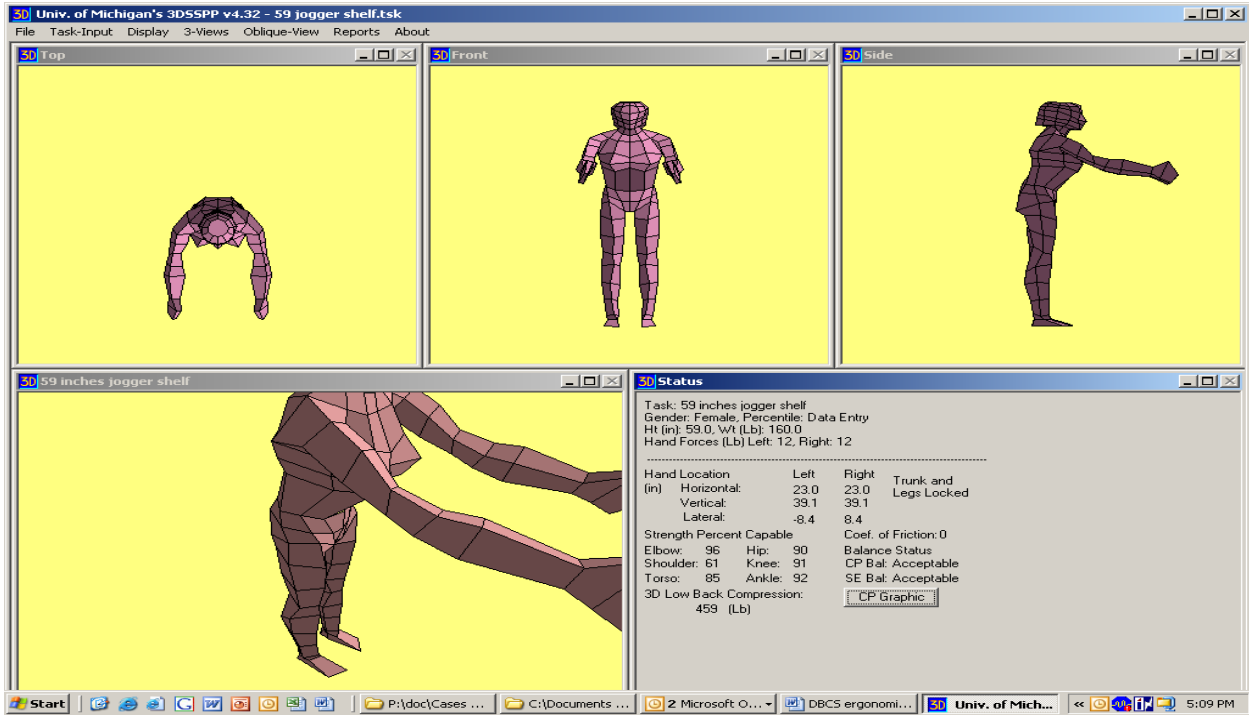
5. General Suggestions:

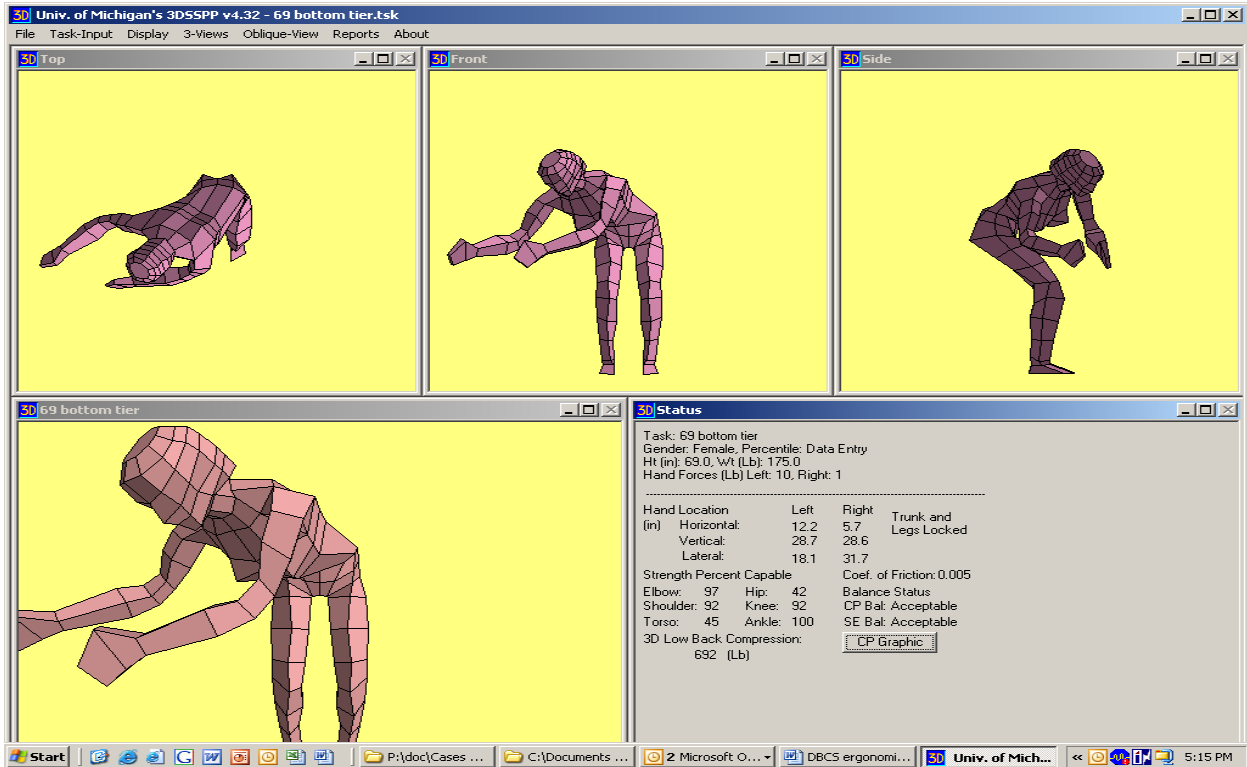
a. Share lessons learned and seek input from other ERRP committees for suggestions and implementation options for engineering controls, administrative, work method controls. Continue to send suggestions to the appropriate engineering, design, or safety and health staff for consideration in future designs, modifications, or decision making activities.

b. To determine the full extent of the musculoskeletal injuries occurring at the Sweeper and Feeder tasks on the DBCS machines, an evaluation of the Feeder and Sweeper tasks should be considered. This evaluation should assess these tasks on different DBCS machines and different tours to determine potential physical hazards due to static and dynamic postures, force, frequency, and duration risks present during various rotation schedules, sweeping patterns, mail volume, mail categories, run time, machine through-put and performance expectations. This evaluation should include employee anthropometrics, employee work methods and operation methodology:

- Explore a method that would allow mail to be moved from the mail tray to the jogger without manually lifting it.
- Continue to assess the method for visual verification and reaching into the rear of the pockets.
- Continue to refine cost analysis data of DBCS musculoskeletal injuries.

# Appendix B





**RNGP -- Job Analysis**

### Revised NIOSH Guide Program for Manual Lifting

Analysis of Entire Job

**Analyst:** Dana Root  
**JOB:** Sweeping  
**Duration:** 3 Hours 0 Minutes

**Composite Recommended Weight Limit (CRWL)**      0.0 lbs     

**Composite Lifting Index (CLI)**      100.00     

**Recommended Rest Allowances**      0 min     

**Estimated percent capable population:**  
 Female = 1% Capable  
 Male = 1% Capable

Task		Frequency Independent (Origin)	Single Task (Origin)	Frequency Independent (Destination)	Single Task (Destination)
Top Tier	LI	0.22	0.21	0.22	0.21
	RWL	40.7	19.5	41.6	19.9
Second Tier	LI	0.20	0.21	0.19	0.20
	RWL	45.1	22.5	46.0	23.0
Third Tier	LI	0.18	0.18	0.17	0.17
	RWL	37.4	16.8	46.1	20.7
Bottom Tier	LI	0.21	0.24	0.17	0.19



Employee Name: Sweeper  
 Dept./Position/Location: USPS Denver P & DC  
 Analyst Name: DR

Date: 11/01/2007  
 Shift/Hours: 10:00 to 06:30am  
 # Exposed: 160

Strain Index (SI) Internal Job Hazard Analysis (JHA)

Task	Task Description	Exertions								Hours per Day	T S I	IM	EM	DM	PM	SM	HM
		Intensity of Exertion		Per minute	%Duration of Exertion	Posture		Speed									
1	Flipping mail out of tray onto jogger platform	Moderate	▼	2	20	Bad	▼	Fair	▼	3	4.5	6	.5	1	2	1	.75
2	Flipping mail out of tray onto jogger platform	Moderate	▼	2	20	Fair	▼	Fair	▼	3	3.38	6	.5	1	1.5	1	.75
3	Rolling mail out of tray onto jogger platform	Light	▼	4	20	Fair	▼	Fair	▼	3	1.13	1	1	1	1.5	1	.75
4	Placing tray of letters onto jogging shelf	Moderate	▼	3	20	Bad	▼	Fair	▼	3	4.5	6	.5	1	2	1	.75

file: USPS Denver Apr 15, 2008

NIOSH investigative report on the new DBCS-7:

Date: April 16, 2008

From: Max Kiefer, MS, CIH  
NIOSH Denver Regional Office

Subject: Qualitative Review of USPS Prototype Delivery Bar Code Sorter  
(DBCS-7)

To: NIOSH Chief of Staff

In response to a request from (US) Rep. DeGette (CO-01), NIOSH conducted a site visit on April 1, 2008 at Siemens AG, Inc., in Arlington, TX to review a prototype 7th generation Delivery Bar Code Sorter (DBCS-7). The purpose of the visit was to ergonomically compare human interaction with the DBCS-7 to existing DBCS equipment in use by the U.S. Postal Service (USPS). The prototype "testbed" DBCS-7 was not a fully completed system for processing mail in a factory setting; it was, however, operational and conducting runs of mail for focused testing. As such, only subjective comparisons could be made regarding how operators would interact with the new equipment versus previous DBCS versions. This letter provides you with the results of this site visit.

Prior to conducting the site visit, previous reports from NIOSH ergonomic evaluations of USPS (DBCS) sorting machines (HETA 92-073-2337, 2003-0179/2004-0103)

Links to the NIOSH investigations:

<http://www.postalreporter.com/pdfs/DenverPO1992-0073-2337.pdf> and  
<http://www.postalreporter.com/pdfs/DenverGMF062.pdf>

the USPS response to the NIOSH evaluations were reviewed. Additional background information about the DBCS-7 was obtained from discussions with USPS safety and engineering representatives.

During the site visit I met with Mssrs. Wolfgang Schwarz (Siemens, VP Sorting Machines), Meinhard Natterman (Siemens, Director Product Development, Sorting Machines), Thomas Potter (USPS, Mechanical Engineer) and other Siemens technical representatives. We first met to discuss the purpose of my visit, review specifications for the DBCS-7 prototype, modifications that would impact human interface, differences from existing DBCS machines, and plans for further development of the DBCS-7. Following this meeting I visually reviewed the prototype DBCS-7 and compared it to an adjacent 6th generation DBCS. Siemens and USPS engineering personnel were available to answer questions during this review.

Findings

Externally, the DBCS-7 is very similar to previous generation DBCS systems currently operational in USPS facilities and human interaction is not anticipated to change. DBCS-7 is a one-sided, 4 stack unit with nearly identical dimensions (# of stackers, shelf height) to the previous generation, and "feeding" and "sweeping" activities requiring worker interaction are still necessary. The primary modifications to the machine are internal and include:

- Upgrades to the electronics
- Improving maintainability (access)
- Decrease in repair time and frequency/increase reliability

- Decrease in jam occurrence
- Upgrade to emergency shutdown system.

Siemens and USPS representatives indicated that the machine (belt) speed has not changed, but there will be throughput improvements due to decreases in jam frequency, increased reliability, and operator access to the back of the machine (previously required maintenance personnel). The feeder area, typically a high maintenance area, has been modified with the addition of a mechanism to identify and discard "unmachineable mail." It is anticipated that this will result in significant time savings and increase in throughput.

Modifications to the DBCS-7 that may impact ergonomics/safety include:

**Autojogger:** With this new design some activities of the Feeder Operator are reduced; mail is placed onto the jogger and does not have to be "walked" into the feeder or checked as diligently for unmachineable mail. The noise from the mail jogging operation has been reduced at this station and a light-curtain safety interlock installed.

**Shelf Dividers:** Dividers between the shelves on the stackers have been lowered to approximately 1 inch which could enhance access.

**Belt Stop:** During a jam, the belts at the stacker on the DBCS-7 will stop (on previous versions the belts did not shut down).

**Noise:** According to Siemens personnel, the DBCS-7 will be quieter (specific noise reduction levels from existing units were not available).

The Sweeper operation has not been automated and mail will still be manually removed from the stacker shelves. A step-up for the Sweeper operators to aid in accessing the top shelf will be available (this was not yet installed on the unit inspected). As noted, shelf heights were measured on previous models (DBCS-6) and found to be identical to the DBCS-7 (distance from floor to shelf lip: 21", 32", 44", 55"); there will be slight variation on each machine due to leveling during installation.

Concerns noted in the request included ergonomic hazards from increased operator activity associated with throughput efficiencies. Biomechanical stress on the Feeder operator can occur from lifting trays of mail and the pace of work. An ergonomic concern with Sweeper operators is an increased frequency of trunk flexion (sweeping bottom tier of stackers) and long reaches (accessing top tier of stackers). Siemens representatives indicated that USPS would be responsible for all procedural and operational programming revisions that may be implemented to address ergonomics (e.g., rotation, additional workers, preferentially

diverting mail to the middle tier stackers). At the time of the site visit, procedural changes had not yet been developed by USPS to address any anticipated increase in activity, although there was conjecture that an additional Sweeper may be necessary for the second sequencing pass during mail processing.

#### Plans

According to Siemens and USPS personnel, the prototype DBCS-7 is scheduled to undergo an internal USPS "in-plant" test and evaluation in July, 2008. This evaluation will include a safety inspection and entails a USPS ergonomics assessment of the machine. Following completion of this "in-plant" evaluation, the unit will be installed and tested for 5 months at a USPS Processing and Distribution Center. Upon successful completion of these tests and subsequent machine modifications, the DBCS-7 is intended to replace existing first generation DBCS units in various USPS facilities.

#### Conclusions

A site visit to Siemens AG in Arlington, Texas was conducted to determine differences in human interaction between a prototype "testbed" DBCS in a Research and Development setting and existing operational DBCS machines at USPS facilities. Because the unit was not operational in a factory setting, human interaction could not be evaluated. Furthermore, the unit was still under development and had not completed internal USPS safety evaluation (including procedural development). As such, only a limited qualitative assessment could be made.

Information obtained from this site visit indicates that modifications to the next generation delivery bar code sorter (DBCS-7) are internal, intended to increase efficiency and throughput, and reduce downtime. With the exception of some Jogger activities and access to the back of the machine, operator interaction with this machine does not appear to have changed from previous versions. At the time of the NIOSH review, USPS engineering, operation, and safety personnel had not completed their evaluation of the prototype DBCS-7 and procedural or programming enhancements to address ergonomic concerns had not yet been determined.

Loyd Reeder  
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National Institute for Occupational  
Safety and Health  
Robert A. Taft Laboratories  
4676 Columbia Parkway  
Cincinnati OH 45226-1998

March 16, 2006  
HETA 2003-0179  
HETA 2004-0103

David Smith  
Safety Department  
USPS Main Office  
951 20<sup>th</sup> Street  
Denver, Colorado 80202-9998

Dear Mr. Smith:

This report pertains to the health hazard evaluation (HHE) requests submitted by employees to the National Institute for Occupational Safety and Health (NIOSH) regarding the incidence of musculoskeletal disorders of the back, shoulder, and hands among workers operating Delivery Bar Code Sorter (DBCS) machines at the Denver General Mail Facility (GMF). The first HHE request, received by NIOSH on February 28, 2003, requested that NIOSH review injury prevention procedures contained in a new release of the On-The-Job Safety Review/Analysis (JSA) for the DBCS machine, which included revised sweeping methods and use of a lifting technique known as PowerLift.<sup>®</sup> The second HHE request, which was also submitted by employees, was received by NIOSH on January 23, 2004. This HHE requested that NIOSH review the merits of a new United States Postal Service (USPS) injury reduction program called the Ergonomics Risk Reduction Process (ERRP). This program, a collaborative effort with the Occupational Safety and Health Administration (OSHA) and USPS unions, was aimed at identifying new approaches to working safely in USPS facilities. I agreed to evaluate specific injury reduction strategies resulting from the ERRP process pertaining to the DBCS machines. I received this information from the requestors and from USPS safety personnel. No onsite evaluation was conducted during the course of the second HHE investigation.

## Background

In 1991 and 1992, NIOSH investigators evaluated the potential for ergonomic hazards on three types of automated mail processing machines, one of which was the first generation DBCS. These types of DBCS machines have 102 stackers arranged in three tiers at heights of 22 inches, 36.5 inches and 50.25 inches above the floor, respectively. The latest generation DBCS machines currently used by the USPS have more than 200 stackers, arranged in four rows, ranging in height from 21.5 inches to 56 inches.

In the final report (attached), NIOSH investigators concluded that the automated equipment used by the USPS “put employees at potential risk for low back and upper extremity musculoskeletal

## Page 2 – David Smith

disorders” due to the awkward postures and repetitive tasks to which workers were exposed. The report noted in particular the design flaws at the DBCS sweeper position.<sup>1</sup>

The main flaw cited in the report was the height of the three rows of stackers, the first row being too low to avoid excessive trunk flexion (bending over) while sweeping mail, and the third row being too high for most workers to avoid reaching above shoulder height to sweep mail. The report cautioned against bending the knees as an acceptable method of sweeping the bottom row of stackers due to the excessive ligament forces at the knee during deep knee flexion. Another risk factor noted in the report was the potential of highly repetitive upper extremity motions from sweeping 102 stacking locations from a machine capable of sorting 35,000 pieces of mail per hour.

The recommendations pertaining to the DBCS contained in the July 1993 NIOSH report were as follows:

1. Assign additional workers to the machines to help with sweeping.
2. Limit the time that workers spend on the DBCS machines.
3. Provide additional rest breaks for workers on the DBCS machines.
4. In the long term, automate the sweeping position of the DBCS.

## Discussion of Current Concerns

### *JSA and PowerLift*

The JSA is a form used by the USPS to describe the basic steps of a job task, list the potential hazards, and prescribe a recommended action to prevent injury from the listed hazards. For the feed and sweep positions of the DBCS, the JSA recommends using the PowerLift technique. For the sweep position only, the JSA recommends using two hands for sweeping, bending knees while lifting, turning the body instead of twisting when lifting, and rotating with the feeder every hour to prevent repetitive injuries.

In January 2004, I met with Dr. Michael Schaefer, developer of the PowerLift technique and related training programs, at the GMF in Las Vegas, Nevada. He was conducting a train-the-trainer refresher course to lead workers at the facility and he invited me to participate in the training. The key element of the PowerLift is the establishment of a wide base when lifting, coupled with methods to move a box, tray, or other load close to the body while simultaneously lifting with the legs. I considered the methods to be biomechanically sound and a good approach to injury prevention when lifting. I also considered the methods to be complicated and difficult to learn in a single training session.

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<sup>1</sup> NIOSH HETA 92-0073-2337, United States Postal Service General Mail Facility, Denver, Colorado, July 1993.

Dr. Schaefer emphasized that the PowerLift techniques need to be reinforced through periodic audits of worker lifting practices and repeat of PowerLift training sessions. He felt that his lifting techniques were most applicable to the feeding part of the DBCS job where bulk mail is lifted into the machine for sorting. Even though the sweeping portion of the job is not actually a lifting task, but rather a repetitive motion task, he felt that the bent knee/wide base posture put the worker in the best position to sweep the bottom two rows of the DBCS. He added that this bent knee/wide base posture cannot be used by most workers to sweep the top two rows because these rows are often above the shoulders of the sweepers. Finally, Dr. Schaefer added that a good lifting technique is only effective if there are no other factors which negate its positive aspects, such as too heavy a load, slippery load, lifting barriers, or poor ergonomic design.

As noted in the attached HHE report, NIOSH investigators consider the sweep portion of the DBCS to be poor ergonomic design and caution against deep knee bending to sweep the bottom rows of the machine, work practices inherent in the JSA and PowerLift method. The recommendation in the JSA for the workers on the DBCS to rotate every hour is sound because the differences between these two tasks (feeding and sweeping) provide a break from the stereotyped motions comprising each of the tasks. Sweeping with two hands and turning the body instead of twisting is also a good injury prevention practice, provided the receiving mail carts are far enough from the stackers of the DBCS machines.

Conversations with safety personnel at the Denver GMF indicated that new workers are given training on operation of the DBCS machine and use of the PowerLift techniques, but follow up and reinforcement is limited to making the training materials available to workers who want to practice what they were taught during work orientation.

### ***Ergonomics Risk Reduction Process***

Recognizing the effect of musculoskeletal disorders on the workforce, the USPS, the American Postal Workers Union, the National Postal Mail Handlers Union, and the Occupational Safety and Health Administration (OSHA) entered into a strategic partnership to identify and control ergonomic risk factors. This partnership, known as the Ergonomic Risk Reduction Process (ERRP) was formed so that the members could work together to reduce the number of injuries and ergonomic related hazards at USPS facilities.

The ERRP was started in the summer of 2003 at select sites, with implementation at the Denver GMF beginning in the Spring of 2004. The program establishes a subgroup of the Local Safety & Health Committee called a Core Team, which has the responsibility to develop and administer the local program. Each participating facility has a “site coordinator” and, for the initial 30-60 days, a certified ergonomist on site.

## Page 4 – David Smith

Training is provided to all craft employees as well as supervisors and managers. Each task in the plant is evaluated and a job hazard analysis is conducted to identify ergonomic risk factors. The core team recommends and implements changes to work practices, work area design and overall work procedures to reduce ergonomic related injuries. The core team also has the responsibility to document and report fixes (best practices) that have been successful in reducing injuries.

The second HHE request stated that the ERRP was charged with establishing new work practices for many postal work job tasks, including those used on the DBCS machines. I reviewed these new work practices as requested. The ERRP is an important program because it acknowledges the work-relatedness of musculoskeletal disorders associated with the tasks performed by USPS workers, and the need for new approaches to reducing the incidence of these disorders.

In July 2005, I received from the HHE requestors the DVDs and written documentation outlining the train-the-trainer sessions that took place at the Denver GMF as part of the ERRP training segment. Upon inspection, I realized that these were the same materials that NIOSH investigators evaluated during the time the DBCS was initially deployed. The “DBCS/DPS Methods & Support Equipment Guide” dated November 1995 was already in my possession and the DVD outlining the proper method for feeding and sweeping the DBCS machine has the same content as the videotape I received from your office in June 2003.

I contacted the Safety Department at the Denver GMF and they reminded me that the ERRP program addresses ergonomic problems in all areas of the facility, not just the DBCS, and that as a result of ERRP, musculoskeletal disorders have decreased by as much as 40%, including decreases among workers on the DBCS machines. Examples they gave me included numbering the bottom two rows of the DBCS stackers to correspond with the numbered carts across the aisle from the DBCS machines to which the swept mail is placed, and eliminating the practice of “flipping” trays of mail to load it into the sorter. Labeling the stackers and mail carts is intended to reduce the amount of bending needed to sweep the lower two stackers. Removing mail from a tray using a neutral wrist posture instead of rotating the hands and wrists to dump (“flip”) mail onto the sorting platform is an effective way to reduce deviated wrist postures. There is no doubt that flipping should be avoided. However, bending less to sweep the mail from the bottom rows seems to conflict with the employee’s need to leave two inches of mail in the stacker after each sweep, as prescribed in the DBCS instructional DVD, to avoid getting their hands caught in the machine.

Despite the reported reductions in musculoskeletal disorders, it is important to emphasize that for progress to be sustained administrative remedies must be periodically reinforced through training review sessions and monitoring of employee work practices. For proper control of physical hazards on repetitive tasks requiring deviated postures and hand intensive activities, NIOSH recommends a more permanent solution, known as engineering controls, in which the physical hazard is eliminated. While such changes may have been effective in other areas of the Denver GMF, such as elimination of physical lifting tasks through installation of conveyors to transport mail, the physical demands of the DBCS machines, particularly on the sweeper side, have been essentially unchanged.



Designing engineering controls for the DBCS machine is a challenge. In such instances NIOSH recommends that job factors be modified to prevent injuries. In the case of the DBCS, controlling mail throughput per hour or the number of pieces of mail sorted each hour, presents an opportunity for effective intervention. To my knowledge, no study has ever been performed to determine how many pieces of mail a pair of DBCS workers can safely process in an hour or a day with little risk of injury. This may be due to the variety of mail types sorted on the DBCS machines. The Union's policy emphasizes minimizing the amount of time a worker spends on the DBCS machines to the extent possible. Another alternative a worker has is to bid to another type of job, but this option is becoming increasingly limited as new generations of DBCS machines, such as the DIOSS and DIOSS-EC, are scheduled for deployment, eliminating older, single tier machines such as the Input Subsystem (ISS) Optical Character Reader (OCR).

## **Conclusions and Recommendations**

Based on meetings and conversations with USPS consultants, safety personnel, managers, and workers the following conclusions can be made:

1. The DBCS machines presently in use by the USPS (four tiers, 201 stackers) present the same or greater risk of injury to workers as the three-tiered DBCS machines evaluated by NIOSH in 1991-92.
2. The USPS recognizes the need to reduce the incidence of musculoskeletal disorders at its facilities by identifying new and better methods for workers who perform mail processing tasks.
3. The ERRP and other engineering/administrative strategies are sound and logical approaches to achieving the goal of lower incidences of musculoskeletal disorders.
4. The engineering controls developed under the ERRP initiative are more likely to result in long term reductions in injuries and musculoskeletal disorders than the administrative methods which do not eliminate the hazards or design shortcomings that resulted in high incidences of musculoskeletal disorders. Most of the controls developed for the DBCS machine have been administrative in nature.

In addition to the conclusions listed above and the recommendations contained in the attached HHE report, the following is recommended for the DBCS machines:

1. Conduct periodic training and monitoring of worker activities to reinforce safe work practices that have been taught and developed at the USPS.
2. Rotate workers frequently between the feeder and sweeping positions. Rotation should take place at least once per hour, but more frequent rotation such as every 30 or 45 minutes may be more beneficial to workers.
3. The feeder should occasionally stop loading new mail into the DBCS and help the sweeper to ensure that the amount of mail accumulated in the stackers does not exceed desired levels.

**Page 6 – David Smith**

4. Encourage workers to use sound work practices like the PowerLift while working on the DBCS machines, particularly at the feeder position where the wide stance and lift with the legs techniques are most applicable.
5. Determine and implement a mail processing rate of work which will prevent workers from sustaining injury. This can be established either through time and motion studies or by manipulating numbers of pieces of mail processed per hour or per day until injury rates are under control. As noted in the Discussion section above, reducing the rate of work is the most effective administrative means of injury control when engineering controls are not implemented, such as in the case of the DBCS.

This letter closes our file on these health hazard evaluation requests. NIOSH recommends that employers post a copy of this letter for 30 days at or near work areas of affected employees.

Thank you for your cooperation with this evaluation. If you have any questions, please do not hesitate to contact me at (513) 841-4438.

Sincerely yours,

Daniel J. Habes, MSE, CPE  
Industrial Engineer  
Hazard Evaluations and Technical  
Assistance Branch  
Division of Surveillance, Hazard  
Evaluations and Field Studies

enclosure

cc: R. Romero  
T. Valenzuela  
D. Enderson  
L. Reeder (requestor)



HETA 92-073-2337  
JULY 1993  
UNITED STATES POSTAL SERVICE  
DENVER GENERAL MAIL FACILITY  
DENVER, COLORADO

NIOSH INVESTIGATORS:  
Thomas R. Hales, M.D.  
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Katharyn A. Grant, Ph.D.

## I. SUMMARY

In December 1991 and June 1992 NIOSH received confidential employee health hazard evaluation (HHE) requests to evaluate the potential for ergonomic hazards associated with three types of automated mail processing machines [the Optical Character Reader (OCR), the Bar Code Sorter (BCS), and the Delivery Bar Code Sorter (DBCS)] and the stool or "rest bar" utilized at the manual letter casing area. In August 1992 and December 1992 NIOSH investigators videotaped employees using these machines, and two NIOSH ergonomists reviewed these videotapes to assess the potential for ergonomic hazards associated with the development of work-related musculoskeletal disorders.

Manual letter sorting is a mildly repetitive job, with the pace controlled by the worker. With the adjustable sit/stand stool provided at the workstation, this task probably poses little risk for musculoskeletal disorders.

The Pitney Bowes (P-B) OCR feeding table was lower (31 inches) than the recommended work surface height (36-42 inches), thereby placing "feeders" at potential risk for low back disorders. In addition, the P-B stackers were deeper (25.5 inches) than recommended for work between the waist and shoulders (20 inches), placing "sweepers" at potential risk for low back and shoulder disorders. Finally, the vertical reaches to place sorted mail from the stackers into trays were higher (between 47-64 inches) than the recommended heights (less than 50 inches), placing employees at potential risk for shoulder disorders. The Postal Service has made efforts to replace these machines with other brands at recommended work surface heights.

Other than the low P-B feeder table, the "feeder" positions were similar for the three types of automated equipment reviewed during this evaluation.

The principle activity which placed feeders at risk for low back injury was the stooping required to retrieve trays of mail from the lowest levels of the general purpose mail carriers. Mechanisms to reduce trunk flexion while retrieving trays of mail from the mail carriers are included in this report.

The sweeping positions varied between machines due to differing 1) number and configuration of stackers, 2) methods to transfer the sorted mail into trays, and 3) methods used to transport filled trays onto mail racks. The DBCS machine, with its three rows of stackers, was noteworthy for its bottom row of stackers being just 22 inches above the floor. This feature requires trunk flexion of 90° for most employees, putting DBCS sweepers at high risk for low back disorders. The arm reaches required by sweepers to access the top row of stackers

on the DBCS machines, and place filled trays onto racks on the P-B OCR and BCS machines, pose a potential risk for shoulder disorders.

Both the sweeper and feeder positions were potentially very repetitive due to the processing capabilities of the machines (up to 35,000 letters per hour). Frequent machine jams, however, reduced the "machine-paced" time pressures and provided short rest breaks reducing the job's repetitive nature. In summary,

employees operating the automated mail processing machines are exposed to moderately repetitive tasks with awkward postures, two factors associated with musculoskeletal disorders.

NIOSH investigators identified several ergonomic hazards associated with the Postal Service's Automated Mail Processing Machines. These hazards put employees at potential risk for low back and upper extremity musculoskeletal disorders. Of particular note were the design flaws at the DBCS sweeper position. Recommendations are provided in this report to reduce the ergonomic hazards associated with operating these machines.

KEYWORDS: SIC Code 4311 (United States Postal Service), ergonomics, biomechanical hazards, postal employees, musculoskeletal disorders, cumulative trauma disorders (CTDs), low back pain, tendinitis.

## **II. INTRODUCTION & BACKGROUND**

In December 1991, the National Institute for Occupational Safety and Health (NIOSH) received a confidential health hazard evaluation (HHE) request from employees working at the Denver General Mail Facility (GMF) located in Denver, Colorado. The requesters were concerned about potential ergonomic hazards associated with the use of two types of automated mail processing machines: the Bar Code Sorter (BCS) and the Optical Character Reader (OCR). In June of 1992, NIOSH received three separate HHE requests to expand the original Denver GMF evaluation to include the Delivery Bar Code Sorter (DBCS), the Pitney-Bowes (PB) OCR, and the stool or "rest bar" utilized at the manual letter casing area.

In August 1992 NIOSH investigators videotaped employees using the ElectroCom Automation, Inc. (ECA) BCS and OCR machines at the GMF located in Merrifield, Virginia. In December 1992, NIOSH investigators videotaped employees at the Denver GMF using the ECA BCS, PB OCR, ECA DBCS, and rest bar. These videotapes were reviewed by two NIOSH ergonomists to assess the potential for ergonomic hazards associated with the development of work-related musculoskeletal disorders.

## **III. JOB DESCRIPTIONS**

### **A. CASING MAIL** (taped at the Denver GMF)

Mail that cannot be processed by machine is sorted by hand in a process known as casing mail. The casing work stations provide employees with a padded sit/stand stool which has a mechanism for adjusting seat-pan height, seat-pan tilt, and footrest location. The footrest appears most useful to employees tilting the seat-pan towards the vertical while leaning on the stool. There is a ring on the shaft of the stool for the feet of employees who choose a more horizontal seat position and use the stool like a chair.

Employees retrieve trayed mail from a staging area. After sorting the mail, employees "pigeon hole" envelopes into slots located to their front and side. A tray of mail takes approximately one hour to empty, after which employees retrieve a new, full tray from the staging area.

### **B. PITNEY-BOWES (PB) OCR** (taped at the Denver GMF)

An Optical Character Reader (OCR) is a machine that scans the city, state, and/or zip code information on a piece of mail and places a bar code on the envelope. The bar code allows other machines to sort the mail. All OCR machines require someone to 1) feed mail into the machine (feeder), and 2) remove processed mail and place it into cardboard or plastic trays (sweeper).

1. FEEDER

The feeder on the PB OCR lifts trays of mail from a rolling cage called a "general purpose mail carrier," and places them on a tilted stand (feed table) located near the machine. The cage is a tall, thin carrier with trays as low as eight inches from the ground, or as high as five feet above the ground. Trays typically weigh 10-15 pounds, but, depending on the type of mail, can weigh up to 25-30 pounds. The feed table height is approximately 31 inches from the floor.

Two techniques are used to transfer mail from the tray onto the feed tables: grasping or flipping. Employees who use the grasping technique remove mail from the tray with their hands in three to four portions. Employees who use the flipping technique toss the entire tray contents onto the feed table in one, quick movement. Once loaded onto the feed table, the mail is pushed horizontally from right to left toward the OCR machine.

Rollers transfer individual pieces of mail to the optical eye which reads the city, state, and/or zip code information. The unit is designed to process up to 35,000 pieces of mail per hour, however irregular or damaged envelopes can jam the machine, thereby slowing the process. In addition, rubber bands binding bunches of mail must be removed by the feeder, also slowing the process. Rejected mail is manually placed in a tray located at the rear of the machine.

2. SWEEPER

The sweeper removes sorted mail from slots called "stackers" and places them into trays. The stackers are 31.5 inches above the floor height and 25.5 inches deep. The trays are arranged in a single row on racks located across the aisle from the OCR. The tray racks are slanted toward the worker, with the bottom and top edges of the tray located 47 inches and 64 inches above the floor height, respectively. One sweeper usually attends to the 60 stackers located on one side of the Pitney Bowes OCR machine. After a tray is filled with mail, the sweeper places it on a roll conveyor located below the rack and replaces it with one of the empty trays located in the work area.

**C. ECA OCR (taped at the Merrifield GMF)**

1. FEEDER



The feed table of the ECA OCR differs from the Pitney Bowes OCR in two respects. First, it is four inches higher (35"), and second, it has a vibrating jogger, as do all ECA machines (OCR, DBCS, BCS), located to the right of the optical scanner. The jogger

facilitates the feeding of loose mail into the processing machines by reducing the potential for single mail pieces to jam the machines.

2. SWEEPER

Like the PB OCR, the sweeper on the ECA OCR attends to 60 stackers, all located on one side of the machine. Each stacker is 34.5 inches high and 18.5 inches deep. The sweeper removes mail from each stacker and places it into a tray located directly below the stacker. The trays are accessed using a sliding motion. When the trays are filled, they are placed on a multi-tiered rack, located across the aisle from the machine.

**D. ECA BCS** (taped at the Merrifield and Denver GMF)

The Bar Code Sorter (BCS) processes mail in a manner similar to that of the OCR machines.

1. FEEDER

Retrieving trayed mail, loading the feed table, and pushing the unsorted mail into the machine is identical to that of the ECA OCR machine. The feed table height is 35 inches.

2. SWEEPER

The ECA BCS has 96 stackers arranged in a single tier on both sides of the machine. This stacker arrangement is the main difference between the BCS (96 stackers on two sides of the machine), and OCR machines (60 stackers on one side of the machine). Stackers are 34.5 inches high and 18.5 inches deep. The sweeper walks around the perimeter of the machine, stopping for brief moments to remove sorted mail from the stackers. After grasping the sorted mail, the sweeper places the mail into trays located across the aisle from the machine. This procedure is similar to those found in the Pitney Bowes OCR/CS area.

**E. ECA DBCS** (taped at the Denver GMF)

The Delivery Bar Code Sorter (DBCS) sorts bar-coded mail. Like the OCR and BCS, it requires mail to be fed into, and swept from, it.

1. FEEDER

Retrieving of trayed mail, loading the feed table, and pushing the unsorted mail into the machine is identical to

that of the ECA OCR and ECA BCS machines. The feed table height is 35 inches.

## 2. SWEEPER

The ECA DBCS sorts mail to any of three tiers of stackers located on both sides of the machine. These stackers are located 22, 36.5, and 50.25 inches above the floor (Table 1). Each is 15.5 inches deep. The main distinction between the DBCS machines and the BCS machines is the arrangement and number of stackers. The DBCS has 102 stackers located in three tiers (rows) on both sides of the machines. Due to its more "compact" shape, the DBCS requires less floor space than either the BCS, or the OCR.

The DBCS stackers are not equally distributed on both sides of the machine: the feeder side has fewer stackers. If the sweeper cannot keep pace with the machine, the feeder will occasionally assist the sweeper by clearing the stackers located on his side of the machine.

After mail is sorted and removed from the stackers, the sweeper places mail into trays located across an aisle from the machine. The trays are located on a four-tiered rack called a "pie cart." The bottom rack appeared to be a foot above the floor, and the top shelf was about the same height as the top stacker (approximately 50 inches). When a tray of mail is filled, the sweeper lifts the tray from the pie cart and carries it to a general mail carrier. Conveyors serve this function for the OCR and BCS machines.

## **IV. EVALUATION CRITERIA AND HEALTH EFFECTS**

Several case reports over the years have cited certain occupational and nonoccupational risk factors which give rise to musculoskeletal injuries.<sup>1,2,3,4</sup> However, only recently have epidemiologic studies attempted to examine the association between job risk factors (such as repetition, awkward postures, and force) with excess musculoskeletal morbidity. Several cross-sectional and case control retrospective studies of work-related musculoskeletal disorders (WRMDs) have been performed.<sup>5,6,7,8,9,10</sup> The conclusions from these studies have drawn us closer to identifying risk factors associated with disease outcome.

### **Work-Related Musculoskeletal Disorders**

Work-related musculoskeletal disorders of the upper limbs have been associated with job tasks that include: (1) repetitive movements of the upper limbs; (2) forceful grasping or pinching of tools or other objects with the hands; (3) awkward positions of the hand, wrist, forearm, elbow, upper arm, shoulder, neck and head; (4) direct pressure over the skin and muscle tissue; and

(5) use of vibrating hand-held tools. Because repetitive movements are required in many service and industrial occupations, new occupational groups at risk for developing WRMDs of the upper limb continue to be identified.

Evaluation of work-related risk factors which may cause upper limb WRMDs should be conducted to not only aid in their recognition, but to assist with the implementation of controls measures designed to eliminate or reduce such risk factors. Engineering controls are the preferred method; however, administrative controls such as work enlargement, rotation, etc., can be used as an interim measure. Surveillance of WRMDs (including the use of health-care-provider reports) can aid in identifying high-risk workplaces, occupations, and industries and in directing appropriate preventive measures.<sup>11</sup>

Occupational risk factors for low back injuries include manual handling tasks,<sup>12</sup> twisting,<sup>13</sup> bending,<sup>13</sup> falling,<sup>14</sup> reaching,<sup>15</sup> lifting excessive weights,<sup>13,16,17</sup> prolonged sitting,<sup>14</sup> and exposure to vibration.<sup>13,18</sup> Some nonoccupational risk factors for low back injury include obesity,<sup>19</sup> genetic factors,<sup>20</sup> and job dissatisfaction.<sup>21,22</sup> Multiple approaches such as job evaluation and redesign, worker placement, and training may be the best methods for controlling back injuries and pain.<sup>23</sup>

## **V. RESULTS**

### **A. CASING MAIL**

Mail sorting is a mildly repetitive job, with the pace controlled by the worker. Task factors which could result in discomfort or fatigue are

1) reaching to case the mail, and 2) prolonged periods of standing or leaning against the sit/stand stool. By tilting the seat-pan forward, however, the employee can reduce reach distances and maintain the trunk in a neutral position. Therefore, this task probably poses little risk for musculoskeletal disorders. In addition, the padded seat appears wide enough for the majority of employees.

### **B. PITNEY-BOWES (PB) OCR**

#### **1. FEEDER**

Tasks which impose biomechanical stress on the employees in this job category are (1) lifting trays from the cages to the feeder table, and (2) grasping and transferring the mail from a tray to the OCR machine. Lifting trays from the lowest levels of the mail carrier poses a risk of low back injury, while lifting trays from the highest levels poses a risk of shoulder injury. Reaching across the machine to the reject mail tray (located in back of the machine) can also place stress on the back and shoulder. The pace of work dictated by the feeder is a potential risk factor because of the processing capabilities of the machine (30,000 - 35,000 pieces of mail per hour). However, this pace was never achieved during the NIOSH site

visit due to frequent machine jams.

## 2. SWEEPER

Tasks which impose biomechanical stress on sweepers include (1) reaching horizontally to access mail in the back of the stackers, (2) grasping mail (using a pinch-grip) to remove mail from the stackers and place it in the trays, and (3) reaching up (vertically) to the trays. These tasks place the shoulders, lower forearms, and hands at risk for musculoskeletal disorders. The pace of work appeared moderate, but the potential for faster work speeds exists due to the processing capabilities of these machines and the large number of stackers attended by each sweeper.

An additional stressor common to all feeder and sweep positions on all machines is excessive bending and reaching while clearing machine jams. The frequency of machine jams cannot be estimated from our videotape, however some of the most extreme postures occurred while employees attended to jammed machines.

## C. ECA OCR

### 1. FEEDER

Because of the similarities between the two machines, feeders on the ECA OCR are generally exposed to the same risk factors as feeders on the PB OCR (described above). The higher feed table height of the ECA machine compared to the PB machine (35 verses 31 inches) reduces the stress on the low back.

### 2. SWEEPER

Tasks which impose biomechanical stress on ECA OCR sweepers are (1) grasping mail using a pinch-grip to remove mail from the stackers and place it in the trays, and (2) reaching up to place mail in the trays. These tasks place the shoulders, lower forearms, and hands at risk for musculoskeletal disorders. The ECA stackers are not as deep as the PB stackers (18.5 compared to 25.5 inches), thereby posing less risk of musculoskeletal disease to the shoulder area. As with the PB, the pace of work appeared moderate, but the potential for faster work speeds exists due to the machine's processing capabilities and the large number of stackers attended by each sweeper.

**D. ECA BCS**

1. FEEDER

Due to similar activities, the feeder on the BCS is exposed to the same potential ergonomic hazards as the feeders on the ECA OCR machines (see above).

2. SWEEPER

At the time the video tapes were taken, the operator on the ECA BCS was performing an activity known as "sleeving." This operation involves sliding a cardboard cover over a filled tray of mail that is to be sent out of the GMF, perhaps to another city or state. The sweeper observed on videotape sleeved five trays of mail from two stacker locations during a 14 minute period. Sleeving does not appear to be physically stressful, but appeared to be time consuming since the sweeper must remove existing tags, and attach new address labels and/or other instructional tags. As a result, sleeving reduces the time available for the sweeper to clear the stackers, which could impose increased time pressures during peak sorting periods.

Except for the potential risk factors associated with sleeving and attending to stackers on both sides of the machine, the sweeper on the ECA BCS is exposed to the same ergonomic risk factors as the sweepers on the ECA OCR.

**E. ECA DBCS**

1. FEEDER

The task of feeding the DBCS is similar to the task of feeding the ECA OCR and BCS machines. Therefore, all ECA feeders are exposed to the same ergonomic risk factors (see above for description). [Additional functions performed by the DBCS feeder [e.g. occasionally assisting the sweeper (see below)], could reduce the monotony and repetitiveness of the job], but also increases the work load.

2. SWEEPER

If the DBCS is used to process small lots of mail, or mail that has already been sorted at least once ("zone" mail), the stackers are often allowed to fill until the feeding process is complete. Then, both the feeder and sweeper remove the sorted mail. This procedure essentially changes the sweepers job from being "machine paced" to being "self paced." Unfortunately, this practice can only occur with small lots, or zoned mail. Another desirable



characteristic of zone mail lots is when the feeding is complete, the DBCS machine is shut down while the feeder and/or sweeper return the empty mail carrier to the incoming mail area and pick-up a full mail carrier to sort. This practice provides a break for the feeder and sweeper from their normal mail processing activities.

While processing large mail sorts, the sweeper frequently clears unfilled stackers to provide a buffer against the rapid accumulation of mail into a few stackers located on the opposite side of the machine. This "preventative" sweeping adds to the repetitiveness of the job, and is not unique to the DBCS machines.

Because there are fewer stackers on the feeder side of the machine, the bottom row on the tray rack is often unused. An unusual feature of the tray racks is that they are angled away from the sweeper. This orientation raises the height of the bottom tray, which is beneficial, but it also increases the reach to the top tray. Also, because the far end of the tray is lower than the leading edge, the sweeper must reach up, over and then down to place mail in the back of the tray. Finally, the rack arrangement often causes workers to bump their hands and arms while accessing the trays.

One of the specific concerns detailed in the HETA request was the manual force needed to push down each mail plate after mail is removed from an individual stacker. Mail plates are pivoting gates that provide a stop for the mail as the stackers fill. It has been suggested that heavier or counter-weighted mail plates would fall back into place after removing the sorted mail. Although returning the mail plates to the proper position is an additional work task, the forces required seemed minimal. Furthermore, if the mail plates were heavy enough to fall back into position themselves, they would be more difficult for the sweeper to lift when removing the mail. Therefore, weighting the mail plates is not recommended.

Sweepers on the ECA DBCS are not only exposed to the same ergonomic hazards as the sweeper on the ECA OCR, but they are also required to execute more trunk flexion (when sweeping the bottom tier of stackers) and long reaches (when reaching up to the top tier of stackers). A short worker would be best able to reach to the bottom tier, but would have difficulty reaching the top tier; conversely, a tall worker could more easily reach the top tier, but would have to bend excessively to sweep mail from the bottom tier. The 5'7" worker viewed on the video tape (approximately 25%ile male height)<sup>24</sup> appeared to have

difficulty placing mail in the top row of trays. This worker also had difficulty visualizing the mail in the bottom stacker causing more trunk flexion than required by mail removal alone.

## **VI. DISCUSSION**

The mail processing machines evaluated in this report are fast and efficient. If the jamming problems could be overcome, the machines would be even faster and more efficient. The technological breakthrough for this increased efficiency is the machine's optical scanner. In stark contrast to the high efficiency of the optical scanner is the primitive manner in which mail is loaded (feeders) and unloaded (sweepers) from these machines. Future machines should automate these tasks, particularly the sweeper position. The remainder of this report will primarily discuss the ergonomic hazards encountered by feeders and sweepers, and provide recommendations for their elimination or reduction.

### **A. MAIL CASING**

The sit/stand or rest bar stool used in the mail casing area was well suited to the task performed. Sit/stand work stations are recommended when repetitive operations are performed with frequent reaches more than 16 inches forward and/or more than 6 inches above the work surface.<sup>25</sup> Both of these situations are characteristics of the mail casing task.

As noted previously, the sit/stand stool is big enough and has enough adjustability to accommodate a wide range of workers. A traditional chair or stool with a seat back, but without a tilt feature, is not recommended for this task. Although a traditional chair would provide support for the back, it would also require the worker to lean forward while placing mail in the pigeon holes. Frequent forward bending could result in back fatigue. The sit/stand stool allows the trunk to be maintained in a neutral position during the casing task.

### **B. AUTOMATIC MAIL PROCESSING MACHINES**

#### **1. FEEDERS**

From a biomechanical and postural loading standpoint, the feeding tasks associated with the PB OCR, and the ECA OCR, BCS, and DBCS machines are similar. A problem common to all feeders working on these machines was the frequent stooping to retrieve trays of mail from the lowest levels of the general purpose mail carrier. This puts these employees at risk for low back injury. A minor difference among these machines is that the feeding table of the PB OCR is 31 inches high, 4 inches lower than that of any of

the ECA machines. The recommended work surface height for a light task that may require some sideward forces (e.g., loading a machine) is 36-42 inches.<sup>26</sup> Lower heights could result in unnecessary trunk flexion and low back disorders, particularly among tall employees.

## 2. SWEEPERS

Forward reaches more than 20 inches in front of the body should be avoided when standing.<sup>27</sup> The PB stacker depth was 25.5 inches, (4.5 inches more than recommended), and the stacker height was 31.5 inches (5.5 inches less than recommended). These dimensions could result in excessive shoulder flexion (reaching) in shorter workers and excessive trunk flexion (bending) in taller workers. With stacker depths of 18.5 inches, and heights of 34.5 inches, the ECA OCR and BCS machines appear to be of better ergonomic design.

The racks which held filled trays of mail were similar for the PB OCR and the ECA BCS machine. In general, reaches or lifts above 50 inches (shoulder height for the 25<sup>th</sup> percentile female) should be avoided.<sup>24,27</sup> Placing mail in the top tray requires a reach of 47-64 inches, therefore shorter workers may have difficulty reaching the top tier of trays. The trays used with the ECA OCR in Northern Virginia were superior to those used with the Pitney Bowes OCR and the ECA BCS in Denver because they were conveniently located below the stackers. Instead of reaching across the aisle with each handful of mail, the sweeper on the ECA OCR could fill the trays, then reach across the aisle (once) to put the tray onto the carts.

The tray racks used in Denver, however, were better than the multi-tiered tray carts used in Northern Virginia because the Denver racks were in a single tier, whereas those in Virginia varied in height from less than a foot to up to five feet above the floor. A better design would be to locate trays under the stackers, and provide a single-tiered row of tray racks across the aisle, with a roll conveyor located beneath the racks. The **best** design would be to provide trays under the stackers, and provide a roll conveyor located across the aisle (38-46 in. height) to carry filled trays away (no tray racks at all). This design would minimize reach distance and allow trays to be transferred laterally (without a vertical lift) to the conveyor.

The height of the top stacker of the ECA DBCS machine (50.25 inches) only slightly exceeds the maximum recommended reach height (50 inches), and the 15.5 inch depth is within that recommended for work between the waist and shoulder height (<24 inches).<sup>27</sup> However, the 22 inch height of the lower shelf exposes workers to excessive trunk flexion with the shortest workers bending nearly 90° to retrieve mail from

the lowest stacker. Bending more than 20°, especially if repetitive, is a risk factor for musculoskeletal injury.<sup>28</sup> Workers could avoid trunk flexion while sweeping the bottom stacker by flexing the knees instead of their backs. This, however, is not recommended

because of the asymmetric muscle and ligament forces imposed on the knee during knee flexion. Mechanical forces on the knee are almost 8 times body weight while in a deep knee bend posture.<sup>29</sup>

These employees were also required to reach above shoulder height, flexing their shoulders more than 90°, to sweep mail from the top stacker. Workers who are required to repetitively flex their shoulders more than 45° are considered to be at increased risk of injury.<sup>29</sup> The ECA DBCS machine does have a fold-down step at its base reducing the reach height to the top stacker by six inches. This step, however, was never used in the hours of videotape reviewed by NIOSH. If employees could sweep one row at a time the step would be useful. But stackers fill in no particular row sequence, therefore, raising and lowering the step was impractical. Leaving the step in the down position could pose a tripping hazard to sweepers, therefore, it is not surprising that the step was not utilized, and we do not recommended its use.

The Postal Service appears to be in the process of ordering and purchasing DBCS machines with four, rather than three, rows of stackers. This would result in greater bottom-to-top stacker height distances than observed in this evaluation, and would probably exacerbate the current problem of excessive back and shoulder flexion.

The pie carts in the DBCS area were similar to the tray carts used by the sweeper on the ECA OCR in Northern Virginia. Their poor design adds to the biomechanical hazard of the job by requiring workers to 1) bend over to reach the bottom levels, 2) reach above shoulder height with fully extended arms to place mail in the top tray, and 3) carry filled trays to a secondary mail carrier. Locating trays below the stackers (discussed above for the OCR and BCS machines) is not practical for the DBCS because of the number and the arrangement of the stackers. Furthermore, such an arrangement would require even greater trunk flexion to access the bottom row.

## **VII. CONCLUSIONS**

Manual letter sorting probably poses little risk for musculoskeletal disorders. Work on the automatic mail processing machines is potentially hazardous to employees due to design flaws and the high volume capacities of these machines. Under moderate mail volume conditions, the feeder positions on the OCR, BCS, and DBCS machines could be improved by providing a mechanism to reduce trunk flexion while retrieving trays of mail from the mail carriers. The sweep positions on the OCR and BCS machines could be made safer by

redesigning the work station to reduce the amount of trunk flexion and arm reaching. Recommended design changes to achieve these ends will be presented in the following section.

The stacker layout on the DBCS machine is a significant departure from good ergonomic design. The current design, 102 stackers arranged in three rows with no adjustable features, results in excessive flexion of the trunk and shoulders for **all employees**. These extreme postures can lead to low back and upper extremity musculoskeletal disorders.

The pie carts used by sweepers in the Denver DBCS and the Merrifield ECA OCR were not designed to accommodate the various sizes of employees and add to the biomechanical hazards of their job.

### **VIII. RECOMMENDATIONS**

As mentioned previously, the manual operations associated with the mail processing machines should be automated, particularly the sweeping positions. One possible design to accomplish this goal would include a "weight sensitive" stacker bin. Once full, the bin could eject its contents into a container located either below or adjacent to the bin where a moving conveyor could carry the mail away. Workers would still be needed to monitor the machines, attending to malfunctions and jam-ups. Given that such automation may be infeasible or in the distant future, the following recommendations, specific to operations at the Denver GMF, are offered to prevent and/or control trunk and upper extremity cumulative trauma disorders among employees.

#### **A. FEEDER POSITIONS ON ALL AUTOMATED MACHINES (ECA OCR, BCS, DBCS, PITNEY BOWES OCR)**

To eliminate extreme trunk flexion while retrieving trays of mail, an alternative method of delivering mail to the feeders could be devised, or the mail carriers could be redesigned. Redesign options include

1) raising the bottom of the mail carrier, 2) using smaller carriers, or 3) using carriers with spring-controlled leveling systems that raise the load as trays are removed. The lowest load height should be in the range of 26-32 inches, and total stack heights should not exceed 60 inches.

#### **B. SWEEPER POSITIONS ON ALL AUTOMATED MACHINES (ECA OCR, BCS, DBCS, PITNEY BOWES OCR)**

Locate empty trays under the stackers (except DBCS) to minimize the number of reaches to the tray racks while sweeping. Also, provide an expedient means of dispensing filled trays. Possible options include providing general mail carriers (modified as recommended in "A" above), or a roll conveyor that leads to a central location (38-46 in. height).



C. **OCR MACHINES**

Continue to replace the older PB OCR with the ECA OCR. The ECA OCR reduces worker exposure to ergonomic stressors in three ways: 1) the feed table is higher, 2) the stackers are higher and more shallow, and 3) the tray racks are located below the stackers. These design features decrease reaching, bending, and lifting during mail processing tasks.

D. **ALL AUTOMATED MAIL PROCESSING MACHINES**

Recognize that handling bulk mail is a moderately repetitive task which poses a risk of injury to the back and upper extremity. Administrative controls to reduce hazards and minimize injuries need to be implemented. Some measures to be considered are:

1. Assign additional sweepers to the machines (particularly the DBCS).
2. Limit the time spent working on machines (particularly DBCS). This control measure could require identification of lighter duty work activities for workers rotating out of the feeder and sweeper positions.
3. Provide additional rest breaks for employees working on machines (particularly DBCS). One way to increase rest time is to process more mail in the way that zones are run: sort mail in smaller lots so that the machines are periodically shut down, with both the feeder and sweeper clearing out the stackers, and then allow one or both to leave the work area to return empty mail carriers in exchange for filled ones.
4. Eliminate job tasks performed by the machine operators that could be completed in other areas of the mail facility. An example activity is mail sleeving, which could be performed in the tray binding area.

**IX. AUTHORSHIP AND ACKNOWLEDGEMENTS**

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**TABLE 1**

**STACKER CHARACTERISTICS BY TYPE OF MACHINE**  
**Denver General Mail Facility**  
HETA 92-073

	P-B <sup>1</sup> OCR <sup>2</sup>	ECA <sup>3</sup> OCR	ECA BCS <sup>4</sup>	ECA DBCS <sup>5</sup>
# of Stacker Rows	1	1	1	3
Total # of Stackers	60	60	96	102
Stacker Row Height	31.5"	34.5"	34.5"	22.0" 36.5" 50.25"
Stacker Depth	25.5"	18.5"	18.5"	15.5"
Tray Racks: Bottom Top	47" 64"	Below Stacker	47" 64"	≈12" ≈50"

- 1 Pitney Bowes
- 2 Optical Character Reader
- 3 ElectroCom Automation
- 4 Bar Code Sorter
- 5 Delivery Bar Code Sorter

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