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DENVER GENERAL MAIL FACILITY  
DENVER, COLORADO

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## I. SUMMARY

On October 15, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from employees of the Denver General Mail Facility (DGMF) to conduct a health hazard evaluation. The request concerned lower extremity musculoskeletal problems potentially related to poor ergonomic working conditions around the optical character reader (OCR) and bar code sorter (BCS) machines.

A walk-through inspection of the facility was conducted on December 16, 1991. During this time, informal employee interviews were conducted while employees were working on the OCR and BCS machines. Employees alternate between loading and sweeping the machines every 30 to 120 minutes at the discretion of the individual employees. During the loading task, employees stood on a hard floor or a small mat. During the sweeping task, employees walked on a hard floor surface transferring the mail collecting in the bins.

On the basis of the walk-through survey of the Denver General Mail Facility, a potential ergonomic hazard exists among OCR and BCS employees due to prolonged standing postures on a hard floor surface. These postures could result in potential lower extremity discomfort. Recommendations to eliminate or reduce exposure to this potential hazard are included in this report.

**KEYWORDS:** SIC code 4311 (US Postal Service), ergonomics, lower extremity discomfort, static lower extremity posture, standing postures, Postal employees.

## II. INTRODUCTION

On October 15, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from employees of the Denver General Mail Facility (DGMF) to conduct a health hazard evaluation at their workplace. The request concerned lower extremity musculoskeletal problems potentially related to the hard surface upon which optical character reader (OCR) and bar code sorter (BCS) employees are required to work. The request specifically mentioned the lack of cushioned matting to prevent lower extremity discomfort. On December 16, 1991, NIOSH conducted a site-visit consisting of an opening conference and a walk-through survey of the facility which focused on the OCR and BCS machines.

## III. BACKGROUND and JOB DESCRIPTION

The DGMF became operational in September, 1990 and employs approximately 2500 workers on three shifts: day, evening and night. The DGMF processes approximately two million pieces of mail per day. The bulk of the mail is sorted during the evening shift and transported during the night. Currently, standard letter sized mail is processed by one of five methods:

- Manually
- Multi-Position Letter Sorting Machines (MPLSM)
- Multi-line Optical Character Reader (OCR)
- Bar Code Reader/Sorter (BCS)

The manual method involved one person sorting approximately 1000 pieces per hour. There are approximately 100 employees at the DGMF currently working in this area.

The MPLSM utilizes a small mechanical arm to place letters in the front of a keying operator who enters a code to sort the mail to one of 277 bins. Operators memorize hundreds of routing codes for incoming mail (specific letter carrier routes), or outgoing mail (destinations anywhere in the world). Crews of 17 employees operate the MPLSM, which process approximately 18,000 pieces of mail per hour. The crew is composed of 12 key operators, two loaders, and three sweepers. They are maintained on a job rotation schedule of approximately 30-45 minutes of keying followed by 15 minutes of sweeping or loading. At the DGMF there are 8 MPLSM machines employing approximately 250 workers.

The OCR is an automated mail sorting system that reads the city, state, and zip code written on the face of the envelope, sprays a visible corresponding bar code onto the envelop, and proceeds to sort the mail to one of 60 bins. All 60 bins are located on one side of the machines. Crews of two employees operate the OCR

machines, which process approximately 30,000 pieces of mail per hour. The crew is composed of one loader and one sweeper. Employees rotate between loading and sweeping every 30 to 120 minutes, at the discretion of the individual employees. At the DGMF there are 11 OCR machines (seven Electro-Com Automation L.C. machines and four Pitney-Bowe machines).

Bar codes applied on the envelope by the sender are processed by the BCS. After reading the bar code, the machine sorts the letters to one of 98 bins destined for a specific post office (outgoing mail), or a carrier route (incoming mail). The bins are located on both sides of the machine, 49 on each side. Crews of two to three employees operate the BCS machines which process approximately 35,000 pieces of mail per hour. Like the OCR crews, there is one loader and one sweeper, although occasionally a second sweeper is available. Employees rotate between loading and sweeping every 30-60 minutes. At the DGMF there are 10 BCS machines employing approximately 180 workers between the OCR and BCS machines.

The OCR and BCS machines are approximately sixty feet long and 10 feet wide at the loader, narrowing to 5 feet at the sweep area. The floor surface is an industrial floor covering called DURA-TRED made by the Manville Roofing Systems Division.

#### IV. EVALUATION CRITERIA

Lower extremity musculoskeletal disorders from long-term standing and walking has not been well researched. In 1983 the American Podiatric Association reported that 83 percent of industrial workers had foot or lower leg problems such as discomfort, pain, or orthopedic deformities.<sup>1</sup> Cardiovascular and muscular demands are increased during standing tasks: increased heart rate and diastolic blood pressure, and static contraction of the lower extremity and back muscles to maintain an erect position.<sup>2</sup> In the absence of leg movement, blood and other tissue fluids can accumulate in the legs, causing increased venous pressure and possibly varicose veins.<sup>2</sup> Fatigue and discomfort associated with prolonged standing tasks could be attributable to insufficient venous blood return and static muscular effort.<sup>3</sup>

A few studies have examined the relationship between lower extremity musculoskeletal problems and prolonged standing postures.<sup>4,5</sup> Swiss and British studies found the prevalence of painful feet among saleswomen, department store clerks, and supermarket staff to be approximately 48-50%. The prevalence increased as these women maintained a standing rather than walking position, and as the "time on their feet" increased.

Two studies have evaluated the effects of floor surfaces on lower extremity discomfort.<sup>1,6</sup> Redfern and Chaffin found that a concrete floors and hard mats had the highest discomfort ratings, while 3/8-inch rubber mats, trilaminate mats, and shoe inserts had the lowest discomfort ratings.<sup>1</sup> In contrast, Zhang found mat thickness had little effect on lower extremity discomfort, and employees wearing hard-soled shoes had slightly more foot discomfort.<sup>6</sup> However, like the studies cited in the previous paragraph, Zhang did find a strong association between "amount of time on their feet" and lower extremity discomfort, which his group called the "Period Effect."

## V. CONCLUSIONS

Prolonged standing and walking on hard floor surfaces at the DGMF represents a potential ergonomic hazard to the lower extremities. Recommendations to eliminate or reduce exposure to this potential hazard are included in the following section.

## VI. RECOMMENDATIONS

Prevention of the lower extremity discomfort associated with prolonged standing at the OCR and BCS machines can be grouped into engineering and administrative controls.

### A. Engineering

1. Redesign the OCR and BCS machines to provide a sit/stand option for the employees operating the loader. Alternating between sitting and standing can minimize lower extremity fatigue.
2. Pad or redesign the front edge of the loader with a rounded edge. Padded or rounded edges can eliminate the potential contact hazard associated with leaning on a small surface area.
3. Provide foot rests 4-6 inches above the floor allowing employees loading the mail to rest one leg while standing. Foot rests are believed to alleviate back stress as well as minimize foot fatigue.
4. Install cushioned mats. The mats should be approximately 3/8 of an inch in height and run the length and width of both the loading and sweeping areas. To reduce the potential trip hazard, the mat should have a bevelled edge, and extend from bin to tray supports in the sweeping area. Mats should be re-positioned prior to each workshift, or some other method (e.g, velcro) could be used to keep the mats in place.

### B. Administrative

1. Provide shoes with well-cushioned insteps and insoles.
2. During down time, stools should be provided to allow employees to sit.

## VII. REFERENCES

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