HHE Health Hazard® Evaluation Program

Ergonomic and Musculoskeletal Evaluation of an Aircraft Distribution Center

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Introduction

Request

Management and union representatives at an aircraft distribution center requested a health hazard evaluation. They were concerned about ergonomic risk factors and potential musculoskeletal injuries among employees who performed material handling duties.

Workplace

The aircraft distribution center received and delivered aircraft engine parts from other regional and international facilities. The 400,000 square foot distribution center has been at its current location since 1985 and employed 116 workers at the time of our evaluation. The distribution center consisted of a receiving area, warehouse, assembly areas, shipping dock, and an office area.

To learn more about the workplace, go to Section A in the Supporting Technical Information

Our Approach

We visited the facility in April 2021 to evaluate ergonomic hazards and musculoskeletal health symptoms of employees. During this site visit, we completed the following activities:

- Observed work processes, practices, and workplace conditions.
- Measured workstation heights and reach distances.
- Reviewed injury and illness records.

To learn more about our methods, go to Section B in the Supporting Technical Information

Our Key Findings

Most workstations and areas were not ergonomically designed to prevent work-related musculoskeletal disorders

- Most workstations were static and did not adjust.
- Most workstations lacked antifatigue mats and adjustable chairs or stools.
- Tools were not ergonomically designed.

The most common injuries and illnesses reported involved sprains, strains, and tears

- The upper extremities, trunk, and lower extremities were equally affected.

To learn more about our results, go to Section B in the Supporting Technical Information

Our Recommendations

The Occupational Safety and Health Act requires employers to provide a safe workplace.

Potential Benefits of Improving Workplace Health and Safety:	
↑ Improved worker health and well-being	↑ Enhanced image and reputation
↑ Better workplace morale	↑ Superior products, processes, and services
↑ Easier employee recruiting and retention	↑ Increased overall cost savings

The recommendations below are based on the findings of our evaluation. For each recommendation, we list a series of actions you can take to address the issue at your workplace. The actions at the beginning of each list are preferable to the ones listed later. The list order is based on a well-accepted approach called the "hierarchy of controls." The hierarchy of controls is a way of determining which actions will best control exposures. In most cases, the preferred approach is to eliminate hazards or to replace the hazard with something less hazardous (i.e., substitution). Installing engineering controls to isolate people from the hazard is the next step in the hierarchy. Until such controls are in place, or if they are not effective or practical, administrative controls and personal protective equipment might be needed. Read more about the hierarchy of controls at https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html. Most of the recommendations provided in this report were adapted from principles outlined in *The Handbook of Ergonomic Design Guidelines* [Humantech 2009].

We encourage the company to use a health and safety committee to discuss our recommendations and develop an action plan. Both employee representatives and management representatives should be included on the committee. Helpful guidance can be found in *Recommended Practices for Safety and Health Programs* at https://www.osha.gov/safety-management.

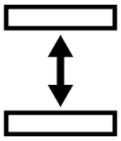
Recommendation 1: Reduce risks for musculoskeletal disorders

Why? Evidence associates low-back and shoulder disorders with work-related lifting, forceful movements, and awkward postures such as bending, reaching, and twisting. The best way to prevent and control work-related musculoskeletal disorders is through design. Job tasks, workstations, tools and other equipment should be designed to match the physical capabilities of the employee.

How? At your workplace, we recommend these specific actions:

Make sure reach distances range from 11 inches (") to 22".

- Provide tools, such as grabbers, for employees to bring items closer without reaching.
    - The grip span for the grabber handle should be less than or equal to 3.5".



Provide workstations that adjust for sitting and standing based on employees' job demands.

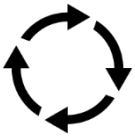
- Standing workstations are recommended if the job includes heavy lifting, long reaches, or frequent walking. Adjust these as follows:
    - Standing hand working heights should have an adjustability range between 38"–47" or fixed at 42". The display viewing height (top of screen) should have an adjustability range between 58"–71" or fixed at 66". Viewing distance should have an adjustability range between 18"–30" or fixed at 23".
    - Parts bins used during standing work should be placed in front of the employee. The reaching distance to the bins should be less than 16". The bins' vertical height should be 24"–70".
- Seated workstations are recommended if the job is visually demanding. Adjust these as follows:
    - Seated hand working heights should have an adjustability range between 27"–36" or fixed at 36". The display viewing height (top of screen) should have an adjustability range between 35"–46" or fixed at 46".
    - Seated workstation clearance should be greater than 18" for knee depth and greater than 30" for knee width.
    - Parts bins used during work should be placed in front of the employee. Reaching distance to the bins should be less than 16". The bins' vertical height should be less than 46".
    - A height adjustable chair with footrest can be provided, if needed.

Reorganize flow racks.

- Retrieval heights should be between 38"–49".
- Replenish heights should be between 38"–62".
- Rack angles should be between 0°–30°.
- Minimum clearance between levels is 5" (from top of the bin to the bottom of the next shelf height).

Provide antifatigue mats for employees who usually stand as a part of their job.

- Mats should be at least 0.5" thick, have an optimal compressibility (firmness) of 3%–4%, and have beveled edges so they are not tripping hazards.
- Place mats at least 8" under a workstation to keep standing surfaces even.
- Mats should cover the entire area that employees move while performing their job tasks.
- Replace mats when they appear worn out or are damaged.



Rotate job tasks and provide breaks for employees performing repetitive work.

- Develop a job rotation plan to move employees between tasks that use different muscle-tendon groups.
- Provide frequent breaks for employees.

Recommendation 2: Get regular input from employees about workplace safety and health issues and use this input to improve work conditions

Why? Monitoring employee concerns, satisfaction, and well-being is useful for finding areas of focus for intervention and improvement. Engaging employees and asking for their input about work builds trust and morale. Employees will feel their input is valued and useful for improving working conditions.

How? At your workplace, we recommend these specific actions:

Use employee input to guide efforts in improving worker safety, health, and well-being.

- Implement an active ergonomics committee that includes management, employee, and union representatives. Effective committees use employee input and experience to help determine work practice and engineering controls.

- Provide a chance for ergonomics committee members to receive ergonomics training. Training could include instructor-led or online classes, as well as training offered at national ergonomics conferences. The purpose of training is to learn about practical, cost-effective workplace solutions.

Recommendation 3: Encourage employees to report health concerns they think are work-related to their supervisors

Why? Recognizing symptoms early can reduce severity. Management can regularly review this information to look for common processes that might be related to reported musculoskeletal health symptoms and safety concerns. Management can use this information to identify opportunities for improvement.

How? At your workplace, we recommend these specific actions:

If needed, employees should seek care for work-related medical concerns from a healthcare provider knowledgeable in occupational medicine.

- The American College of Occupational and Environmental Medicine (https://acoem.org/Find-a-Provider) and the Association of Occupational and Environmental Clinics (http://www.aoec.org/index/htm) maintain databases of providers to help locate someone in your geographic area.

Supporting Technical Information

Ergonomic and Musculoskeletal Evaluation of an Aircraft Distribution Center

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Section A: Workplace Information

Employee Information

- At the time of the evaluation, the facility employed about 116 people.
- Employees were members of the United Auto and Aerospace Workers (UAW) union.

History of Issue at Workplace

- Management and Union submitted the health hazard evaluation (HHE) request after a noticed increase of sprains and strains at the facility.
- Management also noted concern for musculoskeletal injuries among their aging workforce.

Process Description

Some material handlers pick and deliver parts to workers in assembly areas where they are repackaged for distribution. Other material handlers pick parts and take them to their own work areas where they pack the parts for subsequent distribution from the center. Other tasks include assembling pre-cut boxes, sealing boxes with tape, and sealing large boxes with a banding machine. At the time of our evaluation, this facility shipped approximately $32 million of inventory per day and had $650 million in total inventory. The company maintained Occupational Safety and Health Administration (OSHA) Injury and Illness 300 Logs and tracked near misses.

Employees were trained annually regarding ergonomic awareness, back safety, fall protection, bloodborne pathogens, and workplace violence. The company also compiled Job Safety Analyses (JSAs) for each job. The JSAs were reviewed once per year or whenever an injury occurred at the job. The company had created a policy that anything weighing over 40 pounds required a 2-person lift. Items that weighed 50 pounds or more were strapped to a pallet and required a fork truck to move. In 2018, the company started providing a massage therapist onsite. Visits were limited to 15 minutes or less, by appointment only and the therapist typically worked with employees 40 years of age or older and those requiring occupational therapy. The company provided shoe inserts to help with fatigue from standing and walking. They also provided a voucher to each employee for new shoes every 18 months. Employees with plantar fasciitis were offered a more supportive insert and those requiring orthotics could get them provided by the company with a doctor's order.

Section B: Methods, Results, and Discussion

Our objectives were:

- Observe work practices and procedures that may cause musculoskeletal disorders (MSDs) among employees.
- Provide recommendations to reduce work-related ergonomic risk factors and MSDs.

Methods: Ergonomics Evaluation

We observed workplace conditions and work practices to identify ergonomic risk factors. We measured workstation heights and reach and viewing distances. We also noted the availability of antifatigue mats and other personal protective equipment. A description of risk factors for work-related MSDs is provided in Section D.

Results: Ergonomics Evaluation

Small Pack Area

We noted flow racks in this area with loading heights at 17 inches, 36 inches, 54 inches, and 72 inches; recommended heights are 38–62 inches. Retrieval heights were 6 inches, 36 inches, 42 inches, and 60 inches; recommended heights are 38–49 inches. Heights were both above and below recommended levels. We observed a stationary desk for packing materials set at 36 inches and height to the middle of boxes was 68 inches. We also noted the facility had stacked pallets to bring items to approximately knee height but that were not adjustable for larger or smaller items. We noted a gripper that was 36 inches long and had a 5-inch grip, this grip was above the recommended 3.5 inches.

Impact Area

This was the most active area at the facility. Employees brought items from shipping to place in kits. Some workers raised skids to knee height using a fork truck to assemble items. Items were bagged or bubble wrapped and then assembled in a kit. There were long tables that were not height adjustable but fixed at 36 inches high. Some stations had antifatigue mats and others did not. However, the mats did not cover the full length where the employee walked around their area. Management held weekly safety audits checking that items over 40 pounds were labelled properly.

Methods: Records Review

We reviewed Occupational Safety and Health Administration (OSHA) Form 300 Logs of Work-Related Injuries and Illnesses for years 2016 through 2020.

Results: Records Review

Between 2016 and 2020, a total of 25 OSHA Log entries were recorded for this facility (Table C1). The highest number of entries was reported in 2019. Sprains, strains, and tears were the highest injury and illness from all recorded. Some of the back strains were noted from lifting boxes and some of the shoulder strains were noted from pushing and pulling items.

Discussion

Work activities such as pushing, pulling, bending at the back, and lifting items from various levels, could explain the musculoskeletal symptoms, injuries, and disorders that affected employees throughout the facility. Redesigning job tasks and workstations, as well as decreasing the duration of continuous repetitive movements, such as rotation to jobs that use different muscle groups, are well-accepted measures that should reduce employees' risk for MSDs. Additionally, some studies have shown that small increases in break times have decreased symptoms with no significant effect on productivity [Dababneh et al. 2001; Faucett et al. 2007; Galinsky et al. 2007].

A review of participatory ergonomic processes found that training can be tailored to specific workplace risks and hazards or targeted solutions [van Eerd et al. 2010]. However, reaching goals depends on multiple considerations, such as creating teams with appropriate members (employees, union, and employers); defining team members' responsibilities; making decisions using group consultations; providing ergonomic training; and addressing key factors that could help or hinder the process [van Eerd et al. 2010]. During our site visit, management brought up the topic of an aging workforce. Aging affects a variety of health conditions and outcomes, including chronic conditions and the likelihood of workplace injury. Overall, older workers tend to experience fewer workplace injuries than their younger colleagues. However, older workers often require more time to heal from workplace injuries. Therefore, it is important for employers to have a well-planned return to work program. Additional information on creating an age-friendly workplace can be found at: About Productive Aging and Work | Aging | CDC.

Limitations

This evaluation was subject to limitations. The observations of job tasks were limited to the days when the evaluation occurred. The review of the OSHA Form 300 Logs of Work-Related Injuries and Illnesses was only for years 2016 through 2020.

Section C: Tables

Table C1. Nonfatal occupational injuries and illnesses occurring by nature of injury or illness and body part affected as reported on OSHA logs, 2016–2020

	2016	2017	2018	2019	2020	Total	
Cases	n=5	n=4	n=4	n=8	n=4	n=25	%
Nature							
Bruises, contusions	0	0	0	1	0	1	4
Cuts, lacerations	0	0	1	0	0	1	4
Sprains, strains, tears	4	2	2	5	4	17	68
Tendonitis	0	1	0	0	0	1	4
All other natures	1	1	1	2	0	5	20
Body part affected							
Upper extremity	1	2	2	3	1	9	36
Trunk	2	1	0	2	2	7	28
Lower extremity	2	1	2	3	1	9	36

Section D: Occupational Exposure Criteria

Risk Factors for Work-related Musculoskeletal Disorders

MSDs are conditions that involve the nerves, tendons, muscles, and supporting structures of the body. They can be characterized by chronic pain and limited mobility. Work-related musculoskeletal disorder refers to (1) MSDs to which the work environment and the performance of work contribute significantly, or (2) MSDs that are made worse or longer lasting by work conditions. A substantial body of data provides strong evidence of an association between MSDs and certain work-related factors (physical, work organizational, psychosocial, individual, and sociocultural). The multifactorial nature of MSDs requires a discussion of individual factors and how they are associated with work-related MSDs.

Strong evidence shows that employees whose job tasks involve high levels of static contraction, prolonged static loads, or extreme working postures involving the neck/shoulder muscles are at increased risk for neck/shoulder MSDs [NIOSH 1997]. Further strong evidence shows job tasks that require a combination of risk factors (highly repetitious, forceful hand/wrist exertions) increased risk for hand/wrist tendonitis [NIOSH 1997]. Finally, evidence shows that low-back disorders are associated with work-related lifting and forceful movements, awkward postures such as bending and twisting, and whole-body vibration [NIOSH 1997].

A number of personal factors can also influence the response to risk factors for MSDs: age, sex, smoking, physical activity, strength, and body measurements. Although personal factors may affect an individual's susceptibility to overexertion injuries/disorders, studies conducted in high-risk industries show that the risk associated with personal factors is small compared to that associated with occupational exposures [NIOSH 1997].

In all cases, the preferred method for preventing and controlling work-related MSDs is to design jobs, workstations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the employee. Most of the recommendations provided in this report were adapted from principles outlined in *The Handbook of Ergonomic Design Guidelines* [Humantech 2009]. Under these conditions, exposures to risk factors considered potentially hazardous are reduced or eliminated.

Section E: References

Discussion

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Occupational Exposure Criteria

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