*Ergonomics*

*In Action*

**Booklet I**

**General Program Management**

**Contents**



***NOTE:***
***The appendices listed above will be updated as booklets V and VI are completed.***

*Booklet I introduces you to the subject of ergonomics; discusses issues relevant to management of the ergonomics program; addresses managing organizational change; and outlines roles of the key players.*



## PART I: AN OVERVIEW OF ERGONOMICS

### What is "Ergonomics"?

Ergonomics is essentially fitting the workplace to the worker. It involves the application of knowledge about human capacities and limitations to the design of workplaces, jobs, tasks, tools, equipment, and the environment. The goal of ergonomics in the workplace is to—

- Prevent injuries and illnesses by reducing or eliminating worker exposure to occupational hazards. These hazards include: awkward postures, repetition, force, mechanical compression, duration, vibration, temperature extremes, excessive noise levels, inadequate lighting, and improper ventilation.
- Reduce the potential for fatigue, error, or unsafe acts.
- Increase effective, efficient work.

### A Brief History of Ergonomics: From Natural Selection to Ergonomic Intervention

Figure 1 is a fictional account of very real ergonomics issues affecting the work force today.

The story presented in Figure 1 is fictional, but the situation is very real and common in U.S. industry today. The story depicts the plight of a worker whose health is adversely affected by a number of ergonomic issues impacting the work force today, including: a worker working beyond his or her capacity, poor job design, poor workstation design, and poor tool design. In addition, the modern workplace has become more specialized, automated, and production-oriented. Many employees work in companies that have been "downsized" or "rightsized," with little change in output demands. Time issues (such as flextime, shift work, and the compressed workweek) can further the psychological pressures and physiological demands on an aging American work force. Older workers have decreased muscle performance,

***In the glossary:***
✓ occupational illness
✓ ergonomics
✓ downsized
✓ rightsized

**Figure 1. The Tragic Impact of Poor Design: One Worker's Story**

Bill Jackson flinched as a sharp pain shot down his lower back. He managed to stifle a groan then quickly looked to see if anyone had noticed. At 53, he no longer had the strength or lean figure of his high school football days, but he was still in pretty good shape for his age, thanks to the physical nature of his job. Tonight, however, Bill was having difficulty keeping up with his much younger co-workers at Custom Metals, and it was starting to take its toll.

"What's the matter old man, can't ya take it?" teased 19-year old Larry Farkis.

"I can take you," answered Bill, fighting to hide the pain as he picked up the next box.

The shipment of machine parts was a lot larger than expected. Bill and the rest of the shipping crew, which had recently been downsized from six to four, had been working at a steady pace for over 3 hours, but were progressing slowly because of problems with the equipment. The fork-lift blades were too short for the oversized pallets and the sleeve extensions were missing, which meant that both trailers had to be unloaded by hand. The conveyer belt motor burned out one hour into the job, and the roller conveyors, used as back-up, were locked away in a trailer by a worker from the day shift who took home the keys. Topping off the troubles, one of the trailers was a two-decker whose main floor fell below the level of the dock, making it necessary to carry the boxes up hill on a ramp. After unloading, the parts had to be inventoried, processed, and placed in special storage containers so the day shift could meet the company's high production quotas.

By break time, Bill was in agony and went to his locker to take a couple aspirins, which helped dull the pain for the remainder of the shift. At home, a second dose of aspirin failed to calm the nagging ache in his back, and he tossed and turned all night. His wife, Kelly, who worked part-time as a dental assistant, needed to get to sleep and finally moved to the couch. By morning, Bill could hardly get out of bed, and his left leg started feeling numb. Kelly brought her husband some more aspirins and insisted he stay home from work and see the doctor.

The company doctor examined Bill and then referred him to a back specialist, Dr. Polaski, who ordered x-rays and an MRI. The test results revealed a herniated disk.

"You'll need to stay off your feet for a couple weeks, and take your medications regularly," instructed the doctor.

"How soon will I. . . be well enough to go back to work?" asked Bill hesitantly.

"Well, we can't say just yet," replied Dr. Polaski, hedging the question, "we'll need to reevaluate your condition in 2 weeks."

Bill's left leg continued to feel strange, and by the time of his next appointment, he couldn't even sit in a chair without excruciating pain. Dr. Polaski recommended surgery. That meant taking more time off work, but Bill was hopeful, because at least there was a chance he could eventually return to his job and be free of pain. Unfortunately, the surgery failed to restore his back completely. Physical therapy helped increase his range of motion and medication lessened the pain, but Bill's days at Custom Metals were over, and he knew it -- there was no such thing as "light duty" at a machine shop, even the foreman had to do some heavy lifting.

Dr. Polaski finally declared Bill permanently disabled. Kelly was able to increase her hours to full-time and disability provided supplemental income, but Bill wondered how they would manage to pay the mortgage *and* put their daughter Vanessa through college. As senior man at Custom Metals, Bill depended on the seasonal overtime to provide his family with the comforts they had come to expect. The company offered to help out by paying Bill part of his pension early. But to Bill, being permanently disabled meant more than just adjusting to a lower income, it meant losing his purpose in life; and worst of all, he felt he let his family down, and nothing would ever change that.

flexibility, endurance, and joint mobility. All of the above factors have contributed directly or indirectly to the increasing number of job-related disabilities being seen today. Most of these disabilities can be traced to many years of work and workstation design deficiencies.

In the past, many employers were not concerned about the ergonomic design of the workplace. Instead they relied on a process of "natural selection" similar to that outlined in Darwin's Theory of Evolution, where survival depends on the fitness of the individual and his/her capacity to adapt to changing conditions. Workers who had lower capacity (whether strength, endurance, or visual abilities) would move out of the more demanding jobs because they could not sustain the effort required for the job. In short, they would be out-competed by their better fit co-workers. Consequently, the difficulty of the job determined what percentage of people starting the job would be able to complete the tasks on a full-time basis.

As a work philosophy, natural selection has not only become outmoded but is an expensive and legally questionable alternative to ergonomic job design. The 1973 Rehabilitation Act prohibits discrimination based on physical abilities as well as pre-employment physical capabilities screening. In addition, the Occupational Safety and Health Administration (OSHA) has issued numerous citations against government and private agencies for ergonomic deficiencies under the General Duty Clause.

The demographics of the workplace are also changing. Today, there are more women, minorities, immigrants, and older workers in the work force. Meanwhile, the physical capacity of the work force is declining, due to the "couch potato" syndrome, the deconditioning caused by automation, and the physical limitations related to gender and age. In the Armed Forces, there is an increase in outpatient visits, physical limitation profiles, hospitalizations, and medical retirements, all of which ultimately result in decreased unit readiness, deployability, and the ability of the unit to complete its mission.

All these factors have contributed to a dramatic increase in upper extremity work-related musculoskeletal disorders (WMSDs). In fact, WMSDs account for nearly half of the occupational illnesses reported in the annual Bureau of Labor Statistics (BLS) survey, and an increasingly large percentage of annual workers' compensation claims. According to the BLS, sprains and strains accounted for nearly 1 million (44 percent) of 2.3 million injuries and illnesses resulting in lost work time in 1992. WMSDs are also a significant problem for the Army, as overall readiness declines, and the costs associated with workers' compensation continue to escalate.

***In the glossary:***
✓ work-related musculoskeletal disorders

Ergonomics should not be viewed as a labor versus management issue. Preventing WMSDs not only protects the work force, but it also makes good business sense. The production-related costs of an injured worker are at least 8 to 10 times more than their medical costs. Injured soldiers or employees force units to deal with decreased output, replacement costs, retraining, increased errors, and an increased demand on the rest of the work force.

Implementing and maintaining an effective ergonomics program at your Army facility means working smarter and safer. Facilities that have implemented successful programs have seen measurable results in terms of protecting the work force, increasing productivity and quality, decreasing workers' compensation expenditures, increasing readiness, and reducing absenteeism and employee turnover.

Other terms and acronyms used synonymously for *WMSDs* include cumulative trauma disorders (CTDs), repetitive strain injuries, repetitive strain disorders, musculoskeletal disorders, and occupational overuse syndrome.

## What Are Work-Related Musculoskeletal Disorders?

WMSDs arise from repeated stress to the body encountered in the workplace. Such repeated stress can result in a variety of injuries or illnesses of the muscles, tendons, ligaments, nerves (outside the brain and spine), joints, cartilage (including intervertebral discs), bones and supporting blood vessels in either the upper or lower extremities, or back. Over a period of time, WMSDs can cause permanent damage to muscles, tendons, tendon sheaths, the lubrication mechanism of the tendon sheaths, and the related bones, muscles, and nerves, and result in permanent disability. WMSDs result from the cumulative effect of repeated traumas associated with specific workplace risk factors.

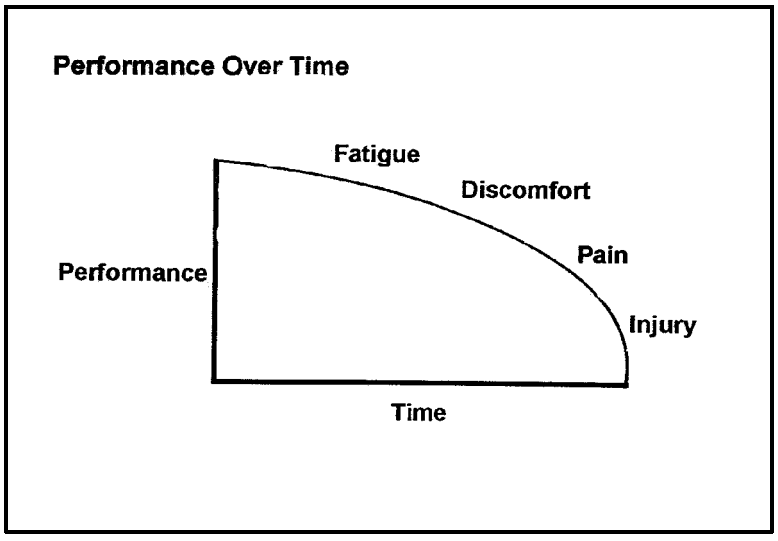
Figure 2 details each workplace risk factor.

Microtraumas are small, limited area tissue damage or tears. Cumulative trauma occurs when rest or overnight sleep fails to completely heal the microtrauma and residual trauma carries over to the next day, adding to the total system trauma. Prolonged exposure to the associated workplace risk factors can eventually lead to permanent damage and disability.

Other terms are used synonymously for *workplace risk factors*. The most common term is WMSD risk factors, but others include: environmental, generic, biomechanical, or basic risk factors.

Signs and symptoms of WMSDs vary according to the type of injury/illness but often include:

- Pain that does not cease overnight.
- Numbness and tingling.
- Decreased joint motion/mobility and decreased strength.
- Fatigue.




***In the glossary***:
✓ workplace risk factors
✓ microtraumas

**Figure 2. Workplace Risk Factors for Work-Related Musculoskeletal Disorders**

Task-related, workplace risk factors that contribute to WMSDs include:

**Posture.** Awkward postures require increased muscle force; contribute to muscle fatigue, tendon fatigue, and joint soreness; and increase forces on the spine.

**Repetition.** Repeated motions or tasks increase fatigue and muscle-tendon strain. Highly repetitive tasks often prevent adequate tissue recovery time from the effects of awkward postures and force. The level of risk varies by body part. A task is considered to be repetitive when—

- One fundamental cycle constitutes more than 50% of the total cycle.
- The cycle time is less than 30 seconds.

**Force.** Forceful exertions increase the physiologic stress to muscles, tendons, and joints. Muscles fatigue faster as the force exerted increases. The following factors can increase the force needed to perform a task:

- Object weight.
- Load distribution characteristics (shifting or bulky loads require more force exertion).
- Object friction (slippery objects require more force).
- Awkward postures.
- Vibration (localized hand tool vibration increases grip forces).
- Type of grip (pinch grip places three to four times more force on tendons than power grip).

**Mechanical Compression or Contact Stress.** Mechanical compression creates pressure over a small area and interferes with blood flow and nerve function. This compression can be caused by hard or sharp objects, the sharp edge of the desk, and small diameter handles.

**Duration.** Duration is the amount of time the worker is exposed to the risk factor. Prolonged exposure increases local and generalized fatigue and tissue stress. As the duration of exposure increases, the required recovery period increases proportionally.

**Vibration.** Localized vibration occurs when a part of the body contacts a vibrating object (e.g., pneumatic, electric, or impact hand tools). The American Conference of Government Industrial Hygienists (ACGIH) (1996) recommends exposures of less than 1 hour for hand vibration in excess of 12 $m/sec^2$.

**Temperature.** Prolonged contact between the bare hand and metal surfaces below 59°F (15°C) may impair dexterity, and contact with metal surfaces below 44.6°F (7°C) may induce numbness. In their booklet on threshold limit values (TLVs), the ACGIH recommends temperature limits for bare skin exposure by type of activity. Exposure to temperatures below these levels may—

- Reduce the dexterity and sensitivity of the hand.
- Increase grip force.
- Exacerbate the effects of localized vibration.

Cold temperatures also decrease circulation and reduce tissues' ability to recover from physiologic stress. The time it takes to heal or recover from an injury is increased as well.

Figure 3 explains how carpal tunnel syndrome (CTS) develops.

Booklet III provides more information on preventive measures for WMSDs.

**Common WMSDs.** Keep in mind, WMSDs are not diagnoses**;** they are work-related disorders with similar characteristics. Common WMSDs include:

- **Carpal tunnel syndrome.** This most common WMSD can lead to permanent disability if not detected early and treated properly.

- **Low back pain.** Currently, medical professionals believe this condition is caused by repeated bending, lifting, and twisting of the lower back, as well as sitting for long periods, standing on hard surfaces, and experiencing vibration over a long period of time — all of which result in cumulative microtrauma. An aggravating event — even one that may seem minor, such as a slip, trip, fall, or awkward lift — often causes an acute episode to occur. The episode occurs because a cumulative trauma reduces the tissues' ability to handle the physiologic stress of the aggravating event.

- **Tendonitis (also Tendinitis)**. This condition is an irritation (inflammation) of a tendon resulting from repeated tensing of that muscle/tendon group.

- **Lateral epicondylitis (tennis elbow).** "Tennis elbow," as this condition is often called, is an irritation (inflammation) of the tendons attached on the outside of the elbow caused by activities that have jerky throwing motions or impact (e.g., turning a screw driver).

- **Medial epicondylitis (golfer's elbow).** This condition is an irritation (inflammation) of the tendon attachments on the inside of the elbow resulting from activities that require repeated or forceful rotation of the forearm and bending of the wrist at the same time.

- **Tenosynovitis.** Tenosynovitis is an irritation (inflammation) of the tendon and the lining of the smooth sheath surrounding the tendon, resulting from repeated movement of the tendon in the sheath.

- **Synosynovitis**. Synosynovitis is an irritation (inflammation) of the inner lining of the membrane surrounding a joint.

- **Stenosing tenosynovitis of the finger.** Sometimes referred to as "trigger finger," this condition results from a tendon surface becoming irritated and rough. If the tendon sheath also becomes inflamed and presses on the tendon, a progressive constriction of the tendon can occur, resulting in a loss of free movement in that joint area. This disorder is commonly caused, for example, by repeated use of a staple gun or pair of pliers.

- **de Quervain's disease**. A stenosing tenosynovitis affecting the tendons on the side of the wrist and base of the thumb. Constriction of these tendons tends to pull the thumb back away from the hand, causing severe pain and limited thumb movement or use. This condition may also cause an ulnar deviation of the wrist (i.e., side bending toward the small finger).

**Figure 3. Carpal Tunnel Syndrome**

## How Carpal Tunnel Syndrome Develops

CTS is one of the most common WMSDs and can lead to permanent disability if not detected early and treated properly. To understand how this disorder develops, you need to know something about the structures within the forearm, wrist, and fingers. When you perform a task using the hand, the wrist and fingers are flexed by muscles located in the forearm. Those muscles are connected to the wrist and fingers by tendons (bands of tough, nonstretchable, flexible fibers that connect the muscles to the bone). These tendons enter your wrist through a U-shaped cluster of eight bones, the carpal bones, which form the "back" and "sides" of the wrist. Across the "top" of the wrist is a tough, strong ligament (similar to a tendon, but linking two bones together at a joint). This ligament forms the arch of the carpal bones, or the "roof" of the carpal tunnel. The median (middle) nerve of the forearm also runs through this tunnel to your palm and some of your fingers. The median nerve is compressed when your wrist is forced into an unnatural posture (such as typing on a straight keyboard) or by direct pressure on the median nerve from hard, sharp edges of work surfaces or tools. Surrounding the median nerve are the tendon sheaths (tubular sacs lined with a thin layer of tissue and a layer of oily lubricating fluid). Continued pressure and tendon activity on the tunnel can cause inflammation, which puts pressure on the nerve, and eventually results in nerve damage or CTS.

## Symptoms of Carpal Tunnel Syndrome

When the median nerve is compressed, the following CTS symptoms typically appear:

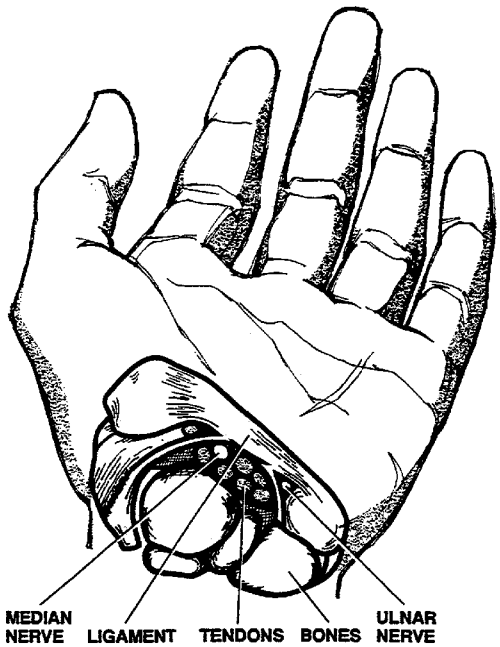
- Burning pain.
- Numbness.
- Tingling in the thumb and first two or three fingers.

These symptoms may radiate to the forearm. Sufferers frequently feel these symptoms at night, and many find performing simple tasks, such as tying their shoelaces, difficult because of weakness or numbness.

## Occupational Factors Associated With Carpal Tunnel Syndrome

Occupational factors associated with CTS include:

- Hands held in fixed positions over prolonged periods.
- Repeated wrist and finger flexion.
- Light, highly repetitive wrist and finger movements such as typing or data entry.
- Repeated flexion or hyperextension (wrist and hand bent back) of the wrist.
- Prolonged strenuous use of the hands.
- Repeated pinching or grasping.
- Vibration, particularly that associated with power tools.
- Bending the wrist toward the little finger.
- Acceleration and velocity of dynamic motions.



# PART II: MANAGEMENT ISSUES

## Establishing the Installation Program

To avoid work-related musculoskeletal injuries and illnesses at your Army facility, an ergonomics program should be implemented. The goal of an ergonomics program is to eliminate or reduce worker exposure to conditions that—

- Do not meet worker capabilities.
- Do not consider worker limitations.
- Lead to WMSDs and related injuries and illnesses.

## Ergonomics Program Elements

Five critical program elements must be accomplished to successfully implement an ergonomics program at an Army installation:

- **Worksite Analysis**. Conduct an organized, orderly, and guided analysis of all worksites.

Booklet II discusses *Worksite Analysis*.

- **Hazard Prevention and Control**. Assess job hazards and, when necessary, provide corrective solutions.

Booklet III discusses *Hazard Prevention and Control*.

- **Health Care Management**. Establish and implement a written plan for the systematic evaluation, treatment, and follow-up of workers with signs and symptoms of WMSDs.

Booklet IV discusses *Health Care Management*.

- **Education and Training.** Organize a program of education and training on the various aspects of ergonomics applicable to your installation. Update the program and the workers as work conditions change or new information becomes available.

Booklet V discusses *Education and Training*.

- **Ergonomics Program Evaluation.** Assess the effectiveness of the ergonomics program by using a variety of evaluation methods at least annually.

Booklet VI discusses *Program Evaluation*.

## Key Ingredients for a Successful Program

To implement the ergonomics program effectively, it requires—

- Commitment by top management.
- Worker involvement.
- A written program plan.
- Regular program review and evaluation.

**Commitment by Management**. The most important factor in the prevention of WMSDs is the support and commitment to the ergonomics program by all managers.

An effective ergonomics program also requires a team approach, led by top management. All managers, supervisors, and workers should be—

- Informed of their responsibilities for various aspects of the program.
- Given the authority and resources to meet their responsibilities.
- Held accountable for carrying out their responsibilities.
- Encouraged to work together to promote good ergonomic design in the workplace, thereby improving production, product quality, and morale while decreasing the costs associated with absenteeism, turnover, training, and replacement.

Additionally, managers should—

- Show personal concern for worker safety and make the elimination of ergonomic hazards a priority.
- Consider safety and health to be as important as production. Safety and health protection should be built into daily production activities.

The issue of WMSDs pertains directly to productivity. Workplace risk factors do more than cause WMSDs; they also create worker fatigue and poor work performance. This cuts into productivity and quality. WMSDs are more than an injury issue; they are also a productivity issue.

This guide is not just a guide for injury prevention. It is a guide for boosting the performance of your workers. It is the performance of your workers that will determine productivity and quality of the output in your

*Worker input* is essential for well-designed and effective ergonomic solutions. The front-line workers know the job better than anyone else in the organization and can address particular nuances of the job in developing solutions. In addition, worker participation improves worker "buy-in" and ultimate commitment to the solution.

work area, which is the ultimate measure of your success as a manager. Work with your workers on issues of WMSDs since the results will be of benefit to you, your workers, and the entire installation.

**Worker Involvement.** Workers should be encouraged to participate in the ergonomics program and in decisions that affect their safety and health by—

- Providing a procedure for complaints or suggestions.
- Allowing workers to bring their concerns to management without fear of reprisal.
- Providing a procedure for workers to report signs and symptoms of WMSDs so they may be evaluated and treated.
- Allowing safety and health committees to make recommendations for corrective action when they receive and analyze information on ergonomic problem areas.
- Encouraging worker groups to identify and analyze jobs for ergonomic stress, and recommend solutions.

**Written Program Plan**. Effective implementation of the ergonomics program requires a written plan for job safety and health that is—

- Endorsed and advocated by top management.
- Suitable for the size and complexity of the workplace.
- Communicated to and understood by all personnel.

The written plan should outline goals and objectives, and include an implementation schedule for worksite analysis, hazard prevention and control, health care management, and education and training.

**Regular Program Review and Evaluation**. The ergonomics subcommittee should review the ergonomics program regularly to evaluate its success in meeting stated goals and objectives. Management's review should be in the form of a written progress report, and should be shared with all workers. Any new or revised goals should also be shared with the workers. Any deficiencies should be identified, and corrective action taken.

Procedures and mechanisms to evaluate the program and monitor its progress include:

- Analyzing trends in injury/illness rates.
- Surveying employees.
- Surveying and evaluating the job/worksite before changes occur and after they are implemented.

***In the glossary:***
✓ action team

- Reviewing results of workplace evaluations.

- Maintaining up-to-date records or logs of problems/concerns, identifications, assessment results, action plans, and results of attempted or implemented job improvements.

## The Team Approach to Problem Solving

A team approach to ergonomics helps to integrate the various elements of the program and focuses the key players on the same goals.

Figure 4 addresses six critical issues in the team problem solving approach as identified by The National Institute for Occupational Safety and Health (NIOSH) in 1994. Recommendations for each issue are also provided.

Use the following guidelines to build your installation's ergonomic program:

- Form an ergonomics subcommittee with the chief, Preventive Medicine, or other qualified health or safety professional serving as the chair. Other members may include, but need not be limited to, health care personnel; an industrial hygienist; a safety professional; representatives from the union, Civilian Personnel Office, Director of Contracting Support, Director of Public Works, and Director of Logistics; and engineering and maintenance personnel.

- Provide ergonomic training to improve the subcommittee's knowledge of ergonomics and explain how each member fits into the installation's overall plan.

- Include team-building in the overall training package. Incorporate periodic updates from current ergonomic issues and methodology into the subcommittee's training schedule.

- Allow the subcommittee access to necessary management information, such as the incidence of WMSDs by job series or work area, so they can focus and prioritize their efforts.

- Build in mechanisms for subcommittee accountability; ergonomic project documentation and tracking; and communication with all employees.

- Empower the subcommittee to make ergonomic changes within specific budgetary constraints.

When faced with an ergonomics problem, members of the ergonomics subcommittee will form an action team to identify and correct hazards in the workplace.

## Authority for Creating an Ergonomics Program

Required publications for the ergonomics program include AR 40-5 (follow the general responsibilities for implementing the preventive medicine program) and AR 385-10 (follow the general responsibilities for implementing the Occupational Safety and Health (OSH) program).

On 4 February 1997, the Deputy Under Secretary of Defense (Environmental Security) issued a memorandum establishing interim requirements and procedures for the control of work related musculoskeletal injury and illness within the Department of Defense (DoD). The memorandum states the DoD components must:

- Incorporate the specific ergonomics program requirements into existing programs to identify and control workplace hazards.
- Be fully operational by January 1998.

In addition, the memorandum states that the ergonomics requirements will be included in the next revision of DoD Instruction 6055.1, "DoD Occupational Safety and Health Program."

Subsequently, an update to AR 40-5 has been submitted to:

- Establish and describe the installation ergonomics program functions, structure, and procedures to help the installation meet all regulatory requirements for ergonomics programs.
- Provide the basis for the installation's ergonomics plan.
- Provide the installation with detailed information and descriptions of the primary ergonomics program functions of worksite analysis, prevention and control, health care management, education and training, and ergonomics program evaluation.

This guide complements the above publications by offering practical "how-to" advice and providing various tools that are useful for implementing an installation ergonomics program.

# PART III: MANAGING CULTURAL CHANGE

## Culture Change

The term "culture change" has several different meanings. Within the context of ergonomics it means transforming an unhealthy work environment into a new, improved work environment for safe, comfortable, and effective human use. More important, it means getting everyone in the organization — from the commander to the front-line workers — to cooperate with this global change.

**Figure 4. Critical Issues in Team Problem Solving**

| Issue | Recommendations |
|---|---|
| **Management Commitment** | 1. Management commitment and support and cooperation of lower level supervisors, union officials, and recognized worker leaders are critical.<br>2. Policy declarations require follow-up for credibility.<br>3. Redefine mid-level supervisors' roles as mentors to workers, promoting ideas for work improvement and ways to implement the ideas. |
| **Training** | 1. Additional training is needed for workers, management staff, work team, task group, or committee. Workers' training should improve communication skills and group problem solving. Managers' training should improve listening and feedback skills.<br>2. The additional training must include the technical skills to assess the targeted worksite problems. This training may require the assistance of outside experts or consultants.<br>3. Training should address relevant issues and active instruction. Consider the learning issues (e.g., language barriers) of the audience. |
| **Composition** | 1. No single form of worker participation will fit all needs. The choice of participation depends on: the problem(s); the number of worker groups, areas, or operations affected; the workforce abilities and characteristics; and the organizational climate.<br>2. Action teams should represent the workers or units affected by the problem, including workers, management, and technical personnel.<br>3. Prevent supervisors/managers, specialists, and consultants from dominating or intimidating front-line workers in the team. |
| **Information Sharing** | 1. The ergonomics subcommittee must have access to information relevant to the problems and issues being addressed.<br>2. The subcommittee must share information with action team members because they may be from different operational units or staff levels.<br>3. Management must be open in communicating support and acknowledging consequences of proposed actions. Address worker concerns for job security. |
| **Activities and Motivation** | 1. Establish orderly and systematic methods for problem clarification, data gathering and analysis, solution development, and implementation planning.<br>2. Set goals and provide frequent feedback to mark the action team's progress and motivate performance.<br>3. Ensure team leader commitment to the team objectives.<br>4. Management must recognize and reward action team success to reinforce and sustain continued interest and commitment. |
| **Evaluation** | 1. Evaluate the action team's performance using appropriate process or outcome measurements.<br>2. Use substitute evaluation criteria if data is not available for directly relevant evaluations. |

Creating an ergonomic environment may call for a radical shift in "business as usual," depending on how your facility currently operates. For example:

- Many organizations manage from the top down, that is, decisions affecting the day-to-day operation of the business (such as production quotas, methods of production, workplace design, etc.) are made by top and middle management, with perhaps some input from front-line supervisors.

- The workers, who actually perform the daily work tasks, must then conform to the management decisions that affect their jobs. However, creating an ergonomic environment requires fitting the job to the worker, rather than the worker to the job. Consequently, input from the front-line workers can offer the greatest help in identifying and resolving many of the work conditions that can lead to WMSDs.

- In an ergonomic environment, the flow of decisions regarding work conditions must flow in both directions, up and down, within the organization.

Use the information in Booklet V as your guide for educating and training the work force.

Although the ultimate goal of creating an ergonomic environment may be understandable and agreeable to everyone, even positive change can create stress. Personnel will be better equipped to break old habits if you teach them new routines. Training builds confidence, competence, and a willingness to change. If you provide personnel with new techniques, you put them in a position to contribute to the overall program.

Provide a well-rounded orientation on the circumstances driving the creation of ergonomic work environments within the Army. Give credit to the "old culture" for its achievements. Honor the past. Then help people see how the transformation is the necessary next step to take. For example, consider the Army's heritage of using new strategies and technology for protecting people around the world. It follows that the Army should use the latest advances in the field of ergonomics to protect its own people by designing safe jobs and safe workstations, while educating its personnel on the various aspects of ergonomics that affect their health and well-being.

## PART IV: KEY PLAYERS

The table presented here outlines the key players in the ergonomics program, and details their role under each element of the program. The success of the ergonomics effort depends on all players being aware of the program elements, even if a player does not have a specific role under a particular element. ***NOTE: Completion of this table is pending final review of the AR 40-5 update.***

# *Appendix A*

## ACRONYMS

| | |
|---|---|
| **ACGIH** | The American Conference of Government Industrial Hygienists |
| **AM** | asymmetric multiplier |
| **ANSI** | American National Standards Institute |
| **AR** | Army regulation |
| **BLS** | Bureau of Labor Statistics |
| **CEI** | cost effectiveness index |
| **CFR** | Code of Federal Regulations |
| **CM** | coupling multiplier |
| **COP** | continuation of pay |
| **CPAC** | Civilian Personnel Advisory Center |
| **CPO** | Civilian Personnel Officer |
| **CTS** | carpal tunnel syndrome |
| **CTD** | cumulative trauma disorder |
| **DA** | Department of the Army |
| **DM** | distance multiplier |
| **DOD** | Department of Defense |
| **DODI** | Department of Defense Instruction |
| **DOL** | Department of Labor |
| **EI** | effectiveness index |
| **FECA** | Federal Employees Compensation Act |

| | |
|---|---|
| **FM** | frequency multiplier |
| **HHIM** | Health Hazard Information Model |
| **HM** | horizontal multiplier |
| **ICD** | International Classification of Disease |
| **ISO** | International Standards Organization |
| **ICPA** | Injury Compensation Program Administrator |
| **JR/PD** | Job Requirements and Physical Demands |
| **L** | current load weight |
| **LC** | load constant |
| **LI** | lift index |
| **MOS** | military occupational specialty |
| **MTF** | medical treatment facility |
| **NCV** | nerve conduction velocity |
| **NED** | number exposed daily |
| **NIOSH** | The National Institute for Occupational Safety and Health |
| **NSAID** | non-steroidal anti-inflammatory drug |
| **OH** | occupational health |
| **OSH** | occupational safety and health |
| **OSHA** | Occupational Safety and Health Administration |
| **OWCP** | Office of Workers' Compensation Programs |
| **POC** | point of contact |
| **PPE** | personal protective equipment |
| **RAC** | risk assessment code |

| | |
|---|---|
| **RWL** | recommended weight limit |
| **SF** | Standard Form |
| **SPM** | severity probability multiplier |
| **TG** | technical guide |
| **TLV** | Threshold Limit Value |
| **USACHPPM** | U.S. Army Center for Health Promotion and Preventive Medicine |
| **VDT** | video display terminal |
| **VM** | vertical multiplier |
| **WMSD** | Work-related musculoskeletal disorder |

***NOTE: This appendix will expand as booklets V and VI are published.***

# *Appendix B*

## GLOSSARY

**Abatement Plan:**

**Active Surveillance:** Involves actively seeking information to target and assess problematic work areas, job series, and tasks.

**Anthropometry:** The study of the physical dimensions of people, including size; breadth; girth; distance between anatomical points; and joint range of motion.

**Biomechanical Risk Factors:** As the word itself implies, these risk factors involve the interaction between human beings (bio) and their work environment (mechanical). More specifically, they represent certain task-related conditions which contribute to WMSDs, including:

- **Postures.** Awkward postures require increased muscle force; contribute to muscle fatigue, tendon fatigue, joint soreness, and increased forces on the spine.

- **Repetition.** Repeated motions or tasks increase fatigue and muscle-tendon strain. Highly repetitive tasks often prevent adequate tissue recovery time from the effects of awkward postures and force.

- **Force.** Forceful exertions increase the physiologic stress to muscles, tendons, and joints. Muscles fatigue faster as the force exerted increases.

- **Mechanical Compression or Contact Stress.** Mechanical compression creates pressure over a small area and interferes with blood flow and nerve function. This compression can be caused by hard or sharp objects, the sharp edge of the desk, and small diameter handles.

- **Duration.** Duration is the amount of time the worker is exposed to the risk factor. Prolonged exposure increases local and generalized fatigue and tissue stress. As the duration of exposure increases, the required recovery period increases proportionally.

- **Vibration.** Localized vibration occurs when a part of the body contacts a vibrating object, e.g., pneumatic, electric, or impact hand tools.

- **Temperature.** Prolonged contact between the bare hand and metal surfaces below 59°F (15°C) may impair dexterity, and contact with metal surfaces below 44.6°F (7°C) may induce numbness.

**Carpal Tunnel Syndrome:** to be added

**Cost Effectiveness Index:** The cost effectiveness index is a measure that represents, in a single value, the ratio between the cost of an abatement project and the potential effectiveness (measured in terms of reduced frequency and severity of WMSDs) to be derived from implementing the abatement project.

**Culture Change:** In the context of ergonomics, culture change means abandoning the out-moded traditions of "business as usual" and learning how to transform the work environment for safe, comfortable, and effective human use throughout the entire organization. This is accomplished by implementing and maintaining an ergonomics program. It requires getting everyone in the organization — from the commander to the front-line workers — to cooperate with this global change and relying on key personnel to ensure that the program proceeds as planned. Creating an ergonomic environment requires fitting the job to the worker, rather than the worker to the job. Accordingly, input from the front-line workers can offer the greatest help in identifying and resolving many of the work conditions which can lead to WMSDs. In an ergonomic environment, the flow of decisions regarding work conditions must flow in both directions, up and down, within the organization.

**Cumulative Stress Injuries:** See work-related musculoskeletal disorder (WMSD).

**Cumulative Trauma:** Cumulative trauma occurs when rest or overnight sleep fails to completely heal the microtrauma and residual trauma carries over to the next day, adding to the total system trauma.

**Cumulative Trauma Disorders (CTDs):** See work-related musculoskeletal disorder (WMSD).

**Cycle:** to be aded

**denervation:**

**de Quervain's Disease:** A stenosing tenosynovitis affecting the tendons on the radial side (e.g., thumb side) of the wrist. Constriction of these tendons tends to pull the thumb back away from the hand, causing severe pain and limited thumb movement or use.

**Design for the Average:** A design approach that uses anthropometric data on the average-sized worker for designing workplaces and equipment. This approach should be used only as the last resort. Although this approach is more economical, the equipment or workplace will not accommodate the majority of the workforce.

**Design for the Extreme:** The second approach, *design for the extreme,* involves designing for either the smallest female or the largest male in the population. The smallest workers (5th percentile) determine reach dimension (e.g., fire extinguisher placement) and visual clearances. The largest workers (95th percentile) determine clearances (e.g., doorways, walkways).

**Design for the Range:** The preferred approach is to *design for the range*. This approach usually involves some adjustability and "fits" the majority of workers. Workstations and equipment designed using the design for the range approach usually fits the majority of workers, from the 95th percentile male to the 5th percentile female, thus accommodating approximately 90% of the working population.

**Dynamic motions:** to be added

**Dynamic Work:** to be added

**Engineering Controls:** Physical changes to work stations, equipment, materials, production facilities or any other relevant aspect of the work environment that reduce or prevent exposure to workplace risk factors.

**Ergonomics:** Field of study that seeks to fit the job to the person, rather than the person to the job. This is achieved by the evaluation and design of workplaces, environments, jobs, tasks, equipment, and processes in relationship to human capabilities and interactions in the workplace.

**Ergonomics Action Team:** A group of workers designated as an *action team* for their worksite, who analyze and identify jobs for ergonomic stress, and recommend solutions.

**Ergonomics Expert:** The ergonomics expert is a qualified professional who possesses a recognized degree or professional credentials in ergonomics or human factors engineering (typically a master's or doctorate degree). He/she must demonstrate the ability to identify and correct WMSDs in the workplace and teaches the 40-hour ergonomics course for the trained ergonomics personnel. The ergonomics expert provides consultation only in cases when trained ergonomics personnel are unable to solve identified problems. In most cases, an ergonomics expert will not be available at each installation.

**Ergonomics Stress:** to be added

**Ergonomics Subcommittee:** Those responsible for identifying and correcting occupational hazards in the workplace, including trained ergonomics personnel, health care providers, industrial hygienists, safety personnel, engineers, and other support personnel, managers, and supervisors.

**Foot-candle:** The illumination of a surface one foot distant from a source of one candela, equal to one lumen per square foot.

**General Duty Clause:** Refers to a safe and healthful working environment as described in title 29, Code of Federal Regulations, Part 1910. Authorizes the enforcement of a recognized industry safety or health standard when identified hazards are not covered by an existing OSHA standard. Only violations viewed as serious may be cited under the general duty clause.

**Health Care Personnel:** Physicians, chiropractic physicians, nurses, occupational therapists, physical therapists, physicians' assistants, and other health care professionals and their related, supervised technicians (e.g., certified occupational therapy assistants and licensed practical nurses). Health care personnel participating in the ergonomics program should have training in basic ergonomics and epidemiology and be up-to-date in the systematic recognition, evaluation, treatment, and rehabilitation of CTDs.

**High-Risk Task Focusing:** Process that uses information from workers' job descriptions, injury report data, and direct input from the workers to classify and sub-classify workers to a level where most of the workers in the group are exposed to the same risk factors.

**Incidence rate:** A frequently used statistic which provides important information for both worksite analysis and the program assessment. It is expressed as:

$$\frac{\text{Number of } \textbf{NEW} \text{ cases over a specific period}}{\text{Total number of workers}}$$

**Isometric Contraction:** Occurs when the muscle remains the same length (doing no work), but the tension within the muscle increases.

**Isotonic Contraction:** Occurs when muscle fibers shorten and perform work.

**Installation Ergonomics Officer (IEO):** to be added

**job series:** to be added

**lateral epicondylitis:** "Tennis elbow," as this condition is often called, is an irritation (inflammation) of the tendons attached on the outside of the elbow caused by activities that have jerky throwing motions or impact (e.g., turning a screw driver).

**low back pain:** This condition can be caused by repeated bending, lifting, and twisting of the lower back, as well as sitting for long periods, standing on hard surfaces, and experiencing vibration over a long period of time.

**kilocalorie (kg):** to be added

**Lateral epicondylitis:** An irritation (inflammation) of the tendon attachments on the outside of the elbow resulting from activities that have jerky throwing motions or impact (e.g., hammering).

**Levelator:** to be added

**Light-duty assignments:** to be added

**Luminance Ratio:** to be added

**Lux:** The International System unit of illumination, equal to one lumen per square meter.

**Medial epicondylitis (golfer's elbow):** This condition is an irritation (inflammation) of the tendon attachments on the inside of the elbow resulting from activities that require repeated or forceful rotation of the forearm and bending of the wrist at the same time.

**Microtraumas:** Small, limited area tissue damage or tears. Cumulative trauma occurs when rest or overnight sleep fails to completely heal the microtrauma and residual trauma carries over to the next day, adding to the total system trauma.

**Modified duty assignments:** to be added

**Neutral Posture:** The position the body naturally assumes. It is the *least stressful, strongest, and most efficient position* for the body.

**Occupational Hazard:** Conditions, procedures, and practices directly related to the work environment that create a potential for producing occupational injuries or illnesses.

**Occupational Injury/Illness:** To be recorded as an occupational illness, the condition must be diagnosed by a physician, registered nurse, or other person who, by training or experience, is capable of making such a determination (such as an occupational therapist, physical therapist, or physicians' assistant). In addition, the condition must meet the following criteria:

- Either a physical findings or subjective symptoms must exist, that is, at least one physical finding (e.g., positive Tinel's, or Finkelstein's test; swelling, redness, or deformity; or loss of motion or strength) or at least one subjective symptom (e.g., pain, numbness, tingling, aching, stiffness, or burning).

- WMSDs must be associated with repeated trauma, and exposure at work must have caused or contributed to the onset of symptoms or aggravated existing symptoms.

  At least one of the following response actions must occur:

- Medical treatment (including self-administered treatment if made available to personnel by their employer).

- Lost or restricted work activity.

- Transfer or rotation to another job.

**Occupational Overuse Syndrome:** See work-related musculoskeletal disorder (WMSD) for definition.

**Old Culture:** to be added

**Passive Surveillance:** The systematic analysis of data provided in existing reports and data sources such as outline injury reports, log and summary of occupational injuries and illnesses, Federal Employees Compensation Act (FECA) claims, medical and safety records, and workforce reports and suggestions.

**Personal Protective Equipment:** to be added

**Phalen's Test:** Wrist flexion test.

**Physical Environment:** The physical environment includes lighting, temperature, and noise level.

**Pinch Grip:** A grip that involves the thumb and one or more other fingers.

**Power Grip:** to be added

**Prevalence rate:** A frequently used statistic which provides important information for both worksite analysis and the program assessment. It is expressed as:

$$\frac{\text{Total number of cases (both and old) at a } \textbf{POINT IN TIME}}{\text{Total number of workers at the point in time}}$$

**Reach Envelope:** to be added

**Repetitive Motion Disorders:** Synonymous with cumulative trauma disorder, occupational overuse syndrome, and repetitive strain. See cumulative trauma disorder for definition.

**Repetitive Strain:** Synonymous with cumulative trauma disorder, occupational overuse syndrome, and repetitive motion disorders. See cumulative trauma disorder for definition.

**Residual Trauma:** to be added

**Restricted assignments:** to be added

**Risk Assessment Code:** to be added

**screening assessment:** to be added

**Seat Pan:** to be added

**Severity Rate:** to be added

**Sorbothane®:** to be added

**Static Work:** to be added

**Stenosing Tenosynovitis of the Finger:** Sometimes referred to as "trigger finger," this condition results from a tendon surface becoming irritated and rough. If the tendon sheath also becomes inflamed and presses on the tendon, a progressive constriction of the tendon can occur, resulting in a loss of free movement in that joint area. This disorder is commonly caused, for example, by repeated use of a staple gun or pair of pliers.

**Strike Zone:** to be added

**Synovial Membrane/Lubrication:** The membrane (a.k.a "synovium") is composed of a single layer of cells and connective tissue that forms the sac enclosing a freely movable joint. The synovial membrane secretes a lubricating fluid which allows for smooth movement of the joint.

**Synovitis :** Synovitis is an irritation (inflammation) of the inner lining of the membrane surrounding a joint or tendon.

**Task:** The task features include work scheduling, pacing, job content (e.g., simple, routine or complex, variable), training, and the level or amount of autonomy.

**Task Analysis:** to be added

**tendinitis:** This condition is an irritation (inflammation) of a tendon resulting from repeated force or stress on that muscle/tendon group.

**Tenosynovitis):** Tenosynovitis is an irritation (inflammation) of the tendon and the lining of the smooth sheath surrounding the tendon, resulting from repeated movement of the tendon in the sheath.

**Thoracic Outlet Syndrome:** to be added

**Threshold Limit Values:** to be added

**Tinel's Sign:** Median nerve percussion.

**Tools, Equipment, and Containers:** The tools, equipment, and containers include hand and power tools, machines, components, keyboards, assembly parts, and boxes.

**Trained Ergonomics Personnel:** Trained ergonomics personnel are health care, industrial hygiene, environmental science, safety, or engineering personnel with approved training in ergonomics. Minimum acceptable training for installation-level ergonomics personnel is the 40-hour ergonomics course offered by USACHPPM or equivalent civilian training.

**Work Area:** The work area consists of three basic components, including the (1) workstation and physical environment; (2) the task; and (3) the tools, equipment, and containers used in the job.

**Work Environment:** to be added

**worker-year:** to be added

**Workplace Risk Factors (Ergonomic):** Actions in the workplace, workplace conditions, or a combination thereof, that may cause or aggravate a work-related musculoskeletal disorder. Workplace risk factors include, but are not limited to, repetitive, forceful or prolonged exertions; frequent or heavy lifting; pushing, pulling, or carrying of heavy objects; a fixed or awkward work posture, contact stress; localized or whole-body vibration, cold temperatures and poor lighting (leading to awkward postures). These workplace risk factors can be intensified by work organization characteristics, such as inadequate work-rest cycles, excessive work pace and/or duration, unaccustomed work, lack of task variability, machine work, and piece rate.

**Workplace Surveillance:** The ongoing systematic collection, analysis and interpretation of health and exposure data used to identify, record, and track WMSDs. Surveillance data are used to determine the need for occupational safety and health action and to plan, implement and evaluate ergonomic interventions and programs.

**Work-Related Musculoskeletal Disorder (WMSD):** An injury or an illness of the muscles, tendons, ligaments, peripheral nerves, joints, cartilage (including intervertebral discs), bones, and/or supporting blood vessels in either the upper or lower extremities, or back, that is associated with musculoskeletal disorder workplace risk factors and are not limited to cumulative trauma disorders, repetitive strain or illnesses, repetitive motion injuries or illnesses, and repetitive stress injuries or illnesses. Refers collectively to any of the following when they are caused or aggravated by exposure to workplace risk factors: signs, or persistent symptoms, or clinically-diagnosed work-related musculoskeletal disorders. Specific examples of reported WMSDs include chronic back pain; carpal tunnel syndrome; deQuervains disease; epicondylitis (tennis elbow); Raynaud's syndrome (white finger); synovitis; stenosing tenosynovitis crepitans (trigger finger); tendonitis; and tenosynovitis.

**Worksite Analysis:** to be added

**Work Space Envelope:** The three-dimensional area within which a person can perform some type of manual activity safely, comfortably, and efficiently.

**Work Environment:** to be added

**Worksite:** The physical area in which a worker performs job activities.

**Worksite Surveillance:** The ongoing systematic collection, analysis, and interpretation of health and exposure data used to identify, record, and track WMSDs.

**Workstation:** An individual person's work area; includes items in the work area, such as a table, bench, desk, chair, stool, mat, vehicle cab, checkout stand, shelves, storage bins, controls and displays, and a computer terminal.

***NOTE: This appendix is still under review.***
***It will expand and be completed when booklets V through VI are published.***

# *Appendix C*

## REFERENCES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5 CFR 339.301, Authority to Require an Examination.

29 CFR 1910, Occupational Safety and Health Standards.

41 CFR 101-20.107

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DA Form 285-AB-R, U.S. Army Abbreviated Ground Accident Report.

DA Form 3075, Occupational Health Daily Log.

DOL Form CA-16, Authorization for Examination and/or Treatment.

DOL Form CA-17, Duty Status Report.

DOL Form CA-1

DOL Form CA-2

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***NOTE: This appendix will be modified as booklets V and VI are published.***

# *Appendix D*

## RESOURCES

### TECHNICAL ASSISTANCE

Commanding General, U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), ATTN: MCHB-DC-OER, Aberdeen Proving Ground, MD 21010-5422. Phone: (410) 671-3928 or DSN 584-3928; Fax: (410) 671-3665 or DSN 584-3665.

U.S. Army Safety Center, Training Division, ATTN: CSSC-RT, Fort Rucker, Alabama, 36362-5363. Phone (334) 255-2643 or DSN 558-2643; Fax: (334) 255-2670/9478 or DSN 558-2670/9478.

Air Force Point of Contact for Ergonomics: Armstrong Laboratory Ergonomics Program at DSN 240-6120.

Navy Point of Contact for Ergonomics: Naval Operations, Occupational Health Section at DSN 332-2575.

Marines Point of Contact for Ergonomics: HQ Marine Corps, Industrial Hygiene Program at DSN 224-1077.

## MANUFACTURERS AND VENDORS

*There are many manufacturers and vendors of ergonomic tools and devices, with more appearing each year. The following list is for information purposes only and is not intended as an endorsement by the Army Safety Center, the U.S. Army Center for Health Promotion and Preventive Medicine, or the Department of the Army. Use of trademarked names does not imply endorsement by the U.S. Army, but is intended only to assist in identification of a specific product.*

### Hand tools

Ames
P.O. Box 1774
Parkersburg, WV 26101
(Hand tools)

AMP, Inc.
Advanced Mfg Tech Div
3901 Fulling Mill Road
Middletown, PA 17057
(Hand tools and automated systems for electromechanical connections)

Atlas Copco Industrial
Tools, Inc.
24404 Indoplex Circle
Farmington Hills, MI 48018
313-478-5330
(Hand tools)

BAHCO Tools, Inc.
570 Lexington Avenue
New York, NY 10022
212-750-3823

Bettcher Industries
P.O. Box 336
Vermillion, OH 44089
800-321-8763

Bodyguard Seating Systems
A Division of Advanced Dental
Concepts, Inc.
7 North Pinckney St, Ste 305
Madison, WI 53703
608-256-0344

Cooper Industries
P.O. Box 728
Apex, NC 27502
919-362-7510
(Scissors)

Dresser Industries, Inc.
Industrial Tool Div
7007 Pienmont
Houston, TX 77040
713-462-4521

Dynamics Operational, Inc.
600 Fondulac Drive
East Peoria, IL 61611
309-699-6046
(Handles)

Fiskars
P.O. Box 1727
Wausau, WI 54401
(Hand tools)

ITD Automation
1765 Thunderbird
Troy, MI 48084
313-244-9250
(Articulating Arms)

Klein Tools, Inc.
7200 McCormick Blvd
Chicago, IL 60645
312-677-9500
(Hand tools)

SCANDEX, Inc.
87 Crescent Road
Needham, MA 02194
617-449-1550
(Hand tools)

Seymour Smith & Son, Inc.
Snap-Cut
Oakville, CT 06779
203-274-2558

Sorbothane, Inc.
P.O. Box 178
Kent, OH 44240
216-678-9444
(Vibration dampening materials)

Stanley Air Tools
700 Beta Drive
Cleveland, OH 44143
216-461-5500
(Power hand tools)

Steere Enterprises
285 Commerce Street
Tallmadge, OH 44278
216-633-4926
(Custom dip/blow-molding, plastics)

Stirex Innovation
c/o Intercodev, Inc.
4 Royal Oak Court
Holbrook, NY 11741
516-472-6384
(Hand tools, scissors, aids for the disabled)

Sullair Corp.
3700 E. Michigan Blvd.
Michigan City, MI 46360
800-348-2722
(Air hammers)

Sunnex Equipment, AB
Box 242
686 00 Sunne Sweden
(Handgrips, power tools)

**<u>All Office Products</u> (e.g., wrist rests, chairs, lumbar supports, keyboards, etc.)**

Kare Pillows, Inc./Ergo Kare*
P.O. Box 2295
Boulder, CO 80306
1-800-927-5273 (KARE)
(GSA prices: up to a 52% discount)

Equipment Direct*
2861 Saturn #D
Brea, CA 92621
1-800-424-4410
FAX 1-800-842-2412

Lakota Scientific, Inc.
P.O. Box 130652
ST. Paul, MN 55113
1-800-945-5782

The Saunders Group, Inc.
7750 W. 78th Street
Minneapolis, MN 55439
1-800-654-8357
(612) 944-1656
FAX (612) 944-1340

Smith & Nephew Rolyan Inc.
N93 W14475 Whittaker Way
P.O. Box 555
Menomonee Falls, WI 53052-0555
1-800-558-8633
FAX 1-800-545-7758

Office Ergonomics*
10206 Old Hunt Road
Vienna, VA 22181
(703) 281-0822
FAX (703) 281-9317

Sunway*
1857 Buerkle Road
White Bear Lake, MN 55110
1-800-969-9708
(612) 773-5320
FAX (612) 773-5324

**GSA*

Mead-Hatcher, Inc.*
P.O. Box 861
Buffalo, NY 14240-0861
(716) 877-1185
FAX (716) 877-7381

ErgoSource
2828 Hedberg Dr.
Minnetonka, MN 55305
1-800-969-4374

North Coast Medical, Inc.
187 Stauffer Blvd
San Jose, CA 95125-1042
1-800-821-9319
(408) 283-1900
FAX (408) 283-1950

Vu-Tek
625 Alaska Ave
Torrence, CA 90503
(310) 320-9768
FAX (301) 320-9357

AliMed
297 High Street
Dedham, MA 02026-9135
1-800-225-2610
FAX (617) 329-8392

Computer & Electronic Safety Solutions
2406 Dunwoody Crossing
Suite E
Atlanta, GA 30338
(404) 250-1004
FAX (404) 451-6432

Alperstein Brothers, Inc.*
Attn: Nancy Ruppert
8121 Piney Branch Road
Silver Spring, MD 20910
1-800-949-4940
(301) 585-1160 / FAX (301) 587-2620

**Ergonomic Chairs**

HÅG
108 Landmark Drive
Greensboro, NC 27409
(910) 668-9544
FAX (910) 668-7331

Neutral Posture Ergonomics*
2301 Fountain Ave
Bryan, TX 77801
(409) 822-5080
FAX (409) 775-1963

Charvoz Dauphin*
180 Passaic Avenue
Fairfield, NJ 07004
1-800-631-1186
(201) 227-6500

BodyBilt Seating Inc.*
3900 Texas Avenue South
College Station, TX 77845
(409) 693-7000
FAX: (409) 764-1935

Douron, Inc.*
40 New Plant Court
Owings Mills, MD 21117
(410) 363-2600
FAX (410) 363-1659

Biofit Engineered Seating*
P.O. Box 109
Waterville, OH 43566
1-800-597-0246
FAX (419) 823-1342

Frank Eastern Co.
599 Broadway
New York, NY 10012-3258
1-800-221-4914

**Document Holder**

WordySturdy*
85 South Mountain Way
Orem, UT 84058
1-800-443-7792

**Wrist Rest/Mouse Rest**

Accu-Back, Inc.
1475 East Sel Amo Blvd
Carson, CA 90746
1-800-272-8888
(310) 639-7992
FAX (310) 639-1080

Computer Expressions, Inc.*
4200 Mitchell Street
Philadelphia, PA 19128-3593
(215) 487-7700
FAX (215) 487-7728

Ergodyne*
1410 Energy Park Drive, Suite 1
St. Paul, MN 55108
1-800-225-8238
FAX (612) 642-1882

KeyTronic*
(Wrist pad with integrated trackball)
P.O. Box 14687
Spokane, WA 99214-0687

Milsco Manufacturing Company
P.O. Box 23176
0990 North 51st Street
Milwaukee, WI 53223
(414) 354-0500
FAX (414) 354-0508

**GSA*

## Alternative Design QWERTY Keyboards

Fountain Hills Systems Inc.*
15022 N. 75th Street
Scottsdale, AZ 85206-2476
(602) 596-8633
FAX (602) 948-1925

Ergonomixx, Inc.
525-K East Market Street
Box 295
Leesburg, VA 22075
(703) 771-1047
FAX: (703) 771-1137

Kinesis Corporation
22232 17th Avenue SE
Bothell, WA 98021-7425
1-800-454-6374
(206) 402-8100
FAX (206) 402-8181

KeyTronic*
P.O. Box 14687
Spokane, WA 99214-0687
1-800-262-6006
(509) 928-8000

## Lumbar Supports

Accu-Back, Inc.
1475 East Sel Amo Blvd
Carson, CA 90746
1-800-272-8888
(310) 639-7992
FAX (310) 639-1080

Ergodyne*
1410 Energy Park Drive, Suite 1
St. Paul, MN 55108
1-800-225-8238
FAX (612) 642-1882

*GSA

## Anti-Vibration Gloves

Chase Ergonomics
P.O. Box 92497
Albuquerque, NM 87199
1-800-621-5436
FAX (503) 344-1426

Viscolas, Inc.*
1018 Dallas Road
Chattanooga, TN 37405
(615) 265-4030
FAX (615) 265-7120

ErgoSource
2828 Hedberg Dr.
Minnetonka, MN 55305
1-800-969-4374

Ergodyne*
1410 Energy Park Drive, Suite 1
St. Paul, MN 55108
1-800-225-8238
FAX (612) 642-1882

Rehab Plus Therapeutic Products
6104 45th Street, Space D
Lubbock, TX 79407
1-800-288-8059
(806) 791-2288
FAX (806) 791-2290

North Coast Medical, Inc.
187 Stauffer Blvd
San Jose, CA 95125-1042
1-800-821-9319
(408) 283-1900
FAX (408) 283-1950

ErgoTech Canada Inc.*
250 Ferrier Street Unit B
Markham Ontario L3R 2Z5
(416) 491-4658

Frank Stubbs Co., Inc.*
ATTN: Alex Rowlings
4518 Vanowen Street
Burbank, CA 91505
1-800-223-1713
(818) 842-5137/FAX (818) 842-1927

**Driver Anti-Vibration Seat**

ErgoTech Canada Inc.*
250 Ferrier Street Unit B
Markham Ontario L3R 2Z5
(416) 491-4658

Equipment Direct*
2861 Saturn #D
Brea, CA 92621
1-800-424-4410
FAX 1-800-842-2412

**Lift Tables**

Air Technical Industries
7501 Clover Avenue
Mentor, OH 44060
(216) 951-5191
1-800-321-9680

Cherry's Industrial Equipment Corp.
180 Devon Ave
Bensenville, IL 60106
(708) 350-0200

Southworth Products Corporation
P.O. Box 1380
Portland, Maine 04104-5001
(207) 772-0130
1-800-341-0122

Lee Engineering Company, Inc.
505 Narragansett Park Drive
Pawtucket, Rhode Island 02861
(401) 725-6100

Interthor, Inc.
1817 Beach Street
Broadview, IL 60153
(708) 345-1270

**Lift Tables (con't)**

American Lifts
601 West McKee Street
P.O. Box 524
Greensburg, IN 47240
(812) 663-4085
1-800-477-5011

Pro-Line
R.W. Hatfield Co., Inc.
12 Rogers Rd
Haverhill, MA 01835
(508) 521-2600

Technological Designs & Assemblies, Inc.
P.O. Box 545
Comstock, MI 49041
(616) 349-8105

Dozier Equipment International
6121 Cockrill Bend Circle
Nashville, TN 37209-1060
(615) 350-6400
1-800-336-6608

Vestil Manufacturing Company
2999 N. Wayne Street
P.O. Box 507
Angola, IN 46703
(219) 665-7586

T&S Equipment Company
2999 N. Wayne Street
P.O. Box 496
Angola, IN 46703
(219) 665-9521

**GSA*

**Anti-Fatigue Mats**

Ergomat USA
871 Canterbury Road
Westlake, OH 44145
(216) 899-1700
1-800-357-2111

Standers' Choice Health Mats
1855-65 Columbia Avenue
P.O. Box 1746
Lancaster, PA 17608-1746
1-800-537-3731

ErgoSource
2828 Hedberg Dr.
Minnetonka, MN 55305
1-800-969-4374

Koffler Sales Company
2500 Devon Avenue
Elk Grove Village, IL 60007
1-800-323-0951
(708) 640-3970
FAX (708) 640-3974

**Illumination**

Aero-Motive Company
P.O. Box 2678
Kalamazoo, MI 49003-2678
(616) 337-7700
1-800-999-8559

Environmental Lighting Concepts, Inc.*
3923 Coconut Palm Drive, Suite 101
Tampa, FL 33619
1-800-842-8848
(813) 621-0058
FAX (813) 626-8790

**Sit/Stand Chairs**

David Eric
9 Portland Road, Unit C
West Conshohocken, PA 19428-2716
(610) 828-1721

Biofit Engineered Seating
P.O. Box 109
Waterville, OH 43566
(419) 823-1089
1-800-597-0246

Frank Eastern Co
599 Broadway
New York, NY 10012-3258
(212) 219-0007
1-800-221-4914

Milsco Manufacturing Co.
P.O. Box 23176
Milwaukee, WI 53223
(414)354-0500

AliMed, Inc.
297 High street
Dedham, MA 02026
(617) 329-2900
1-800-225-2610

Ajusto Equipment Company
P.O. Box 348
Bowling Green, OH 43402
(419) 823-1861
1-800-543-4996

Aero-Motive Company
P.O. Box 2678
Kalamazoo, MI 49003-2678
(616) 337-7700
1-800-999-8559

ErgoSource
2828 Hedberg Dr.
Minnetonka, MN 55305
(612) 595-0881
1-800-969-4374

*GSA*

**Foot rest/railing**

Aero-Motive Company
P.O. Box 2678
Kalamazoo, MI 49003-2678
(616) 337-7700
1-800-999-8559

ErgoSource
2828 Hedberg Dr.
Minnetonka, MN 55305
(612) 595-0881
1-800-969-4374

## HOW TO EVALUATE A PRODUCT

1. **"Real life testing"** - The best way to evaluate equipment is to use the equipment under a variety of conditions with different users, but this usually is not possible prior to purchase.

2. **Evaluate the product literature** - Look for adjustability to accommodate a wide range of users. If the equipment is not adjustable, look at the working dimensions and assess the usability for your working population.

3. **Evaluate the manufacturer's "track record"** - Does the manufacturer usually provide a good ergonomic design - based on your (or someone else) experience with the manufacturer.

4. **Evaluate the vendor's reputation** - Vendors with a reputation for first-quality design work tend to consider the human usability of their designs.

5. **Develop clear specifications for the equipment**. This is the best way to evaluate the equipment without hands-on use prior to purchase.

Specifications such as "ergonomically designed" and "user friendly" are very general and vague. Assume products with these descriptions should are not any better than any other product on the market.

Dimensional specifications such as seat height, table width, and bag weight will tell you more about the equipment; however, this information must be interpreted in order to understand their impact on the user population.

Functional specifications are the best way to evaluate equipment. Examples of functional specifications are:

- "Usable by 95% of the population" for general tasks.

- "Reachable by the 5th percentile female" for anthropometric concerns.

- "Decision time within 2 seconds after alarm sounds" for control room situations.

Keep in mind, it is a vendor's job to sell. It is your job to cut through the sales pitch to determine what is being offered will truly help your employees and co-workers. The best way to do this is to know how WMSDs occur, and that "to develop" means to implement a meaningful product evaluation of the item under consideration for purchase.

**PRODUCT EVALUATION METHODS**

| Method | Purpose | Typical Use |
|---|---|---|
| Worker and consumer feedback | To define general product user needs | When a system or product is to be redesigned or new ones are to be developed, it is desirable to ask people who are using a similar product or system how they feel about it in terms of adequacy to do the job, ease with which the job can be done, and/or special problems that occur with the present hardware, facility, or tools. |
| Human-machine operational observation | To define general, dynamic, and environmental factors associated with product use. | Although feedback from the user may include demonstration, it is advantageous to observe an operation covertly over an extended period of time in order to have a more objective assessment of problems the operator may have. |
| Personal operation experience | To provide the designer with a personal "feel" for the problems a worker may have identified or may have observed from a distance. | When practical, it is recommended that the designer actually operate or use a product similar to the one he or she intends to redesign and/or create in order to experience at firsthand to problems or needs which a worker has pointed out or which the designer may have observed from a distance. |
| Time and motion study | To measure task performance against a time base and thus identify critical product or task conditions. | Especially useful for systems in which worker output is a significant factor, i.e., in which increase in rate of production is a primary objective of the system. The method provides quantitative information that helps establish priorities for design and procedural improvement, either through redesign and/or through new design. |

***NOTE: This appendix may be modified as booklets V and VI are completed.***