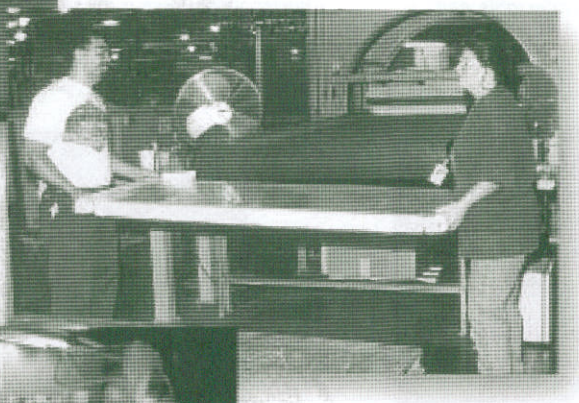
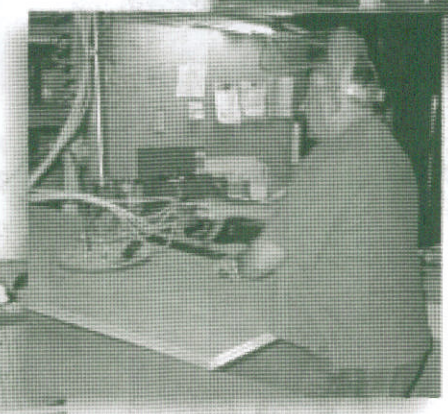
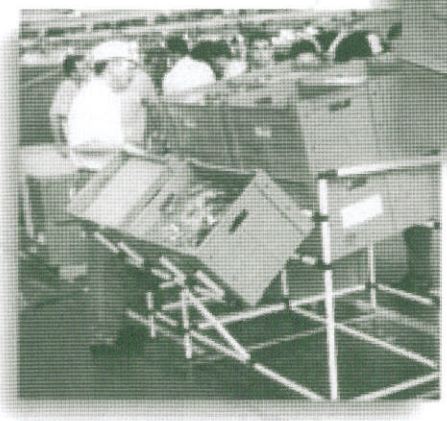
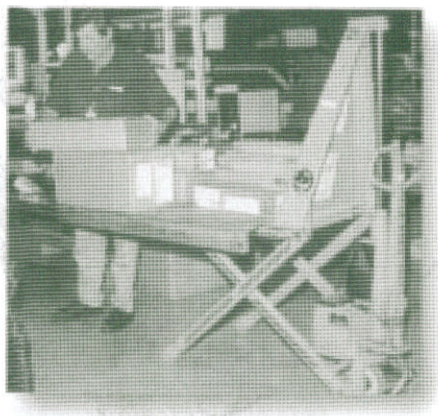
Easy Ergonomics

A Practical Approach for Improving the Workplace









Department of Industrial Relations
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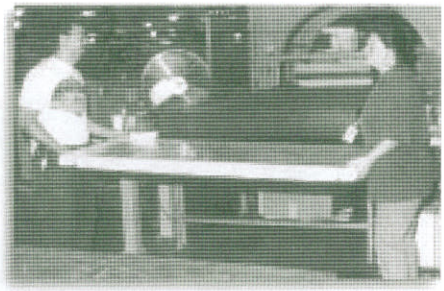
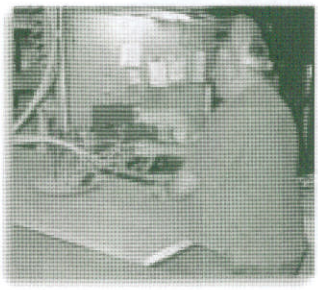
About the Cover

▲ *Simple wooden A-frame makes work more comfortable and efficient*

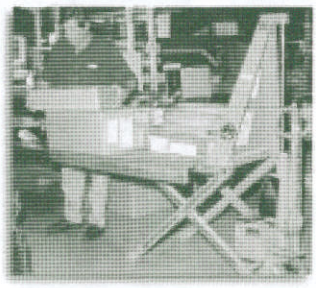
▲ *In-line tool used on a horizontal surface makes the wrist and arm more comfortable*



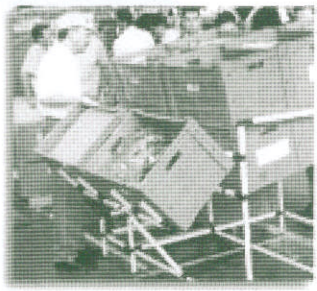
▲ *Team lifting reduces the workload*



▲ *Lift-assist device eliminates manual handling*



▲ *Scissors lift provides a portable, height-adjustable workstation*



▲ *Parts storage is tilted for easy access and convenience*

Publishing Information

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Easy Ergonomics

A Practical Approach for Improving the Workplace

California Department of Industrial Relations
Cal/OSHA Consultation Service
Education and Training Unit

About This Booklet

► This booklet offers a simple, hands-on approach to workplace ergonomics that can work regardless of the size of your organization. It is designed for owners, supervisors, and employees as they work toward improving their workplace.

► The booklet is divided into four sections:

I. **How Ergonomics Can Help.** Introduces you to ergonomics, describes the benefits of taking a proactive approach, and illustrates some practical workplace improvements made by employers and employees in California.

II. **Ergonomics and Your Workplace.** Gives a description of factors that may contribute to problems in work tasks. Also provides a simple method to help you address ergonomics issues in your workplace.

III. **Improving Your Workplace.** Shows examples of ergonomic improvements. Offers suggestions to help set priorities, make informed choices, and determine whether your improvements are working effectively.

IV. **Resources.** Includes a problem-solving exercise. Presents basic information on musculoskeletal disorders, suggestions for getting help from a health care provider, and ergonomics references for further reading (including case studies and Internet web sites).

Note: This booklet *does not* cover ergonomics for the office environment (e.g., the use of video display terminals) or for construction or field agriculture. For a reference on office ergonomics, contact Cal/OSHA Consultation Service (1-800-963-9424) and ask for a copy of:

► *Four-Step Ergonomics Program for Employers with Video Display Terminal (VDT) Operators.* State of California, Department of Industrial Relations, Division of Occupational Safety and Health, Education and Training Unit, 1997.

For an additional reference on health issues related to the use of computers in the workplace, see the Resources section, page 79.

► The information in this booklet is intended to provide general guidance. There may be instances in which workplace issues are more complex than those presented here. You may need the advice of an ergonomics consultant or other outside experts.

► The content is intended to provide current information about workplace ergonomics. The field of ergonomics is dynamic, and new information is constantly being developed. Cal/OSHA will periodically update this publication to reflect changes.

NO ONE IS REQUIRED TO USE THE INFORMATION IN THIS BOOKLET. THIS BOOKLET IS **NOT** INTENDED TO PROVIDE EMPLOYERS WITH INFORMATION ON HOW TO COMPLY WITH CAL/OSHA REGULATIONS.

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Section I

How Ergonomics Can Help

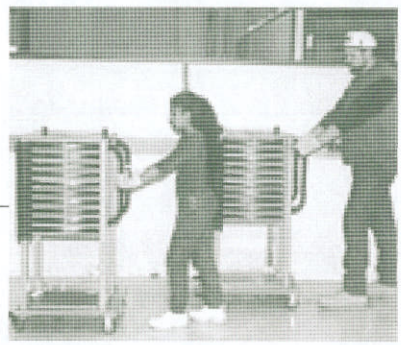
How Ergonomics Can Help

If work is performed in awkward postures or with excessive effort, fatigue and discomfort may be the result. Under these conditions muscles, tendons, ligaments, nerves, and blood vessels can be damaged. Injuries of this type are known as musculoskeletal disorders, or MSDs. MSDs can increase the cost of doing business both directly and indirectly. Direct costs may include medical services and higher workers' compensation premiums. Indirect costs from increased employee turnover, absenteeism, and retraining may also occur. Productivity, product quality, and employee morale may also suffer. Estimates indicate that the indirect costs associated with MSDs may be four to ten times higher than the direct costs.[1]

► You may ask, "What can our organization do to reduce or prevent costly MSDs and avoid the other problems mentioned above?" One answer is to use ***ergonomics*** in your workplace. Ergonomics is the study of how to improve the ***fit*** between the physical demands of the workplace and the employees who perform the work. That means considering the variability in human capabilities when selecting, designing, or modifying equipment, tools, work tasks, and the work environment. **Employees' abilities to perform physical tasks may vary because of differences in age, physical condition, strength, gender, stature, and other factors.**

[1] See Dan MacLeod, *The Ergonomics Edge: Improving Safety, Quality, and Productivity.* New York: Van Nostrand Reinhold, 1994

Differences in stature can mean the job is awkward for one employee but comfortable for the other .



Consider the differences in employees when improving the fit between the work and the employees who perform it.

► Improving the ***fit*** often involves a process of trial and error until a more effective and appropriate improvement is found. More often than not, maximizing the fit reduces injuries, increases productivity, saves money, and improves product quality and job satisfaction.

A Proactive Approach to Problem Solving

► You don't have to wait for a problem to find you before you address it. Being proactive helps you "get a jump" on solving problems. Taking a proactive approach in your workplace can be as simple as taking a look around, talking to employees, and asking questions such as these:

- Do employees have ideas about how to improve products and make their jobs less physically demanding and more efficient?
- Are employees working in comfortable postures—that is, with no significant fatigue and discomfort?

Remember, it is always best to:

- Take action as soon as you become aware of early warning signs (employee fatigue or discomfort, reports of problems, or high levels of absenteeism, etc.).
- Minimize factors that may contribute to musculoskeletal disorders at the ***design*** stage of the work process, if possible.

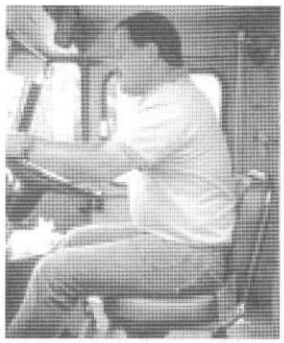
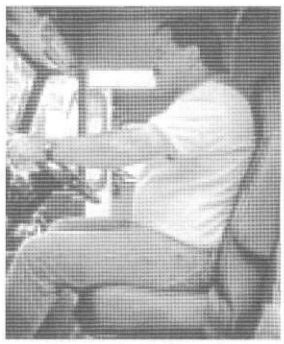
- Be proactive.
- Promote a healthy workplace.
- Save money.

► Early action is particularly important when addressing MSDs because they tend to be treatable and less expensive in the early stages but irreversible and very expensive later. For example, medical costs and workers' compensation claims for ***one*** serious back injury case can run up to or even exceed $85,000.

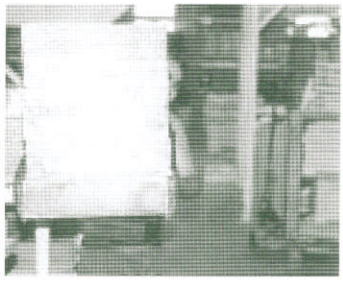
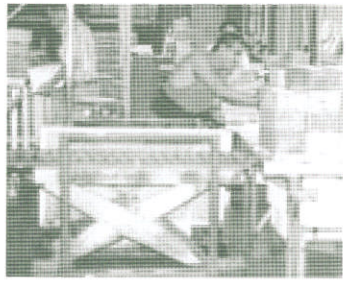
Employees discuss potential workplace improvements.

A pallet elevated by an employee makes moving the product easier.

► The following pictures illustrate some practical ways proactive employers and employees in California have improved their workplaces.

BEFORE	AFTER
	
Microscope workstation—leads to uncomfortable work posture with bending	*Height-adjustable computer monitor stand under the microscope allows comfortable, upright work posture for shorter and taller employees*
	
Seat too small with poor back support—leads to poor back and neck posture	*Larger, more comfortable adjustable seat with improved back support*
	
A physically demanding task in an awkward posture with a heavy tool	*A pull chain makes opening the valve easier*

Maximizing the *fit* reduces injuries, increases productivity, saves money, and improves product quality and job satisfaction.

BEFORE	AFTER
	
Lifting and carrying—leads to forceful exertions, awkward posture, and blocked vision	*Scissors lift replaces lifting and carrying with sliding and rolling*
	
Manual lifting of drums leads to forceful exertions	*Lift gate eliminates manual lifting and increases productivity—allows loading several drums at once*
	
Short handle on tool leads to bending and squatting—uncomfortable working posture	*Extended handle on tool allows upright, comfortable posture*

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Section II

Ergonomics and Your Workplace

Ergonomics and Your Workplace

Jobs are made up of tasks. Tasks are the things employees must do to accomplish their jobs. Put simply, ***tasks are the parts of a job.*** Some jobs may contain only a single task, but many jobs are made up of multiple tasks. Below are some examples:

Job	Tasks
Cabinet shop worker	Retrieving wood, feeding saw, stacking cut wood
Custodial worker	Emptying trash, dusting, vacuuming
Jewelry manufacturer	Waxing, cutting, finishing
Metal fabricator	Shaping bar stock, cutting, threading
Supermarket clerk	Stocking shelves, checking out groceries
Warehouse worker	Filling containers, shrink-wrapping, loading trucks

► Most work tasks involve movement and physical exertion. But how do you know—

- When repeated movements, forceful exertions, and other aspects of work tasks may lead to fatigue, symptoms of MSDs, and injuries?
- Why workplace problems are occurring (i.e., the reasons or root causes)?

► In short, how do you find out which work tasks may be causing problems and what to do about them? One possible way to help answer these questions is to become aware of workplace "contributing factors."

Workplace Contributing Factors

► Contributing factors are aspects of work tasks which can lead to fatigue, musculoskeletal disorder (MSD) symptoms and injuries, or other types of problems. These factors may be present in one or more of the tasks employees must perform to accomplish their jobs. The contributing factors you and your employees should be aware of include:

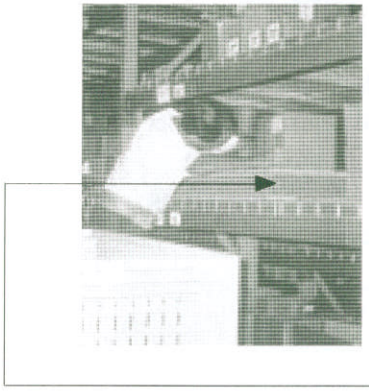
- Awkward postures
- Repetitive motions
- Forceful exertions
- Pressure points (e.g., local contact stress)
- Vibration

► There are also environmental factors associated with the workplace which can cause problems. Extreme high temperatures can increase the rate at which the body will fatigue. Alternatively, exposure of the hands and feet to cold temperatures can decrease blood flow, muscle strength, and manual dexterity. These conditions can also cause excessive grip force to be applied to tool handles or objects. Another problem may be caused by tools or equipment that exhaust cold or hot air directly onto the operator. In addition, the lighting in a workplace may be too dark or too bright for the work task. This may result in employees assuming awkward postures to accomplish work tasks and a loss of product quality.

Don't forget to consider the duration of work tasks.

► You should also be aware of the amount of time in a workday that employees spend performing physically demanding or repetitive tasks (i.e., the duration of tasks). Both the total time per work shift and the length of uninterrupted periods of work can be significant in contributing to problems. As repetitive motions, forceful exertions, and other contributing factors increase in work tasks, so does the recovery time (i.e., the length and frequency of muscle relaxation breaks) needed to help reduce fatigue and prevent injury.

► Finally, remember that it is important to uncover ***why*** (i.e., the reasons or root causes) the contributing factors are occurring in work tasks. The ***why*** is important because it allows you to fully understand the nature of the problem and eventually to come up with effective improvement options.



► The employee pictured here is bending and reaching to retrieve a part. The contributing factor is awkward posture (i.e., bending and reaching). The employee is bending and reaching because there is limited access. But why is the access limited? If you look closely, you will see that access is limited because a pallet was left on the shelf. The part the employee needs to retrieve was pushed behind the box on the pallet. **Therefore, the real *why* for the awkward posture is improper storage of a pallet loaded with boxes.**

Awkward Postures

Contributing factors:

- **Awkward postures**
- Repetitive motions
- Forceful exertions
- Pressure points
- Vibration

► Posture affects which muscle groups are active during physical activity. Awkward postures can make work tasks more physically demanding, by increasing the exertion required from smaller muscle groups, and preventing the stronger, larger muscle groups from working at maximum efficiencies. The increased exertion from the weaker, smaller muscle groups impairs blood flow and increases the rate of fatigue.

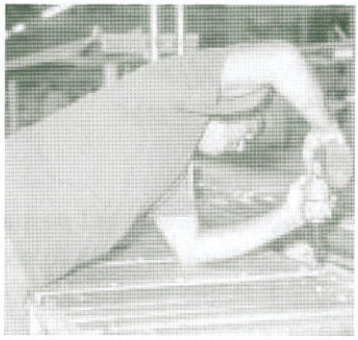
► Awkward postures typically include ***repeated or prolonged*** reaching, twisting, bending, working overhead, kneeling, squatting, and holding fixed positions or pinch grips. They may affect various areas of the body such as the hands, wrists, arms, shoulders, neck, back, and knees. The effects of awkward postures are worse if work tasks also involve repetitive motions or forceful exertions. Awkward postures may be caused by using poorly designed or arranged workstations, tools, and equipment and poor work practices.

Awkward postures include repeated or prolonged:

- Reaching
- Twisting
- Bending
- Working overhead
- Kneeling
- Squatting
- Holding of fixed positions
- Pinch grips

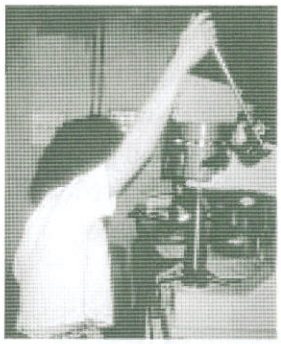
Work too low—bending, reaching, and twisting

Work too far away—extended reach

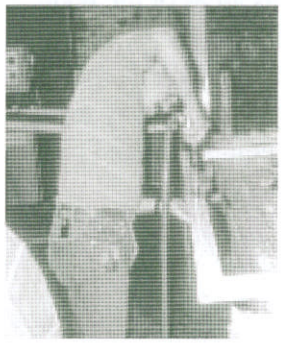


Lack of access or clearance—bending and awkward upper body posture

Awkward postures
(Continued)



Work too high—extended reach



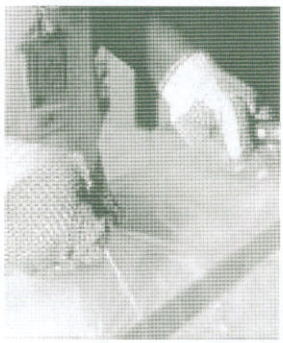
Using a pistol grip tool on a horizontal surface—awkward upper body posture and bent wrists

Using a hand tool—bent wrist

Using a hand tool—grip span too wide

Awkward postures may be caused by:

- Poorly designed or arranged workstations, tools, and equipment
- Poor work practices


Pinch grips

Visual Effort

► Sometimes employees assume awkward postures or experience eye strain and fatigue because it is hard for them to see their work. For example, when the lighting is bad, the work is too far away, or materials are blocking the field of vision, employees may have to bend, reach, twist, or hold fixed positions. Similarly, handling or assembling very small parts and materials or performing extremely precise tasks may contribute to eye strain and awkward postures.

Visual effort from precision task—fixed posture with bent neck

Visual effort—bent and twisted upper body posture

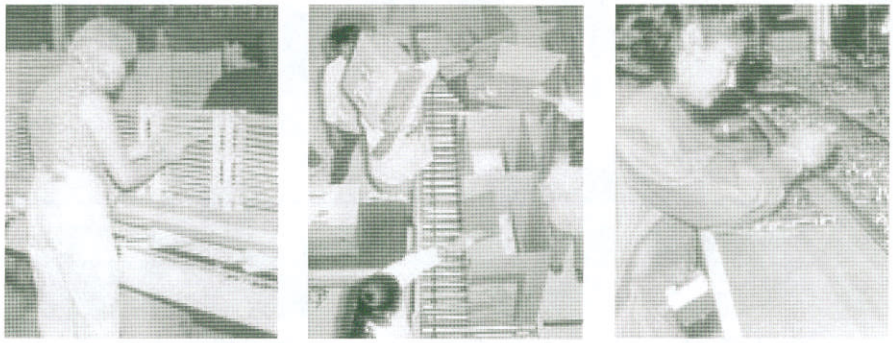
Repetitive Motions

Contributing factors:

- Awkward postures
- **Repetitive motions**
- Forceful exertions
- Pressure points
- Vibration

► In repetitive work the same types of motions are performed over and over again using the same muscles, tendons, or joints. The amount of repetition can be affected by the pace of work, the recovery time provided (i.e., number and length of muscle relaxation breaks), and the amount of variety in work tasks. The pace of work may be controlled by the employee performing the task, machines, other employees, or administrative procedures. Examples of jobs involving machine-controlled pace include working on assembly, packaging, or quality-control lines. Work tasks linked to performance or incentives are examples of administratively controlled pace.

Repetitive work tasks



Machine controlled pacing

► The risk of injury is greater when repetitious jobs involve awkward posture or forceful exertions. Injuries may also develop when highly repetitive jobs are combined with low-force exertions, such as in light assembly tasks involving the hands, wrists, elbows, and shoulders. For example, having to grip a cutting or trimming tool throughout the entire work task without being able to set it down momentarily to rest the hand.

Contributing factors:
- Awkward postures
- Repetitive motions
- ► **Forceful exertions**
- Pressure points
- Vibration

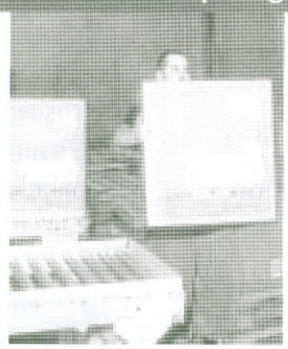
Forceful Exertions

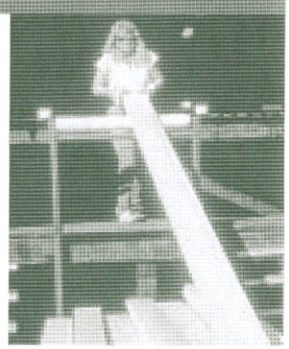
► Force is the amount of muscular effort expended to perform work. Exerting large amounts of force can result in fatigue and physical damage to the body. The amount of force exerted when moving or handling materials, tools, or objects depends on a combination of factors, including the:

- Load shape, weight, dimensions, and bulkiness
- Grip type, position, and friction characteristics
- Amount of effort required to start and stop the load when moving it (i.e., how physically demanding it is to accelerate or decelerate the load)
- Length of time ***continuous force*** is applied by the muscles (e.g., the amount of time the load or object is held, carried, or handled without a muscle relaxation break)
- Number of times the load is handled per hour or work shift
- Amount of associated vibration
- Body posture used
- Resistance associated with moving the load (e.g., over rough flooring or with poorly maintained equipment)
- Duration of the task over the work shift
- Environmental temperature
- Amount of rotational force (e.g., torque from tools or equipment)

Tasks requiring forceful exertions

Load too heavy





Heavy, bulky loads with no handles

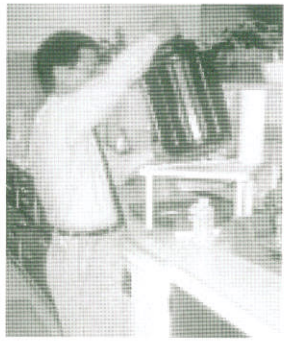
Tasks made more physically demanding by awkward postures

Bending and reaching—work too far away

Heavy load with no handles—pinch grip

Heavy hand tool—extended reach

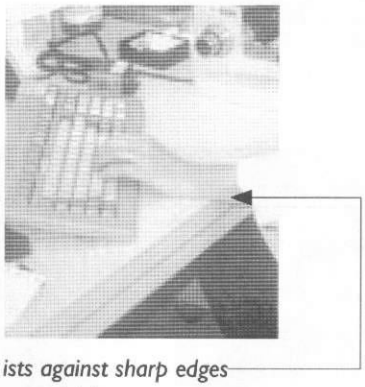
Heavy load with no handles—twisted upper body posture



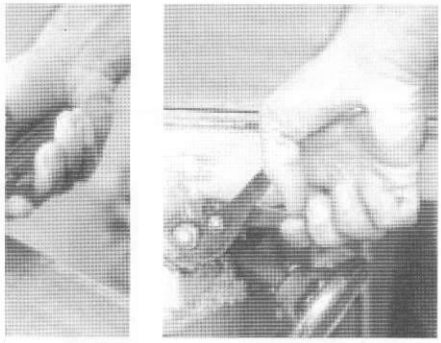
Reaching up—work too high

t stress)

pressing against hard or sharp
nore susceptible because nerves,
the skin and underlying bones.
gers, palms, wrists and forearms,



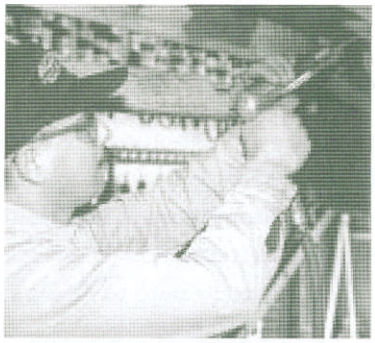
ists against sharp edges
ce or table



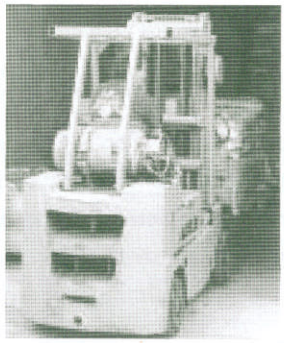
ndles digging into the palm and fingers

en it is continuous or of very high
sanders, grinders, chippers, routers,
ular saws can cause exposure to
roperly maintained or are inappro-
unt of hand-arm vibration. These
umbness, tingling, increased sensi-
to touch in the fingers, hands, and

Hand-arm vibration–vibrating sander



Hand-arm vibration–pneumatic chisle



Whole-body vibration

► Whole-body vibration commonly results from sitting or standing on work surfaces that vibrate. Examples of such surfaces include vibrating vehicles, equipment, and platforms. Whole-body vibration may be associated with general discomfort and lower back pain.

Final Thoughts on Contributing Factors

► As you and your employees become aware of contributing factors in your work tasks, keep in mind that it is still not known precisely:

- How many repetitions are too many.
- What degree of awkward posture is harmful.
- What duration of a task is too long.
- How much force is too much.
- What the effects are on individuals from combinations of these factors.

► Contributing factors are similar to speed limits. No one knows exactly at what speed people will get into accidents. We do know, however, that after a certain point, the faster you drive the more likely you are to have an accident and the more severe that accident is likely to be. Similarly, with workplace contributing factors we do not know exactly how much is "too much." ***Therefore, contributing factors should be minimized in work tasks as much as possible to prevent fatigue, pain, and disability.*** Finally, remember that activities outside the workplace can also contribute to the development or aggravation of MSDs.

Activities Outside the Workplace

Our bodies do not stop functioning when we go home from work. Home and recreational activities may also contain factors that contribute to MSDs or make them worse. These activities may be different from those at work, but the types of effects they have on the body (e.g., awkward postures, forceful exertions, or repetitive motions) may be the same. Activities that may contribute to MSDs include:

- Knitting
- Crocheting
- Playing musical instruments
- Playing recreational sports
- Using home computers
- Doing other work involving hard physical labor

Personal Factors

Keep in mind that personal factors, such as level of physical fitness, weight, diet, habits, and lifestyle, may also affect the development of MSDs. Also, various medical conditions may predispose individuals to MSDs or make the disorders worse. Examples include:

- Arthritis
- Bone and muscle conditions
- Contraceptive use
- Diabetes mellitus
- Pregnancy
- Previous trauma
- Thyroid problems

In addition, psychosocial factors may have an impact on MSDs. These factors include:

- Level of stress
- Level of job security and satisfaction
- Amount of autonomy on the job (e.g., degree of control over the arrangement of work areas or the pace of work)

Develop Your "Ergo Eye"

You and your employees may feel you want some practice at identifying contributing factors before you go into your workplace to address potential problems. If you would like some practice, review Section III, "Improving Your Workplace," then try the Problem-Solving Exercise in the Resources section (pp. 56–71).

Ergonomics Job Analysis Methods

► There are many different types of ergonomics job analysis methods. These methods consist of various techniques for taking a systematic look at jobs and work tasks. They help you decide which jobs and specific tasks may contribute to problems. Once you know where problems may exist, it is easier to come up with ideas for making improvements.

► Some methods are relatively simple, and others require detailed analysis and sophisticated equipment. Checklists are generally a simpler, less comprehensive type of ergonomics job analysis method. More comprehensive methods break jobs down into specific movements (e.g., reach, grasp, place) or use other complicated techniques.

► Ergonomics job analysis methods also vary according to what types of work activities they address. Some focus on workstation design. Others are more specific to certain types of work (e.g., manual materials handling or the office environment) or focus on the work environment (e.g., lighting, cold exposures). See the Resources section (pp. 76–82) for references on methods that are more comprehensive than the checklist provided here.

Ergonomics Awareness Checklist

► The purpose of this checklist is to increase your ***basic awareness*** of potential problems associated with jobs and their tasks. This awareness can help provide clues on how to make effective improvements. Be sure to read through the following information completely (including "A Note of Caution") before trying to use the "Ergonomics Awareness Checklist" in your workplace.

Using the "Ergonomics Awareness Checklist"—As Easy as 1, 2, 3

The "Ergonomics Awareness Checklist" was designed to be easy to use. Just follow three simple steps:

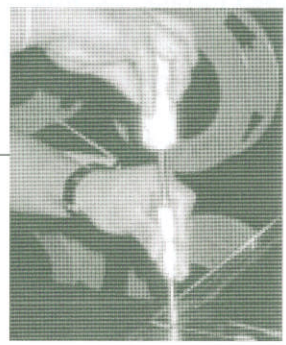
1. Look for clues.
2. Prioritize the tasks in each job.
3. Observe the work.

1 *Look for clues.* Try to find out which *jobs* may be causing problems. You can do this by looking around your workplace, talking to employees, and becoming aware of early warning signs, such as:

- Employee fatigue or discomfort
- Employees restricting their movements or range of motion because of fatigue or discomfort (e.g., a stiff neck, sore shoulder, or backache)
- **Employees modifying tools, equipment, or workstations on their own**
- High absenteeism or employee turnover rates
- Poor product or service quality
- High error rates or waste of materials
- Customer complaints
- Production bottlenecks
- Employee reports of problems

► You can also review your written records (e.g., OSHA Log 200, past employee reports, and workers' compensation information).

Examples of employee-modified workstations—"footrests" (i.e., boxes) help relieve back strain and pressure on the back of the knees



Examples of employee-modified tools or equipment—"padded" handles (i.e., tape added) reduce pressure points on the palms and fingers

► Based on the clues you found, list the *jobs* you want to look at on a separate piece of paper.

2 *Prioritize the tasks in each job.* For each job you noted in step 1, use the work sheets on this page to list and prioritize the tasks in that job. Make additional copies for each job you plan to look at.

Job title: _____

The **tasks** in this job are:

_____

_____

_____

_____

_____

► Now, for ***each task*** you have noted for this job, ask the employee(s) performing the work the following questions:

How hard is this task?	Score	How often is this task done?	Score
Very easy	1	Seasonally (a few times a year)	1
Easy	2	Occasionally (a few times a shift or week)	2
Somewhat hard	3	Frequently (up to 4 hours per shift)	3
Hard	4	Constantly (more than 4 hours per shift)	4
Very hard	5	Extended hours (more than 8 hours per shift)	5

► Next, give ***each task*** listed a score and multiply the two scores together to get a total for the task.

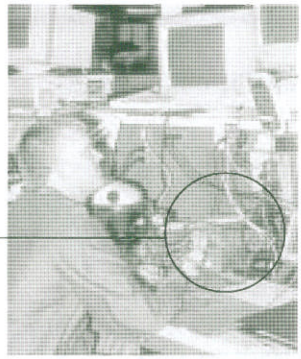
Tasks	Score for "how hard"	x	Score for "how often"	=	Total score for the task

Make copies as needed.

3 *Observe the work.* The Ergonomics Awareness Checklist provided on page 25 is designed for use while observing employees performing their work. ***Observe only one job at a time, using one complete copy of the checklist for each job.*** Use additional sheets if there are more than five tasks in any one job. Make copies of the checklist for as many jobs as you plan to observe.

- ***Look at each task in the job separately.*** Begin with those tasks assigned the highest total score. Any tasks that are "very hard" (i.e., score of 5) should automatically be looked at because they might contribute to fatigue and injury even if they are performed very rarely (e.g., on a seasonal basis). For each task, list the contributing factors you observe and the *reasons* for them.

Example



In this photo the employee is experiencing neck strain from bending his neck backward. Why is the employee bending his neck backward? You can see that the monitor he is looking at is too high. But why is the monitor too high? A close look at the situation provides the answer. You will notice that equipment is located below the shelf holding the monitor; therefore, the shelf cannot be lowered. The real ***why*** for the visual effort and awkward neck posture is a lack of workspace for equipment at this workstation.

Note: If you look closely, you will also see a pressure point from resting the right elbow on the work surface.

- Talking to the employees who actually perform the work can often provide valuable information about why tasks are hard and how they may be improved. Also, remember it is important to carefully observe all of the tasks in a given job because each of them may contain contributing factors. Musculoskeletal disorders can be associated with a combination of contributing factors in multiple tasks.

► When you have finished looking at your work tasks, save the checklist results. These results can be useful when considering ergonomic improvements and evaluating the effectiveness of changes you decide to make.

A Note of Caution

► The "Ergonomics Awareness Checklist" may not be the best method for addressing your particular workplace problem. You may need more sophisticated methods for addressing your workplace MSDs. If you feel uncomfortable using the checklist, or if problems seem complicated, severe, or widespread, you probably need additional help. You may contact the following sources:

- Cal/OSHA Consultation Service
- Ergonomics consultants or other outside experts
- Ergonomics equipment vendors
- Peers in your industry
- Trade associations/industry groups
- Unions or employee organizations

► For more help, see the Resources section (pp. 55–82). Finally, remember that the "Ergonomics Awareness Checklist" was not designed to be used for jobs at computer workstations.

Notes

Ergonomics Awareness Checklist

Job Title: _____ Job Location: _____

Name of Employee: _____

Name of Observer: _____ Date: _____

Contributing Factor Descriptions

- ***Awkward postures***–Repeated or prolonged reaching, twisting, bending, working overhead, kneeling, squatting, holding fixed position, or pinch grips
- ***Repetition***–Performing the same types of motions over and over again using the same muscles, tendons, or joints
- ***Forceful exertion***–The amount of muscular effort expended to perform work
- ***Pressure points*** *(local contact stress)*–The body pressing against hard or sharp surfaces
- ***Vibration***–Continuous or high-intensity hand–arm or whole-body vibration
- ***Other factors***–Extreme high or low temperatures; lighting too dark or too bright

➧ For each task list the contributing factor(s) you observe and the reasons for them.

Contributing Factors (CF)	*Reason for CF*	*Comments*
Task 1 _____		**Total score** _____
Task 2 _____		**Total score** _____

Make copies as needed.

Ergonomics Awareness Checklist *(Continued)*

Contributing Factors (CF)	*Reason for CF*	*Comments*
Task 3 _____		**Total score** _____
Task 4 _____		**Total score** _____
Task 5 _____		**Total score** _____

Make copies as needed.

Section III

Improving Your Workplace

Improving Your Workplace

With your "Ergonomics Awareness Checklist" results in hand, you may decide to improve your workplace. Before you begin, look at the following basic information designed to help you and your employees answer some relevant questions:

- What are ergonomic improvements?
- Which tasks should we try to improve first?
- How do we make informed choices about ergonomic improvements?
- How do we know if our improvements are working?

What Are Ergonomic Improvements?

Ergonomic improvements are changes made to improve the "fit" between a job and the capabilities of the employees performing it. They are commonly grouped into three categories:

- Engineering improvements
- Administrative improvements
- Safety gear

Engineering improvements include rearranging, modifying, redesigning, or replacing:

- Tools,
- Equipment,
- Workstations,
- Packaging,
- Parts, or
- Products.

Engineering Improvements

Engineering improvements include rearranging, modifying, redesigning, or replacing tools, equipment, workstations, packaging, parts, or products. These improvements can be very effective because they may reduce or eliminate the underlying reasons for contributing factors. The best time to select engineering improvements is when new facilities, processes, or work procedures are being planned. For examples of engineering improvements, look at the following pictures (pp. 29–39) and the references in the Resources section (pp. 76–82).

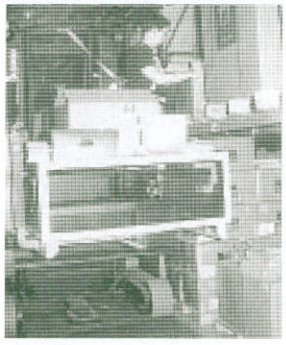
Improvement Options for Workstations

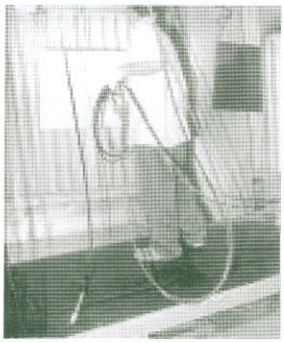
Raise or lower the work surface or the employee—reduces bending, reaching, and awkward postures.

Raise the work surface

Adjustable work surface

Scissors lift





Adjustable work platforms

A rule of thumb

A rule of thumb is to try to keep your hands at about elbow height when working. Suggested heights (in inches) above the floor ***for the hands*** while working are as follows:

Seated Work

- Light assembly tasks, *24–28*
- Writing and reading, *26–31*
- Fine visual work, *31–44*

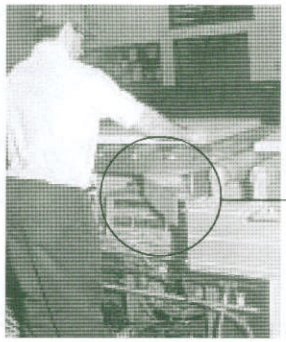
Standing Work

- Heavy work, *28–37*
- Light assembly, *34–38*
- Precision work, *38–46*

Improvement Options for Workstations

Use cut-out work surfaces—allows employees to get closer to their work, reducing visual effort and awkward postures.

Seated work



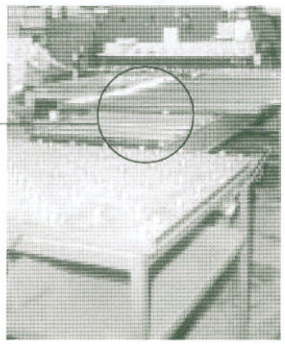
Standing work

Reposition the work—reduces bending and reaching.

Pop-up table

A-frame

Reconfigure the workstation—sliding and rolling replaces lifting and carrying.



Roller conveyor and roller ball tables

Roller ball tables

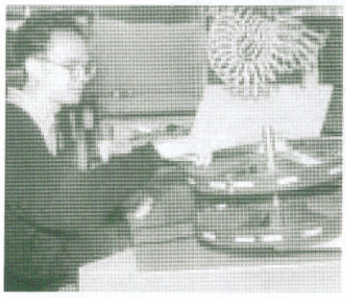
Improvement Options for Workstations

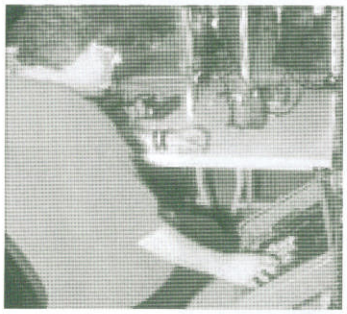
Use adjustable equipment—allows comfortable, upright working posture.

Microscope adjusts horizontally and vertically.

Work surface, chair, and shelves all adjust easily.

Provide close, convenient storage for frequently used materials, parts, or tools—reduces reaching and awkward postures.





A rule of thumb

A rule of thumb for maximum reach distances for frequently used items is as follows:

Seated Work

- 15 inches from the employee
- 10 inches above the work surface

Standing Work

- 14 inches from the employee for two-handed tasks
- 18 inches from the employee for one-handed tasks

Note: Reach distances for standing work apply to tasks (other than lifting) performed within the "general safety zone" between the hips and shoulders. For lifting tasks see pages 41 and 42.

Improvement Options for Workstations

Provide comfort.

Foot rests reduce pressure behind the knees and reduce strain on the lower back.

Padding reduces pressure points on the forearm and knees.

Good task lighting reduces eyestrain and makes work tasks easier.

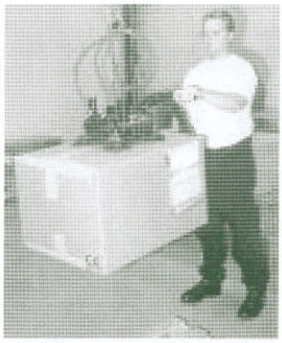
Be innovative.

Slippery coatings on work surfaces (ultra-high molecular weight polyethylene) reduce the force necessary to slide materials or products. ***Note clamps for holding material or parts in place when needed.***

Improvement Options for Movement of Materials

Lifting

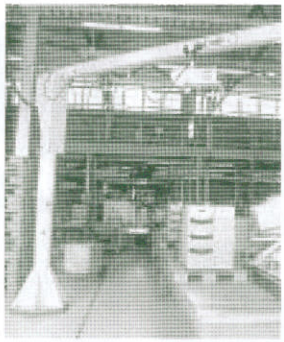
Lifting aids reduce force, repetition, and awkward postures in lifting or handling tasks



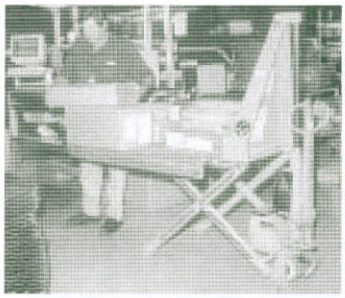
Vacuum-assist devices

Manipulators

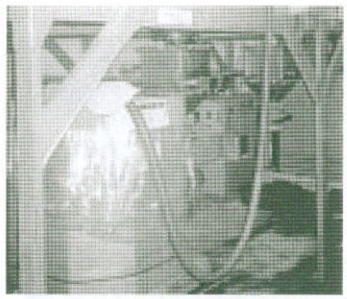
Powered mechanical lift



Workstation crane for heavy loads



Mobile scissors lift



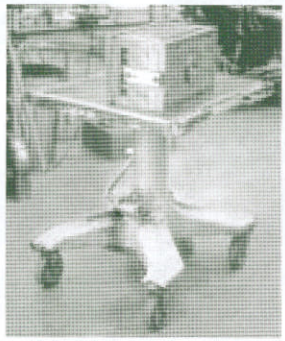
Automatic feed systems reduce lifting and materials handling

Improvement Options for Movement of Materials

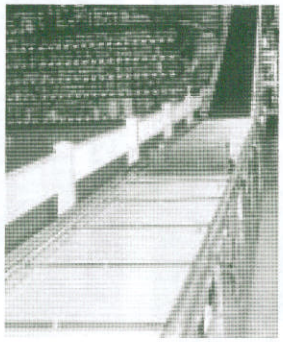
Transporting

Mechanical aids reduce force, repetition, and awkward postures in transporting materials and products around the workplace.

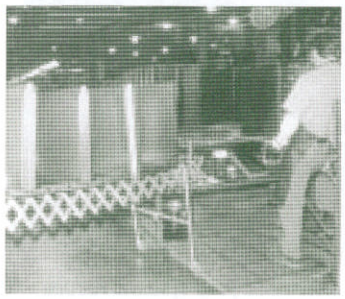
Adjustable carts and carriers



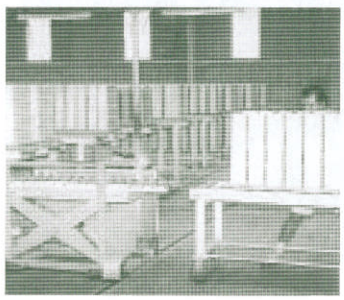
Height-adjustable cart for heavy loads



Powered conveyors



Portable roller conveyor—eliminates carrying of products between workstations



Roller conveyors on a cart and scissors lift—replaces lifting and carrying with rolling and sliding

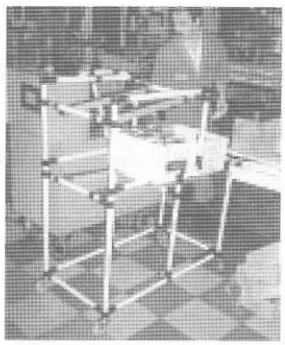
Transporting *(Continued)*

Powered transport for longer distances

Improvement Options for Storage and Retrieval of Materials

Provide adequate, well-lit storage with easy access for employees—reduces repetitive reaching, bending, twisting, and forceful exertions.

Mobile, lightweight storage carts with adjustable trays

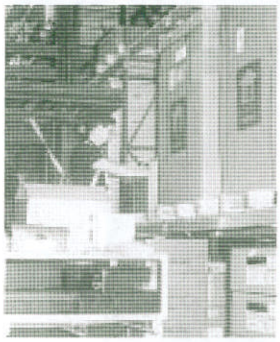


Tilted container with step for easier access

Lift adjusted to waist height for easy loading of containers onto a gravity flow rack

Storage of Materials
(Continued)

Increase the efficient use of storage space by grouping stored items by container size or shape.



Larger containers

Small containers

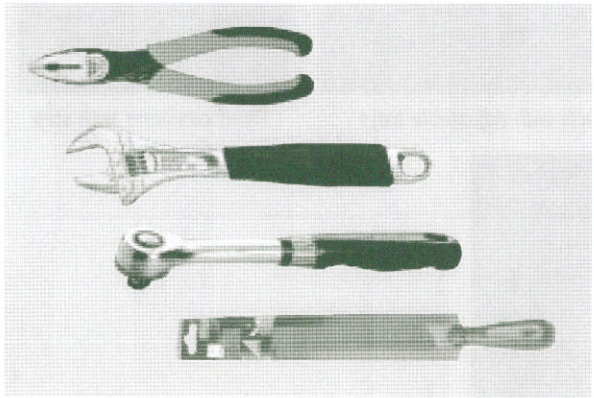
Rolls

Improvement Options for Tools

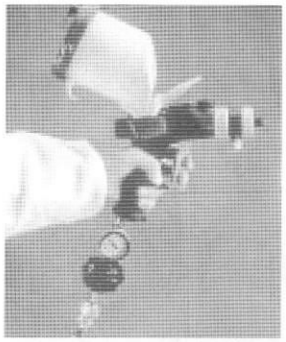
Good design and proper maintenance can help reduce pressure points on the hands, awkward postures (e.g., bent wrists), forceful exertions, and other contributing factors.

Handles

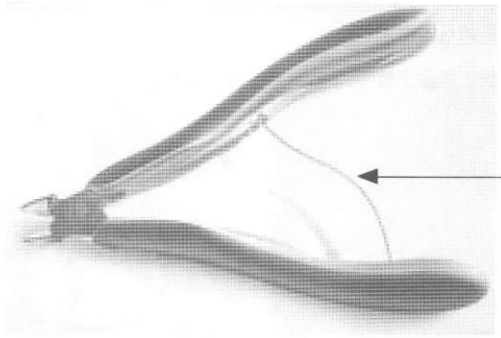
- Rounded, soft, and padded—no sharp edges or deep grooves (reduces pressure points on fingers and hands)
- At least 1 to 2.5 inches in diameter (allows a power grip) and 5 inches long (do not dig into palms)
- High-friction surfaces or moldable substances may be added to handles to improve the grip



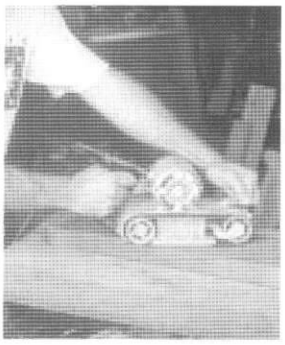
Tools–Handles *(Continued)*

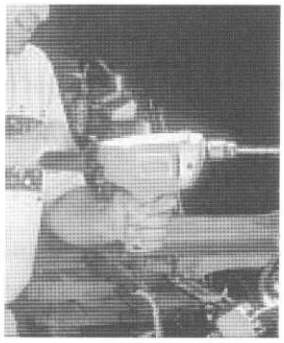


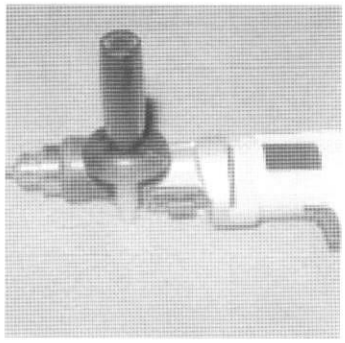
Well-balanced tool (sprayer) with a swivel connector for hoses



Pliers or cutting-type tools—a maximum grip span of 2 to 3 inches and an adjustable spring return to reduce fatigue and provide a better fit to the hand.

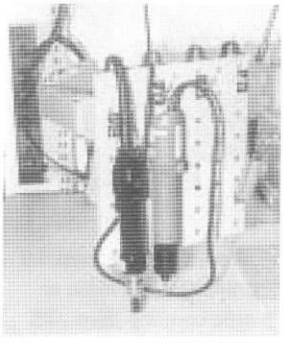






Two handles help to improve control

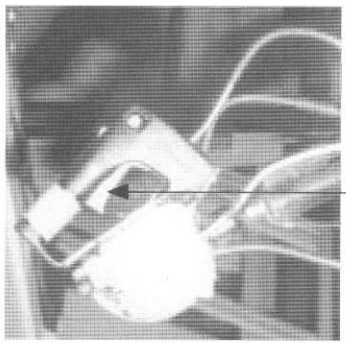
► Triggers



Triggerless tools—contact switches replace triggers

Triggerless infra-red scanner

Multifinger trigger



Trigger bar with low activation forces

Fixtures

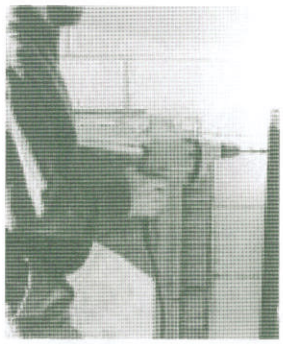
Reduce forceful exertions by supporting the weight of the tool

Other Ideas

Look for tools with the appropriate design, such as:

- The right orientation for the work (e.g., horizontal versus vertical surfaces)
- Reduced weight, impact, and vibration
- Padding or other useful additions to the handles (e.g., extensions)
- The cold or hot air exhausted away from the operator
- Torque shock controls (torque arms, reaction bars, etc.)

In-line tool—can be used with a straight wrist on horizontal *surfaces*



Pistol-grip tool—can be used with a straight wrist on vertical *surfaces*

A dead-blow type hammer (composed of a nylon or plastic covering filled with metal shot)—reduces impact and contact stress from metal-on-metal hammering

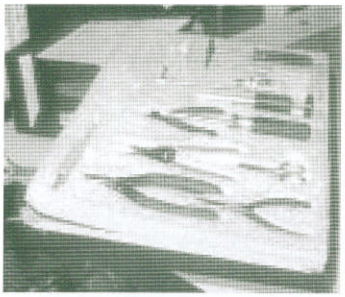
Tools—Other Ideas
(Continued)

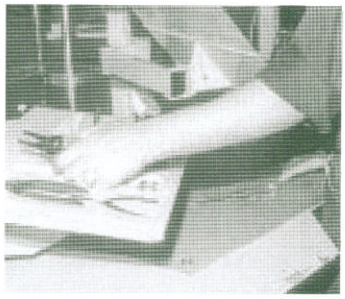
Padded handles—reduce pinch grip and pressure points on the fingers

Disk added to handle—reduces grip force needed to hold and use the roller

Extended handle reduces bending and reaching to move parts

Storage





Foam tool pad on adjustable tray—employees cut out the foam and arrange their own tools. Reduces reaching for frequently used tools and eases pressure points on the hands and fingers

Vibration Reduction

Ways to reduce hand-arm and whole-body vibration

- Routine maintenance
- Vibration-dampening wraps on handles
- Isolating the tool from the operator
- Properly fitting vibration-dampening gloves
- Good design of an alternate or low-vibration tool
- Suspending or supporting tools (e.g., by a fixture)
- Providing vibration isolators (e.g., springs or pads) for seated work tasks
- Providing cushioned floor mats for standing work tasks
- Mounting equipment and work platforms on vibration-dampening pads or springs
- Altering the speed or motion of tools and equipment

Administrative Improvements

Administrative improvements include changing work practices or the way work is organized. They may not address the reasons for the contributing factors or other problems. Administrative improvements usually require continual management and employee feedback to ensure that the new practices and policies are effective.

Administrative Improvement Options

- Providing variety in jobs
- Adjusting work schedules and work pace
- Providing recovery time (i.e., muscle relaxation time)
- Modifying work practices
- Ensuring regular housekeeping and maintenance of work spaces, tools, and equipment
- Encouraging exercise

Providing variety in jobs

There are a couple of ways to increase variety in jobs. *Job rotation* means rotating employees through different jobs. *Job enlargement* means increasing the variety by combining two or more jobs or adding tasks to a particular job. To be effective, both of these improvements rely on rotating through or combining jobs and tasks which differ in the:

- Muscles or body parts used
- Working postures
- Amount of repetition
- Pace of work
- Amount of physical exertion required
- Visual and mental demands
- Environmental conditions

Adjusting work schedules and work pace

Try to limit the amount of time any employee has to spend performing a "problem job." If you have new employees or employees returning from long absences, introduce them to a normal work pace and workload gradually, like an athlete in spring training.

ERROR: interrupt
OFFENDING COMMAND: interrupt

STACK:

47

Resource ID 6981

Easy Ergonomics: A Practical Approach
for Improving the Workplace