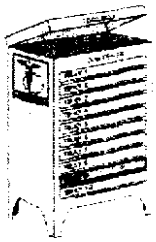


TRAY 9
PROACTIVE ERGONOMICS

PROACTIVE ERGONOMICS

Ergonomics focuses on the interactions between work demands and worker capabilities. The goal is to achieve those interactions between the work and the worker that will optimize productivity and, at the same time, preserve the safety and health of the workforce. This primer, and the manuals mentioned earlier in the main text and listed in Tray 10–A of the Toolbox, indicate various job and workplace recommendations that would assist in meeting this goal. According to this literature, certain sets of design principles govern workstation layout (Tray 9–A), task design (Tray 9–B), handtool selection (Tray 9–C), and manual materials handling (Trays 9–D, 9–E, 9–F). These principles can aid employers in reducing the risk of work-related musculoskeletal disorders. They offer ideas for correcting existing problems as well as preventing other problems when new production processes or job operations are planned. It is a matter of timing. Proactive ergonomics, by stressing these principles at the early design stages of developing work processes and job tasks, avoids the difficulty of finding retrofit solutions and any economic and human costs associated with an after-the-fact approach.

Tray 9–A. General Workstation Design Principles*

1. Make the workstation adjustable, enabling both large and small persons to fit comfortably and reach materials easily.

2. Locate all materials and tools in front of the worker to reduce twisting motions. Provide sufficient work space for the whole body to turn.

3. Avoid static loads, fixed work postures, and job requirements in which operators must frequently or for long periods

   — lean to the front or the side,
   — hold a limb in a bent or extended position,
   — tilt the head forward more than 15 degrees, or
   — support the body's weight with one leg.

4. Set the work surface above elbow height for tasks involving fine visual details and below elbow height for tasks requiring downward forces and heavy physical effort.

5. Provide adjustable, properly designed chairs with the following features

   — adjustable seat height,
   — adjustable up and down back rest, including a lumbar (lower-back) support,
   — padding that will not compress more than an inch under the weight of a seated individual, and a
   — chair that is stable to floor at all times (5-leg base).

6. Allow the workers, at their discretion, to alternate between sitting and standing. Provide floor mats or padded surfaces for prolonged standing.

7. Support the limbs: provide elbow, wrist, arm, foot, and back rests as needed and feasible.

8. Use gravity to move materials.

9. Design the workstation so that arm movements are continuous and curved. Avoid straight-line, jerking arm motions.

10. Design so arm movements pivot about the elbow rather than around the shoulder to avoid stress on shoulder, neck, and upper back.

11. Design the primary work area so that arm movements or extensions of more than 15 in. are minimized.

12. Provide dials and displays that are simple, logical, and easy to read, reach, and operate.

13. Eliminate or minimize the effects of undesirable environmental conditions such as excessive noise, heat, humidity, cold, and poor illumination.

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP, Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Tray 9–B. Design Principles for Repetitive Hand and Wrist Tasks*

1. Reduce the number of repetitions per shift. Where possible, substitute full or semi-automated systems.

2. Maintain neutral (handshake) wrist positions:

   - Design jobs and select tools to reduce extreme flexion or deviation of the wrist.
   - Avoid inward and outward rotation of the forearm when the wrist is bent to minimize elbow disorders (i.e., tennis elbow).

3. Reduce the force or pressure on the wrists and hands:

   - Wherever possible, reduce the weight and size of objects that must be handled repeatedly.
   - Avoid tools that create pressure on the base of the palm which can obstruct blood flow and nerve function.
   - Avoid repeated pounding with the base of the palm.
   - Avoid repetitive, forceful pressing with the finger tips.

4. Design tasks so that a power rather than a finger pinch grip can be used to grasp materials. Note that a pinch grip is five times more stressful than a power grip.

5. Avoid reaching more than 15 in. in front of the body for materials:

   - Avoid reaching above shoulder height, below waist level, or behind the body to minimize shoulder disorders.
   - Avoid repetitive work that requires full arm extension (i.e., the elbow held straight and the arm extended).

6. Provide support devices where awkward body postures (elevated hands or elbows and extended arms) must be maintained. Use fixtures to relieve stressful hand/arm positions.

7. Select power tools and equipment with features designed to control or limit vibration transmissions to the hands, or alternatively design work methods to reduce time or need to hold vibrating tools.

8. Provide for protection of the hands if working in a cold environment. Furnish a selection of glove sizes and sensitize users to problems of forceful overgripping when worn.

9. Select and use properly designed hand tools (e.g., grip size of tool handles should accommodate majority of workers).

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Tray 9–C. Handtool Use and Selection Principles*

1. Maintain straight wrists. Avoid bending or rotating the wrists. Remember, bend the tool, not the wrist. A variety of bent-handle tools are commercially available.

2. Avoid static muscle loading. Reduce both the weight and size of the tool. Do not raise or extend elbows when working with heavy tools. Provide counter-balanced support devices for larger, heaver tools.

3. Avoid stress on soft tissues. Stress concentrations result from poorly designed tools that exert pressure on the palms or fingers. Examples include short-handled pliers and tools with finger grooves that do not fit the worker's hand.

4. Reduce grip force requirements. The greater the effort to maintain control of a handtool, the higher the potential for injury. A compressible gripping surface rather than hard plastic may alleviate this problem.

5. Whenever possible, select tools that use a full-hand power grip rather than a precision finger grip.

6. Maintain optimal grip span. Optimum grip spans for pliers, scissors, or tongs, measured from the fingers to the base of the thumb, range from 6 to 9 cm. The recommended handle diameters for circular-handle tools such as screwdrivers are 3 to 5 cm when a power grip is required, and 0.75 to 1.5 cm when a precision finger grip is needed.

7. Avoid sharp edges and pinch points. Select tools that will not cut or pinch the hands even when gloves are not worn.

8. Avoid repetitive trigger-finger actions. Select tools with large switches that can be operated with all four fingers. Proximity switches are the most desirable triggering mechanism.

9. Isolate hands from heat, cold, and vibration. Heat and cold can cause loss of manual dexterity and increased grip strength requirements. Excessive vibration can cause reduced blood circulation in the hands causing a painful condition known as white-finger syndrome.

10. Wear gloves that fit. Gloves reduce both strength and dexterity. Tight-fitting gloves can put pressure on the hands, while loose-fitting gloves reduce grip strength and pose other safety hazards (e.g., snagging).

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Tray 9–D. Design Principles for Lifting and Lowering Tasks*

1. Optimize material flow through the workplace by

   — reducing manual lifting of materials to a minimum,
   — establishing adequate receiving, storage, and shipping facilities, and
   — maintaining adequate clearances in aisle and access areas.

2. Eliminate the need to lift or lower manually by

   — increasing the weight to a point where it must be mechanically handled,
   — palletizing handling of raw materials and products, and
   — using unit load concept (bulk handling in large bins or containers).

3. Reduce the weight of the object by

   — reducing the weight and capacity of the container,
   — reducing the load in the container, and
   — limiting the quantity per container to suppliers.

4. Reduce the hand distance from the body by

   — changing the shape of the object or container so that it can be held closer to the body, and
   — providing grips or handles for enabling the load to be held closer to the body.

5. Convert load lifting, carrying, and lowering movements to a push or pull by providing

   — conveyors,
   — ball caster tables,
   — hand trucks, and
   — four-wheel carts.

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Tray 9–E. Design Principles for Pushing and Pulling Tasks*

1. Eliminate the need to push or pull by using the following mechanical aids, when applicable:

   - Conveyors (powered and non-powered)
   - Powered trucks
   - Lift tables
   - Slides or chutes

2. Reduce the force required to push or pull by

   — reducing side and/or weight of load;
   — using four-wheel trucks or dollies;
   — using non-powered conveyors;
   — requiring that wheels and casters on hand-trucks or dollies have (1) periodic lubrication of bearings, (2) adequate maintenance, and (3) proper sizing (provide larger diameter wheels and casters);
   — maintaining the floors to eliminate holes and bumps: and
   — requiring surface treatment of floors to reduce friction.

3. Reduce the distance of the push or pull by

   — moving receiving, storage, production, or shipping areas closer to work production areas, and
   — improving the production process to eliminate unnecessary materials handling steps.

4. Optimize the technique of the push or pull by

   — providing variable-height handles so that both short and tall employees can maintain an elbow bend of 80 to 100 degrees,
   — replacing a pull with a push whenever possible, and
   — using ramps with a slope of less than 10%.

*Adapted from design checklists developed by Dave Ridyard. CPE, CIH. CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Tray 9–F. Design Principles for Carrying Tasks*

1. Eliminate the need to carry by rearranging the workplace to eliminate unnecessary materials movement and using the following mechanical handling aids, when applicable:

    - Conveyors (all kinds)
    - Lift trucks and hand trucks
    - Tables or slides between workstations
    - Four-wheel carts or dollies
    - Air or gravity press ejection systems

2. Reduce the weight that is carried by

    — reducing the weight of the object,
    — reducing the weight of the container,
    — reducing the load in the container, and
    — reducing the quantity per container to suppliers.

3. Reduce the bulk of the materials that are carried by

    — reducing the size or shape of the object or container,
    — providing handles or hand-grips that allow materials to be held close to the body, and
    — assigning the job to two or more persons.

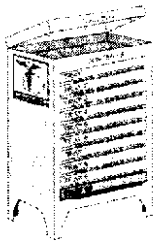
4. Reduce the carrying distance by

    — moving receiving, storage, or shipping areas closer to production areas, and
    — using powered and nonpowered conveyors.

5. Convert carry to push or pull by

    — using nonpowered conveyors, and
    — using hand trucks and push carts.

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.



TRAY 10
OTHER PRIMERS AND MANUALS

OTHER PRIMERS AND MANUALS

The Introduction to the main text mentioned several ergonomics primers and manuals. Some of these documents and selected ergonomics texts are listed in Tray 10–A. These documents, along with other reports already cited in the toolbox and located in the reference list at the end of the main text, can serve as added sources of information in addressing various ergonomics topics.

NIOSH staff can be helpful in identifying materials appropriate to your needs. Requests can be made by calling 1–800–35–NIOSH (1–800–356–4674). In addition, computer on-line services are available to access assorted ergonomic information. The Internet sites are:

ERGOWEB at htt://ergoweb.com/

NIOSH at http://www.cdc.gov/niosh/homepage.html

Tray 10–A. Other Selected Ergonomics Primers, Manuals, and Texts

General Ergonomics Manuals

Making the Job Easier—An Ergonomics Idea Book. [1988]; National Safety Council, 1121 Spring Lake Drive, Itasca, IL 60143–3201.

Ergonomics—A Basic Guide. [1988]; Canadian Center for Occupational Health and Safety, Hamilton, Ontario, Canada: L8N 1H6

Cumulative Trauma Disorders—A Manual for Musculoskeletal Diseases of the Upper Limbs. [1988]; Putz-Anderson V, ed.: Taylor and Francis Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.

Lessons For Lifting and Moving Materials. [1996]; Department of Labor and Industries, Division of Consultation and Compliance, P.O. Box 44610, Olympia, WA 98504–4610.

Creating the Ergonomically Sound Workplace. [1993]; Ostrom LT; Jossey-Bass Publishers, 350 Sansomee Street, San Francisco, CA 94104.

The Ergonomics of Workspaces and Machines—A Design Manual. [1995]; Corlett EN, Clark TS; Taylor & Francis, Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.

Industrial Ergonomics—A Practitioner's Guide. [1985]; Alexander DC, Pulat BM, eds.; Institute of Industrial Engineers, 25 Technology Park/Atlanta, Norcross, GA 30092.

Industry or Operation Specific Manuals

Ergonomics Program Management Guidelines for Meatpacking Plants. [1993]; Occupational Safety and Health Administration, U.S. Department of Labor, Washington, DC, OSHA Report No. 3123.

Stand, Lift, Carry—Back Care and Manual Materials Handling in Construction. [1993]; Construction Safety Association of Ontario, 74 Victoria Street, Toronto, Ontario, Canada M5C 2A5.

Ergonomics Awareness Manual. UAW Health and Safety Department, 8000 East Jefferson Avenue, Detroit, MI 48214.

Management Strategies for Preventing Strains and Sprains: A Guide to Practical Ergonomics. [1988]; American Meat Institute, P.O. Box 3556, Washington, DC 20007.

UAW—GM Ergonomics Handbook. [May 1990]; UAW-GM Center for Health and Safety, 29815 John R. Road, Madison Heights, MI 48071.

Tray 10–A (Continued). Other Selected Ergonomics Primers, Manuals, and Texts
Ergonomics Texts

Work-Related Musculoskeletal Disorders (WMSDs): A Reference Book for Prevention. [1995]; Kuorinka I, Forcier L, eds.; Taylor & Francis Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.

Occupational Ergonomics—Theory and Applications. [1996]; Bhattachrya A, McGlothlin JD, eds.; Marcel Dekker, Inc., 270 Madison Avenue, New York, NY 10016.

Ergonomic Design for People at Work. Vol 1. [1983]; Eastman Kodak Co., Van Nostrand Reinhold Company, 115 Fifth Avenue, New York, NY 10003

Ergonomic Design for People at Work. Vol 2. [1986]; Eastman Kodak Co., Van Nostrand Reinhold Company, 115 Fifth Avenue, New York, NY 10003

Fitting the Task to Man. [1982]; Grandjean E; Taylor and Francis Ltd, London, England.

Ergonomics—How to Design for Ease and Efficiency. [1994]; Kroemer K, Kroemer H, Kroemer-Elbert K; Prentice-Hall, Englewood Cliffs, NJ.

Ergonomic Interventions to Prevent Musculoskeletal Injuries in Industry. [1987]; American Conference of Governmental Industrial Hygienists, Lewis Publishers Inc.,121 S. Main St., Chelsa, MI 48118

Cumulative Trauma Disorders—Prevention, Evaluation, Treatment. [1997]; Erdil M, Dickerson OB, eds.; Van Nostrand Reinhold, 115 Fifth Avenue, New York, NY 10003.

Evaluation of Human Work. [1990]; Wilson JR, Corlett EN, eds.; Taylor & Francis Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.

*U.S. Government Printing Office: 1997 — 550-920