THINK **PREVENTION**

Industrial Ergonomic Design Checklist

A proactive approach to ergonomics emphasizes primary prevention of MSD through recognizing, anticipating and eliminating risk factors in the design and planning stages of new work processes.

Although evaluating and improving existing work task and process design is important, certainly **the most cost-effective approach to workplace ergonomics is to establish a robust proactive program**.

Can you answer "yes" to the following questions? If not, you have some work to do in making your ergonomic improvement process proactive.

- Have engineers responsible for work process design received special training on MSD prevention and ergonomics?
- Are the ergonomics specialist and/or ergonomics team involved in new process development and design?
- Do engineering specifications exist for new and modified equipment, jobs, and processes?
- Is ergonomics specification approval required prior to capital expenditure and/or implementing new work production processes?
- Are affected employees involved in the design process?
- Is consideration given to affected upstream and downstream production processes?

The following ergonomic design checklist is designed to help engineers and those involved in process design evaluate what is needed and should be considered for a good ergonomic workstation design.

Note: *This checklist is unable to anticipate all variables and complexities and all possible combinations of people, work tasks, equipment, and work environment. Please recognize these limitations. However, use of this ergonomic design checklist, along with an understanding of the principles of ergonomics, will give you guidance on workstation design to maximize productivity and minimize employee fatigue and discomfort that could eventually lead to an MSD.*

Lifting & Material Handling Design

- Can the vertical height of material handling be designed to be adjustable to the optimal handling heights for each worker? If not, are workers able to accomplish manual material handling tasks in an acceptable vertical range as determined by the NIOSH Lifting Equation?
- Are mechanical lifts and turntables used where feasible?
- If adjustability is not practical, are the material handling and lifting tasks performed in a vertical height above the knees and below shoulder level?
- Can the horizontal distance between initial and final points of lifting tasks be decreased? Or, can the start of the lift be moved closer to the worker's body? When reaches exceed 16", lifting and holding should be replaced with sliding if possible. Or, a mechanical lifting or assist device should be considered. If sliding or a mechanical assist is not feasible, the vertical height should be no greater than the optimal height. In many cases lowering the vertical height to the lower end of the acceptable vertical range can significantly reduce the stress on the arms when excessive reaching is required.
- Can the shape of any containers be changed to allow material handling with the load held close to the body?
- When objects are to be lifted and transferred between two points in the sagital plane (front to back), can the distance be adjusted to where no twisting without an opportunity to pivot is required? Critical distances are 24 to 48 inches; repeated lifting with 180 degree twisting and turning without foot pivoting should be avoided in this critical distance range.
- Can hoists, cranes, conveyors, work carts, or other types of material handling devices be used for transporting heavy and bulky components within and between workstations?

Workstation Design

- Can the worker be seated or can a sit/stand option be provided? Consider a seated or sit/stand workstation for high repetition and low force work with minimal reaching and movement requirements.

- ☐ Is the height of the work surface adjustable?
- ☐ For standing workstations, is the hand working height for normal assembly tasks between 36" and 48" (optimal fixed height = 42")?
- ☐ For standing workstations, is the hand working height for smaller precision assembly tasks between 40" and 52" (optimal fixed height = 46")?
- ☐ Can workers perform job demands with arms and elbows close to the body and wrists in a neutral position? Are there any physical obstructions that increase the reaching requirement?
- ☐ Are seated workers provided with a good ergonomic chair or stool with adjustability, lumbar support and swivel features?
- ☐ Can sustained static muscular work be avoided? Can elbow, wrist, arm, foot, and backrests be provided where needed to avoid static work?
- ☐ Are materials supplied in a logical sequence?
- ☐ Is there proper lighting for the task? Is task lighting provided where needed?
- ☐ Are anti-fatigue mats provided for standing workstations?
- ☐ Is the space adequate for the smallest and largest worker for reach and clearance?

Hand Tool Design

- ☐ Are hand tools operable with straight wrist position?
- ☐ Are hand tools powered where feasible?
- ☐ Are hand tools counter balanced if weight is excessive? (Power grip tools should weigh < 4.0 lb., precision grip tools should weigh < 1.0 lb.)
- ☐ Are hand tools equipped with handles shaped to contact as much of the hand and finger as possible? Do tools have a grip span between thumb and forefinger of less than three inches? (Optimal power grip span is 1.25 inches - 1.75 inches)
- ☐ Are hand tools designed to eliminate sharp edges or ridges that might impair circulation or exert pressure on the nerves, and to eliminate pinch points?

- Are hand tools designed to keep vibrations, torque, and “kick” within limits outlined in the Ergonomics Plus HAV evaluations and control guide?
- Are hand tools designed to direct any cold air exhaust away from the hand?
- Are hand tools designed to keep noise level within OSHA approved limits?

Visual Displays

- Is the display correctly located for good posture, easy arm and foot reach, and clear viewing for all workers?
- Can required data be easily and quickly obtained?
- Is data readily visible without requiring awkward head/neck postures?
- For standing workstations, is the top line of the screen within the acceptable range of 58” – 71” above the standing surface?
- For seated workstations, is the top line of the screen within the acceptable range of 35 – 46” above the floor surface?
- Is the viewing distance between 18” – 30”?
- Is the pointer simple and non-obstructive?
- Are displays located near its corresponding control?

Controls

- Are controls within easy operating reach and operable with good posture such as wrists neutral and elbows close to the body?
- Are push buttons or switches used repetitively for machine start cycle designed ergonomically to eliminate excessive force (greater than 3.4 lb.) and holding time (greater than 1.5 seconds)? If not, can the buttons or switches be replaced with a door switch? If not, can the buttons be replaced with an ergonomic cycle switch that requires no force to activate?
- Does the control design conform to function?

- ☐ Are levers used for continuous adjustment?
- ☐ Are hand controls used for precision and speed?
- ☐ Are foot controls used for power?
- ☐ Is the control function logical? For example, does the leftward control movement give leftward unit movement and vice versa?
- ☐ Do similar controls have similar functions?
- ☐ Are controls shape-coded for good grip and easy identification?
- ☐ Are controls consistent with population stereotypes?
- ☐ Are controls labeled clearly?
- ☐ Are controls color-coded between machines, operation, and departments?

Ergonomic Considerations from Head to Toe

Following are ergonomic considerations for different parts of the body, from head to toe. Each body part has its potential MSDs and ergonomic design principles for prevention.

Head / Neck

The nerves of the body enter the head through the neck. With such sensitive wiring passing through such a mobile structure, potential for problems is high.

Potential MSDs

- thoracic outlet syndrome
- tension neck syndrome
- cervical disc disease

Ergonomic Design Principles

A. Allow for tallest workers

B. Avoid forced forward head posture

C. Natural posture is to look down slightly

D. Avoid narrow viewing angles and visual obstructions

Shoulders

Shoulder MSDs are associated with postures that place heavy loads on its muscles and tendons. Since the arm provides a very long lever, holding even small loads in the hand with the arm held away from the body will quickly result in shoulder fatigue and discomfort, and place substantial stress on the tendons in the shoulder.

Potential MSDs

- rotator cuff tendonitis
- bicepital tenosynovitis
- frozen shoulder syndrome

Ergonomic Design Principles

A. Place items and parts between shoulders and waist height

B. Avoid reaches above shoulder and reduce any excessive reaching

C. Avoid greater than 45^{o} shoulder flexion and abduction

Elbows

The elbow is actually two different joints. It raises and lowers the arm (flexion and extension) and also acts as the pivot point for forearm rotation (pronation and supination). There are numerous vulnerable soft tissues (tendons, nerves, blood vessels) that pass though the elbow to reach the forearm and hand.

Potential MSDs

- lateral and medial epicondylitis
- radial tunnel syndrome
- cubital tunnel syndrome

Ergonomic Design Principles

A. Normal work (medium weights) work surface designed to just below elbow height

B. Precision work (light weights) raise surface above elbow height and provide upper extremity weight bearing support when possible

C. Heavy work place work surface 6-8" below elbow height

Wrist / Hand

The wrist is an incredibly mobile joint that contains numerous tendons, nerves, and blood vessels, which service the hand and are vulnerable to MSD.

Potential MSDs

- tendonitis
- carpal tunnel syndrome
- ganglion cysts
- trigger finger
- DeQuervain's

Ergonomic Design Principles

A. Maintain neutral posture

B. Avoid repeated or sustained flexion and ulnar deviation

C. Avoid repeated or sustained pinching and allow for small hands when designing gripping tasks and selecting hand tools

D. Allow plenty of access space for large hands

Lower Back

The back is a flexible curved column composed of a series of bones (vertebrae) separated by shock absorbing discs. The structure is held together by a large number of muscles and ligaments. Acting together, they give the spine the ability to bend and twist. The spine protects the spinal cord and acts as a distribution center for the nerves.

Potential MSDs

- degenerative disc disease
- fatigue strains (muscle or tendon) and sprains (ligaments)

Ergonomic Design Principles

A. Avoid repeated lifting that requires excessive forward bending

B. Avoid sustained forward bending

Legs

Very little research exists on the relationship between work activities and lower extremity MSDs. However, there are some MSDs associated with the legs, and ergonomic design principles that we should keep in mind.

Potential MSDs

- plantar fasciitis
- tarsal tunnel syndrome
- Tailor’s Bunion

Ergonomic Design Principles

A. Avoid foot actuation if possible

B. Avoid repeated walking up and down steps

C. Avoid mechanical stress on the legs

D. Allow for long legs

E. Provide adjustments or footrests for shorter legs for prolonged sitting