Easy Ergonomics:

A Guide to Selecting Non-Powered Hand Tools

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Research and Education Unit

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Centers for Disease Control and Prevention
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About This Booklet

The purpose of this booklet is to help you select or purchase the best available ergonomically designed non-powered hand tool. The information and the hand tool checklist are based on peer-reviewed articles and expert input. The checklist has been evaluated for reliability in identifying the presence or absence of basic ergonomic design features (Dababneh et al.*). The right tool will help you reduce your risk of injury, such as carpal tunnel syndrome, tendonitis, or muscle strain.

*Dababneh A, Lowe B, Krieg E, Kong Y, and Waters T, A Checklist for the Ergonomic Evaluation of Non-Powered Hand Tools, accepted for publication in the December 2004 issue of the Journal of Occupational and Environmental Hygiene.

Note: This booklet covers most ergonomic features that should be considered when selecting or purchasing hand tools, but does not cover all features. Specifically, it does not address tool weight, tool balance, vibration or tool maintenance.

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.

Foreword

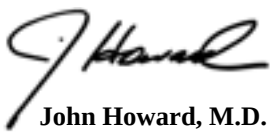
Non-powered hand tools are widely used in a variety of industries including construction, manufacturing, and agriculture. National data suggests that a large number of injuries known as musculoskeletal disorders are attributable to hand tool use in occupational settings, resulting in unnecessary suffering, lost workdays, and economic costs. Prevention of work-related musculoskeletal disorders is a high priority for both the National Institute for Occupational Safety and Health (NIOSH) and the California Occupational Safety and Health Administration (Cal/OSHA). Both agencies recognize the importance of design and selection of hand tools in strategies to reduce injuries of this type.

To the untrained eye, however, it may be difficult to evaluate tools from an ergonomic point of view. The purpose of this document is to demystify the process and help employers and workers identify non-powered hand tools that are less likely to cause injury--those that can be used effectively with less force, less repeated movement, and less awkward positioning of the body. Presented here are the ergonomic basics of hand tool use. These principles are meant to complement the ordinary process of deciding on what tool to select by knowing how it is used and the task to which it will be applied.

The reasonable and common-sense approaches outlined in this document can be directly applied to challenges like these:

- deciding whether to stay with traditional tool designs or opt for new designs
- evaluating the effectiveness of different designs
- choosing a tool of the right size and shape for the task and the user

This document also contains an easy-to-use checklist for comparing tools against several design characteristics that have been shown to reduce physical stresses on the user. We hope this checklist and the accompanying background material will be of practical use to all who wish to select tools that get the job done more safely, comfortably, and productively.



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Is this an ergonomic hand tool?

You be the judge . . .

Some tools are advertised as “ergonomic” or are designed with ergonomic features. A tool becomes “ergonomic” only when it fits the task **you** are performing, and it fits **your** hand without causing awkward postures, harmful contact pressures, or other safety and health risks. If you use a tool that does not fit your hand or use the tool in a way it was not intended, you might develop an injury, such as carpal tunnel syndrome, tendonitis, or muscle strain. These injuries do not happen because of a single event, such as a fall. Instead, they result from repetitive movements that are performed over time or for a long period of time, which may result in damage to muscles, tendons, nerves, ligaments, joints, cartilage, spinal discs, or blood vessels.

DEFINITIONS

Awkward Postures

Postures that strain the neck, shoulders, elbows, wrists, hands, or back. Bending, stooping, twisting, and reaching, are examples of awkward postures.

Power Grip

The hand grip that provides maximum hand power for high force tasks. All the fingers wrap around the handle.

Contact Pressure

Pressure from a hard surface, point, or edge on any part of the body.

Pinch Grip

The hand grip that provides control for precision and accuracy. The tool is gripped between the thumb and the fingertips.

Single-Handle Tools

Tube-like tools measured by handle length and diameter.

Diameter
The length of a straight line through the center of the handle.

Double-Handle Tools

Plier-like tools measured by handle length and grip span.

Grip Span
The distance between the thumb and fingers when the tool jaws are open or closed.

The cost of an injury can be high, especially if the injury prevents you from doing your job.

The best tool is one that:

- Fits the job you are doing
- Fits the work space available
- Reduces the force you need to apply
- Fits your hand
- Can be used in a comfortable work position

How do you know if you have a problem?

You may have a problem if you have any of these symptoms:

- Tingling
- Swelling in the joints
- Decreased ability to move
- Decreased grip strength
- Continual muscle fatigue
- Sore muscles
- Numbness
- Change in the skin color of your hands or fingertips
- Pain from movement, pressure, or exposure to cold or vibration

These symptoms may not appear immediately because they develop over weeks, months, or years. By then, the damage may be serious. Take action before you notice any symptoms.

Reduce your risk of injury by using these guidelines to select hand tools:

A. **Know your job** (pg. 4).
B. **Look at your work space** (pg. 6).
C. **Improve your work posture** (pg. 7).
D. Review the **"Tips for Selecting Hand Tools"** (pg. 8) and then **Select the Tool** (pgs. 13,14).

Use the **Checklist** on pages 13 and 14 to select the best tool. The features listed on the Checklist correspond to the tips found on pages 8 to 11, "**Tips for Selecting Hand Tools**."

A. Know your job

Before you select a tool, think about the job you will be doing. Tools are designed for specific purposes. Using a tool for something other than its intended purpose often damages the tool and could cause you pain, discomfort, or injury. You reduce your chances of being injured when you select a tool that fits the job you will be doing.

The list of tools in each category shows a few examples of tools that are most frequently used.

Cutting, pinching, gripping tools

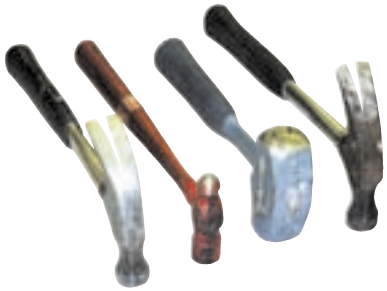
Examples:

- Pliers
- Snips
- Cutters

Striking tools

Example:

- Hammers



Driving tools

Examples:

- Screwdrivers
- Hand wrenches
- Nut drivers
- T-handle wrenches

Struck or hammered tools

Examples:

- Punches
- Chisels
- Nail sets

Next, consider whether you need the tool to provide power or precision. Then select the tool with the correct handle diameter or grip span.

For POWER tasks

Single-Handle Tools

HANDLE DIAMETER for power tasks is 1 1/4 inches to 2 inches

Double-Handle Tools

OPEN GRIP SPAN for power tasks is not more than 3 1/2 inches

CLOSED GRIP SPAN for power tasks is not less than 2 inches

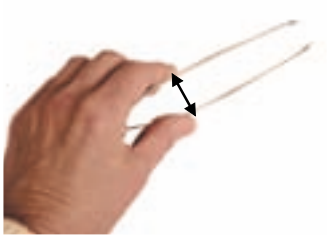
For PRECISION tasks

Single-Handle Tools

HANDLE DIAMETER for precision tasks is 1/4 inch to 1/2 inch

Double-Handle Tools

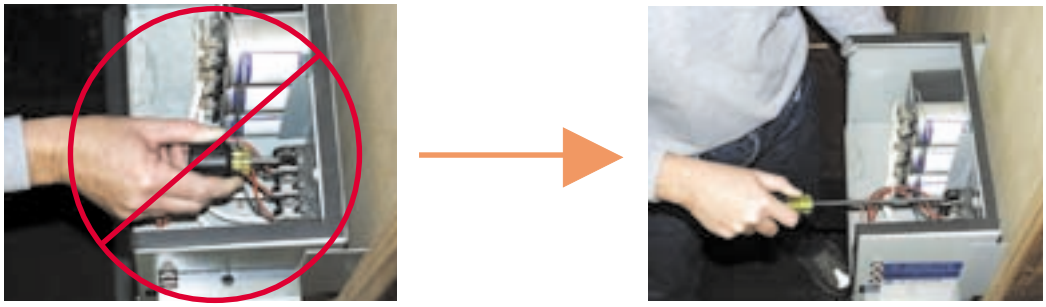
OPEN GRIP SPAN for precision tasks is not more than 3 inches



CLOSED GRIP SPAN for precision tasks is not less than 1 inch

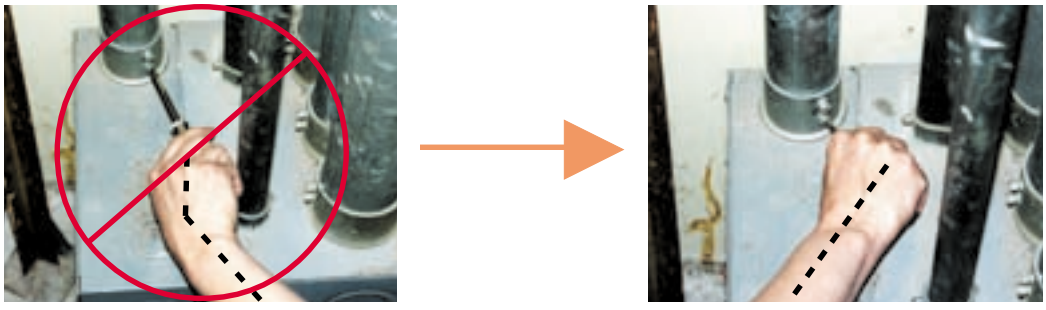
B. Look at your work space

Now look at your work space. Awkward postures may cause you to use more force. Select a tool that can be used within the space available. For example, if you work in a cramped area and high force is required, select a tool that is held with a **power grip**. A **pinch grip** will produce much less power than a power grip. Exerting force with a pinch grip means you will work harder to get the job done.



pinch grip **power grip**

If you work in a cramped space, you may not be able to use a long-handle tool. Use of a long-handle tool may cause awkward postures or harmful contact pressure on your hand as you use more force. Instead, use a tool that fits within the work space. A short-handle tool can help you reach your target directly as you keep your wrist straight.



long-handle tool **short-handle tool**

C. Improve your work posture

Awkward postures make more demands on your body. In some cases, the placement of the work piece will affect your shoulder, elbow, wrist, hand, or back posture. Whenever possible, choose a tool that requires the least continuous force and can be used without awkward postures. The right tool will help you to minimize pain and fatigue by keeping your neck, shoulders, and back relaxed and your arms at your sides.

For example, avoid raising your shoulders and elbows. Relaxed shoulders and elbows are more comfortable and will make it easier to drive downward force.

If you are sitting ...

Stand

If you are standing ...

Reposition your work piece

Work on a lower work surface

D. Select the Tool

Over time, exposure to awkward postures or harmful contact pressures can contribute to an injury. You can reduce your risk of injury if you select hand tools that fit your hand and the job you are doing.

Tips for Selecting Hand Tools

Tools used for **power** require **high force**. Tools used for **precision or accuracy** require **low force**.

1 For single-handle tools used for power tasks: Select a tool that feels comfortable with a handle diameter in the range of 1 1/4 inches to 2 inches. You can increase the diameter by adding a sleeve to the handle.

Tool with sleeve

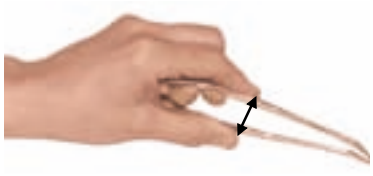
2 For single-handle tools used for precision tasks: Select a tool with a handle diameter of 1/4 inch to 1/2 inch.

3 For double-handle tools (plier-like) used for power tasks: Select a tool with a grip span that is at least 2 inches when fully closed and no more than 3 1/2 inches when fully open. When continuous force is required, consider using a clamp, a grip, or locking pliers.

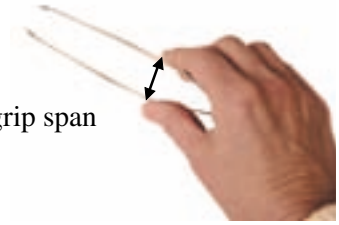
Closed grip span

Open grip span

4 For double-handle tools (plier-like) used for precision tasks: Select a tool with a grip span that is not less than 1 inch when fully closed and no more than 3 inches when fully open.

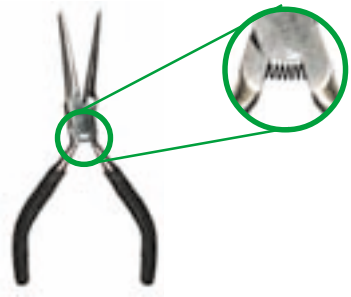


Closed grip span



Open grip span

5 For double-handled pinching, gripping, or cutting tools: Select a tool with handles that are spring-loaded to return the handles to the open position.



6 Select a tool without sharp edges or finger grooves on the handle.

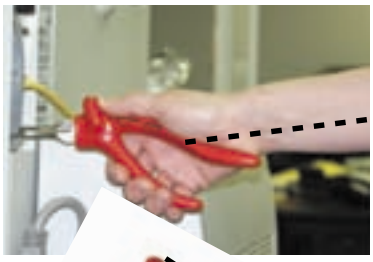
7 Select a tool that is coated with soft material. Adding a sleeve to the tool handle pads the surface but also increases the diameter or the grip span of the handle (see 1, 2, 3, or 4 above).

8

Select a tool with an angle that allows you to work with a straight wrist.

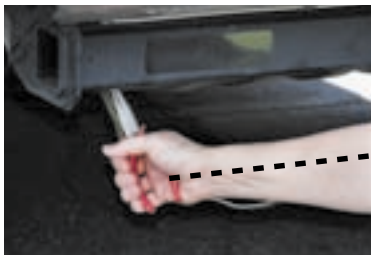
Tools with bent handles are better than those with straight handles when the force is applied horizontally (in the same direction as your straight forearm and wrist).

Straight handle

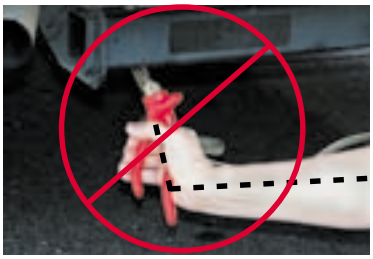


Bent handle

Tools with straight handles are better than those with bent handles when the force is applied vertically.



Straight handle



Bent handle

9

Select a tool that can be used with your dominant hand or with either hand.

10

For tasks requiring high force: Select a tool with a handle length longer than the widest part of your hand – usually 4 inches to 6 inches.

Prevent contact pressure by making sure the end of the handle does not press on the nerves and blood vessels in the palm of your hand.

If the handle is too short, the end will press against the palm of your hand and may cause an injury.

11

Select a tool that has a non-slip surface for a better grip. Adding a sleeve to the tool improves the surface texture of the handle. To prevent tool slippage within the sleeve, make sure that the sleeve fits snugly during use.

Remember: A sleeve always increases the diameter or the grip span of the handle (see 1, 2, 3, or 4 above).

Tools and sleeves

These guidelines are from the following resources:

American Industrial Hygiene Association, “An Ergonomics Guide to Hand Tools”, p. 18

Dababneh A, Lowe B, Krieg E, Kong Y, and Waters T, A Checklist for the Ergonomic Evaluation of Non-Powered Hand Tools, accepted for publication in the December 2004 issue of the Journal of Occupational and Environmental Hygiene.

Eastman Kodak Company, “Ergonomic Design for People at Work”, Vol. 2, p. 350

Eastman Kodak Company, “Ergonomic Design for People at Work”, Vol. 1, p. 146

Kodak’s Ergonomics Design for People at Work, 2nd Edition, p. 349

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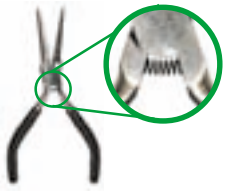
Use **BOTH** sides of the **checklist** to compare similar tools. For example, if you have two pliers and want to select the best of the two, compare each tool against the features on the checklist. The more "Yes" answers the tool has, the better the tool.

Refer to Section D, **Tips for Selecting Hand Tools**, for more details.

Checklist for Hand Tool Selection Select the tool that has the most "YES" answers.		**Examples**	Check if "YES"			
			Single-handle tools		Double-handle tools	
			Tool 1	Tool 2	Tool 1	Tool 2
1	For single-handle tools used for power tasks: Does the tool feel comfortable and have a handle diameter between 1 1/4 inches and 2 inches? (pg. 8)					
2	For single-handle tools used for precision tasks: Is the handle diameter between 1/4 inch and 1/2 inch? (pg. 8)					
3	For double-handle tools used for power tasks: Is the grip span at least 2 inches when closed and no more than 3 1/2 inches when open? (pg. 8)					
4	For double-handle tools used for precision tasks: Is the grip span no less than 1 inch when closed and no more than 3 inches when open? (pg. 9)					
5	For double-handle tools: Is the handle spring-loaded? (pg. 9)					

Checklist for Hand Tool Selection Select the tool that has the most "YES" answers		Examples	Check if "YES" for all tools	
			Tool 1	Tool 2
6	Is the tool handle without sharp edges or finger grooves? (pg. 9)			
7	Is the tool handle coated with soft material? (pg. 9)			
8	Can the tool be used while keeping your wrist straight? (pg. 10)			
9	Can the tool be used with your dominant hand or with either hand? (pg. 10)			
10	For high-force tasks: Is the handle longer than the widest part of your hand (usually 4 inches to 6 inches)? (pg. 11)			
11	Does the tool handle have a non-slip surface? (pg. 11)			

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COMPLETE BOTH SIDES

Dababneh A, Lowe B, Krieg E, Kong Y, and Waters T, A Checklist for the Ergonomic Evaluation of Non-Powered Hand Tools, accepted for publication in the December 2004 issue of the Journal of Occupational and Environmental Hygiene.

NOTES:

Cal/OSHA and NIOSH value and welcome your comments about our booklet. Send your comments to us at: **dosheducation@dir.ca.gov**. We want to provide the best possible service to employers and employees.

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