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## **Module 17: Tools - Hand and Power**

### **Module Description**

This module gives you a basic understanding about OSHA's role in the prevention and elimination of work-related illnesses and injuries. Hand and power tools are a part of our everyday lives and help us to perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention to hand and power tool safety is necessary to reduce or eliminate these hazards.

### **Module Learning Objectives**

At the conclusion of this module, you should be able to:

- Discuss OSHA standards and rules associated with hand and power tools
- Explore guarding techniques or principles that apply to hand and power tools
- Identify the precautions that are essential for safe use of hand and power tools

# Lesson 1: Safe Use of Hand and Power Tools

## Lesson Focus

This lesson focuses on the following topics:

- Introduction
- General Requirements
- Hazards of Hand and Power Tools
- Switches

## Introduction

Hand and power tools are a part of our everyday lives. These tools help us in performing tasks that otherwise would be difficult or impossible. However, even simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention to hand and power tool safety is necessary to reduce or eliminate these hazards.

## General Requirements

### Hazards

Workers using hand and power tools may be exposed to these hazards:

- Falling or flying objects which can be abrasive, or may splash
- Harmful dusts, fumes, mists, vapors, and gases
- Frayed or damaged electrical cords, hazardous connections, and improper grounding

### Basic Tool Safety Rules

Basic tool safety rules include the following:

- Perform maintenance regularly
- Use the right tool for the job
- Inspect tools before use
- Operate according to manufacturers' instructions
- Use the proper personal protective equipment (PPE)
- Use required and provided guards

## Hazards of Hand and Power Tools

### Hand Tool Hazards

The employer is responsible for the safe condition of tools and equipment used by employees. Employers shall not issue or permit the use of unsafe hand tools. Employees should be trained in the proper use and handling of tools and equipment.

Hand tool hazards are often caused by misuse and improper maintenance.

Do not use:

- Wrenches when jaws are sprung.
- Impact tools (chisels and wedges) when heads have mushroomed.
- Tools with loose, cracked or splintered handles.
- A screwdriver as a chisel.
- Tools with taped handles—(They may be hiding cracks.)

### Hand Tools—Protection

When using saw blades, knives, or other sharp tools, employees should direct the tool away from other employees working in close proximity. Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones. Cracked saw blades must be removed from service.

- Use PPE, such as safety goggles and gloves as necessary
- Keep the floor surface where working free from debris and tripping or slipping hazards
- Keep cutting tools sharp

### Power Tools

Power tools must be fitted with appropriate guards and safety switches. They are extremely hazardous when used improperly.

Different types of power tools are determined by their power source:

- Electric
- Pneumatic
- Liquid fuel
- Hydraulic
- Powder-actuated

## Switches

Hand-held power tools must be equipped with one of the following:

- Constant Pressure Switch
- Positive On/Off Switch
- Momentary On/Off Switch

### **Constant Pressure Switch**

Circular saws, chainsaws, and percussion tools without positive accessory holding means must be equipped with a constant pressure switch that will shut off when the pressure is released.

### **Positive On/Off Switch**

This switch is used with many hand-held tools, including powered platen sanders, grinders with wheels two inches in diameter or less, routers, laminate trimmers, nibblers, shears, scroll saws, and jigsaws with blade shanks one-fourth of an inch wide or less.

### **Momentary On/Off Switch**

Hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels greater than two inches in diameter, disc sanders, belt sanders, reciprocating saws, and saber saws must be equipped with a momentary contact "off" switch and may have a lock-on provided that they can be turned off by a single motion of the same finger that turned them on.

## Power Tools—Precautions

- Disconnect tools when not in use, before servicing and cleaning, and when changing accessories
- Keep people not involved with the work away from the tools
- Secure work with clamps or a vice, freeing both hands to operate the tool
- Don't— hold the switch button while carrying a tool
- Keep tools sharp and clean
- Consider what you wear, as loose clothing and jewelry can get caught in moving parts
- Remove damaged electric tools and tag them: "Do Not Use"

## **Electric Cords**

- Don't carry portable tools by the cord
- Don't use electric cords to hoist or lower tools
- Don't yank cord or hose to disconnect it
- Keep cords and hoses away from heat, oil, and sharp edges

## **Lesson Summary**

We regularly use hand and power tools as part of our everyday lives. They help us in performing tasks that otherwise might be difficult or impossible to accomplish. However, even simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. So, paying special attention to power tool safety is necessary to help reduce or eliminate hazards.

## Lesson 2: Classification of Tools

### Lesson Focus

This lesson focuses on the following topics:

- Types of Tools
- General Safety Precautions

### Types of Tools

#### Electric Power Tools

To protect a worker from shock, these tools must:

- Have a three-wire cord plugged into a grounded receptacle.
- Be double insulated.

#### Electric Tools—Good Practices

Good practices for the use of electric tools include:

- Operate within design limits.
- Use gloves and safety shoes. (Care must be exercised when using gloves with rotating power tools. In some cases, using gloves can become more dangerous as they may possibly come into contact with the rotating parts, thereby drawing the hand into the tool.)
- Store in a dry place.
- Don't use in wet locations unless approved for those conditions.
- Keep work areas well lit.
- Ensure that cords don't present a tripping hazard.

### Abrasive Wheels and Tools

Abrasive wheels and tools may throw off flying fragments.

Abrasive wheels must be equipped with guards that:

- Cover the spindle end, nut, and flange projections.
- Maintain proper alignment with the wheel.
- Do not exceed the strength of the fastening.
- Guard so that a minimal amount of the wheel is exposed.

## Inspecting Abrasive Wheels

Before mounting:

- Inspect closely for damage.
- Perform sound or ring test to ensure that the wheel is free from cracks and/or defects.

To test:

- Tap wheel gently with a light, non-metallic instrument.
- If the wheel sounds cracked or dead, do not use it because it could fly apart. Keep in mind that this test is most accurate if the abrasive wheel is suspended and not held. By holding the wheel you could possibly alter the sound and giving off a false indicator of defects.

## Abrasive Wheel Use

To prevent cracking:

- Fit the wheel on the spindle freely.
- Tighten the spindle nut enough to hold the wheel in place without distorting the flange.
- Let the tool come up to speed prior to grinding or cutting.
- Don't stand in front of the wheel as it comes up to full speed.
- Use eye and/or face protection while operating wheel.

## Abrasive Wheel Work Rests

The following information applies to abrasive wheel work rests:

- Keep work rests not more than 1/8<sup>th</sup> inch from wheel surface, and tongue guards at the top of the wheel not more than 1/4 inch from wheel surface.
- This minimizes the chance of jamming the work between the wheel and the rest, which may cause the wheel to break.
- Don't adjust the wheel while it is rotating.

## Guarding

Never remove guards or use a power tool without proper guarding in place. The removal of guards on moving parts may cause severe injury or even death to an employee or other persons near them.

The following information applies to guarding:

- Guard exposed moving parts of power tools

- Guard belts, gears, shafts, pulleys, sprockets, spindles, flywheels, chains, and other moving parts
- Never remove a guard when a tool is in use

### **Guarding—Point of Operation**

The point of operation is where the work is actually performed on the materials. The point of operation must be guarded or otherwise protected.

### **Guarding—Protection**

Machine guards must protect the operator and others from:

- Point of operation
- In-running nip points
- Rotating parts
- Flying chips and sparks

### **Radial Arm Saw Guarding**

The lower blade guard on a radial arm saw is designed to prevent the operator from coming into contact with the rotating blade. This guard must automatically return to the covering position when withdrawn from the work.

### **Guarding Portable Circular Saws**

Guard these saws above and below the base plate or shoe. The upper and lower guards must cover the saw to the depth of the teeth. When withdrawn from the work, the lower guard must automatically return to the covering position.

### **Table Saw Guarding**

Use a hood for guarding against contact with the upper blade.

## **Pneumatic Tools**

The following information applies to the use of pneumatic tools:

- Pneumatic tools are powered by compressed air.
- They include nail guns, staplers, chippers, drills, and sanders.
- Hazards include getting hit by a tool attachment or by a fastener that worker is using with the tool.
- Take the same precautions with an air hose that you would take with electric cords.

## **Pneumatic Tools—Fastening**

Ensure tool is fastened securely to the air hose to prevent a disconnection. Use a proper wire or positive locking device that attaches the air hose to the tool.

## **Pneumatic Tool Safety**

- All pneumatic driven nail guns, staplers, and other similar equipment with automatic fastener feeds, shall have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.
- The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fittings shall not be exceeded. Eye protection must be worn while operating pneumatic tools.
- Hearing protection is typically required while operating jackhammers due to the high noise levels generated.
- Compressed air hoses with an inside diameter (ID) greater than one half (1/2) inch must have a safety device in place to reduce pressure in case of hose failure.

## **Compressed Air Cleaning**

The following information applies to compressed air cleaning:

- Do not use compressed air for cleaning.
- Exception: compressed air may be used for cleaning where it is reduced to less than 30 P.S.I. with effective chip guarding and PPE and appropriate controls are in place to prevent injuries and damage.

## **Liquid Fuel Tools**

The following information applies to Liquid Fuel tools:

- Usually gas powered.
- Main hazards are fuel vapors and exhaust; therefore they should not be used in enclosed and confined spaces.
- Use only approved flammable liquid containers.
- Before refilling a fuel-powered tool tank, shut down the engine and allow it to cool.

## **Powder-Actuated Tools**

The following information applies to powder-actuated tools:

- User must be trained to operate.

- Tools must be tested each day before loading to ensure the safety devices are working properly.
- Wear suitable ear, eye, and face protection.
- Select a powder level that will do the work without excessive force.

### **Easily Penetrated Material**

Avoid driving into materials easily penetrated unless materials are backed by a substance that will prevent the pin or fastener from passing through. Also, don't drive fasteners into very hard or brittle material that might chip or splatter, or make the fasteners ricochet.

### **Powder-Actuated Tool Safety Tips**

The following safety tips apply to the use of powder-actuated tools:

- Do not use powder-actuated tools in explosive or flammable environments.
- Inspect powder-actuated tools before use to ensure:
  - The tool is clean
  - That moving parts of the tool operate freely
  - The barrel of the tool is free from obstructions and has the proper shield, guard, and attachments
- Do not load the tool unless it will be immediately used.
- Do not leave a loaded tool unattended.
- Keep hands clear of the barrel end of the tool.
- Never point the tool at anyone.
- Store unloaded tools in a secured box.

### **Jacks**

To set up a jack, ensure that:

- The base of the jack is on a firm, level surface.
- The jack is centered.
- The jack head is placed against a level surface.
- You apply the lift force evenly to the jack.
- The jack is lubricated and inspected regularly.

### **Jacks—Capacity**

The following information applies to the capacity of a jack:

- The manufacturer's rated capacity must be marked on all jacks and must not be exceeded.
- All jacks must have a stop indicator that must not be exceeded.

## **Jacks—Blocking**

Immediately block the load after it is lifted. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack-cap and load if the cap might slip.

## **General Safety Precautions**

Employees who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and/or splashing objects or harmful dusts, fumes, mists, vapors, and/or gases must be provided with the PPE necessary to protect them from those hazards.

All hazards involved in the use of power tools can be prevented by following five basic safety rules:

1. Keep all tools in good condition with regular maintenance
2. Use the right tool for the job
3. Examine each tool for damage before use
4. Operate the tool according to the manufacturer's instructions
5. Provide and use the appropriate PPE.

**More Information:** Employees and employers have a responsibility to work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought to the attention of the proper individual(s) immediately.

## **Case Study**

### **What Happened?**

An employee was killed when he was struck in the head by a nail fired from a powder-actuated tool. The tool operator was attempting to anchor a plywood form in preparation for pouring a concrete wall.

### **Description of the incident:**

A 22-year-old carpenter's apprentice was killed when he was struck in the head by a nail fired from a powder-actuated nail gun. The nail gun operator fired the gun while attempting to anchor a plywood concrete form causing the nail to pass through the hollow form. The nail traveled 27 feet before striking the victim. The nail gun operator had never received training on how to use the tool, and none of the employees in the area were wearing PPE.

In another situation, two workers were building a wall while remodeling a house. One of the workers was killed when he was struck by a nail fired from a powder-actuated nail

gun. The tool operator who fired the nail was trying to attach a piece of plywood to a wooden stud. But, the nail shot through the plywood and stud, striking the victim.

Below are some OSHA regulations that should have been followed.

- Powder-actuated nail guns should not be used to drive nails into easily penetrated materials unless the material is backed by a substance that will prevent the nail from passing through.
- Employees who operate powder or pressure-actuated tools must be trained to avoid firing into easily penetrated materials (like plywood).
- In areas where workers could be exposed to flying nails, appropriate PPE must be used.

## Lesson Summary

In this lesson, we discussed the various types of tools and their general safety precautions. Electric power tools must be double insulated and have a three-wire cord plugged into a grounded receptacle. When using power tools, you should use gloves and safety shoes, keep work areas well lit, and ensure that cords don't present a tripping. Don't use power tools in wet locations unless approved for those conditions.

Abrasive wheels and tools may throw off flying fragments and should have guards and be inspected before use. Never remove guards or use a power tool without proper guarding in place. The point of operation must be guarded or otherwise protected.

The lower blade guard on a radial arm saw is designed to prevent the operator from coming into contact with the rotating blade. This guard must automatically return to the covering position when withdrawn from the work.

Pneumatic tools are powered by compressed air and they include nail guns, staplers, chippers, drills, and sanders. Hazards include getting hit by a tool attachment or by a fastener that worker is using with the tool. They should have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.

Avoid driving into materials easily penetrated unless materials are backed by a substance that will prevent the pin or fastener from passing through. Do not use powder-actuated tools in explosive or flammable environments.

## **Lesson 3: Mechanical Power-Transmission Apparatus**

### **Lesson Focus**

This lesson focuses on the following topics:

- Introduction
- Prime mover guards—flywheels
- Cranks and connecting Rods
- Shafting
- Pulleys
- Belt, Rope, and Chain Drivers
- Gears, Sprockets, and Chains
- Guarding Friction Drives
- Keys, Setscrews and Other Projections
- Collar and Couplings
- Guarding of Clutches, Cutoff Couplings, and Clutch Pulleys
- Belt Shifters, Clutches, Shippers, Poles, Perches and Fasteners

### **Introduction**

#### **Mechanical Power-Transmission Apparatus**

Mechanical power-transmission apparatus includes all the parts that make up a mechanical system used to transmit energy from a main power source to the component that performs the work. These components include flywheels, pulleys, belts, connecting rods, shafting, couplings, cams, spindles, chains, cranks, and gears. OSHA has established basic guidelines for all employers to ensure that their employees do not get injured by getting caught in rotating parts, in-running nip points, pulleys, or other such components.

## Prime-Mover Guards

Never remove guards while in operation. Always use proper lockout/tagout procedures when performing maintenance.

Flywheels that are located within 7 feet or 2.128 meters or less above a platform must be enclosed with a perforated sheet or with an enclosure of woven wire. Guard rails must be placed within 15 inches, or 38.1 centimeters and 20 inches, or 50.8 centimeters from the outer rim of the flywheel. A standard toeboard must be in place if the flywheel extends into a pit or is within 12 inches or 30.48 centimeters of the floor.

Any part of the flywheel that extends through the working floor must be completely enclosed or surrounded by a guardrail and toeboard.

A flywheel having a smooth rim five feet in diameter or less, where a guardrail and toe board cannot be installed, must have a disk attached to it in such a way that it covers the spokes of the wheel on the exposed side and present a smooth surface and edge. It must also provide means for periodic inspection. To allow the wheel to be turned over, an open space of more than 4 inches or 10.16 centimeters in width may be left between the outside edge of the disk and rim of the wheel. If the disk cannot cover any dangerous projections, such as the key, they must be cut off or covered.

Flywheels that are located above working areas must be guarded by installing guards that have sufficient strength to hold the weight of the flywheel in the event of a shaft or wheel mounting failure.

## Flywheels

### Cranks and Connecting Rods

Never place your hands past protective guards or try to remove them. Doing so may result in one or multiple body parts being injured.

When exposed to contact, cranks and connecting rods must be guarded with proper materials by securely fastening it to the frame. Approved materials include expanded metal, perforated or solid sheet metal, wire mesh on a frame of angle iron, or iron pipe securely fastened to the floor or frame of a machine. You must ensure that all metal is free from burrs and sharp edges at all times.

Alternatively, a guardrail can also be used to guard cranks and connecting rods. The guardrail used must be 42 inches or 106.68 centimeters in height, with mid-rail between top rail and the floor. Posts cannot be more than 8 feet or 2.432 meters apart; they must be fixed permanently and should be strong, smooth, and free from protruding nails, bolts, and splinters.

## **Tail Rods or Extension Piston Rods**

Tail rods or extension piston rods must be guarded in a similar way as cranks and connection rods. If a guardrail is used on sides and end, it must have a clearance between 15 inches or 38.1 centimeters and 20 inches or 50.8 centimeters when the rod is fully extended.

## **Shafting**

Each continuous line of shafting must be secured in position against excessive endwise movement. Inclined and vertical shafts, particularly inclined idler shafts, have to be securely held in position against endwise thrust.

## **Guarding Horizontal Shafting**

Any exposed parts of horizontal shafting that are 7 feet or 2.128 meters or less from the floor or the working platform must be protected by enclosing the shafting completely with a stationary casing or by a trough enclosing sides and top or sides and bottom of shafting as location requires. This enclosing is not required for runways used exclusively for oiling, or running adjustments.

Shafting under bench machines has to be enclosed by a stationary casing, or by a trough at sides and top or sides and bottom, as location requires. The sides of the trough must come within at least 6 inches or 15.24 centimeters of the underside of the table, or if shafting is located near floor within 6 inches or 15.24 centimeters of the floor. In every case, the sides of the trough must extend at least 2 inches or 5.08 centimeters beyond the shafting or protuberance.

## **Guarding Vertical and Inclined Shafting**

Vertical and inclined shafting 7 feet or 2.128 meters or less from the floor or working platform, except maintenance runways, must be enclosed with a stationary casing made of expanded metal, perforated or solid sheet metal, wire mesh on a frame of angle iron, or iron pipe securely fastened to the floor or frame of the machine.

## **Projecting Shaft Ends**

All projecting shaft ends and edges must be smooth and not project more than one-half the diameter of the shaft, unless guarded by non-rotating caps or safety sleeves. Unused keyways have to be filled up or covered.

## **Pulleys**

Any part of a pulley which is 7 feet or 2.128 meters or less from the floor or working platform, must be guarded with a sheet made of expanded metal, perforated or solid sheet metal, wire mesh on a frame of angle iron, or iron pipe securely fastened to the floor or frame.

Pulleys serving as balance wheels, (e.g., punch presses), on which the point of contact between belt and pulley is more than 6 feet, 6 inches or 1.976 meters from the floor or the platform, can be guarded with a disk covering the spokes.

Pulleys that have cracks or pieces broken out of rims, must never be used. Pulleys should never be operated at a speed in excess of the manufacturer's recommendations.

## Location of Pulleys

A guide must be provided to prevent the belt from leaving the pulley on the side where there is insufficient clearance, unless the distance to the nearest fixed pulley, clutch, or hanger exceeds the width of the belt used.

## Approved Guarding Materials

### Belt, Rope, and Chain Drives Horizontal Belts and Ropes

The belt must be fully enclosed where both runs of the horizontal belt are 42 inches, 106.68 centimeters or less from the floor. If both runs of horizontal belts are 7 feet or 2.128 meters or less from the floor level, the guard should extend to at least 15 inches or 38.1 centimeters above the belt.

### Overhead Horizontal Belts

Overhead horizontal belts, with lower parts 7 feet or 2.128 meters or less from the floor or platform, must be guarded on the sides and the bottom. Guards must run the entire length of the belt and follow the line of the pulley to the ceiling or be carried to the nearest wall, thus enclosing the belt effectively. Where belts are so located as to make it impractical to carry the guard to a wall or ceiling, construction of those guards should be such as to completely enclose the top and bottom runs of the belt and face of the pulleys.

Horizontal overhead belts more than 7 feet or 2.128 meters above the floor or platform must be guarded for their entire length if located over passageways or work places and traveling 1,800 feet or more per minute. They also have to be guarded for the entire length if center to center distance between pulleys is 10 feet or 3.04 meters or more or if the belt is 8 inches or 20.32 centimeters or more in width.

### Overhead Horizontal Belts

If the upper and lower runs of horizontal belts are located in such a way that passage of persons between them would be possible, the passage must be completely barred by a guardrail or other barrier. Alternatively, a platform can be provided over the lower run guarded on either side by a railing completely filled in with wire mesh or other filler, or by

a solid barrier. The upper run must be guarded in a way as to prevent contact with either the worker or by objects carried by him. In power plants, only the lower run of the belt needs to be guarded.

Overhead chain and link belt drives follow the same rules as overhead horizontal belts and should be guarded in the same manner.

## **Vertical and Inclined Belts**

Vertical and inclined belts must be enclosed by a guard made of expanded metal, perforated or solid sheet metal, wire mesh on a frame of angle iron, or iron pipe securely fastened.

Alternatively, a guardrail can also be used to guard vertical and inclined belts. The guardrail used must be 42 inches or 106.68 centimeters in height, with mid-rail between top rail and floor. Posts cannot be more than 8 feet or 2.432 meters apart; they must be fixed permanently and should be strong, smooth, and free from protruding nails, bolts, and splinters.

All guards for inclined belts have to be arranged in such a manner that a minimum clearance of 7 feet or 2.128 meters is maintained between belt and floor at any point outside of guard.

## **Vertical Belts**

Vertical belts running over a lower pulley more than 7 feet or 2.128 meters above floor or platform must be guarded at the bottom in the same manner as horizontal overhead belts.

## **Cone-Pulley Belts**

To properly guard the nip point of the belt and pulley, the cone belt and pulley must be equipped with a belt shifter. If the belt shifter does not have a frame that completely guards the nip point of the belt and pulley, the nip point must be protected by placing a vertical guard in front of the pulley that extends to at least the top of the largest step of the cone.

## **Belt Tighteners**

All suspended counterbalanced tighteners and their parts must be strong enough and fastened securely. All bearings must be securely capped. Some means must be present that prevents the tightener from falling if the belt breaks. All suspended counterweights

that are not guarded by location, must be encased in such a way as to prevent any accidents.

## **Belts and Guarding**

## **Gears, Sprockets, and Chains**

### **Gears**

All gears used must be guarded by completely enclosing them with guardrails at least 7 feet or 2.128 meters high extending 6 inches or 15.24 centimeters above the mesh point of the gears. A gear can also be guarded by a band guard covering the face of the gear and having flanges extended inward beyond the root of the teeth on the exposed side or sides. When any portion of the train of gears guarded by a band guard is less than 6 feet or 1.824 meters from the floor, a disk guard or a complete enclosure to the height of 6 feet or 1.824 meters must be used.

### **Hand-Operated Gears**

Although not required, it is highly recommended to guard hand-operated gears that are used only to adjust machine parts and which do not continue to move after hand power is removed.

### **Sprockets and Chains**

All sprocket wheels and chains have to be enclosed unless they are more than 7 feet or 2.128 meters above the floor or platform. Protection against falling must be provided in any area where the drive extends over other machines or working areas. However, this does not apply to manually operated sprockets.

### **Openings for Oiling**

Openings with hinged or sliding, self-closing covers must be present if frequent oiling has to be done. Oil feed tubes must be attached to all points that are not easily accessible to add lubricant while machinery is in motion.

## **Sprocket and Chain**

### **Guarding Friction Drives**

All driving points of all friction drives that come in contact must be guarded. It is important to completely cover all arm- or spoke-friction drives and all web-friction drives with holes in the web. The projecting belts on friction drives that are exposed to contact must also be guarded.

### **Keys, Setscrews, and Other Projections**

It is important to remove or guard with metal covers all projecting keys, setscrews, and other projections in revolving parts. However, this does not apply to keys or setscrews within gear or sprocket casings, other enclosures, or keys, setscrews, or oil-cups in hubs of pulleys less than 20 inches (or 50.8 centimeters) in diameter where they are within the plane of the rim of the pulley. It is recommended that no projecting setscrews or oil-cups be used in any revolving pulley or part of machinery.

## **Collars and Couplings**

### **Collars**

All revolving collars, including split collars, must be cylindrical. All screws or bolts used in collars should not project beyond the largest periphery of the collar.

### **Couplings**

Shaft couplings must be constructed in a way that they prevent hazards from bolts, nuts, setscrews, or revolving surfaces. However, bolts, nuts, and setscrews can be used where they are covered with safety sleeves, used parallel with the shafting and are countersunk or else do not extend beyond the flange of the coupling.

## **Guarding of Clutches, Cutoff Couplings, and Clutch Pulleys**

### **Guards**

Clutches, cutoff couplings, or clutch pulleys that have any projecting parts and which are located 7 feet or 2.128 meters or less above the floor or working platform must be enclosed by a stationary guard. A "U" type guard can be used.

## **Belt Shifters, Clutches, Shippers, Poles, Perches, and Fasteners**

### **Belt Shifters**

Tight and loose pulleys on all new installations made on or after August 31, 1971 must be equipped with a permanent belt shifter. The belt shifter must be equipped with mechanical means to prevent it from creeping from loose to tight pulley. Old installations should be changed so that they conform to this rule.

Belt shifters and clutch handles should be rounded. They must be located as far as possible from danger of accidental contact but within easy reach of the operator. Where belt shifters are not directly located over a machine or bench, the handles should be cut off 6 feet 6 inches or 1.976 meters above floor level.

### **Belt Shippers and Shipper Poles**

It is not recommended to use belt poles instead of mechanical shifters.

### **Belt perches**

Belt perches, in the form of brackets, rollers etc., can be used where loose pulleys or idlers are not practical to keep idle belts away from the shafts.

### **Belts Fasteners**

Belts that have to be shifted by hand and belts within 7 feet (2.128 meters) of the floor or working platform which are not guarded must not be fastened with metal in any case.

## **Belts, Couplings, and Collars**

### **Lesson Summary**

If the upper and lower runs of horizontal belts are located in such a way that passage of persons between them would be possible, the passage must be completely barred by a guardrail or other barrier. Alternatively, a platform can be provided over the lower run and guarded on either side by a railing completely filled in with wire mesh or other filler, or by a solid barrier. The upper run must be guarded in a way so as to prevent contact with either the worker or with objects carried by him. In power plants, only the lower run of the belt needs to be guarded.

Any part of the flywheel that extends through the working floor must be completely enclosed or surrounded by a guardrail and toe board. If a belt breaks, all suspended counterweights that are not guarded by location, must be encased in such a way so as to prevent any accidents. OSHA has established some basic guidelines for all employers to ensure that their employees do not get injured by getting caught in rotating parts, in in-running nip points, in pulleys, or other such components.