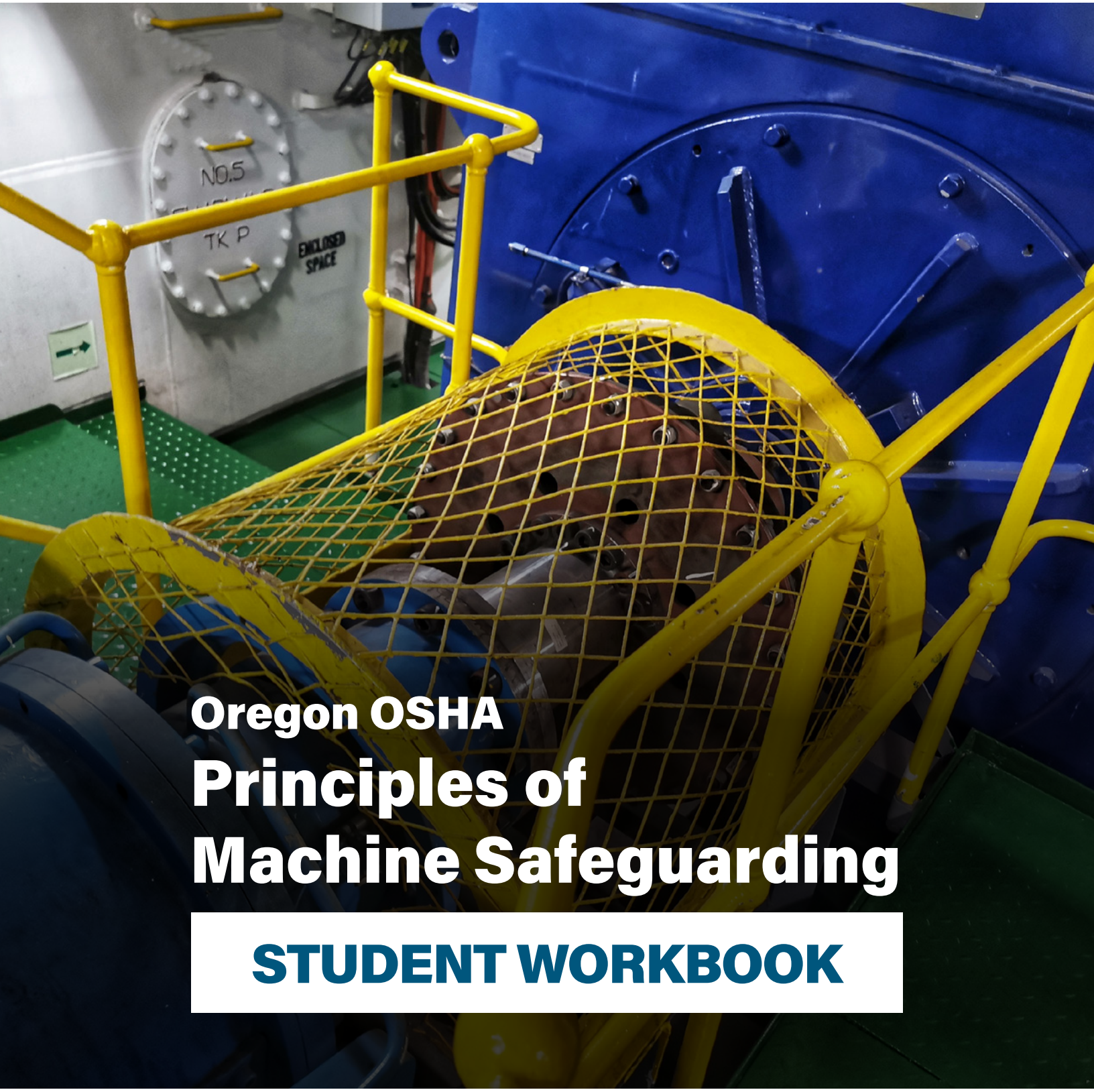

Oregon OSHA

Principles of Machine Safeguarding

STUDENT WORKBOOK

OSHA | Oregon OSHA
Department of Consumer and Business Services

Oregon OSHA Principles of Machine Safeguarding

Presented by Oregon OSHA

Public Education — Our Mission:

We provide knowledge and tools to advance self-sufficiency in workplace safety and health.

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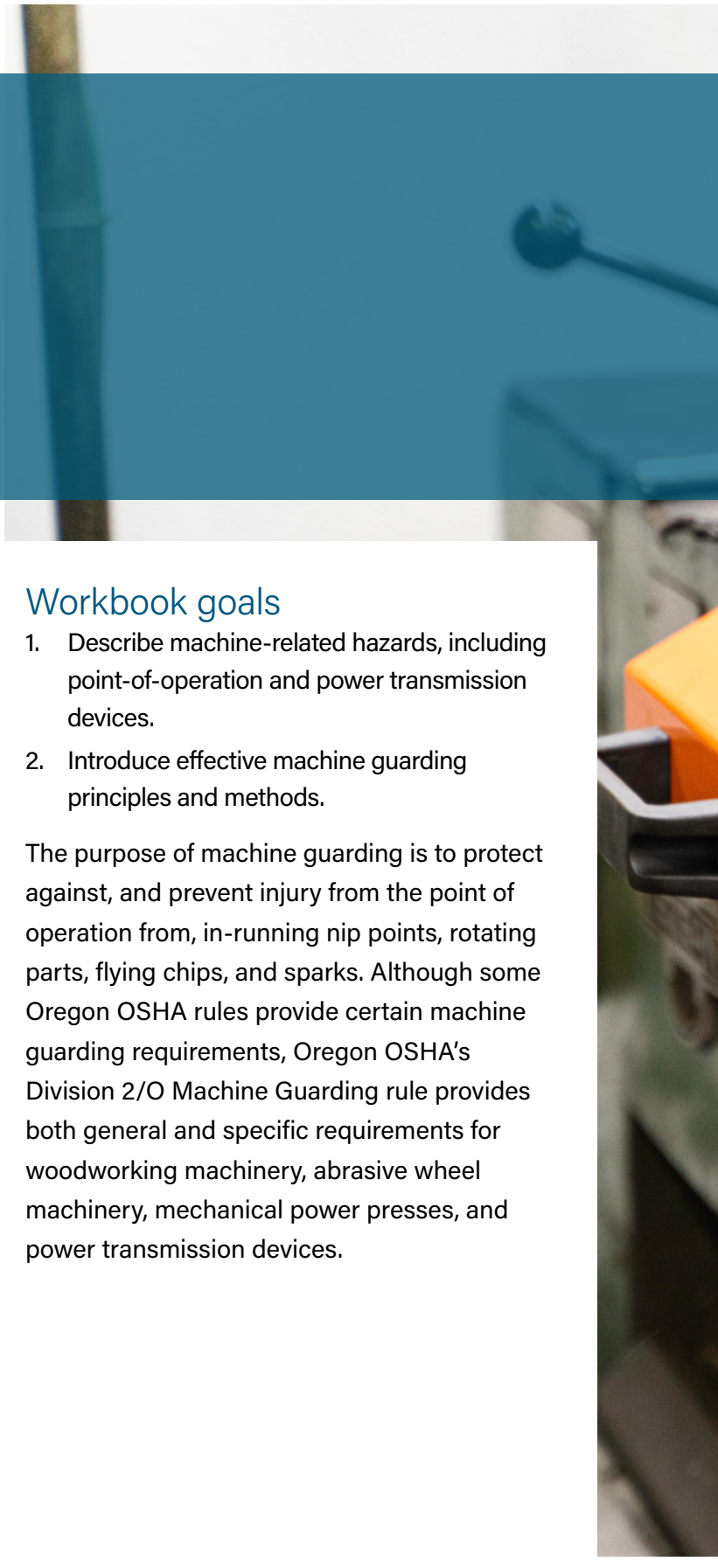

Welcome

There are as many hazards created by moving machine parts as there are machines. Any machine part, function, or process that may cause injury must be safeguarded to protect workers from preventable injuries. Hazards must be eliminated or controlled where the operation of a machine — or contact with it — can injure the operator or others.

This workbook describes the hazards of mechanical motion and actions, and offers techniques for protecting workers. The information covered includes where mechanical hazards occur; hazards created by different motions; and requirements for effective safeguards.

Workbook goals

1. Describe machine-related hazards, including point-of-operation and power transmission devices.
2. Introduce effective machine guarding principles and methods.

The purpose of machine guarding is to protect against, and prevent injury from the point of operation from, in-running nip points, rotating parts, flying chips, and sparks. Although some Oregon OSHA rules provide certain machine guarding requirements, Oregon OSHA's Division 2/O Machine Guarding rule provides both general and specific requirements for woodworking machinery, abrasive wheel machinery, mechanical power presses, and power transmission devices.

Three areas where mechanical hazards occur

1. **The point of operation** — the point where the following work is performed:
   - Cutting
   - Shaping
   - Boring
   - Forming
   - Grinding
   - Turning
   - Shearing
   - Punching
   - Bending
   - Drilling
2. **The power transmission apparatus** — consists of all the components in the mechanical system that transmit energy to the part of the machine performing the work. These components can be:
   - Flywheels
   - Couplings
   - Pulleys
   - Cams
   - Spindles
   - Belts
   - Chains
   - Cranks
   - Sprockets
   - Gears
   - Shafts
   - Rods
3. **Other moving parts** — all parts of the machine that move while the machine is working, including:
   - Reciprocating moving parts
   - Rotating moving parts
   - Transverse moving parts
   - Feed mechanisms

Hazardous mechanical motions and actions

Many mechanical motions and actions present hazards to the worker, including the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and parts that impact or shear.

These hazardous mechanical motions and actions are present in most machines; recognizing them is the first step toward protecting workers.

Hazardous mechanical motions

Rotating motion — examples of rotating motion parts are:

- Sprockets
- Couplings
- Fans
- Clutches
- Flywheels
- Shafts
- Pulleys
- Gears

Nip points are areas in machinery where two rotating or moving parts come close together, creating a small opening or point of contact.

In-running nip points occur when material is pulled into a gradually narrowing opening. There are three types of in-running nip point hazards:

1. Parts rotating in opposite directions
2. Rotating and moving parts
3. Rotating and fixed parts

Reciprocating motion — a repetitive back-and-forth or up-and-down motion. Workers may be struck or caught between reciprocating motion and stationary parts, which can include:

- Scissor lifts
- Shaker screens
- Feed tables
- Knife sharpeners
- Slicers
- Feeding and ejecting parts

Transverse motion — movement in a straight and continuous line. Workers may be struck or caught in a pinch or shear point by the moving part. Examples:

- Conveyor lines
- Lengthy belts

Hazardous mechanical actions

- Cutting
- Shearing
- Bending
- Punching

Machine safeguarding

There are many ways to safeguard machines, including:

- Type of operation
- Size or shape of stock
- Handling method
- Physical layout of the work area

Safeguarding strategies

The type of material and production requirements or limitations will help determine the appropriate safeguarding strategy for the machine.

As a general rule, the power transmission apparatus is best protected by fixed guards that enclose the danger areas.

For hazards at the point of operation, where moving parts perform work on stock, several safeguarding strategies may be possible. Always choose the most effective and practical strategy.

Primary safeguarding strategies include guards and devices.

Guard strategies

- Fixed
- Interlocked
- Adjustable
- Self-adjusting

What makes an effective guard?

- Must eliminate any contact around, over, through, or under the guard
- Must not present a hazard in itself or create interference
- Must not allow objects to fall into moving parts
- Allows safe maintenance and lubrication
- Affixed to the machine where possible and remains secure
- Conforms with other appropriate standards

Devices strategies

- Presence-sensing
- Pullback
- Restraints
- Controls and trips
- Gates

Other safeguarding strategies include:

- Location and distance
- Feeding and ejection
- Awareness barriers
- Protective shields
- Hand-feeding and holding tools
- Anti-restart devices

First safeguarding strategy: Guards

Fixed guards

- Permanent part of the machine
- Not dependent on moving parts to perform its intended function
- Constructed of sheet metal, screen, substantial material
- Usually preferable to all other types of safeguarding strategies because of its relative simplicity and permanence

Interlocked guards

- The tripping mechanism or power automatically shuts off or disengages when opened or removed
- The machine cannot cycle or be started until the guard is back in place
- The guard uses electrical, mechanical, hydraulic, or pneumatic power
- Replacing the guard should not automatically restart the machine

Adjustable guards

- Allow flexibility in accommodating various sizes of stock

Self-adjusting guards

- Opening is only large enough to admit the stock
- Openings are determined by the movement of stock
- Guard is pushed away as stock is introduced
- Guard returns to rest position after stock passes through

Second safeguarding strategy: Devices

A safety device controls access to dangerous areas and may perform one of several functions:

- It may stop the machine if a hand or other body part is inadvertently placed in the danger area.
- It can restrain or withdraw the operator's hands from the danger area during operation.

- It can require the operator to use both hands on the machine controls.
- It can provide a barrier synchronized with the operating cycle of the machine to prevent entry to the danger area during the hazardous part of the cycle.

Presence-sensing devices

- **Photoelectric:** Uses a system of light sources and controls that can interrupt the machine's operating cycle.
- **Radiofrequency:** Uses a radio beam that is part of the machine's control circuit. When the capacitance field is broken, the machine will stop or not activate.
- **Electromechanical:** Has a probe or contact bar that descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full predetermined distance, the control circuit does not activate the machine cycle.
- **Pullback:** Uses cables attached to the operator's hands, wrists, or arms; primarily used on machines with stroking action. Slack is taken up during the downstroke cycle, "pulling" the operator's hands from the point of operation, if they are still there. When the slide or ram is up between cycles, the operator is allowed access to the point of operation.
- **Restraint:** Uses cables or straps attached to the operator's hands at a fixed point. The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area. There is no extending or retracting action involved; hand-feeding tools are often necessary if the operation involves placing material into the danger area.

- **Safety trip controls:** Provide a quick means for deactivating the machine in an emergency situation. A pressure-sensitive bar, strategically placed, will deactivate the machine when depressed. Safety tripwire cables may also be located around the perimeter or near the danger area.
- **Two-hand controls:** Require constant, concurrent pressure by the operator to activate the machine. The operator's hands must be on the control buttons at a safe distance from the danger area.
- **Two-hand trip:** Requires concurrent application of both the operator's control buttons to activate the machine cycle, after which the hands are free.
- **Gate:** A movable barrier that protects the operator at the point of operation before the machine cycle can be started. Gates are usually designed to operate with each machine cycle; there are two types:
  - **Type A:** Remains closed during the entire cycle
  - **Type B:** Remains closed during the downstroke only

Third safeguarding strategy: Location and distance

The machine or its dangerous moving parts are positioned so that the hazardous areas are not accessible or do not present a hazard during normal operation. Location and distance options include:

- Walls
- Barriers and fences
- Height above worker
- Size of stock
- Controls positioned at a safe distance

Factors to consider when guarding by location and distance:

- Can dangerous parts still be accessed, even with great effort?
- Can pieces break off?
- Are sparks or other flying debris being produced?

Fourth safeguarding strategy: Feeding and ejection

- **Automatic feeding and ejection:** Operator involvement is not necessary after the machine is set up.
- **Semiautomatic feeding and ejection:** Manually fed without reaching into the point of operation or other danger zones.
- **Robots:** Machines that load and unload stock, assemble parts, transfer objects, and perform other tasks done by the operator. Robot concerns include being struck by robotic arms (or their claws) and other mechanisms within or near its working envelope. Also, possible malfunctions or missed steps can surprise nearby workers.

- **Miscellaneous aids:**
  - Miscellaneous aids **do not** give complete protection from machine hazards, but can help in moving stock, deflecting minor chips, or providing awareness. Examples include awareness barriers, ropes, shields, holding tools, push sticks, or blocks. Ensure hand-feeding tools are made of soft materials to prevent shattering.
  - Miscellaneous aids do not replace the need for personal protective equipment or guarding. For example, plexiglass shields on abrasive wheel grinders do not substitute the requirement for eye or face protection, or a tongue guard if distance from safety guard and top periphery of stone exceeds one-quarter inch. Miscellaneous aids can also get in the way and if broken or dirty, create a hazard in themselves.
  - Metal turning machines require chip or coolant shields and chuck shields. A spring-loaded chuck wrench should always be used on metal lathes. Automated cutting and turning machines require point-of-operation guarding.
  - Anti-restart devices are required if machinery can automatically start when power is restored, such as after a power failure.

Notes

Oregon OSHA services

Oregon OSHA offers a wide variety of safety and health services to employers and employees:

Appeals

- **503-378-3272**

- Discusses Oregon OSHA's requirements and clarifies workplace safety or health violations.
- Discusses abatement dates and negotiates settlement agreements to resolve disputed citations.

Conferences

- **503-378-3272; oregon.conferences@dcbs.oregon.gov**

- Hosts, co-hosts, and coordinates conferences throughout Oregon that enable employees and employers to learn and share ideas with local and nationally recognized safety and health professionals.

Consultations and Evaluations

- **503-378-3272; 800-922-2689; consult.web@dcbs.oregon.gov**

- Offers no-cost, on-site safety and health assistance to help Oregon employers recognize and correct workplace safety and health problems.
- Provides consultations in the areas of safety, industrial hygiene, ergonomics, occupational safety and health programs, assistance to new businesses, the Safety and Health Achievement Recognition Program (SHARP), and the Voluntary Protection Program (VPP).

Enforcement Information

- **503-378-3272; 800-922-2689; enforce.web@dcbs.oregon.gov**

- Offers pre-job conferences for mobile employers in industries such as logging and construction.
- Inspects places of employment for occupational safety and health hazards and investigates workplace complaints and accidents.
- Provides abatement assistance to employers.

Public Education and Training

- **503-947-7443; 888-292-5247, Option 2; ed.web@dcbs.oregon.gov**

- Provides workshops and materials covering management of basic safety and health programs, safety committees, accident investigation, technical topics, and job safety analysis.

Standards and Technical Resources

- **503-378-3272; 800-922-2689; tech.web@dcbs.oregon.gov**

- Develops, interprets, and gives technical advice on Oregon OSHA's safety and health rules.
- Publishes safe-practices guides, pamphlets, and other materials for employers and employees.
- Manages the Oregon OSHA Resource Center, which offers safety videos, books, periodicals, and research assistance for employers and employees.

Need more information? Call your nearest Oregon OSHA office.

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