WELCOME TO OSHA 7100:
MACHINERY & MACHINE
SAFEGUARDING
WE WILL START AT 8:00 AM (EDT)

SAFETY, HEALTH, AND ENVIRONMENTAL SERVICES AT GEORGIA TECH
WELCOME TO TODAY’S SEMINAR

• Instructor Contact Information:
  o Rachel Schneider – rachel.schneider@innovate.gatech.edu
  o Paige Rohrig– paige.Rohrig@innovate.gatech.edu
  o Additional contact information can be found at www.oshainfo.gatech.edu
ON-SITE SAFETY AND HEALTH CONSULTATION PROGRAM

• No cost, confidential
• On-site assistance in occupational safety and/or health
• Confidential written report sent to company
• Serious hazards must be corrected
• www.oshainfo.gatech.edu
• Paul Schlumper, Manager
  • pschlumper@gatech.edu
  • 404-894-4148
TYPES OF ASSISTANCE

• Full Service – a comprehensive review and evaluation of a facility’s:
  o Physical safety & health hazards
  o Required technical programs (i.e., lock-out/tag-out, confined spaces, hazard communications, respiratory protection, BBP, etc.)
  o Safety & Health Management Program

• Limited Service – a specific review and evaluation of a facility based on a defined scope established by the company

• Technical Assistance – a focused visit to assist the company in addressing a problem without the identification of hazards

• Training – providing training and education to the employer or employees to enable them to perform training for other employees in the future (train-the-trainer)
TYPES OF SERVICES

- **Safety**
  - Fire protection
  - Emergency response
  - Electrical safety

- **Health**
  - Exposure to chemicals
  - Noise
  - Bloodborne pathogens

- **Safety & Health Management System Development**
  - Hazard identification and control
  - Management leadership

- **Safety & Health Training**
  - Machine guarding
  - Fall protection
  - Powered industrial trucks
  - Confined spaces
  - Ergonomics
  - Respiratory protection
  - Employee involvement
  - Safety & health training
HOW TO REQUEST ASSISTANCE

• Complete and submit a “Request for Consultation Services” form
  o Available at www.oshainfo.gatech.edu
The Georgia Tech OSHA Consultation Program is operational and has resumed limited on-site visit activity. We are still conducting virtual visits as well. If you would like assistance, please click the gold button and complete our Online Request Form. Feel free to contact us via phone or e-mail with any questions.

What's New

- Steps Construction Employers and Workers Should Take in Response to the Coronavirus (COVID-19)
- Checklist for Healthcare Facilities: Strategies for Optimizing the Supply of N95 Respirators during the COVID-19 Response
- Georgia Manufacturing Extension Partnership’s (GaMEP) Coronavirus Resources
GEORGIA TECH OSHA TRAINING
INSTITUTE EDUCATIONAL CENTER

• Safety and Health Training
• Courses conducted **virtually** and in person
  o [www.pe.gatech.edu/safety](http://www.pe.gatech.edu/safety)
• Anginique Walker, Program and Operations Manager
  o [anginique.walker@innovate.gatech.edu](mailto:anginique.walker@innovate.gatech.edu)
ADDITIONAL RESOURCES AT GEORGIA TECH

• GECAP – Georgia Environmental Compliance Assistance Program [www.GECAP.org](http://www.GECAP.org)
  o Free and confidential environmental consultation program
  o **Virtual** and in person environmental consultations

• Georgia’s Manufacturing Extension Partnership
  [www.gamep.org](http://www.gamep.org)
  o Assistance to manufacturers in strategic business development, lean/process improvement, sustainability, energy management, quality management, product development, and ISO standards.
SUBPART O – MACHINE GUARDING

GEORGIA TECH SAFETY AND HEALTH CONSULTATION PROGRAM
WE WILL COVER:

• Machine Guarding Principles
• Subpart O - Highlights
• Lockout/Tagout Overview
WHY ARE MACHINES NOT GUARDED?

• No one would stick their arm, hand, finger, head, etc. in there.
• No one is supposed to be back there, in there, around it while it is running.
• The machine came that way; it never had a guard.
• I’ve been doing it this way for twenty years without any problems.
WHY ARE MACHINES NOT GUARDED? (CONT.)

• The guard is in the way
• The OSHA inspector didn’t say anything about it
• We’ll put it back on if OSHA comes
EMPHASIS ON AMPUTATIONS: WHERE CAN THEY OCCUR?

• Power Presses
• Saws
• Shears
• Press Brakes
• Slicers
• Conveyors
• Printing Presses
• Roll Forming/Bending Machines
• Drill Presses/Milling Machines
WHERE MACHINE HAZARDS OCCUR:

• Point of operation
• Mechanical power transmission
• Other moving parts
MACHINE GUARDING REQUIREMENTS

• Prevent contact
• Be secure
• Protect from falling objects
• Create no new hazards
• No interference
• Maintainability and accessibility
MACHINE GUARDING REQUIREMENTS

• Must NOT be able to reach under, through, over or around the guards or otherwise access the hazard!
Any Hazards?
IN-RUNNING NIP POINTS

- Rotating cylinders
- Chain and sprocket
- Belt and pulley
- Rack and pinion
METHODS OF MACHINE SAFEGUARDING

• Physical guards

• Devices

• Location/Distance
Guards v. Safeguarding Devices

- Fixed
- Interlocked
- Adjustable
- Self-adjusting

- Presence sensing
- Pullback
- Restraint
- Safety controls and trips
- Gates
This illustration shows the accepted safe openings at various distances from the nearest point-of-operation hazard. The clearance line marks the distance required to prevent contact between guard and moving parts. The minimum guarding line is the distance between the infeed side of the guard and the nearest point of operation which is 1/2-inch from the nearest point-of-operation hazard.

Illustration 3
Positioning of Guards
**Table 1**

**Recommended Maximum Openings**

<table>
<thead>
<tr>
<th>Distance of Opening from Point-of Operation Hazard (Inches)</th>
<th>Maximum Width of Opening (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 to 1-1/2</td>
<td>1/4</td>
</tr>
<tr>
<td>Over 1-1/2 to 2/-12</td>
<td>3/8</td>
</tr>
<tr>
<td>Over 2-1/2 to 3/-12</td>
<td>1/2</td>
</tr>
<tr>
<td>Over 3-1/2 to 5/-12</td>
<td>5/8</td>
</tr>
<tr>
<td>Over 5-1/2 to 6/-12</td>
<td>3/4</td>
</tr>
<tr>
<td>Over 6-1/2 to 7/-12</td>
<td>7/8</td>
</tr>
<tr>
<td>Over 7-1/2 to 12/-12</td>
<td>1-1/4</td>
</tr>
<tr>
<td>Over 12-1/2 to 15/-12</td>
<td>1-1/2</td>
</tr>
<tr>
<td>Over 15-1/2 to 17/-12</td>
<td>1-7/8</td>
</tr>
<tr>
<td>Over 17-1/2 to 31/-12</td>
<td>2-1/8</td>
</tr>
</tbody>
</table>

This table shows the distances that guards should be positioned from the nearest point-of-operation hazard.

The various openings are such that for average size hands, an operator's fingers will not reach the point of operation.

After installation of point-of-operation guards, and before a job released for operation, a check should be made to verify that the guard will prevent the operator's hands or other body parts from reaching the point of operation.
FIXED GUARD

Provides a barrier - a permanent part of the machine, preferable to all other types of guards.
INTERLOCKED GUARD

When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place.
ADJUSTABLE GUARD

Provides a barrier which may be adjusted to facilitate a variety of production operations.

Bandsaw blade adjustable guard
SELF-ADJUSTING GUARD

Provides a barrier which moves according to the size of the stock entering the danger area.

Circular table saw self-adjusting guard
SAFEGUARDING DEVICES

- Presence sensing
- Pullback
- Restraint
- Safety controls and trips
- Gates
PRESENCE SENSING DEVICES
PULLBACKS AND RESTRAINTS
Pullback device

Adjustable wrist straps
TWO-HAND CONTROLS
SAFETY TRIPWIRE CABLES

- Device located around the perimeter of or near the danger area
- Operator must be able to reach the cable to stop the machine
OTHER METHODS
GATE

• Movable barrier device which protects the operator at the point of operation before the machine cycle can be started

• If the gate does not fully close, machine will not function
SAFEGUARDING BY LOCATION/DISTANCE

• Locate the machine or its dangerous moving parts so that they are not accessible or do not present a hazard to a worker during normal operation

• Maintain a safe distance from the danger area
PROTECTIVE SHIELDS

These do not give complete protection from machine hazards, but do provide some protection from flying particles, splashing cutting oils, or coolants.
Source: Concepts and Techniques of Machine Safeguarding, OSHA
FIXED GUARDS (PRO VS. CON)

**PROS:**
- Many applications
- Often built in-house
- Can provide maximum protection
- Minimal maintenance
- Suitable for high production, repetitive

**CONS:**
- Can interfere with visibility
- Can be limited to specific operations (e.g. where point of operation access not necessary)
- Machine adjustment and repair can require removal, requiring other protection of maintenance
INTERLOCKED (PRO VS. CON)

PROS:
• Can provide maximum protection
• Allows access for removing jams without time-consuming removal of guards (subject to lockout requirements)

CONS:
• Requires careful adjustment and maintenance
• May be easy to disengage or defeat
PRESENCE SENSING (PROS VS. CONS)

PROS:
• Can allow more movement for operator into point of operation

CONS:
• Limited to machines that can be stopped
• Does not protect against flying objects
• May require frequent alignment and calibration
PULLBACKS/RESTRAINTS (PROS VS. CONS)

**PROS:**
- Eliminates need for additional guarding
- Smaller risk of mechanical failure for restraints

**CONS:**
- Limits movement of operator
- May obstruct work space around operator
- Adjustments must be made for each operation and individual
- Requires frequent inspections and maintenance
- Requires close supervision of the operator
2-HAND CONTROLS
(PROS VS. CONS)

PROS:
• Operators hands at a predetermined location (if controls fixed)
• Operators hands free to pick up parts

CONS:
• Requires partial cycle machine with a brake
• Some 2-hand controls can be defeated
• Protects only the operator
GUARDED????
GUARDED???
GUARDED???
SUBPART O - MACHINERY AND MACHINE GUARDING

- 211 - Definitions
- 212 - General requirements
- 213 - Woodworking machinery
- 215 - Abrasive wheel machinery
- 216 - Mills and calendars
- 217 - Mechanical power presses
- 218 - Forging machines
- 219 - Mechanical power transmission
1910.212

GENERAL REQUIREMENTS FOR ALL MACHINES
TYPES OF GUARDING
1910.212(A)(1)

• One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by the point of operation, in-going nip points, rotating parts, flying chips and sparks.
POINT OF OPERATION
1910.212(A)(3)(II)

• The point of operation of machines whose operation exposes an employee to injury, shall be guarded.
Point of Operation Guarded??
Point of Operation Guarding
Hand Tools
FANS
1910.212(A)(5)

- When the periphery of the blades of a fan is less than seven (7) feet above the floor or working level, the blades shall be guarded. The guard shall have openings no larger than 1/2 inch.
Machines designed for a fixed location shall be securely anchored to prevent walking or moving.
CONVEYORS

• Most common hazards associated with conveyors:
  o In-running nip points
  o Rotating parts

• Can be cited under 1910.212(a)(1) or under 1910.219 for rotating shafts
BENCH GRINDERS-WORK RESTS
1910.215(A)(4)

• Work rests shall be adjusted closely to the wheel with a maximum opening of one-eighth inch to prevent the work from being jammed between the wheel and the rest, which may cause wheel breakage.
BENCH GRINDERS-TONGUE GUARDS
1910.215(B)(9)

• The distance between the wheel periphery and the adjustable tongue must not exceed one-quarter inch.
• Immediately before mounting, all wheels shall be closely inspected and sounded by the user (ring test) to make sure they have not been damaged.
RING TEST

• Hold the wheel in a vertical position
• Strike the wheel with a non-metal object
• If the wheel creates the ringing effect it is in good condition
• Crack will create a dead space
See what can happen?
Wheel Disintegration
Factors Contributing to Wheel Breakage

- Improper mounting of the wheel
- Excessive speeds
- Abusive operation
- Careless handling
- Improper maintenance
Improper Speed

Safety Criteria

• Ensure the wheel is designed for the speed of the machine

• There are different types of wheels designed to be used at varying speeds (i.e., non-reinforced resin — 9500 SFPM and reinforced resin — 12,500+ SFPM)

Grinding Wheel Speed

![Grinding Wheel Speed Image]
Grinders Exercise — Hazard Hunt

For this exercise, you are going to look at the following slides. From the pictures, be prepared to discuss the following:

• What are the hazards in the slide?

• How would you correct the issues or the problems that you see in the slides?
• Plastic shield is not sufficient
• Wheel not centered
• No tongue guards
• Material on periphery of wheel-can clog pores and cause wheel to explode
• No tongue guard
• No side guard (spindle end and nut exposed)
• Tool rest may need to be further adjusted
• Wheel may be too small for grinding machine (look at size of guard)
• No tongue guard
• No tool rest
• Material on periphery of wheel-can clog pores and caused wheel to explode
• Is it anchored?
How to use a bench or floor grinder safely

Tech Guide No. 2 Published by the Safety, Health, Environmental Technology Division of Georgia Tech Research Institute 1988

- Make sure the manufacturer’s recommended speed, as posted on the wheel, is compatible with your grinder.
- Always protect your eyes—wear only an eye or face shield bearing the logo Z-87.
- Be sure the power transmission cover is securely in place.
- Maintain the tongue guard within 1/4 inch of grinding wheel.
- Be sure the outer wheel guard is in place.
- Maintain the tool rest within 1/8 inch of grinding wheel.
- Mount the grinder securely.

* As the wheel wears down, readjust the tool rest and tongue guard. When you can no longer adjust them, replace the wheel.

Important: When installing a new wheel, closely follow the manufacturer’s instructions. An improperly installed wheel can break (right) and cause injury.

For more information, call Georgia Tech Research Institute, (404) 894-3806
SHAFTING
1910.219(C)

• If located 7ft or less above floor or platform:
  • Horizontal, vertical, and inclined shafting must be enclosed
  • Must be enclosed by stationary casing or by a trough
  • Includes guarding shafts under work tables
PROJECTING SHAFT ENDS
1910.219(C)(4)

- Must not project more than \( \frac{1}{2} \) the diameter of the shaft unless guarded by a non-rotating cap or safety sleeve
PULLEYS
1910.219(D)

• Pulleys 7’ or less from the floor or working platform must be guarded
• Broken or cracked pulleys must not be used
BELT, ROPE, AND CHAIN DRIVES
1910.219(E)

- Horizontal belts and ropes 7’ or less from the floor or working platform must be guarded
  - Guard must extend to at least 15” above the belt
  - Belt shall be fully enclosed if located 42” or less from the floor
VERTICAL AND INCLINED BELTS

1910.219(E)

- Vertical and inclined belts below 7’ must be enclosed
- Vertical belts more than 7’ must be completely enclosed if:
  - Traveling 1800ft or more per minute
  - The belt is more than 8” in width
GEARS
1910.219(F)

• Meshing gears must be guarded (nip-point hazard)
• Guarding of hand-operated gears is highly recommended
• Mesh point must be enclosed
CHAINS AND SPROCKETS
1910.219(F)(3)

- All chains and sprockets located 7’ or less above the floor or platform must be enclosed
- If the drive extends over other machines or working areas, protection against falling must be provided
Portable Tools
PORTABLE POWERED TOOLS - GENERAL SAFETY PRECAUTIONS

• 1910.242(a)
  ○ Employers responsibility
    • Safe condition of tools
    • Including personal tools

• 1910.242(b)
  ○ Compressed air not used for cleaning except where reduced to less than 30 p.s.i. and only when effective chip guarding and PPE.
POWER TOOLS (CONT.)

• 1910.243 (a)(1) – Portable Circular Saws
  – Upper blade guard
  – Lower blade guard
    • Automatically returns to starting position
POWER TOOLS (CONT.)

• 1910.243(a)(3)
  ○ Portable belt sanding machines
    • Guard nip point where belt runs onto pulley
    • Guard unused run of belt
PNEUMATIC POWER TOOLS
AND AIR HOSES

• 1910.243(b)
  o Tool Retainer – A tool retainer must be installed on each piece of equipment where ejection could result
  o Air hose – Hose and hose connections must be designed for the pressure and service to which they are subjected
PNEUMATIC TOOL CONNECTIONS

UNACCEPTABLE

ACCEPTABLE

HOSE CLAMP
PORTABLE ABRASIVE WHEELS

- Exposure angle will not exceed 180 degrees.
- Top portion of the wheel must be guarded.
PORTABLE ABRASIVE WHEELS

180 deg
PORTABLE ABRASIVE WHEELS

• 1910.243(c)(1)(i)
  ○ Exceptions
    • Wheels used within the work
    • 2” or smaller in diameter
    • Cones, plugs, etc. where work offers protections

• 1910.243(c)(6) – Other exclusions
  ○ Natural sandstone wheels
  ○ Metal, wooden, cloth, or paper discs having a layer of abrasive surface
POWDER ACTUATED TOOLS

Georgia Tech

Cut-Away View

Muzzle Busing (fastener loading end of tool)
- Piston
- Trigger
- Handle

10 Shot Disc Load

CREATING THE NEXT®
POWDER ACTUATED TOOLS

• 1910.243(d)
  ○ Operators and assistants must wear eye protection
  ○ Head and face protection dependent on working conditions
POWDER ACTUATED TOOLS (CONT.)

• Must have protective shield or guard at least 3 ½ inches in diameter.
• Firing must be dependent on at least 2 separate and distinct operations.
• Firing mechanism must prevent tool from firing during loading, while preparing, if dropped.
Fasteners/Charges Used in Powder Actuated Tools

- Concrete
- Concrete/wood
- Wood

Be sure to use the right size charge with right size fastener.

Specific size = Specific operation
SEOUL, Korea -- The X-ray picture shows a 5-centimeter nail stuck in an unidentified South Korean patient's skull Thursday, Dec. 2, 2004. According to a Seoul hospital, doctors found the nail after the man came to the hospital, complaining about a severe headache. They speculate that the nail stuck in the man's head four years ago in an accident but the man didn't know about it. The nail was removed in a surgery last Saturday. (12/07/04 AP photo)
1910.213

WOODWORKING MACHINERY REQUIREMENTS
Main Types of Hazards Associated with Woodworking Operations

Safety
• Machine hazards
  – Point of operation
  – Rotary and reciprocating movements
  – In-running nip points (pinch points)
• Kickbacks
• Flying chips, material
• Tool projection
• Fire and explosion hazards
• Electrical hazards

Health
• Noise
• Vibration
• Wood dust—carcinogens
• Chemical hazards—from exposure to
  – coatings,
  – finishings,
  – adhesives,
  – solvent vapors
All belts, pulleys, gears, shafts, and moving parts shall be guarded in accordance with the specific requirements of 1910.219
1910.213(a)(11)

• All tools operating at more than 90v must have their metal parts grounded
  ○ Separate ground wire and polarized plug
MACHINE CONTROLS AND EQUIPMENT
1910.213(B)

• A mechanical or electrical power control shall be provided on each machine to make it possible for the operator to cut off the power from each machine without leaving his position at the point of operation.
• On applications where injury to the operator might result if motors were to restart after power failures, provision shall be made to prevent machines from automatically restarting upon restoration of power.
OPERATING CONTROLS

1910.213(B)

• Operating controls must be placed so the operator has access to them without reaching over the cutting blade
  o Must be placed within reach of their regular work station

• Machines operated by electrical motors must have controls capable of being rendered inoperative
  o For maintenance, repairs, adjustments, etc.
FOOT PEDALS AND FEEDER ATTACHMENTS

1910.213(B)

- Operating treadles must be protected from unintended operation

- Feeder attachments must have feed rolls or other moving parts covered to protect operator from pinch points
FOOT PEDAL
HAND-FED RIPSAWS
1910.213(C)

• Each circular hand-fed ripsaw shall be guarded by a hood which shall completely enclose that portion of the saw above the table and that portion of the saw above the material being cut. The hood and mounting shall be arranged so that the hood will automatically adjust itself to the thickness of and remain in contact with the material being cut without considerable resistance.
TABLE SAW
TABLE SAW
KICKBACK

• Kickbacks occur when a saw seizes the stock and hurls it back at the operator. This can happen when the stock twists and binds against the side of the blades or is caught in the teeth. A blade that is not sharpened, or that is set at an incorrect height, can cause kickbacks.

• This can happen with many operations, but primarily with RIP cuts where the wood is being cut with the grain. The wood wants to bind back on the blade and project the scrap piece of wood back at the operator.
Each hand-fed circular ripsaw shall be provided with non-kickback fingers or dogs so located as to oppose the thrust or tendency of the saw to pick up the material or throw it back toward the operator.
Anti-Kickback Fingers & Spreader Bar
HAND-FED CROSSCUT TABLE SAW

1910.213(D)

• Each circular crosscut table saw shall be guarded by a hood which shall meet all the requirements of 1910.213(c)(1) for hoods for circular re-saws
SELF-FEED CIRCULAR SAWS
1910.213(F)

• Self-feed circular saws
  o Guarded by a hood or guard to prevent hands of operators from coming in contact with the in-running rolls
  o If self-fed saws are used for ripping they must be equipped with anti-kickback devices (dogs)
SWING CUT OFF SAWS
1910.213(G)

• Provided with a hood that completely covers the upper half of the blade and the arbor
• Provided with a guard that will protect the point of operation
• Must be provided with a means to return to it’s resting position
• Limit chain to limit the travel beyond or behind the working table
SWINGING CUT OFF SAW
• The upper hood shall completely enclose the upper portion of the blade down to a point that will include the end of the saw arbor....The sides of the lower exposed portion of the blade shall be guarded to the full diameter of the blade by a device that will automatically adjust itself of the thickness of the stock and remain in contact with the stock.
1910.213(h) – RADIAL SAWS
ADJUSTABLE STOP
1910.213(H)

• An adjustable stop shall be provided to prevent the forward travel of the blade beyond the position necessary to complete the cut in repetitive operations
• Installation shall be in such a manner that the front end of the unit will be slightly higher than the rear, so as to cause the cutting head to return gently to the starting position when released by the operator.
NON-KICKBACK FINGERS/DOGS
1910.213(H)

- Each radial saw used for ripping shall be provided with non kickback fingers or dogs located on both sides of the saw.
RADIAL SAWS
RADIAL SAWS
RADIAL SAWS
• All portions of the saw blade (bandsaws) shall be enclosed or guarded, except for the working portion of the blade between the bottom of the guide rolls and the table.
VERTICAL BANDSAWS
• Each hand-fed jointer with a horizontal cutting head shall have an automatic guard which will cover all the section of the head on the working side of the fence or gage
JOINTERS
WOOD SHAPERS AND SIMILAR EQUIPMENT
1910.213(M)

• The cutting heads of each wood shaper, hand-fed panel raiser, or other similar machine not automatically fed, shall be enclosed with a cage or adjustable guard so designed as to keep the operator’s hand away from the cutting edge.
• Planers
  o Guard covering the cutting heads
  o If exhaust hood used, must be integral to the guard
  o Guard/hood must protect the feed rolls/in-running nip points
PLANERS
1910.213(p) – SANDING MACHINES

• Sanding Machines
  ○ Where the sanding belt runs over rollers a guard must prevent the operator from coming into contact with the in-running nip points
  ○ Drum sanders must be protected above the table by a guard or exhaust hood except for that portion of the sander which is necessary for the stock
• The mention of specific machines in paragraphs (a) thru (q) and this paragraph (r) of this section, inclusive, is not intended to exclude other woodworking machines from the requirements that suitable guards and exhaust hoods be provided to reduce to a minimum the hazard due to the point of operation of such machines.
• All knives and cutting heads of woodworking machines shall be kept sharp, properly adjusted, and firmly secured. Where two or more knives are used, they shall be properly balanced.
• Sharpening or tension of saw blades or cutters shall be done by persons of demonstrated skill.

• Emphasis shall be placed on the importance of cleanliness of the woodworking area.
PUSH STICKS
1910.213(s)

- Push sticks and push blocks shall be provided for small pieces of wood and for pushing the stock past the blade.
QUESTIONS?
ROBOT SAFETY STANDARDS

• Current National Standards
  o ANSI/RIA R15.06-2012
  o CSA Z434-14 (Canadian)

• Current International Standards
  o ISO 10218-1:2011 Industrial robots
  o ISO 10218-2:2011 Industrial robot systems and integration

• Technical Reports
  o RIA TR R15.306-2014 – Task-based risk assessment
  o RIA TR R15.406-2014 – Safeguarding
  o RIA TR R15.506-2014 – Existing Applications
APPLICABLE STANDARDS

• 1910.212(a)(1)
• 1910.212(a)(2)
• 1910.212(a)(3)(ii)
• 1910.212(b)
• 1910.147
• 1910.331-.335
• Section 5(a)(1)
CONFIGURATIONS

Figure IV:4-1. Robot Arm Design Configurations

- Rectangular Coordinate Robot
- Cylindrical Coordinate Robot
- Spherical Coordinate Robot
- Articulated Arm Robot
- Gantry Robot
- SCARA Robot
Figure IV:4-6. A Robot’s Work Envelope

- Maximum Envelope
- Restricted Envelope
- Operating Envelope
RISK ASSESSMENT

• Give particular consideration to:
  o Intended operations of the robot including teaching, maintenance, setting, and cleaning
  o Unexpected start-up
  o Access by personnel from all directions
  o Reasonably foreseeable misuse
  o Effect of failure in the control system
  o Hazards associated with the specific robot application
• Standard provides requirements for the safety of personnel associated with the use of robots and robot systems
• Excludes specific robot applications
• Standard applies to industrial robots used in industrial automation applications
OPERATING MODES

• Program/Teaching
• Normal Operations
• Maintenance
ACCIDENTS INCLUDED THE FOLLOWING:

• Robot’s arm functioned erratically during programming and struck the operator.
• Operator entered the work envelope during operations and was pinned between the back end of the robot and a pole.
• A fellow employee accidentally tripped the power switch while a maintenance worker was servicing a robot. The robot arm struck the maintenance worker.
TYPES OF ACCIDENTS INCLUDE:

• Impact or Collision Accidents – Unpredicted movements, malfunctions, peripheral equipment.
• Crushing or Trapping Accidents
• Mechanical Part Accidents – Breakdown, release of energy, failure of end-effectors
• Other – Ruptured hydraulic lines, arc flash, metal spatter, dust, tripping hazards.
SAFEGUARDING

• Required when design does not remove hazards or adequately reduce risks

• Guards and protective devices can (See RIA TR R15.406):
  o Prevent access to the hazard(s)
  o Cause hazard(s) to cease before access
  o Prevent unintended operation
  o Contain parts and tooling
  o Limit other process hazards

• Guards or sensitive protective devices used for perimeter safeguarding

• Selection takes into account all the hazards within the safeguarded space
REQUIREMENTS FOR GUARDS

• Openings in any fixed guard shall not allow a person to reach over, under, around or through any opening or gap and access a hazard
  o Max opening at bottom 7 inches
  o Minimum height at top 55 inches
• Moveable guards shall open laterally or away from the hazard, and not into the safeguarded space and bring any hazards to a safe state before an operator can gain access
BARRIER PROTECTED AREA
Industrial robots are programmable multifunctional mechanical devices designed to move material, parts, tools, or specialized devices through variable programmed motions to perform a variety of tasks. Robots are generally used to perform unsafe, hazardous, highly repetitive, and unpleasant tasks. They have many different functions such as material handling, assembly, welding, machine tool load and unload functions, painting, spraying, and so forth.

Studies indicate that many robot accidents occur during non-routine operating conditions, such as programming, maintenance, testing, setup, or adjustment. During many of these operations the worker may temporarily be within the robot’s working envelope where unintended operations could result in injuries.

There are currently no specific standards for the robotics industry.
QUESTIONS?
1910.217
MECHANICAL POWER PRESSES
WHAT IS A MECHANICAL POWER PRESS?
MECHANICAL POWER PRESSES

• Mechanical Full Revolution Clutch
  o Can not be disengaged during full stroke
• Mechanical Part Revolution Clutch
  o Can be disengaged at any time during a full stroke
• Guarding is dependent on which type of press
  o Example – Presence sensing devices or two hand controls can’t guard a full revolution – the stroke can’t be disengaged when device is activated
POINT OF OPERATION
1910.217(C)(1)

• Use of point of operation guards or properly applied and adjusted point of operation devices on every operation performed on a mechanical power press. See Table O-10.
EXAMPLES OF GUARDS/SAFEGUARDS
POINT OF OPERATION GUARDS
1910.217(c)(2)

- Prevent entry of hands or fingers into point of operation by reaching through, over, under, or around guard
- Conform to O-10.
- Create no pinch point between guard and moving parts
- Utilize fasteners not readily removable by operator
- Facilitate inspection
- Offer maximum visibility of the point of operation
Various guards (cont’d)
a) Prevent and/or stop normal stroke if hands inadvertently placed in point of operation (light curtain); or

b) Prevent operator from inadvertently reaching into point of operation or withdrawing hands as the dies close (pull-back); or

c) Prevent the operator from inadvertently reaching into point of operation at all times (restraint);
• Prevent and/or stop normal stroke of press if operator’s hands inadvertently placed in point of operation
• May not be used on full revolution clutch machines
• May not be used as tripping means to initiate motion
Presence sensing devices

- Light curtain
  - Horizontal mounted light curtain
  - Vertical mounted light curtain
TWO-HAND CONTROL
1910.217(c)(3)(vii)

• Require both hands to machine operating controls and locating controls at safety distance

• Meet 217(b)(7)(v) – Includes: Concurrent use of both hands, permit adjustment requiring both hands, incorporate anti-repeat, require release of operators’ hands before interrupted stroke can be resumed
MECHANICAL POWER PRESSES

• Periodic and regular inspections
• Foot pedal protected to prevent unintended operation
• Machine guarding power transmission apparatus same as other equipment
• The employer must report all point-of-operation injuries within 30 days of occurrence
QUESTIONS?
WHAT CAUSES INJURIES?

• Based on a Bureau of Labor Statistics (BLS) study:
  o 80% fail to turn off the equipment
  o 10% activated by someone else
  o 5% failed to control potential energy
  o 5% failed to verify
WHAT IS COVERED UNDER 29 CFR 1910.147?

• Servicing and maintenance

• Normal production operations where:
  • Employees by-pass guard(s)
  • Employees place any part of their body in a hazardous area
WHAT IS NOT COVERED?

• Construction, agriculture, and maritime
• Normal production operations (subpart O)
• Cord-and-plug under the control of employee (written procedure still required)
• Exposure to electrical conductors (subpart S and electrical-safety related work practices)

• THIS JUST MEANS THEY ARE NOT COVERED UNDER 29 CFR 1910.147 – DOES NOT MEAN LOCKOUT TAGOUT DOES NOT APPLY IN THESE CASES
PURPOSE OF LOCKOUT/TAGOUT

Prevent injury due to the unexpected energization or startup of machines or equipment during service or maintenance.

• Including release of stored energy
DEFINITIONS

• Affected employee
• Authorized employee
• Capable of being locked out
• Energy isolating device
• Servicing and/or maintenance
LOCKOUT APPLIES WHEN:

1. Workers are performing servicing and maintenance

2. There is a potential for injury from unexpected start-up or release of stored energy.

Normal production operations are not taking place.
LOCKOUT ALSO APPLIES WHEN:

Service and maintenance that takes place during normal production, if employee:

- Must remove or bypass a guard or safety device; or
- Must place any part of their bodies into the danger zone
LOCKED OUT?
ENERGY TYPES

• Electrical
• Mechanical
• Hydraulic
• Pneumatic
• Chemical
• Thermal
• Other
LOCKOUT VERSUS TAGOUT

If capable of being locked out:

• Prefer lockout

• Tags allowed, if employer can demonstrate FULL EMPLOYEE PROTECTION

Machine Modifications

• If you alter a machine you must make the machine capable of accepting a lock.
SERVICING AND MAINTENANCE

- Setting up
- Adjusting
- Inspecting
- Modifying
- Installing
LOCKOUT/TAGOUT REQUIREMENTS

• Written program
• Written energy control procedures
• Training of employees (not just maintenance employees)
• Periodic review of procedures
ENERGY CONTROL PROCEDURE

• Notification of employees
• Preparation for shutdown
• Machine or equipment shutdown
• Machine or equipment isolation
• Lockout/tagout device application
• Stored energy
• Verification of isolation
• Release from lockout/tagout

These procedures must be specific!
1. Machine has no potential for stored energy
2. Machine has a single energy source
3. Isolation of that source will completely de-energize
4. Machine is isolated during maintenance
5. Machine must be capable of being locked out during maintenance
6. The device is under the control of the employee
7. Servicing or maintenance does not create hazards for other employees
8. The employer has had no accidents involving activation or re-energization during servicing or maintenance

Note: must meet all 8 items before exception applies.
ENERGY ISOLATION
STORED ENERGY EXAMPLES

• Batteries and capacitors
• Pressure differential
  o Hydraulic
  o Pneumatic
  o Vacuum
• Springs
• Gravity
LOCK/TAG REMOVAL IF AUTHORIZED EMPLOYEE IS GONE?

- Verify that authorized employee is not at facility
- Make reasonable efforts to inform him or her
- Ensure that he/she knows of removal upon re-entering
- MUST INCLUDE THIS PROCEDURE IN WRITTEN PROGRAM
HARDWARE REQUIREMENTS:

• Durable
• Standardized
• Substantial
• Identifiable
HARDWARE MUST BE:

• Provided by the employer
• Singularly identified
• Only devices used for control
• Not used for other purposes
LOCKS, HASPS AND TAGS
PERIODIC INSPECTION

• Performed at least annually
• Lockout – include review with authorized employees
• Tagout – include review with authorized and affected employees
• Certification record kept:
  • Identify machine or equipment
  • Date of inspection
  • Employees performing and including in inspection
TRAINING AND RE-TRAINING

• Authorized employees
  • Recognition of hazardous energy
  • Type and magnitude of hazardous energy
  • Methods of isolating energy
  • How to verify isolation
• Affected – Purpose and use of procedure
• Other – Procedure and Prohibition from tampering
• Tagout provisions
RE-TRAINING IS REQUIRED WHEN:

• Change in job assignment
• Change in machine or process
• Change in lockout/tagout procedure
• Inadequacies revealed in periodic review
TRAINING CERTIFICATION

• Certify that the training has been conducted and kept up to date:
  • Employee names
  • Date(s) of training
OUTSIDE PERSONNEL - CONTRACTORS

When outside servicing personnel are engaged in activities covered by this standard, the on-site employer and the outside employer shall inform each other of their respective lockout or tagout procedure.
GROUP LOCKOUT

• Personal lock or tag (usually)
• Lockbox or master tag system with principal authorized employee
• “Shall utilize a procedure which afford a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device”
TESTING OR POSITIONING MACHINES

- Clear the machine of tools and materials
- Remove employees from the area
- Remove lockout/tagout devices
- Energize and proceed with testing/positioning
- De-energize and re-apply energy control measures
MINOR SERVICING EXCEPTION

• Activities which are routine, repetitive, and integral to the use of the equipment for production are not covered by this standard if alternative measures provide effective protection.

• Activity must be conducted during normal production operations.

• Activity must be routine (regular course of procedure in accordance with established practices), repetitive (regularly repeated as part of production), and integral (essential to the production process).
WHICH OSHA STANDARD APPLIES?

• Employee is running product in a mixer. The guard is removed from the top of the mixer so the operator can see the consistency of the product.
• Is this a problem?
• Which OSHA standard applies?
ANSWER

• This is a machine guarding problem (Subpart O). The activity is taking place during normal production operations. It is not a servicing or maintenance activity. The guard should not be removed.

• Note: May want to change the guard so they can see the consistency of the product without removing the guard.
WHICH OSHA STANDARD APPLIES?

• Employee is changing out the die on a press for the next product. The guards are removed and the equipment is not locked out.

• Is this a problem?

• Which OSHA standard applies?
ANSWER

- This is a lockout/tagout problem (29 CFR 1910.147). The activity is a servicing/maintenance activity. The equipment is being set up for the next product and the guards are removed exposing employees to potential hazardous energy. Therefore, lockout/tagout should have been applied prior to removing the guards.
QUESTIONS?
CONTACT INFORMATION

• Website: www.oshainfo.gatech.edu

• www.OSHA.gov

• Email:
  • Rachel Schneider: rachel.schneider@innovate.gatech.edu
  • Paige Rohrig: paige.rohrig@innovate.gatech.edu