1 Safety

Module Goal

The purpose of this module is to inform OSHA employers and employees about safety concerns relating to the use of robotics systems in manufacturing.

INTRODUCTION

In this lesson, the user will:

- Learn about robots and robotics systems which present unusual hazards
- Understand the common safety systems employed to alleviate these hazards.

Introduction

An industrial robot is an automatically controlled, programmable device that can take the place of many jobs that humans c
assembly, pick-and-place warehouse functions, product inspection and testing.

Robots are often used in applications:

- Where precision is needed.
- In harsh environments where humans may be exposed to chemicals
- In physically demanding processes where handling of product may be stressful for humans.

Robot drive units consists of the following functions: driving, transmitting, recording, decelerating. Each of these is controlle
make up the robot drive unit.

Robot Build

Use slide Robot Drive Units from Chris TDL 103 mod 4 Robotics lesson

Teach and Repeat

Avatar - Most robots are set up for an operation by the teach-and-repeat technique. In this technique, a trained operator (p
as a teach pendant) to manually key a robot and its tasks. Robot speeds during these programming sessions are required

Corrective Maintenance

The very nature of robotics systems operations has introduced a new type of employee into the industrial workplace, the c
of a corrective maintenance worker?

Normally present during all operations of a robotics system

Responsible for assuring continuing operation

Adjusts speeds

Corrects grips

Frees jam-ups

Guides a robot through the teach-and-repeat technique

Robot accidents occur more frequently during certain times of operation.

Actually, these are the answers:

during programming

adjustment

testing

cleaning

inspection

repair

During many of these operations, the operator, programmer or corrective maintenance worker may temporarily be within t
the robot system.

List the key terms are required for student understanding of this topic
Available Resources:

Name of Resource	**Author/s**	**Source Location**

Coors Brewing Conveyor	Coors Brewery conveyor	http://commons.wikimedia.org/wiki/File:Coors_brewery_con

NO ATTRIBUTION		
IntelliCart1.jpg  **NO ATTRIBUTION**	Mukeshhrs	http://commons.wikimedia.org/wiki/File:IntelliCart

Typical Accidents

Robot Safety Video

link to youtube video - https://www.youtube.com/watch?v=Fo_RvSmqZF8

Robot Accidents

Various types of robot accidents have occurred, especially with the increased use of the devices. What are some likely scen

A worker turned off the power switch to make an adjustment to the robot.

Limit switch remains active while operator removes imperfect materials from machinery

A worker attempted to remove an imperfectly formed piece from a conveyor with both hands while the operation limit swit position. The worker's back was forced against the robot.- After adjusting a metal shaving machine, an operator was caug feed and removal robot.

Worker removes cover of operating robot- Correct!

worker removed the cover of an operating assembly robot to retrieve a fallen part and caught his hand in the robot's drive

An adjustment was made without stopping the robot- Correct!

An automatic welder robot operator made a manual adjustment without stopping the robot. He was hit in the head by one weldments arrived.

Carton conveyor

Robot Hazards

There is no one reason for a robot hazard. Accidents can occur for a number of reasons.

Human errors

Control errors

Unauthorized access

Mechanical hazards

Environmental hazards

Electric, hydraulic, and pneumatic power sources

An effective safety system protects operators, engineers, programmers, maintenance personnel, and others who could be
combination of methods may be used to develop an effective safety system. Redundancy and backup systems are recomm
conditions.

List the key terms are required for student understanding of this topic

Available Resources:

Name of Resource	**Author/s**	**Source Location**
Accumulation roller conveyor 	Kay-Uwe Rosseburg	http://commons.wikimedia.org/wiki/File:Accumulation_Roller_

"Accumulation roller conveyor" by Kay-Uwe Rosseburg is licensed by CC BY-3.0 Unported		
Carton Conveyor.jpg  **ATTRIBUTION:** "Carton Conveyor.jpg" by TGW Mechanics GmbH is licensed by CC BY 3.0	TGW Mechanics GmbH	http://commons.wikimedia.org/wiki/File:Cart
AGVs amarillos.jpg  **ATTRIBUTION**: "AGVs amarillos.jpg" by Carmenter is licensed by CC BY 1.0.	Carmenter	http://en.wikipedia.org/wiki/File:AGVs_a

Safety Systems

The proper selection of an effective robotics safety system must be based on hazard analysis of the operation involving a particular robot.

What are some of the factors to consider when choosing a safety system? Select the options that apply.

- **the task a robot is programmed to perform**
- **the start-up and the programming procedures**
- **environmental conditions and location of the robot**

- **requirements for corrective tasks to sustain normal operations**
- **human errors**
- **possible robot malfunctions**

List the key terms are required for student understanding of this topic

Available Resources:

Name of Resource	Author/s	Source Location	License

Guarding Methods

Machine Guarding

Serious workplace injuries, such as crushed fingers or hands, amputations, burns or blindness, are always a possibility w
Safeguards are critical to protect employees from these preventable injuries.

Any machine part, function or process that could cause injury must be safeguarded. If the operation of a machine or acci
operator or others in the area, the hazard must be eliminated or controlled.

Types of Guards

Guards are barriers which prevent access to danger areas. Guarding protects the machine operator from hazards at the
parts, flying chips and sparks.

There are many ways to safeguard machines. The type of operation, size or shape of stock, method of handling, work are
requirements or limitations determine the appropriate safeguarding method for the individual machine.

There are four general types of guards.

1. Fixed: A permanent part of the machine, this guard does not depend on moving parts to perform its intended func
2. Interlocked: Power automatically shuts off when this type of guard is opened or removed and the machine cannot
3. Adjustable: This flexible guard is manually adjusted by the operator to accommodate various types of stock.
4. Self-adjusting: As stock moves into the danger area, this guard automatically adjusts to provide an opening only l
   rest position after stock is removed.

Other methods of safe guarding machines are used in addition to physical guards. They include presence sensing device controls, two-hand controls, gates and location of the operator. Automatic stock feeding and ejection systems also provid operator in the danger area.

Interlocked Barrier Guard

This is a physical barrier around a robot work envelope incorporating gates equipped with interlocks. These interlocks are the robot and associated machinery will stop when any gate is opened. Restarting the operation requires closing the gate outside of the barrier. A typical practical barrier is an interlocked fence designed so that access through, over, under, or a is closed.

Fixed Barrier Guard

A fixed barrier guard is a fence that requires tools for removal. Like the interlocked barrier guard, it prevents access throu provides sufficient clearance for a worker between the guard and any robot reach, including parts held by an end-effecto conditions.

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What do you know about these additional guards? Match each term to the correct definition.

Awareness Barrier Device

This is a device such as a low railing or suspended chain that defines a safety perimeter and is intended to prevent inadv be climbed over, crawled under, or stepped around. Such a device is acceptable only in situations where a hazard analysi inter locked or fixed barrier guards are not feasible. Interlocked or fixed barrier guards provide a positive protection need systems hazards.

Presence Sensing Devices

The presence detectors that are most commonly used in robotics safety are pressure mats and light curtains. Floor mats (similar to arrays of photocells) can be used to detect a person stepping into a hazardous area near a robot. Proximity de ultrasonics, radio frequency, laser, and

Emergency Robot Braking

Dangerous robot movement is arrested by dynamic braking systems rather than simple power cut-off. Such brakes will co
Cutting off all power could create hazards such as a sudden dropping of a robot's arm or flinging of a workpiece.

Audible and Visible Warning Systems

Audible and visible warning systems are not acceptable safeguarding methods but may be used to enhance the effectiver
audible and visible signals need to be easily recognizable.

List the key terms are required for student understanding of this topic

Available Resources:

Name of Resource	**Author/s**	**Source Location**
Projecte Barcino.jpg  **ATTRIBUTION:** "Projecte Barcino.jpg" by Biopol'H is licensed by CC BY 3.0.	Biopol'H	http://commons.wikimedia.org/wiki/File:Projecte_Barcino.jpg
Forklift AGV with Straddle, courtesy of Egemin Automation Inc..jpg  **ATTRIBUTION:** "Forklift AGV with Straddle, courtesy of Egemin Automation Inc..jpg"	AGVExpertJS	http://en.wikipedia.org/wiki/File:Forklift_AGV_with_Straddle,_courtesy_of_Egemin

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Control Devices

Control devices are another safety measurement used in robotics safety. Let's see what you know about control devices.

1. Which of the following statements are true?

The main control panel should be located outside the robot system work envelope in sight of the robot.

The main control panel should be located inside the robot system work envelope in the sight of the robot.

The main control panel should be located inside the robot system work envelope behind the robot.

2. Emergency stops are critical and therefore should be:

Readily accessible near the main office.

Readily accessible in all zones where needed. These are clearly situated in easily located positions and the are a prominent part of personnel training.

Readily accessible on a ground floor.

1. The portable programming control device contains an emergency stop.

True

Here is some additional information that is true about control devices.

- Automatic stop capabilities are provided for abnormal robot component speeds and robot traverses beyond the o
- All control devices are clearly marked and labeled as to device purpose. Actuating controls are designed to indica status.
- Controls that initiate power or motion are constructed and guarded against accidental operation.
- Each robot is equipped with a separate circuit breaker that can be locked only in the "off" position.
- User-prompt displays are used to minimize human errors.
- The control system for a robot with lengthy start-up time is designed to allow for the isolation of power to compo motion from the power required to energize the complete robot system.
- Control systems are selected and designed so that they prevent a robot from automatically restarting upon resto power failure. The systems also prevent hazardous conditions in case of hydraulic, pneumatic or vacuum loss or
- A robot system is designed so that it could be moved manually on any of its axes without using the system drive
- All control systems meet OSHA 29 CFR 1910 Subpart S standards for electrical grounding, wiring, hazardous loca requirements.

List the key terms are required for student understanding of this topic

List any resources available (online, handouts, pictures, videos, test materials/questions and answers)

Name of Resource	Author/s	Source Location
AGV-Siemens ANS.jpg  **ATTRIBUTION:** "AGV-Siemens ANS.jpg" by StraSSenBahn is licensed by CC BY 3.0.	StraSSenBahn	http://en.wikipedia.org/wiki/File:AGV-Siemens_ANS.jpg

Installation, Maintenance and Programming

TRAINING

Effective accident prevention programs include training. There are many factors that need to be considered when implem
scenario.

1. A manager is undergoing a 6 week course on safety and accident prevention.

**Managers and supervisors in facilities that use robots are trained in the working aspects of robots so that t
from an informed viewpoint.**

Robot programming and maintenance operations are prohibited for persons other than those who have received adequat
robots.

Training is commensurate with a trainee's needs and includes the safeguarding method(s) and the required safe work pra
assigned job.

2. All employees must sign a safety policy and undergo training when starting work.

The employer insures that his or her company has a written robotics safety policy that has been explained This safety policy states by name which personnel are authorized to work with robots.

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Name of Resource	Author/s	Source Location
Float_Glass_Unloading.jpg  **ATTRIBUTION:** "Float_Glass_Unloading.jpg" by ICAPlants is licensed by CC BY 3.0.	ICAPlants	http://commons.wikimedia.org/wiki/File:Float_G
Chinese knife factory.jpg  **ATTRIBUTION:** "Chinese knife factory.jpg" by Taro Taylor is licensed by CC BY 2.0.	Taro Taylor	http://en.wikipedia.org/wiki/File:Chinese_kn
company factory production machine production line	marcin049	http://pixabay.com/en/company-factory-proc

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SUMMARY

The increased use of robots has created a need for proper training and awareness when using the machinery. It is important to recognize the guards in place and the potential hazards that may arise when using robotics. Safety is the responsibility of the employees and the employers.

LABS

Provide an overview of labs that are required. Include any links to labs that are available for review.

QUIZ

Define how you will ascertain student's knowledge acquisition, i.e., tests, demonstrations, etc. If a test is applicable, then provide questions and answers using MBL Quiz Template.

FURTHER STUDY

Provide brief information here about where students can get more information on this topic (leading organizations, libraries focused on this topic, etc…). Be sure that the information is nonproprietary, reliable, and fairly static (something we won't have to change often).

STATEMENTS

This workforce solution was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites, and including, but not limited to accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability or ownership.