



INDIANA UNIVERSITY

OFFICE OF THE EXECUTIVE VICE PRESIDENT
FOR UNIVERSITY ACADEMIC AFFAIRS

University Environmental Health and Safety

Robots and Robotic Systems Safety Program

May 31, 2017

1. INTRODUCTION

1.1. Purpose

Indiana University Environmental Health and Safety (IUEHS) has developed this Program to establish minimum requirements for the design, rebuild, installation, safeguarding, maintenance, testing, start-up, and employee training as it relates to, or use of, robots or robotic systems. This Program augments applicable standards (ANSI/RIA R15.6-2012 and [29 CFR 1910.212](#)) established for the safe construction and operation of robots and robotic systems.

1.2. Scope

This Program applies to all Indiana University employees who design, install, operate, and service academic and medical robotic systems.

2. AUTHORITY AND RESPONSIBILITY

2.1. University Environmental Health and Safety (IUEHS) is responsible for:

- 2.1.1. Developing the written Robots and Robotic Systems Safety Program and revising the Program as necessary;
- 2.1.2. Reviewing risk assessments and providing guidance as necessary; and
- 2.1.3. Conducting routine inspections to ensure the proper safeguarding and use of robots and robotic systems.

2.2. Departments, Supervisors, Principal Investigators are responsible for:

- 2.2.1. Understanding and complying with the requirements of this Program;
- 2.2.2. Developing a training program for the installation, safeguarding, maintenance, testing, and startup of robots and robotic systems;
- 2.2.3. Completing risk assessments and forwarding to IUEHS for the respective campus for review prior to operating or putting a robot or robotic system in service;
- 2.2.4. Ensuring that safeguards (i.e. barrier fences, interlocked gates, emergency stops, teach pendants, light curtains, safety mats) are in place and operational at all times (when required by the risk assessment).
- 2.2.5. Ensuring employees under their supervision are trained on the safe use of robots and robotic systems;
- 2.2.6. Safeguarding and controlling robot keys (if required) ; and
- 2.2.7. Contacting IUEHS for your respective campus when assistance is needed.

2.3. Employees are responsible for:

- 2.3.1. Completing required training;
- 2.3.2. Complying with the procedures outlined in this Program;
- 2.3.3. Operating the robots and robotic systems as intended; and

2.3.4. Informing their supervisor of any safety issues or defective equipment.

3. PROGRAM ELEMENTS

3.1. Hazard Identification and Risk Assessment

3.1.1. At each stage of design and installation of a robot and robotic system, a hazard identification and risk assessment as well as personnel safeguarding requirements shall be performed (as described in Section 4.0 of part 2 of the ANSI/RIA R15.06-2012). The appropriate level of safeguarding determined by the hazard identification and risk assessment shall be applied prior to operation. In addition, the risk assessments for each stage of development shall be documented (with a copy sent to IUEHS for review) and remain with the robot and robotic system for reference.

3.2. Safeguards

3.2.1. When design does not either remove the hazards or adequately reduce the risks, and the risk assessment indicates a need, safeguarding shall be applied (as described in Section 5.10 of part 2 of the ANSI/RIA R15.06-2012). Therefore, access to hazardous areas of the robot and robotic systems shall be protected by safeguards such as guards and protective devices.

3.2.2. Robot and robotic system guarding/safeguarding shall comply with section 5 of part 2 of the ANSI/RIA R15.06-2012 and contain the following at a minimum:

- 3.2.2.1. Limiting robot motion as described in 5.4 of part 2 of the ANSI/RIA R15.06-2012;
- 3.2.2.2. Use of a key, plug or actuating device which is not easily duplicated or tamper-resistant;
- 3.2.2.3. Supervisory control of spare keys and actuating devices. (If spare keys and actuating devices are in demand for the purpose of defeating the safeguard, the design of the overall safety scheme should be reviewed for deficiencies);
- 3.2.2.4. Barriers that cannot be defeated intentionally without the use of tools;
- 3.2.2.5. Perimeter safeguarding as described in Section 5.5.1 of part 2 of the ANSI/RIA R15.06-2012;
- 3.2.2.6. Installation that cannot be placed in automatic operation until the associated safeguard is active as described in Section 5.6.3.3 of part 2 of the ANSI/RIA R15.06-2012;
- 3.2.2.7. Installation that will result in a shutdown of operations if the safeguard is removed while the hazard is present as described in Section 5.6.3.4 of part 2 of the ANSI/RIA R15.06-2012;
- 3.2.2.8. Installation will not result in an automatic re-start of operation as a result of only activating the safeguard as described in Section 5.6.3.4.2 of part 2 of the ANSI/RIA R15.06-2012; and
- 3.2.2.9. Must be capable of being easily unlocked from the inside of the safeguarded space with or without power available, when the possibility of full body access exists.

3.3. Protective Devices

When protective devices such as pressure sensitive equipment (mats), light curtains, and laser scanners are required, they shall comply with Section 5.10.5 of part 2 of the ANSI/RIA R15.06-2012.

3.4. Emergency Stop

Every robot system, pendent, or cell shall have a protective stop function and an independent emergency stop function as described in Section 5.3.8 and 5.3.9 of part 2 of the ANSI/RIA R15.06-2012. These stops shall stop all robot motion and other hazardous functions in the cell or at the interface between cells and other areas of the workplace.

3.5. **Suspension of Safeguards**

Tasks that require the suspension of safeguards shall have a dedicated mode of operation that automatically selects the appropriate safeguards, as determined by the risk assessment and as described in Section 5.10.11 of part 2 of the ANSI/RIA R15.06-2012.

3.6. **Lockout/Tagout Procedures**

When entering a robot cell for any reason such as maintenance/servicing, un-jamming, or housekeeping, lockout/tagout procedures are required per the IU [Control of Hazardous Energy Program](#).

3.7. **Initial Start-up Procedure Plan**

An initial start-up procedure plan for a new robot or robotic system shall be established that includes, mechanical, electrical, and operational tests, with and without power being applied. These requirements are outlined in Section 5.12.3 of part 2 of the ANSI/RIA R15.06-2012.

4. **TRAINING & RECORDKEEPING**

4.1. All employees affected by this Program shall be trained in robots and robotic systems. The training requirements are outlined in Section 7.2 of part 2 of the ANSI/RIA R15.06-2012. This training includes:

- General information from the Instructional Handbook,
- Handling as it relates to transport, handling and storage,
- Installation and commissioning,
- Information for commissioning test or initial start-up procedure,
- Robot system information,
- Use of the robot system,
- Maintenance,
- De-commissioning,
- Emergency situations, and
- Robot specific information.

4.2. Retraining

Retraining shall occur when:

- There are personnel changes,
- When there are system changes, and
- After an accident/incident.

5. **REFERENCES**

- [29 CFR 1910.147 – Control of Hazardous Energy](#)
- [29 CFR 1910.212 – General Requirements for all Machines](#)
- ANSI/RIA R15.06-2012
- [IU Control of Hazardous Energy Program](#)

6. **REVISIONS**

Revised – May, 2017

APPENDIX A – GLOSSARY

Lockout/Tagout - The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Pendant – A hand-held device linked to the control system by which a robot can be programmed or operated. Also called a teach pendant.

Robot – A multifunctional, reprogrammable machine that moves material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

Reprogrammable – A computer program that can be changed or having the ability to receive new and/or advanced instructions to perform jobs and to change motions without further human action.

Robotic Keys – A key that electrically disables the robotic servo unit and or the robotic cell gate interlock.

Safeguarding – The act of providing personnel with protection from a hazard.