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Applying Robotic Technologies to Improve Manufacturing Processes

Crossco.com

What Can You Automate?

Use Our Expertise to Configure Your Entire Robotic Cell

If you've always thought robotic automation was beyond your reach, it's time to look again. Our collaborative robots fit into any size production environment.

Get a competitive edge by using our flexible, user-friendly robots for small-batch, mixed-product assembly and materials handling. With an average payback period of only 195 days, what could you automate?

5 Beneficial Features

1. Collaborative operation – safely working side by side with people
2. Easy and intuitive programming – ground breaking "teach mode" programming
3. Portability – lightweight and compact design
4. Very low cost of ownership
5. Quick and easy to deploy

Case Studies

COLLABORATIVE ROBOTS: SIMPLE · FLEXIBLE · AFFORDABLE

Pick & Place

Molding

Machine Tending

Dispensing

CNC

Assembly

Quality Inspection

Case Packaging & Palletizing

Fastener Insertion

Services & Support

- Application Evaluation
- Proof of Concept Validation
- Light Integration
- Pre-Configured Robotic Hardware Solutions
- Custom End of Arm Tooling Solutions
- Maintenance Agreements
- Emergency Support Agreements
- Tailored Application Modules
- Training

Robot Safety Standards for Collaborative Operation (ISO 10218)

Step 1:

ISO 10218-1 Section 5.10 says: “Robots designed for collaborative operation shall provide a visual indication when the robot is in collaborative operation and shall comply with one or more of the requirements in 5.10.2 to 5.10.5”

Step 2: Universal Robots comply with section 5.10.5

ISO 10218-1 Section 5.10.5 Power and Force limiting by inherent design and control

“The power and force limiting function of the robot shall be in compliance with **5.4**. If any parameter limit is exceeded aprotective stop shall be issued. The robot is only a component in a final collaborative robot system and alone is not sufficient for a safe collaborative operation. The collaborative operation application shall be determined by the **[risk assessment]** performed during the application system design. Information for use shall include details for setting established parameter limits in the controlled robot. ISO 10218-2 shall be used for designing collaborative operations. Additional information will be contained in ISO TS 15066 (currently under draft)”

Risk Assessment: A risk assessment is the overall processcomprising a risk analysis and a risk evaluation. This means identifying all risks and reducing them to an appropriate level (See ISO 12100 or ISO 12100)

Step 3: OSHA

Understanding OSHA (Occupational Safety and Health Admin.)

Regarding Robot Safety: OSHA recommends that robots comply with the American standard ANSI/RIA R15.06

OSHA has its own regulations and recommendations which they call the OSHA 29 CFR1910 standard. This regulation has two points which the User/integrator of UR robots must consider: OSHA 29 CFR 1910.333: Selection and Use of Work Practices OSHA 29 CFR 1910.147: The Control of Hazardous Energy (Lockout/Tagout)

CFR 1910.333
Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized.

CFR 1910.147
This standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment, or release of stored energy, could harm employees. This standard establishes minimum performance requirements for the control of such hazardous energy.

Safety First

2014 Current Safety Standards

Global Industrial Robots Safety Standard:
ISO10218-1 (Manufacturer)
ISO 10218-2 (Integrator)
ISO TS 15066 (Draft-Guide only)
ISO 13849-1: provides safety requirements and guidance on the principles for the design and integration of safety-related parts of control systems (SRP/CS), including the design of software.

United States Standard:
ANSI/RIA R15.06-2012 **
Canadian Standard:
CAN/CSA Z434-2003(R2013)**

** Standard follows the Global Industrial Safety Standard word for word and is combined into one document

ISO 10218-1 Section 5.4: Safety related parts of control systems shall be designed so that they comply with PL=d with structure category 3 as described in ISO 13849-1.

Performance Level (PL) is a discrete level used to specify the ability of safety-related parts of a control system to perform a safety function under foreseeable conditions. In other words it is a defined measure of how likely it is for a system to fail. In a performance level d systems, it is very unlikely that a dangerous failure will occur. (See ISO 13849-1 for more details)

Category 3 is a term used about a system when it is designed as a dual-channel system. It is pretty common to construct Safety-related systems as dual channel systems. Safety Category 3 means that a single fault does not lead to the loss of the safety function. Furthermore most single faults are detected and well-tried safety principles have been applied. (See ISO 13849-1 for more details)

The above is compliant with both CB2 and CB3 robots. The UR Robots are PLd with Category 3 I/O’s only.

Summary

- It is not the robot that makes an application safe. It is the application that makes the application safe
- EVERY application needs a proper risk assessment
- OSHA is NOT the law. They are there to recommend guidelines for safe operation.
- UR complies with the current US,NA, and global safety standards for collaborative operation
- The UR robot is designed to comply with a PL=d , Category 3 safety Interfaces
- ISO is developing a NEW Technical Specification (TS) for collaborative robots (TS 15066). This is currently in development and scheduled for release early 2015. TS 15066 will bring a more detailed set of guidelines for Users and SI’s to following when deploying Collaborative robots. Universal Robots currently sits on the ISO board and TS 15066 development committee and is in full compliance with all new directives.

FAQ

Question	Answer
Is it required for the robot to comply with ISO 10218-1?	No, it is required to comply with the laws and regulations in the country and/or the state that the robot is installed in. See chapter ”safety” in the UR manual for more guidance.
Do UR5 and UR10 comply with ISO 10218-1?	Partly, but to explain why: UR complies with parts of ISO 10218-1, and does not follow the parts that do not make sense for our robots. This is because the standard also covers other types of robots than UR and different design solutions are possible according to this standard.
Why does Universal Robots not fully comply with ISO 10218-1?	It is a choice from UR’s side. The standard was written when only big, heavy and very dangerous robots existed. Certain parts of the standard will not make sense in relation to the UR Robot.
Is it OK not to comply fully with ISO 10218-1?	One should Think of the standard as a ”Best Practice” document, that was written for big heavy industrial robots. The UR Robot technology is different. UR robots are lighter, and therefore some parts of the standard did not make sense to follow. One could say that the technology is ahead of the standards. Over time this will be more up to date and aligned with the possibilities in new technologies.
Which parts of the standard ISO 10218-1 does UR5 and UR10 comply with?	UR Robots specifically comply with the parts related to ”Collaborative operation”, section 5.10.5. This standard is harmonized under the machinery directive and it specifically states that a robot can operate as a collaborative robot (i.e. without safety guards between the robot and the operator) if it is in compliance with the article 5.10.5. The risk assessment still needs to conclude that the overall robot installation is safe enough of course. A copy of the certification report can be requested from Universal Robots.
What is the difference between ISO 10218-1 and ISO 10218-2?	ISO 10218-1 is considering the design of a robot and this is the one UR follow partly. ISO 10218-2 consider the design of the installation where the robot is used. To say this more popular: ISO 10218-1 is for the manufacturers of robots, ISO 10218-2 is for the Integrators that integrate the robots in their machines or installations.
What is TS 15066, Technical Specification on Collaborative Robots?	TS (Technical Specification) 15066 is a working document. When finished this document can be made to a new Technical Specification for collaborative robots. But it is important to mention that it is work in progress, and will change before the final version. At present time, there is no date set for a final version.
What is ISO 13849?	This is a standard that describes safety related systems. This standard has its background in mechanical and electrical systems. It consists of two parts: ISO 13849-1: provides safety requirements and guidance on the principles for the design and integration of safety-related parts of control systems (SRP/CS), including the design of software. ISO 13849-2: specifies the procedures and conditions to be followed for the validation by analysis and testing of the specified safety functions, the category achieved, and the performance level achieved by the safety-related parts of a control system (SRP/CS) designed in accordance with ISO 13849-1
What is a stop category?	A standardized description of the process to stop a movement. There are three categories: - Stop Category 0: requires immediate removal of power to the actuators. This is sometimes considered as an uncontrolled stop because, in some circumstances, motion can take some time to cease because the motor may be free to coast to a stop. In this category a robots will not follow a path that is controlled. There is no control on the joints. - Stop Category 1: requires that power is retained to apply braking until the stop is achieved and then remove power to the actuator. - Stop Category 2: allows that power need not be removed from the actuator. Note that only Stop Categories 0 or 1 can be used as emergency stops (more information can be found ex. in IEC/EN 60204-1)
Which stop category is used for emergency stop in Universal Robots?	The UR Robots emergency stop is designed according to ”Stop category 1”, which means that power supply is cut, but motors are actively decelerating.
Which stop category is used for safeguard stop in Universal Robots?	The UR Robots safeguard stop is designed according to Stop category 2, which means that it is a controlled stop, where the motors keep being powered. Safety systems monitor the stop.
What is the difference between Emergency stop and Safeguard stop?	The safety interface of a UR Robot is comprised of two parts; the emergency stop interface and the safeguard stop interface. Emergency stops are supposed to be used for emergencies only; the EMERGENCY STOP button immediately stops robot motions. The Safeguard stop are used to pause the robot movement in a safe way. The Safeguard Interface on the UR Robot can be used for light guards, door switches, safety PLCs etc. Resuming from a safeguard stop can be automatic or can be controlled by a pushbutton, depending on the safeguard configuration. (more details to be found in the UR user manual)
Which safety level is the Emergency Stop in Universal Robots?	The Emergency stop system is designed Performance level d and have a Category 3 system monitoring the Emergency Stop (definitions according to ISO 13849-1)
Which safety level is the Safeguard Stop in Universal Robots?	The Safeguard stop system is designed the system for Performance level d (PL d) and have a Category 3 system monitoring the Emergency Stop (definitions according to ISO 13849-1)

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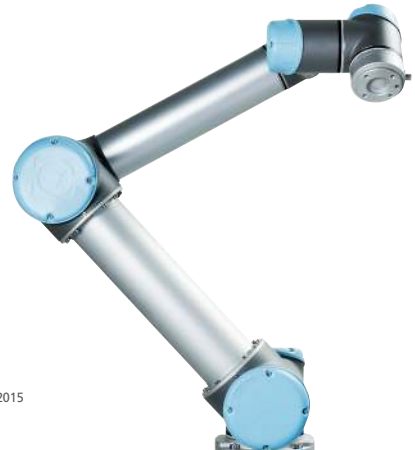
Technical Specifications	UR3 6-axis robot arm working radius of 500 mm / 19.7 in	UR5 6-axis robot arm working radius of 850 mm / 33.5 in	UR10 6-axis robot arm working radius of 1300 mm / 51.2 in
Weight	11 kg / 24.3 lbs	18.4 kg / 40.6 lbs	28.9 kg / 63.7 lb
Payload:	3 kg / 6.6 lbs	5 kg / 11 lbs	10 kg / 22 lbs
Reach:	500 mm / 19.7 in	850 mm / 33.5 in	1300 mm / 51.2 in
Joint ranges:	+/- 360° Infinite rotation on end joint	+/- 360°	+/- 360°
Speed:	All writst joints: 360 degrees/sec. Other joints: 180 degrees/sec. Tool: Typical 1m/s. / 39.4 in/s.	All joints: 180°/s. Tool: Typical 1 m/s. / 39.4 in/s.	Base and Shoulder: 120°/s. Elbow, Wrist 1, Wrist 2, Wrist 3: 180°/s. Tool: Typical 1 m/s. / 39.4 in/s.
Footprint:	Ø118 mm / 4.6 in	Ø149 mm / 5.9 in	Ø190 mm / 7.5 in
Power consumption:	Approx. 200 watts using a typical program	Approx. 200 watts using a typical program	Approx. 350 watts using a typical program

Technical Specifications – All Models

Repeatability	+/- 0.1 mm / +/- 0.0039 in (4 mils)
Degrees of freedom:	6 rotating joints
Control box size (WxHxD):	475 mm x 423 mm x 268 mm / 18.7 x 16.7 x 10.6 in
I/O ports: 	Digital in: Controlbox 16, Tool conn. 2 Digital out: Controlbox 16, Tool conn. 2 Analog in: Controlbox 2, Tool conn. 2 Analog out: Controlbox 2, Tool conn. -
I/O power supply:	24 V 2A in control box and 12 V/24 V 600 mA in tool
Communication:	TCP/IP 100 Mbit: IEEE 802.3u, 100BASE-TX Ethernet socket & Modbus TCP
Programming:	Polyscope graphical user interface on 12 inch touchscreen with mounting
Noise:	Comparatively noiseless
IP classification:	IP54
Collaboration operation:	15 Advanced Safety Functions
Materials:	Aluminum, ABS plastic
Temperature:	The robot can work in a temperature range of 0-50°C
Power supply:	100-240 VAC, 50-60 Hz
Cabling:	Cable between robot and control box (6 m / 236 in) Cable between touchscreen and control box (4.5 m / 177 in)



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