Are You Ready for the Coming Changes in Robot Safety Standards?
Housekeeping

• The Web Seminar will last about 1 hour
• Please type all questions in the Q & A tab
• Web Seminar will be Recorded for Future Playback
• Slides will be available with Recording
Questions?

To ask a question, select the Q&A tab
Guest Speaker: Doug Nix, A.Sc.T

- Industrial Machinery Specialist since 1996
- Managing Director, Compliance InSight Consulting, Inc.
- Member, CSA TC Z1002, Occupational Health and Safety Hazards and Risks - Identification, Assessment, Elimination and Control
- IEEE Product Safety Engineering Society
  - Director At Large
  - Chair, 2009 IEEE Symposium on Product Compliance Engineering, Toronto
  - Chair, Risk Assessment Technical Committee
  - Vice-Chair, Technology Management Council, Toronto Section
Manufacturers seek greater productivity and flexibility
The Robot User
Poll
User requirements create hazards!
Safety Standards bring risk reduction and productivity
The Solution

• Designs should be based on sound technical solutions driven by risk assessment

• Challenging problems require creative thinking, including clear understanding of the application, the user and the regulatory environment.
What is a Robot?
How many Axes?

Three or more

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Programmability

The device **must** be reprogrammable to be considered an industrial robot.

Mechanical changes to effect changes in operation, such as adjusting hard-stops or strokes, are excluded.
Multi vs. Single-purpose

Single-purpose devices, built to serve a particular process and not easily re-tasked or re-deployed are excluded.
How did we get here?

• Earliest Robots built in the 1950’s (Unimate)
• Large-scale deployments began in the 1970’s and 1980’s
• Significant safety-related issues began to be felt in industry during this time
Injuries and fatalities

- Hazards:
  - Impact
  - Crushing
  - Trapping
  - Stabbing
  - Electrocution
  - Arc Flash
  - Etc.

Image from CSA Z432-04, Annex A
End effector service area: guard in accordance with the requirements of this Standard.
Risk Controls (RIA & CSA)

• Risk Assessment
  – Use system described in standard or choose another
  – Select guards based on risk reduction requirements

• ‘Prescribed Method’
  – Provides prescriptive requirements regardless of the application (somewhat simpler than Risk Assessment)
Productivity Issues

• Cell Footprints
  – Prescribed method requires larger cell footprints
  – Prevents use of High Speed Attended Program Verification

• Compact sizes
  – Most users have very limited floor space
  – May need HSAPV for application (adhesives, painting, welding…)

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ISO 10218-1 2006

• Previously a single part standard (ISO 10218)
• Adopted from EN 775 published in the early 90’s
• ANSI version published in 2007
ISO 10218-1 2006
Robots for industrial environments – Safety requirements – Part 1: Robot

- Deals exclusively with the robot itself
- Applies to new and rebuilt robots
- Similar to Section 4 in both ANSI/RIA 15.06 and CSA Z434
- Does not speak to the application safety requirements
ISO 10218-2

Robots and robotic devices – Safety requirements – Part 2: Industrial robot system and integration

• Deals with the application safety requirements (everything else not in ANSI/RIA 15.06 Section 4)
• Completed Inquiry stage in Sep-09, ready for registration as an ‘FDIS’ - Final Draft International Standard
• Expected publication by the end of 2010
• No information on ANSI/RIA or CSA adoption date for this part of the standard.
Risk Assessment

• Required for the Robot
• Performed by the Manufacturer
• Annex A gives guidance on typical hazards
• Risk Assessment methodology based on ISO 14121-1
• Use any scoring system that suits
Control Reliability

• Section 5.4

• Now based on ISO 13849-1:99
  – Uses Reliability Categories B, 1-4
  – ISO10218-1 requires minimum Category 3 unless the Risk Assessment shows that lower reliability is acceptable.
Control Reliability

- ISO 13849-1:07 is soon to be harmonized under EU law (probably 31-Dec-09, may be 31-Dec-2012)
  - EC Machinery Working Group meets 7/8-Dec to make final decision
  - CE Marked robots will likely need to comply with this version and not the 1999 edition as of 31-Dec-09.
  - Introduces Performance Levels (PL)
    - \( \text{MTTF}_d \) - Mean Time to Failure (Dangerous) for components
    - Architecture Categories B, 1-4
    - DC - Diagnostic Coverage
Control Reliability

NOTE: There is no intent to imply direct equivalence between the ISO categories and the ANSI/CSA performance criteria (but they are similar!). See CSA Z432-04, §8.4
Wireless Teach Pendants

- Section 5.8.6
- Permits wireless pendants
- Permits one pendant to be used to select and teach multiple robots
- Includes wireless Emergency Stop and Enabling Devices
- Nothing in current North American standards to permit this.
Simultaneous Motion

• Section 5.9
• Provides options for simultaneous motion of multiple robots
• Robots must be taught individually (multiple-teaching not permitted due to risk of collisions)
• RIA has a TR that discusses this, but neither RIA nor CSA has anything in the existing standards to address this mode.
Collaborative Mode

- Section 5.10
- Permits the robot to work in the same space as a human!
  - Robot is required to stop when a human enters the collaborative area (not an e-stop or safety stop)
  - Hand guiding is permitted, enabling device required
Collaborative Mode

- Robot TCP speed limited to 250 mm/s
- Robot required to maintain a minimum separation distance to the human
- Power and force limits required
  - 80W and 150 N - roughly 35 pounds-force
  - Can be achieved with hardware or safety-rated software

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Poll
Robot Envelopes

- Maximum Space - Robot’s full reach
- Restricted Space - Space limited by stops or other means
- Working Space - Space required to perform task

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Robot Envelopes

Restricted space for robot with end-effector

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Robot Envelopes

Restricted space for robot with end-effector and workpiece

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End effector service area: guard in accordance with the requirements of this Standard.

Legend:
- □ Area requiring additional safeguards
- □ Restricted space (includes operating space)
- □ Sender and receiver of a light curtain
- □ Operating space

Graphic from CSA Z434:03, Annex A
Envelope Limitation

• In the past, only possible with hard stops (Axis 1) and limiting devices (switches, dynamic stops, etc.) on Axes 2-3.

• Axes 4, 5, 6 - Generally software limited

• Inflexible system
Programmable Soft Limits

• Envelopes can now be controlled using SAFETY RATED software based systems
• Operate in Manual High-Speed mode and Automatic
• Can be dynamic
• Can have programmed exclusion zones OR permitted zones OR any combination
• Limits are not changeable at the USER level – i.e. set by the integrator or other authorized person.
Creativity brings new solutions to old problems

• Wireless Pendants
• Simultaneous Motion
• Collaborative Applications
• Programmable Envelope Limitation
Poll
New Safety Technology is required.

Standards are being updated.

- Robots subject to risk assessment
- Simultaneous Motion
- Collaborative Mode
- Wireless Pendants
- Programmable Envelope Limits
Greater Market Access

- Robots now approved internationally under one standard
- Can be sold and used in North America, Europe and Asia
- Reduced costs through reduced variations in requirements
Users Get What They Need, and What They Want!

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Thank You!

• View a Recording of Today’s Web Seminar
  An email will be sent to you with the access information

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