



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



Compliance
InSight
Consulting Inc.

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

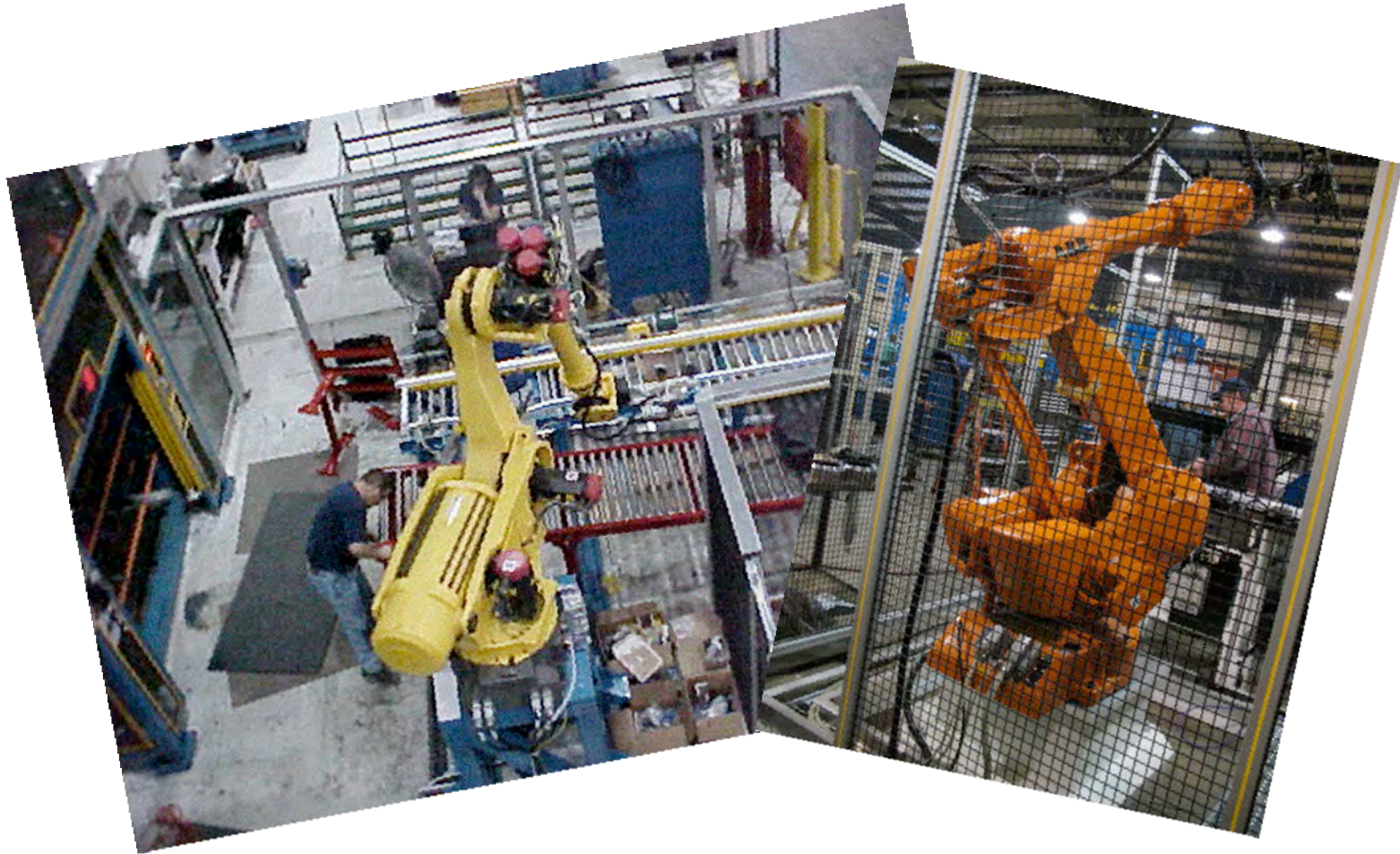
- Industrial Machinery Specialist since 1996
- Managing Director, Compliance InSight Consulting, Inc.
- Member, CSA TC Z1002, Occupational Health and Safety Hazards and Risks - Identification, Assessment, Elimination and Control
- IEEE Product Safety Engineering Society
 - Director At Large
 - Chair, 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

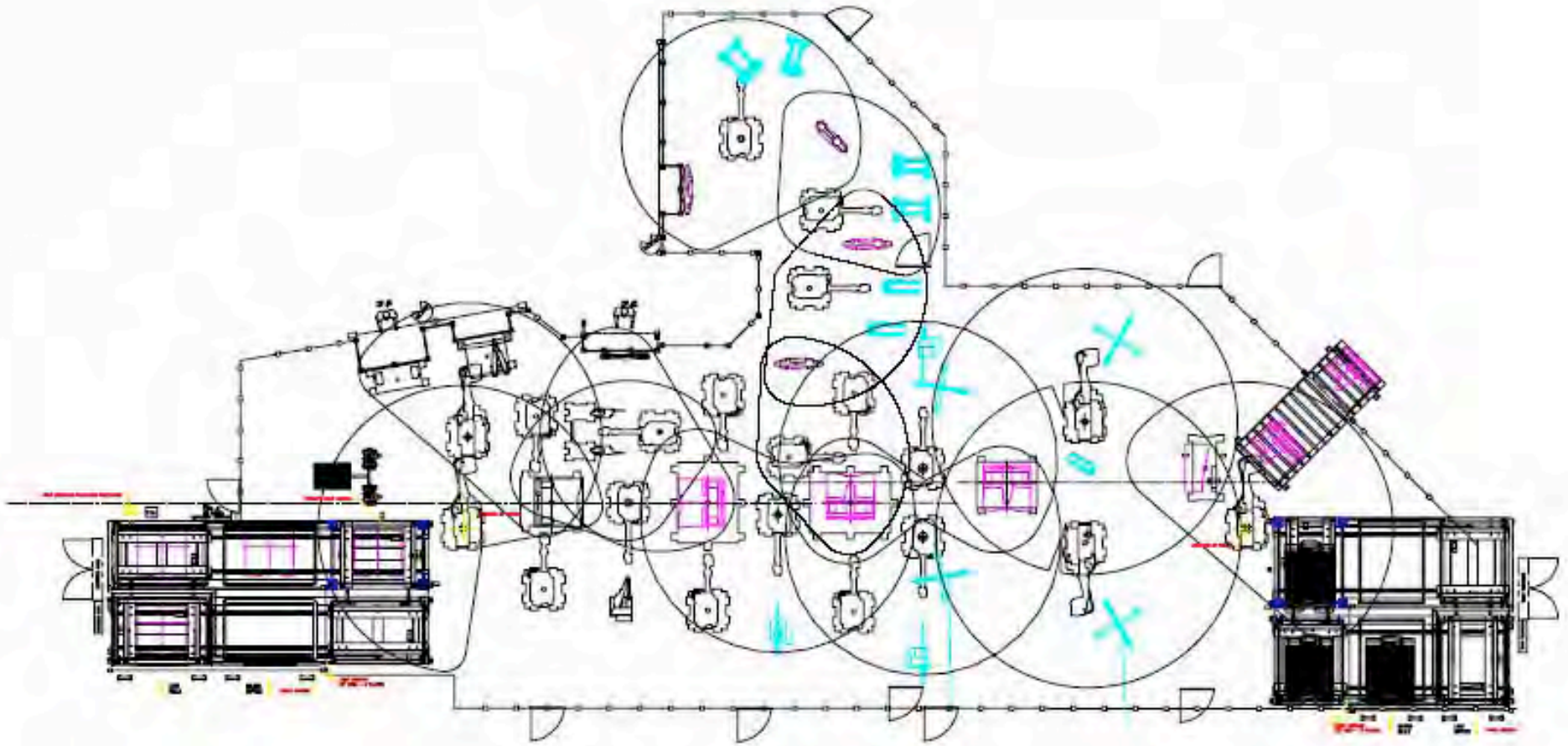


The Robot User

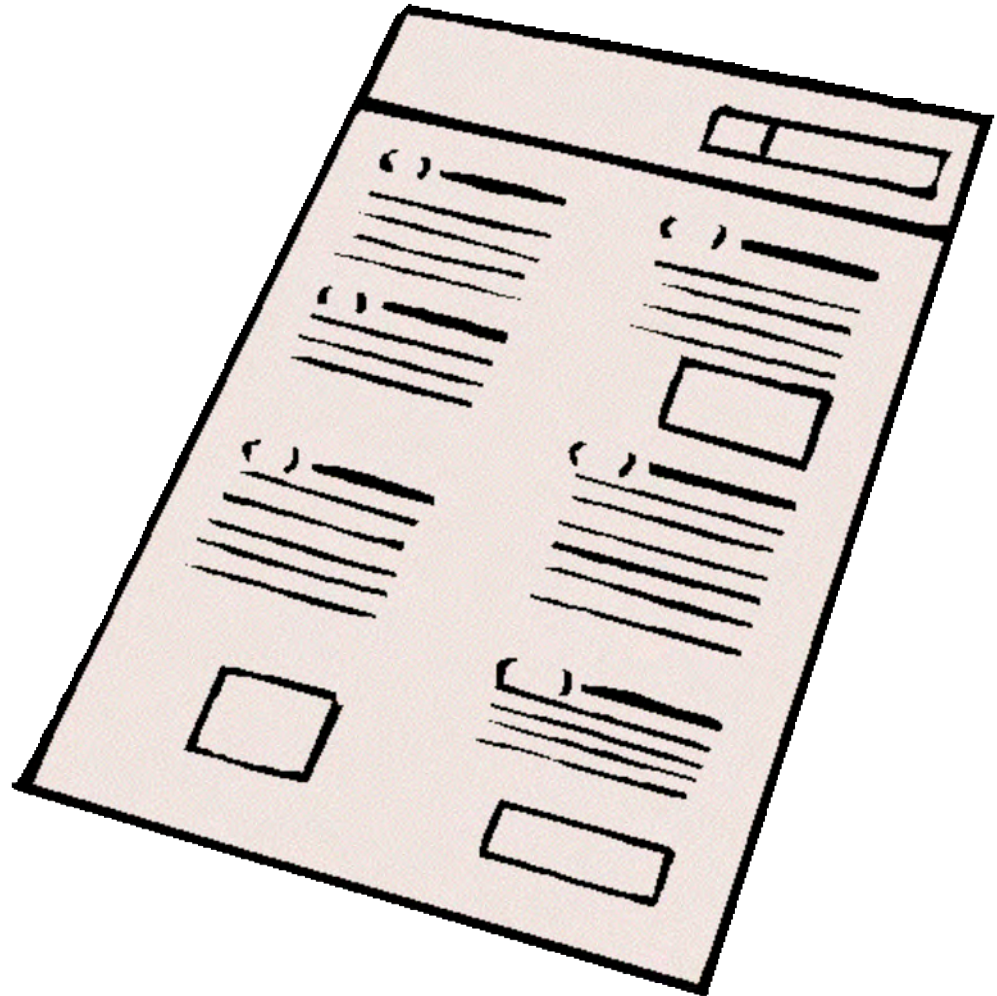


Poll

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 **3** or more

Programmability

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

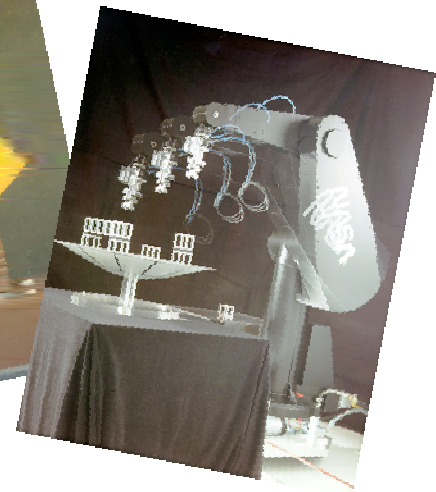
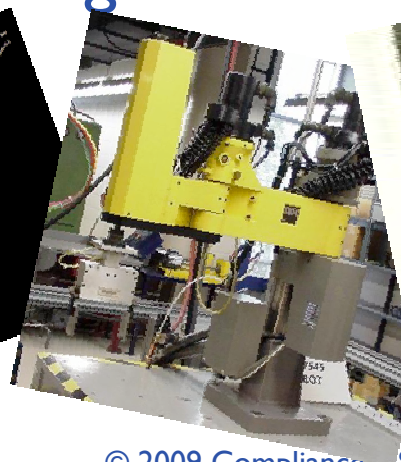
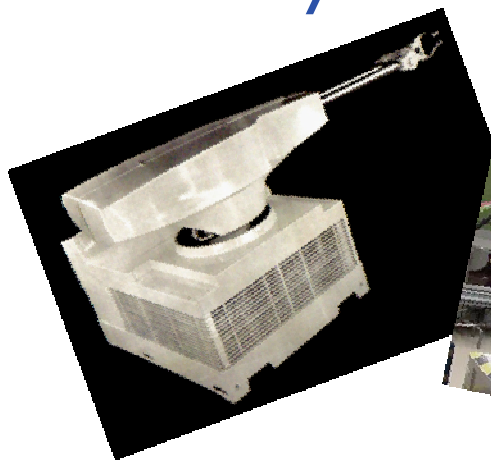
Mechanical changes to effect changes in operation, such as adjusting hard-stops or strokes, are excluded.

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.

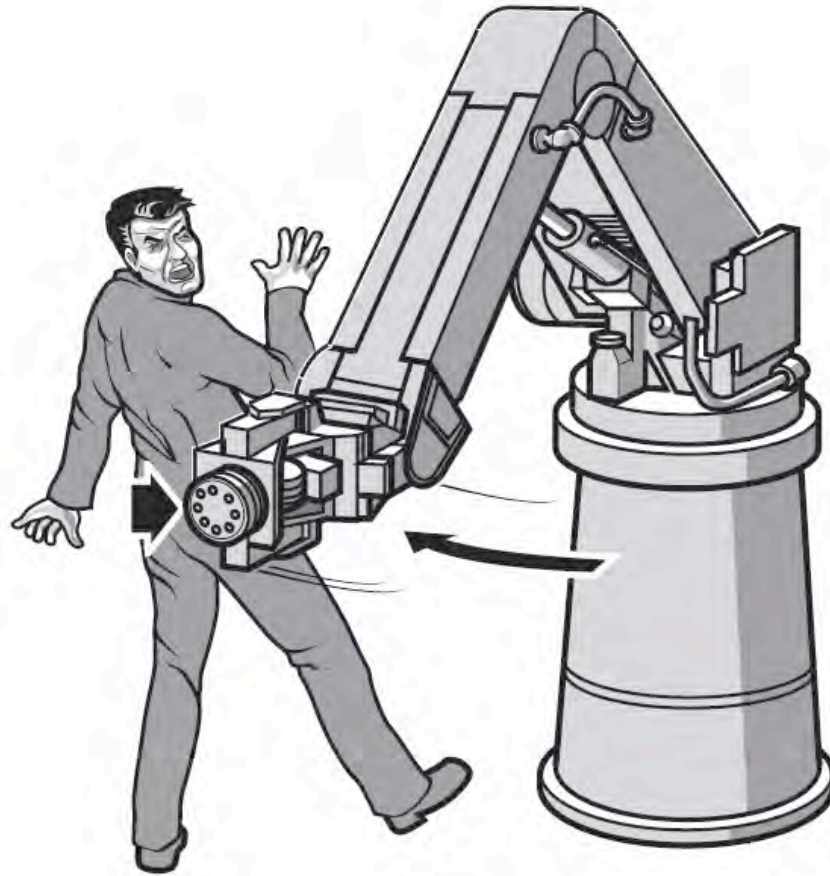
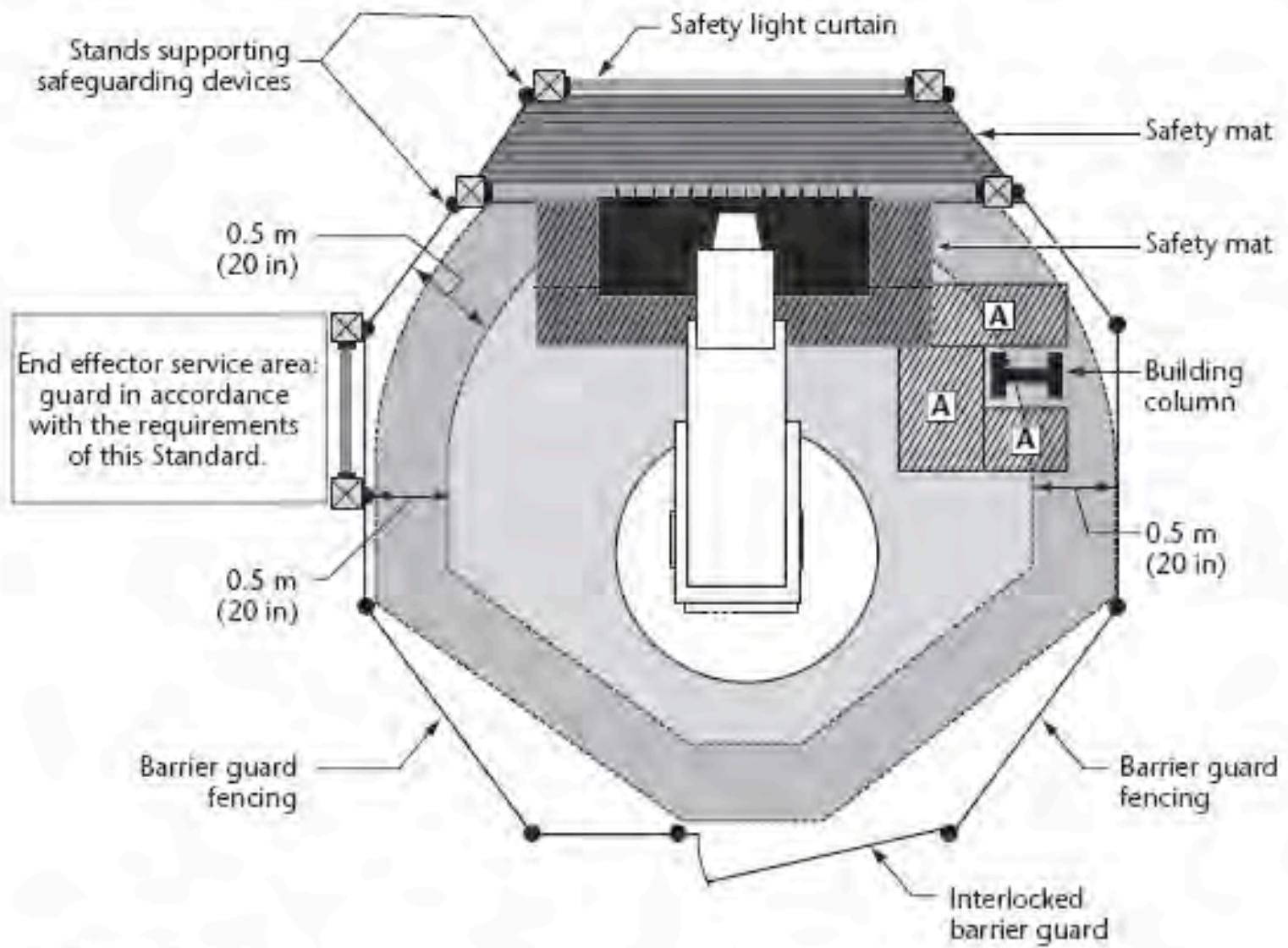







Image from CSA Z432-04, Annex A



Legend:

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

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...)

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 I: 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

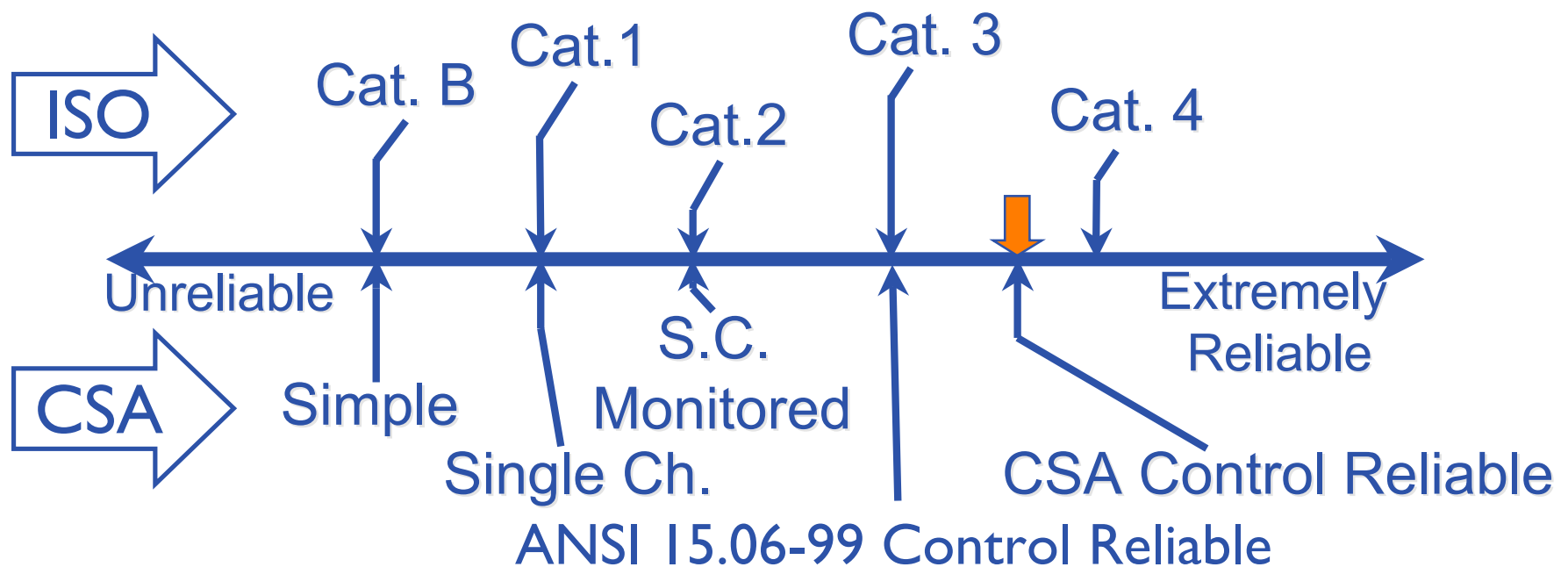
Control Reliability

- Section 5.4
- Now based on ISO 13849-1:99
 - Uses Reliability Categories B, 1-4
 - ISO 10218-1 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)
 - $MTTF_d$ - 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.

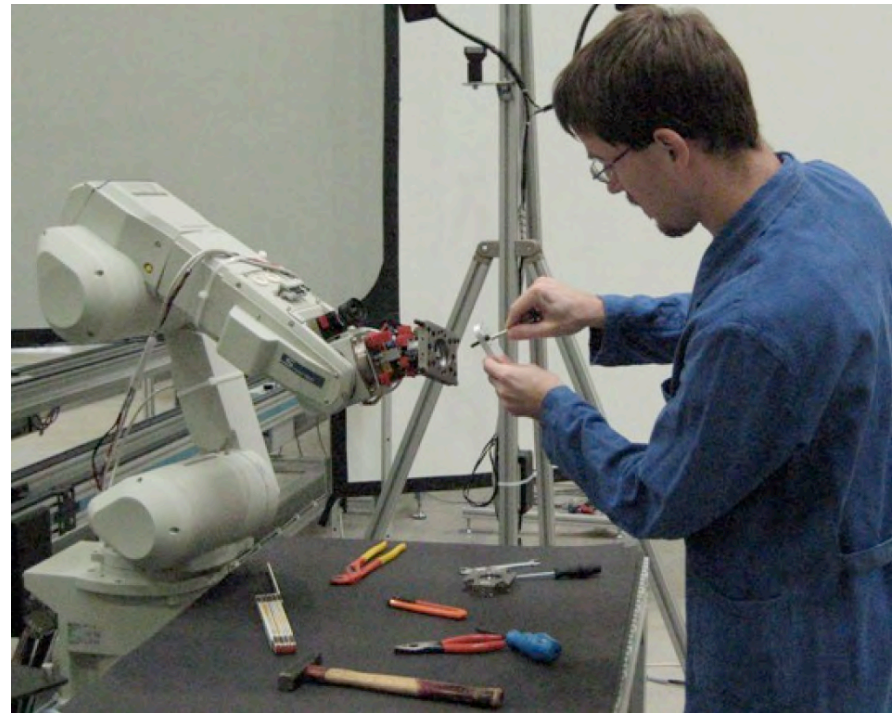
Simultaneous Motion

- 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.

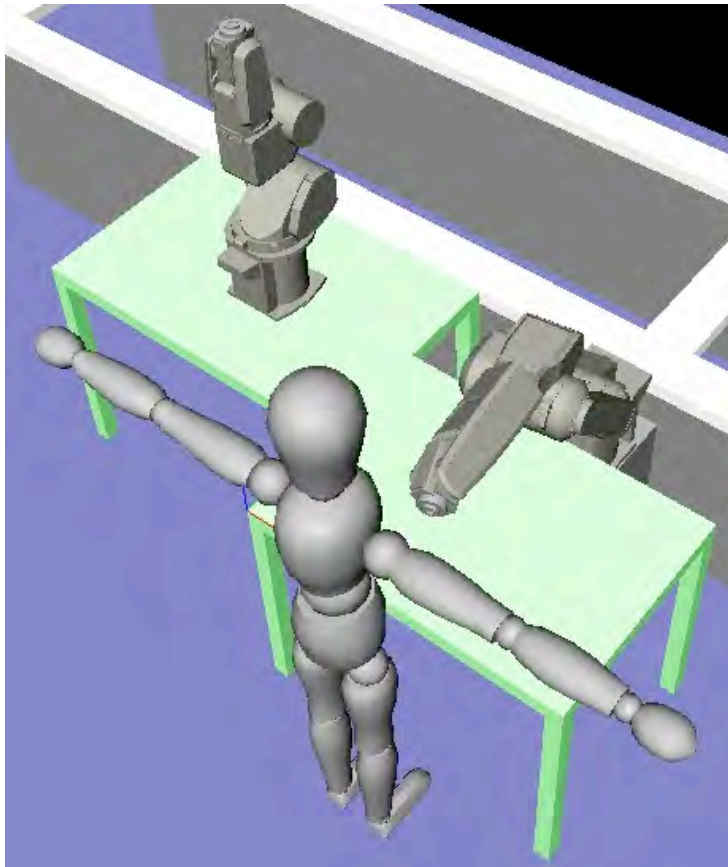


Collaborative Mode

- 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




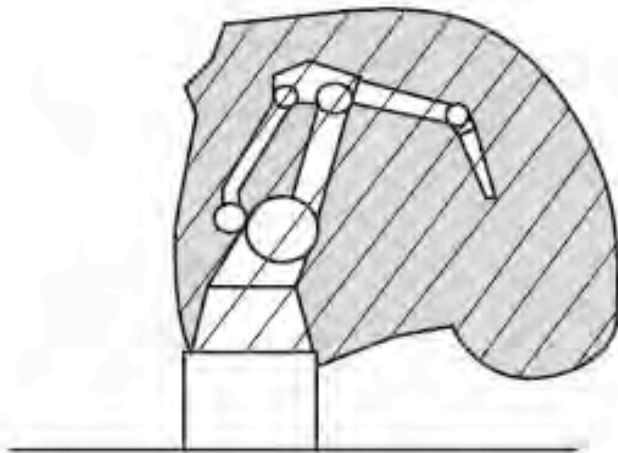
- Robot TCP speed limited to 250 mm/s
- Robot required to maintain a minimum separation distance to the human
- Power and force limits required
 - 80W and 150 N - roughly 35 pounds-force
 - Can be achieved with hardware or safety-rated software

Poll

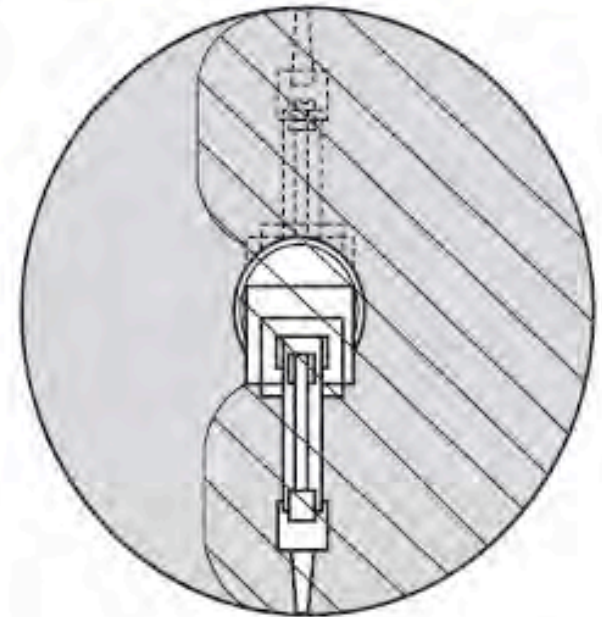
Robot Envelopes

 Maximum space

 Restricted space

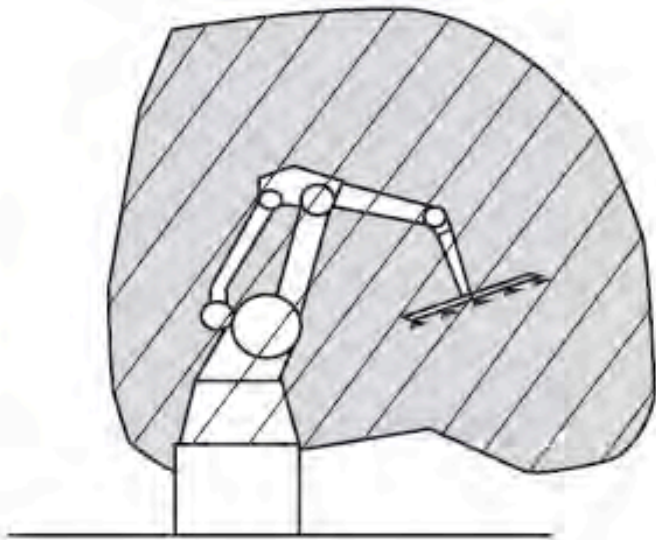


Restricted space
for
stand-alone robot

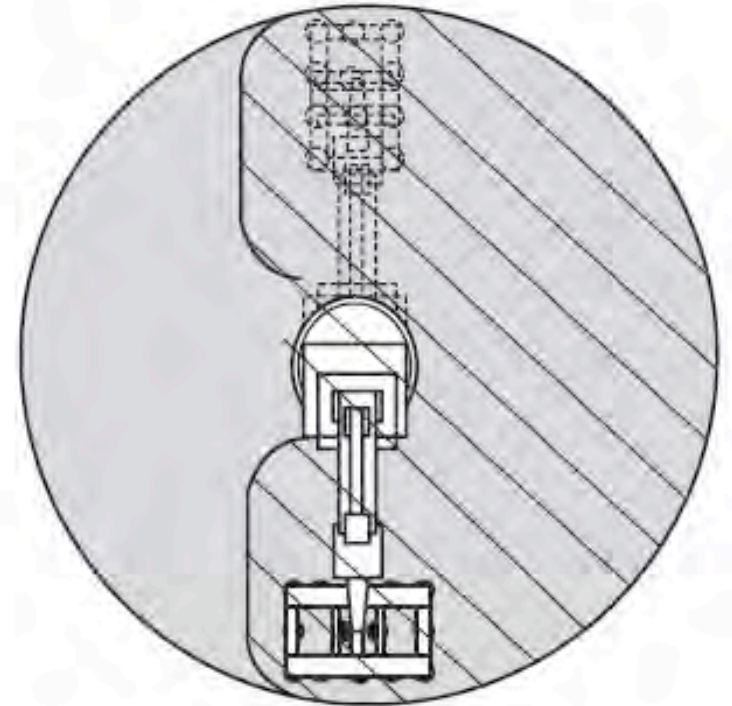


- Maximum Space - Robot's full reach
- Restricted Space - Space limited by stops or other means
- Working Space - Space required to perform task

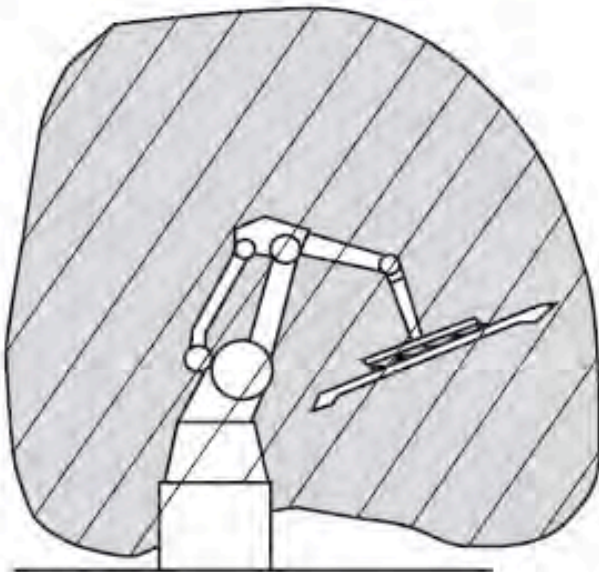
Robot Envelopes



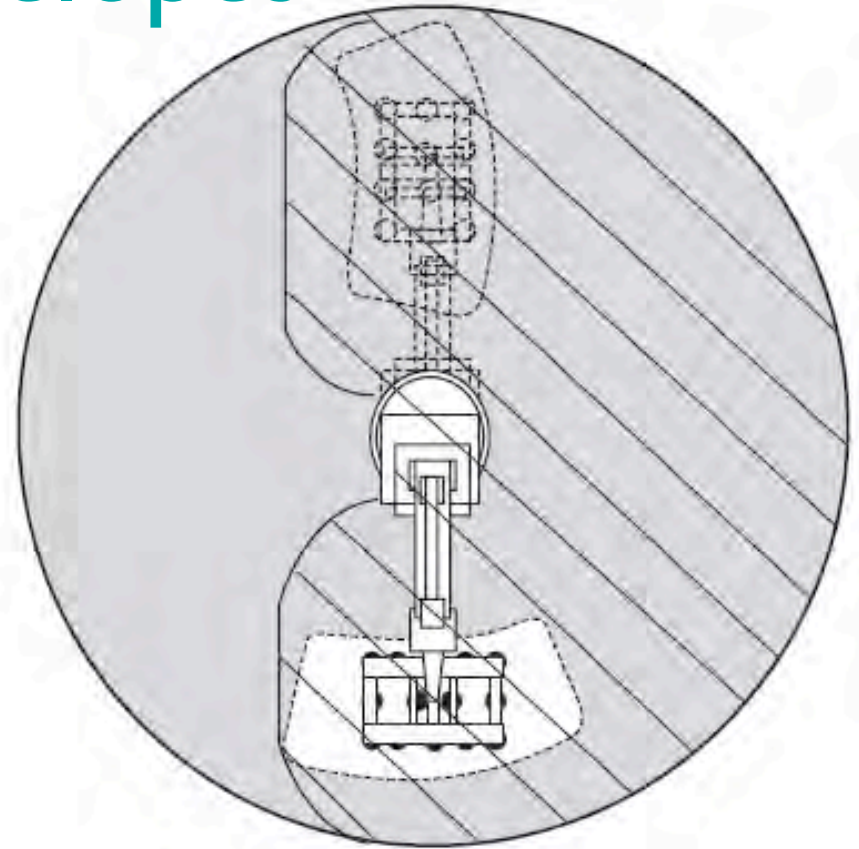
Restricted space
for robot with
end-effector

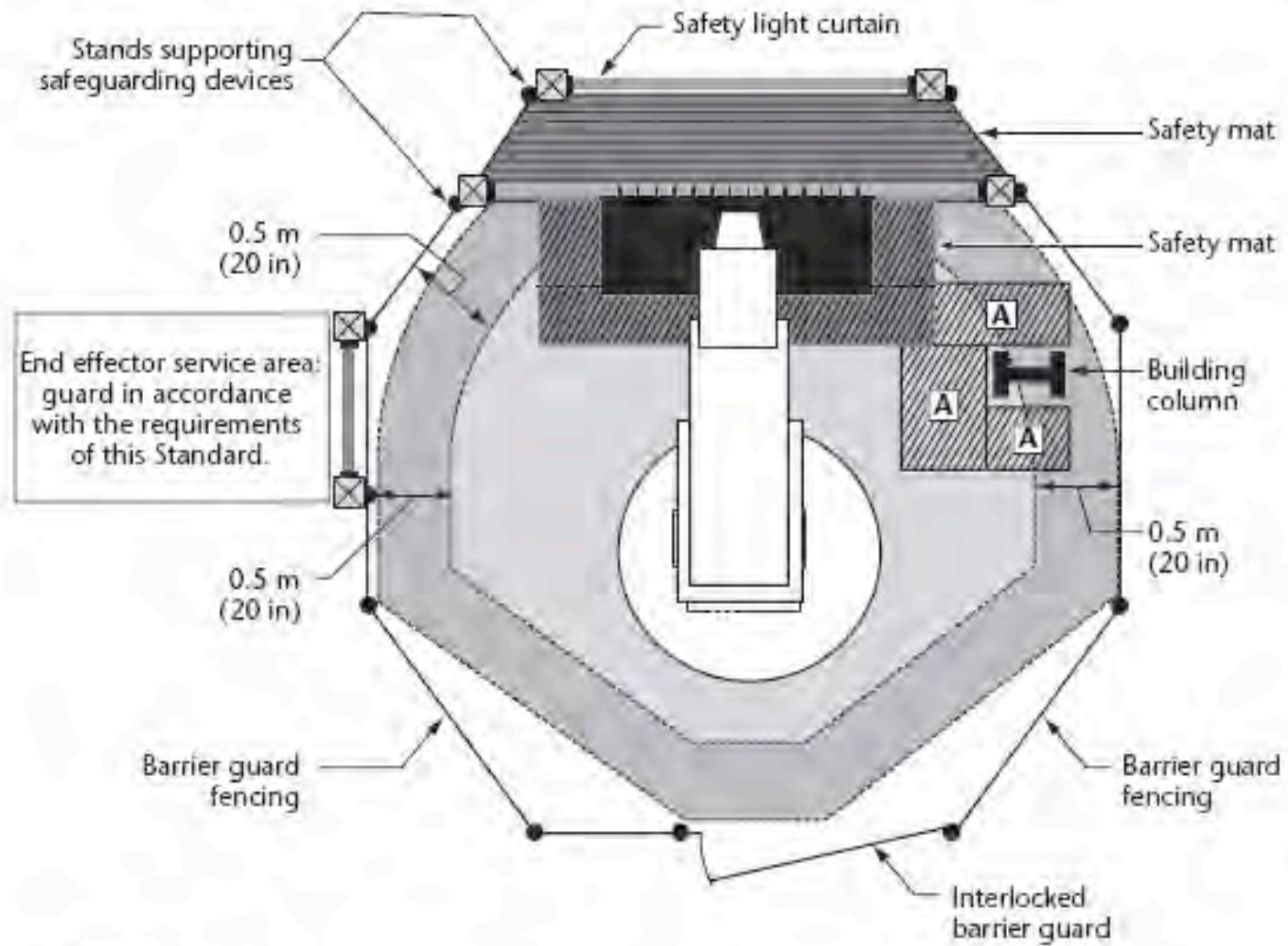


Robot Envelopes







Restricted space
for robot with
end-effector and
workpiece



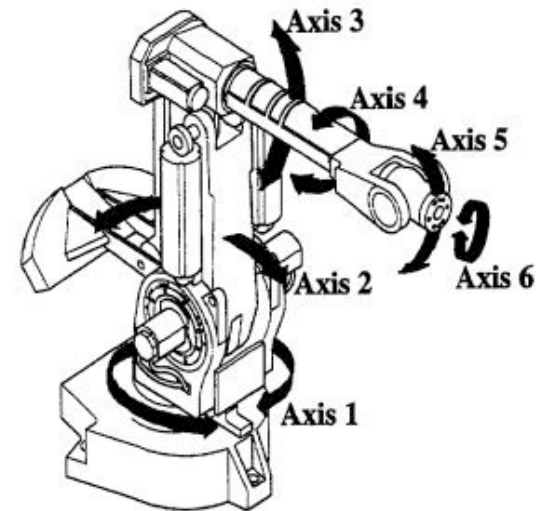


Legend:

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

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.

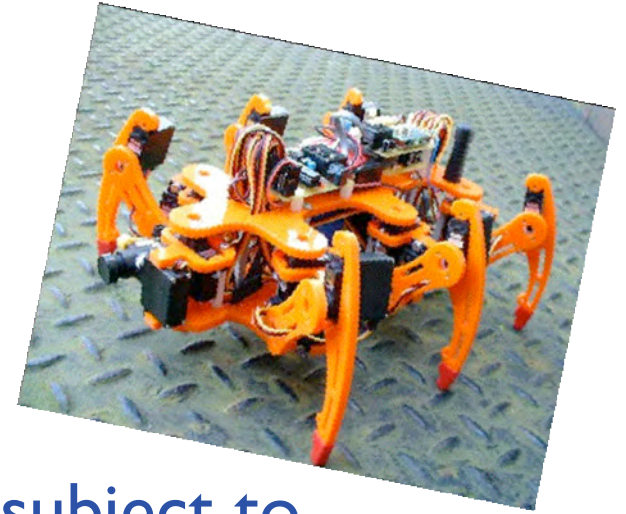
Creativity brings new solutions to old problems

- 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!



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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