

WEBINAR

Beyond 250mm/sec

Implementation and Validation
according to ISO 10218-2

2nd Webinar, in English

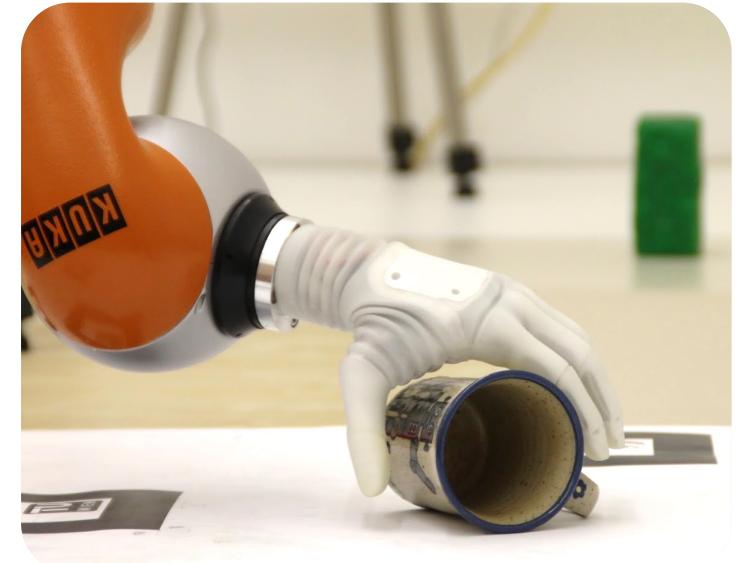
- 
- Laws & Rules for Manufacturers and Operators
 - Norms
 - Myth of 250mm/sec
 - 10218-2:2020 in Detail
What am I allowed to do, how fast can a robot move?



Dr. Walter Wohlkinger, CMSE®

AIRSKIN - Turning industrial robots into fenceless, safe collaborative applications.

Dr. Walter Wohlkinger, CMSE®
Certified Machinery Safety Expert
Mobile: +43 660 212 79 10
E-Mail: wohlkinger@airskin.io walter@relieverobotics.com
LinkedIn: linkedin.com/in/dr-walter-wohlkinger-cmse®-1b051a61



WHO IS RESPONSIBLE FOR A ROBOT CELL (CE MARK)

- Documented, physical check, EU law
- The product, the HRC cell complies to ALL rules/directives
- Free trade and usage in EU
 - WHO? „Inverkehrbringer“ (Distributor)
 - DIY, me as company owner
 - Integrator/Importer
 - Obligatory: Commissioning without CE mark prohibited in the European Economic Area



Item: https://www.linkedin.com/posts/item-industrietechnik-gmbh_vorteile-und-einsatzgebiete-im-%C3%BCberblick-ugcPost-6859841745606217728-VJpf



Wikipedia: <https://de.wikipedia.org/wiki/CE-Kennzeichnung>

FlexLink: <https://www.youtube.com/watch?v=UvUpWvR1svs&t=44s>

THE NATIONAL REGULATIVES IMPLEMENTING EU LAW

- Evaluate the robot system according to the valid legal situation
 - Directives: EU Machinery Directive 2006/42/EC - MRL
 - Develop, implement, verify and validate risk assessment
 - Manual, Declaration of Conformity and CE Marking
- **AT:** Machinery Safety Ordinance (Sicherheitsverordnung) 2010 - MSV 2010
- **DE:** Machinery Ordinance (9th ProdSV, Product Safety Act)
- **CH:** SR 819.14 Machinery Ordinance, MaschV



What about the operator (user)?

USER OF THE MACHINE HAS ALSO TO COMPLY (OSHA)

- Directive 89/391/EEC (Occupational Health and Safety Framework Directive)
 - Work Equipment Directive of the EU 2009/104/EC
 - Regulations, inspection of work equipment
 - Ergonomics and health protection at the workplace
 - Information, instruction of employees
- AT: ArbeitnehmerInnenschutzgesetz (ASchG)
- DE: Betriebssicherheitsverordnung (BetrSichV)
- CH: Unfallverhütungsgesetz UVG
- + DGUV (Unfallverhütungsvorschrift der Deutschen Gesetzlichen Unfallversicherung)

USA Pendant: Occupational Safety and Health Administration (OSHA)

Mustervorschriften der Unfallversicherung
(Stand 01.01.2021)

Gewerbliche Berufsgenossenschaften und Unfallversicherungsträger der öffentlichen Hand			
Titel	Fassung	alte BGV-V-Nr.	neue DGUV-Nr.*
Abwassertechnische Anlagen	Jan. 97	C 5	21 und 22
Arbeiten im Bereich von Gleisen	Jan. 97 / Jul. 99	D 33	77 und 78
Arbeiten mit Schussapparaten	Jan. 97 / Okt 00	D 9	56 und 57
Bauarbeiten	Jan. 97	C 22	38
Betriebsärzte und Fachkräfte für Arbeitssicherheit	Jan. 11	A 2	2
Druckluftbehälter auf Wasserfahrzeugen	Jan. 97	D 22	65
Eisenbahnen	Sep. 98	D 30.1	72
Elektrische Anlagen und Betriebsmittel	Jan. 97	A 3	3 und 4
Elektromagnetische Felder	Jun 01 / Jul 02	B 11	15 und 16
Fahrzeuge	2000 / Jan. 97	D 29	70 und 71
Feuerwehren	Jun. 18	C 53	49
Flurförderzeuge	Jan. 97	D 27	68 und 69

DGUV Vorschrift 3

Unfallverhütungsvorschrift
Elektrische Anlagen
und Betriebsmittel

NORMS ARE GUIDELINES

- Norm = guidelines, principles, best practices

Basic statement: If all standards applicable to the product (=robot cell) are complied with, then it is also compliant with the law, i.e. all directives are complied with → CE, presumption of conformity.

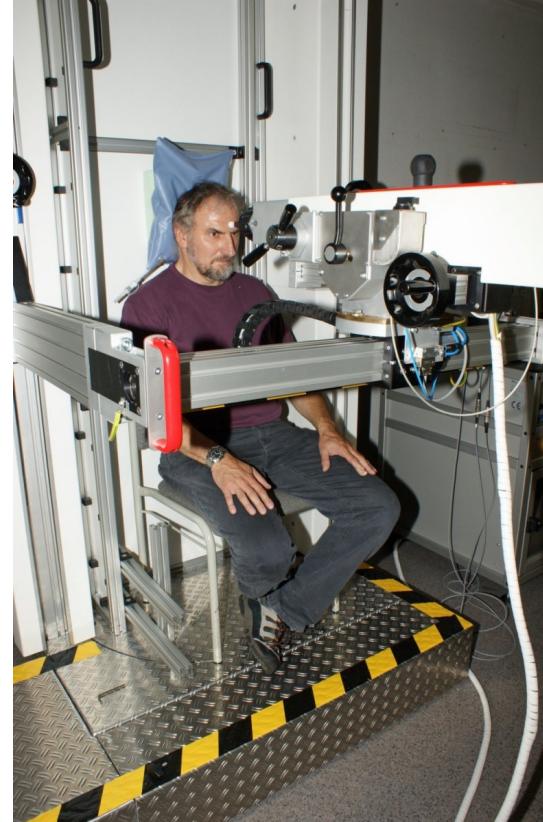
- Standards vs. speed of technological progress (state of the art)
- **Laws:** Must comply with
- **Norms:** Can

„I must comply with the Machinery Directive! I can use the standard - but I don't have to. Especially for innovative projects, I shouldn't either."

Christoph Ryll
Expert for machinery and robot safety, 12.10.2020

NORMS HELP TO DEVELOP PRODUCTS FASTER

- ISO 10218-2: Industrial robots - Safety requirements
 - Part 2: Robot systems and integration
- Problem: Definition of "safe" collisions
 - Pain threshold register



Reference: <https://www.dguv.de/ifa/fachinfos/kollaborierende-roboter/schmerzschwellenkataster/index.jsp>



Reference: DGUV: https://e.video-cdn.net/video?video-id=-2TvVp2iy--ogE3u27Ftc&player-id=2oKNVpMb9dAK93MjNE_tBZ&channel-id=5717

TS 15066 IS NOW INCLUDED IN DRAFT VERSION OF 10218-2

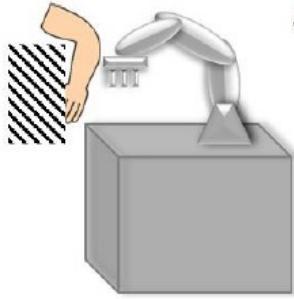
- ISO 10218-2: Industrial robots - Safety requirements
 - Part 2: Robot systems and integration
- Problem: Definition of "safe" collisions
 - Pain threshold register
 - ISO/TS 15066:2016 Robots and robotic devices – Collaborating robots
- New ISO 10218-2:2020 Draft, includes ISO/TS 15066



Referenz: <https://www.dguv.de/ifa/fachinfos/kollaborierende-roboter/schmerzschwellenkataster/index.jsp>

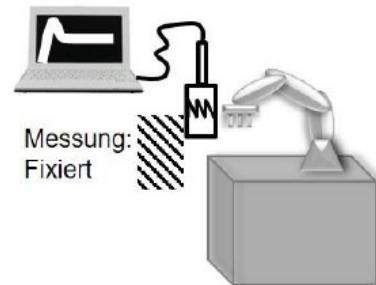
LIMITS

Risikobeurteilung



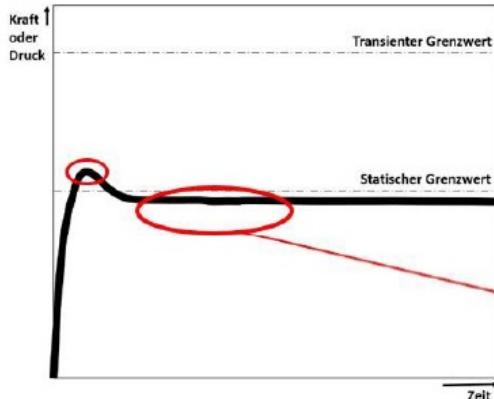
a) Einklemmen

Messung



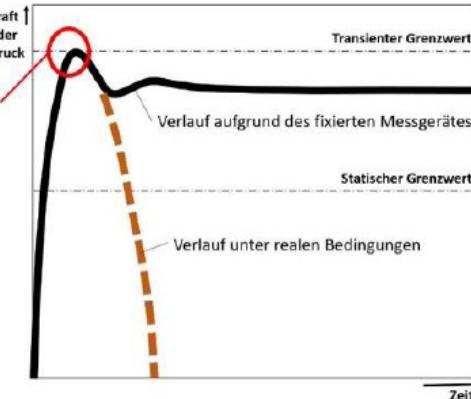
b) Anstoßen

Auswertung



Relevanter Messwert
Einklemmen

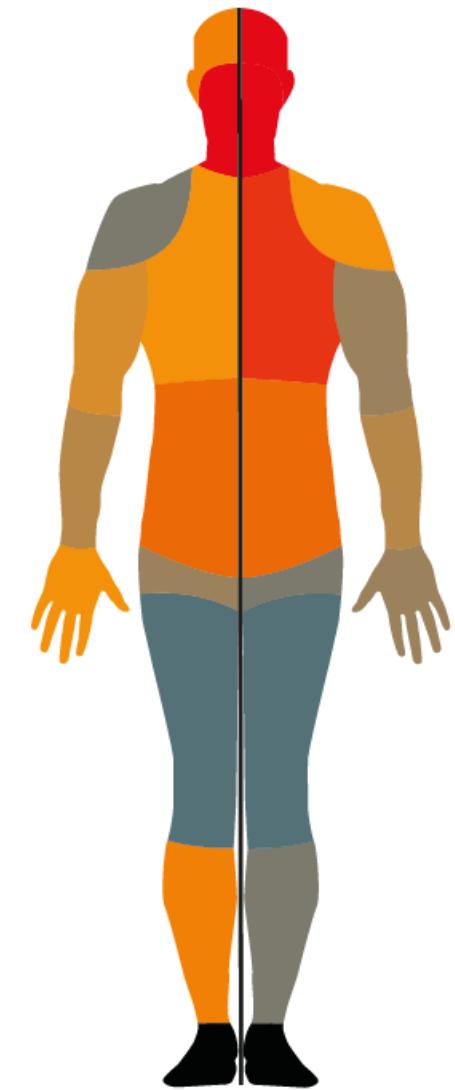
Relevanter Messwert
Anstoßen



Maximal zulässige Kraft / N



Maximal zulässiger Druck / N/cm²

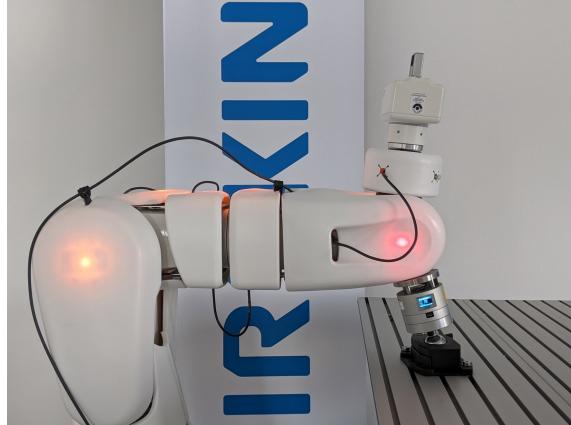


References:

https://www.tuv.at/fileadmin/user_upload/docs/group/innovation/tuv-austria-white-paper-deutsch/002_tuv_austria_white_paper_II_sicherheit_in_der_mensch_roboter_kollaboration_fraunhofer_DE_WEB.pdf

https://www.dguv.de/medien/fb-holzundmetall/publikationen-dokumente/infoblatta/infobl_deutsch/080_roboter.pdf

HOW DO YOU DO MEASUREMENTS IN THE APPLICATION



CBSF-75-Gripper



Referenz: <https://www.gte.de/produktuebersicht/kraftmesssysteme-fuer-kollaborierende-roboter/>

THE MYTH OF 250 mm/sec



Table C. 6 – Examples for determining harm avoidance parameters

Element of risk according to ISO 12100	Parameter	Consideration of confident and reliable data	Range
Harm avoidance or limiting of harm	Operator skill & information (OS)	Skilled persons who are informed about the risks associated with the task	Skilled
		Unskilled persons who are informed about the risks associated with the task	Unskilled
		No operator is required for the task(s). Exposed persons are unskilled or uninformed.	Unmanned
	Hazard perception (HP)	Warnings and signs available and hazards easy to perceive	Easy
		Warnings and signs NOT available BUT hazards are easy to recognize and perceive OR Warnings and signs available BUT hazards are difficult to perceive	Possible
		No warnings or signs available AND hazards are difficult to perceive	Difficult
	Possibility of avoidance (AP)	Possibility to avoid by limiting: — Movement speed(s) < 150 $\frac{mm}{s}$ and/or — Acceleration < 150 $\frac{mm}{s^2}$ (suddenness); Clearance for endangered body parts according to ISO 13854 with a 1.1 multiplier	Almost Possible
		Possibility to avoid by limiting: — Movement speed(s) < 250 $\frac{mm}{s}$ and/or — Acceleration < 250 $\frac{mm}{s^2}$ (suddenness); Clearance for endangered body parts according to ISO 13854 with a 1.5 multiplier	Possible
		Movement speed(s) \geq 250 $\frac{mm}{s}$ or Acceleration \geq 250 $\frac{mm}{s^2}$ (suddenness)	Impossible

THIS IS STATED IN THE NEW 10218-2:2020

You can drive as fast as the application permits in terms of the standard: Limits are force and pressure

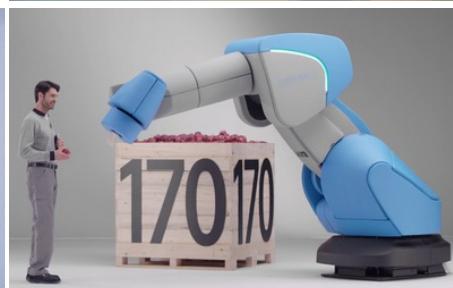
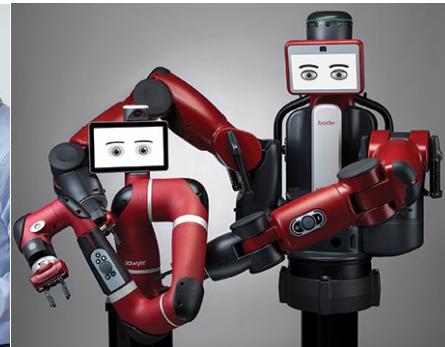
- ISO 10218-2:2020, 4.3 Characteristics of HRC applications.
 - One or more of the following technologies:
 - Hand-guiding, Speed and separation monitoring, **Power and force limiting**
 - Presence, contact, interaction allowed
 - Switch between collaborative and non-HRC mode
- No danger points due to sharp, shearing or cutting edges or no objects allowed in the contact area (no sharp, shearing, cutting edges)

THIS IS SUGGESTED FOR PASSIVE SAFETY DESIGN

- ISO 10218-2:2020, 4.3.3 Risk reduction for contact points

- a) Passive safety design measures include:

- 1) increasing the contact surface area;
- 2) rounded edges and corners;
- 3) smooth surfaces;
- 4) compliant surfaces to absorb energy, extend energy transfer time, or reduce impact forces:
 - padding, cushioning;
 - deformable components;
- 5) compliant joints or links;
- 6) limiting moving masses.



ALL THE CONTACT POINTS, NOT JUST ROBOTS



THIS IS SUGGESTED FOR ACTIVE SAFETY DESIGN

- ISO 10218-2:2020, 4.3.3 Risk reduction for contact points
 - b) Active risk reduction measures include inherently safe design, safeguarding, and/or use of safety functions that:
 - 1) limit forces or torques;
 - 2) limit velocities of moving parts;
 - 3) use protective devices and /or safety function(s) such as:
 - soft axis and space limiting safety function(s);
 - monitored-standstill safety function(s);
 - protective device(s) implemented to anticipate or detect contact, e.g. proximity or contact detection to reduce forces exerted during contact event(s).

As determined by the application risk assessment, application of protective measures shall address the expected exposure of the operator.

NOTE: A combination of safety functions can be required, e.g. the force limiting safety function can be effective only up to a certain speed limit. In such a case, an additional speed limiting safety function could be necessary.

Any **clamping event** between the collaborative application and human body regions shall occur in a way such that the operator shall be able to escape independently and easily from the clamping condition.





充電
ント

内面
り

10)

カ
ス

度
久
と協動

性
ト導入

US KR10

lications

OIT5 15066

utive safety skin

Pls/Gat.3 ISO 13849

ation

pel, workpiece and

required by AIRSKIN

ads, long reach,

and durability, industrial

uses, up to 50% produc-

on

reduction with

AIRSKIN

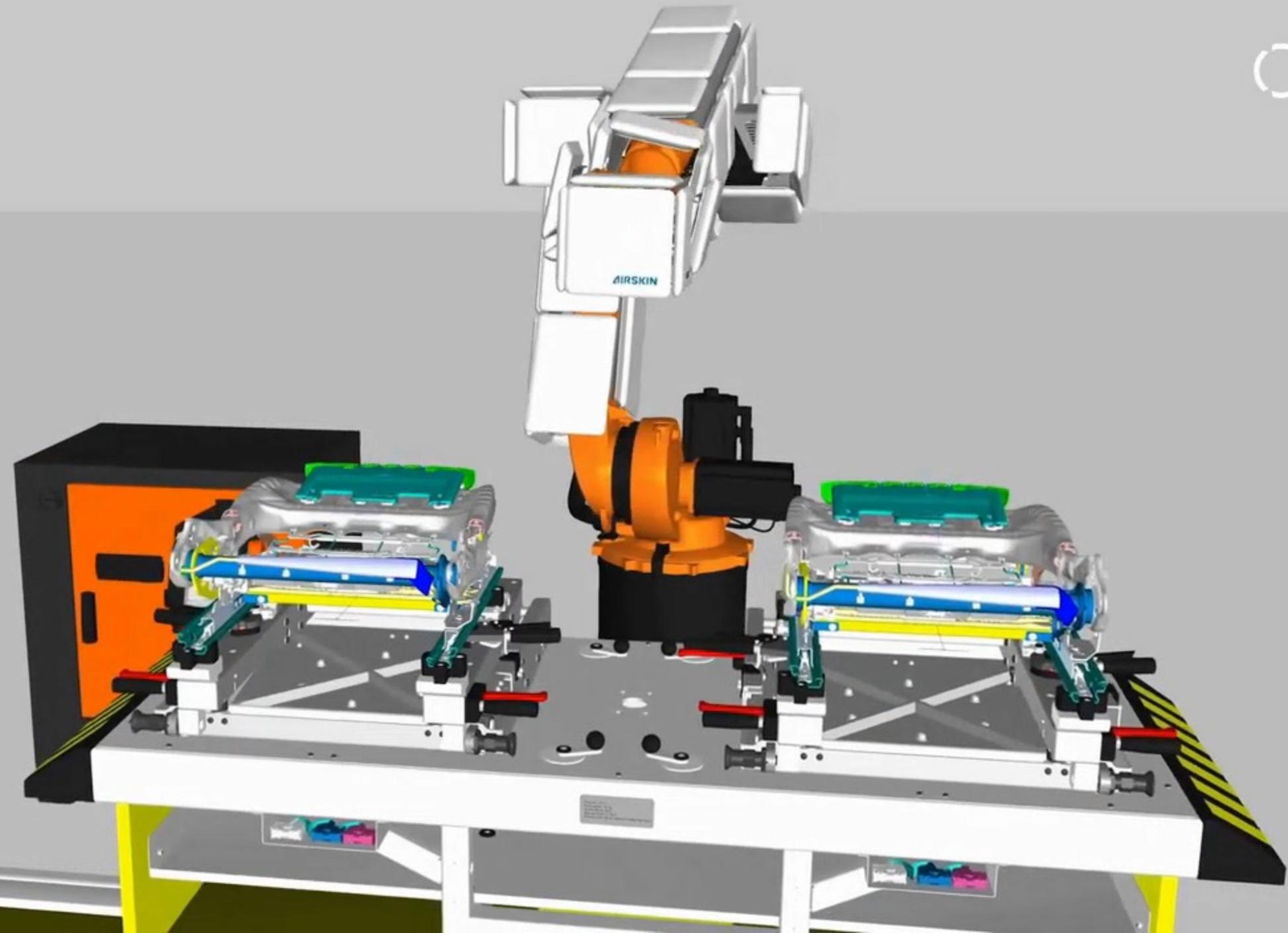
NEXSON

KEY

esie



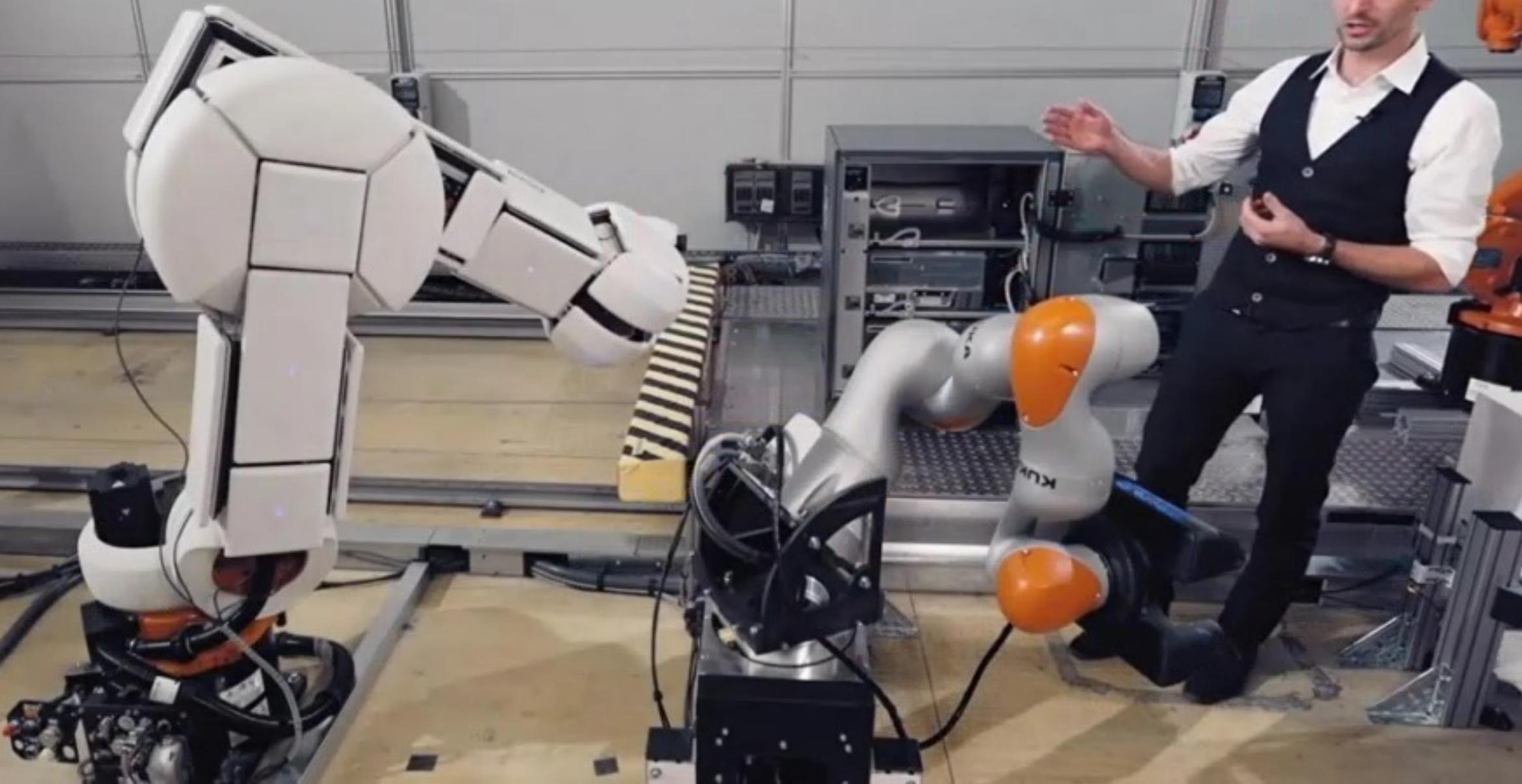






KUKA

KUKA



KUKA FENCELESS WITH AIRSKIN®



- Speed
- Payload and Reach
- Precision
- Longevity

- No Fences
- Flexibility
- Connectivity and
KUKA ecosystem

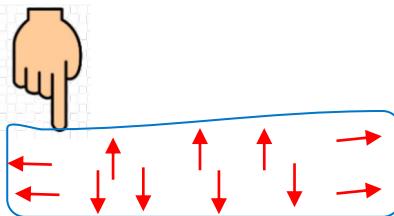
**BEST OF 2
WORLDS**

AIRSKIN® TECHNOLOGY

AIRSKIN is a soft, thin, airtight skin over a flexible dampening structure with smart safety electronics. Contact-deformation of AIRSKIN changes air pressure inside (decrease of volume, increase of pressure).



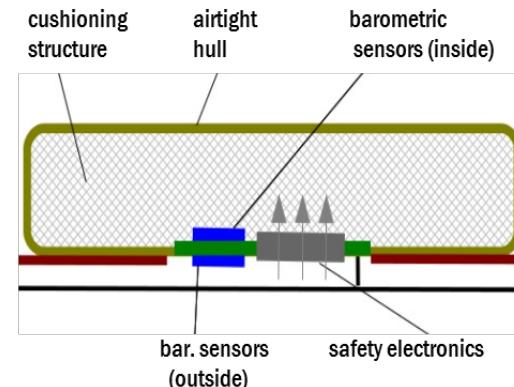
Status: AIRSKIN not activated



Status: AIRSKIN activated

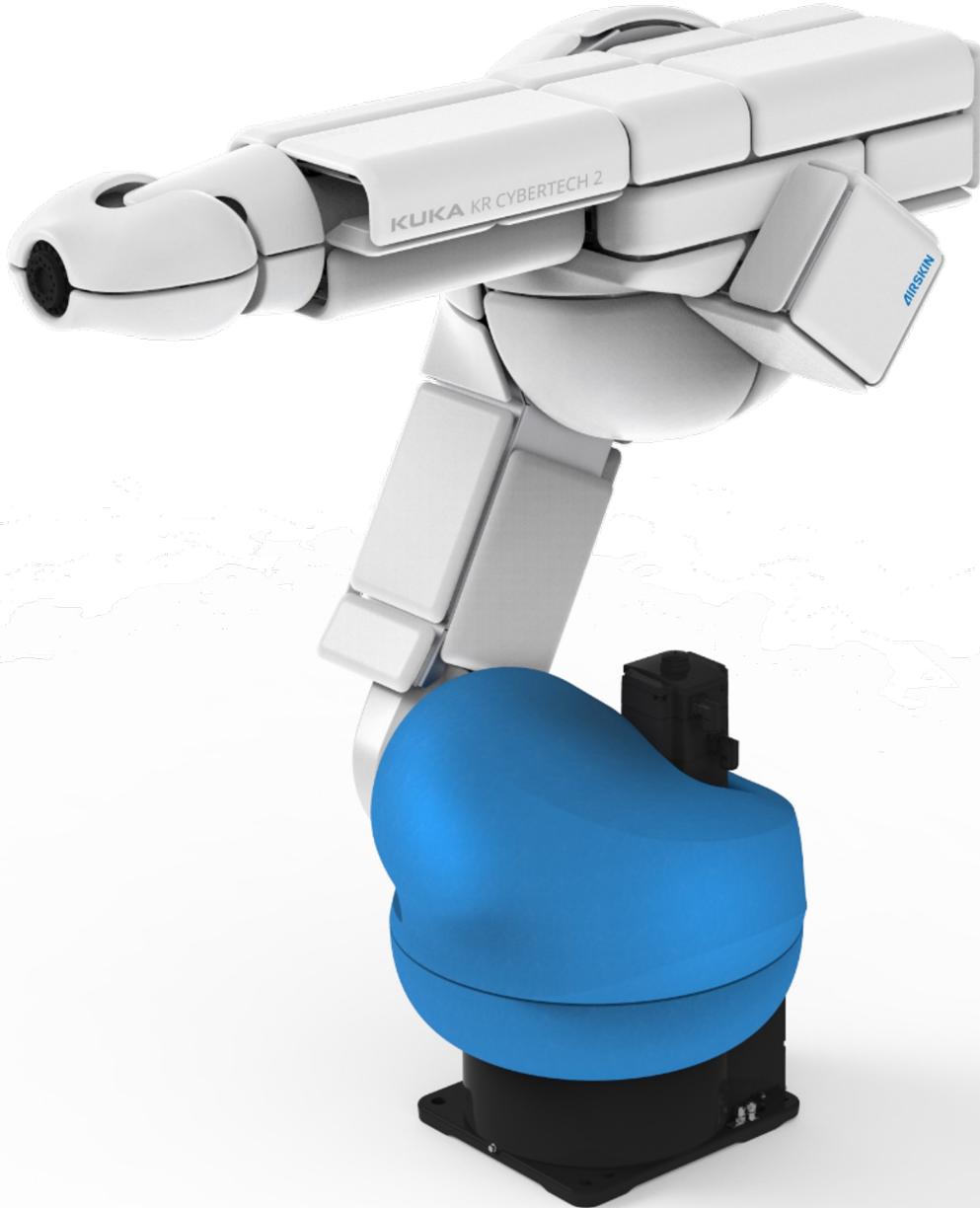


Barometric sensors monitor and detect air pressure change and trigger emergency stop. A piezo-micro-pump creates a small overpressure of ~400 Pa in the pads, to detect leaks.



AIRSKIN® USP

Advantages of Fenceless Robotics



Robotik
PRODUKTION



Fraunhofer





HRC
with
AIRSKIN®

