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project data

Manufacturer	itself (machine for personal use)	Original manufacturer: "Logo"
Manufacturer's address:	–	
Version of this complete document:	0.0.1	
Reason for change	New construction of the machine	
Date of last change: Designation of	–	
the machine: Machine type (model):	Processing station with an assembly robot (movable industrial robot cell)	
Serial number/machine no.:	–	
	0001	
year of commissioning	2014	
Customer:	inIT - Institute for Industrial Information Technology Ostwestfalen-Lippe University of Applied Sciences	
address of the customer	Langenbruch 6; 32657 Lemgo	
Order number:	internal	
Languages)	German	
Conformity assessment procedure:	Appendix VIII of the EC Machinery Directive 2006/42/EC	
notified body:	omitted	

Responsible:

	Surname	date / date	Signature / Signature
Made by / created by	Philip Kleen	05/12/2015	
Checked by / verified by			
Approved by / released			
documentation officer			

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project Manager

mechanical designer:	
Electrical designer:	
Designer control:	
Designer media:	

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1. Purpose of the risk assessment

This documentation serves as proof of the directive-compliant planning/construction of the machine/system described under "Description of the machine/system".

Compliance with the basic health and safety requirements of the EC Machinery Directive 2006/42/EC is documented
~~and other relevant internal market directives. Th~~is proof is part of the technical documentation in accordance with Annex VII of the EC Machinery Directive,
does not fully reflect this.

The hazard analysis (identification of hazards) is part of the comprehensive **risk assessment according to DIN EN ISO 12100.** Based on the determined
and assessed risks, appropriate risk reduction measures were defined after observing the relevant safety regulations.

The risk assessment and the protective measures implemented on the machine/system authorize according to Articles 5 and 12 of the EC Machinery Directiv
line 2006/42/EG for issuing the EC declaration of conformity and for affixing the CE mark. The entire machine can be used for this
documentation can be completed with this.

2. Execution See [1] p.50
When conducting the risk
assessment, the following guidelines and guidelines for the procedure were observed: **EG machines Annex I General principles Directive** Annex I No. 1.1.2 Principles for the integration of safety **2006/42/EG** Annex VII Technical documentation for machines Conformity assessment procedure Annex VII

DIN EN ISO 12100 Machine safety –
General design principles - risk assessment and risk reduction

DIN EN ISO 13849 Machine safety –
Safety-related parts of controls
Part 1: General design principles

A risk checklist (see p. 13 Error! No valid result for table.) and action sheets (see p. 32 action sheets) were essential aids in the implementation and documentation .
Hazard identification of hazards **checklist**

measures sheets	Risk assessment and description of protective measures

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This verification documentation also includes the documents used in the risk assessment

DIN ISO/TR 14121-2:2013-02	Risk assessment according to Section 6.5.2 Example of a hybrid of risk assessment tools or methods Risk assessments
Attachment 1	Control measures
Attachment 2	
Attachment 3	list of standards
...	

The hazards marked with a cross in the **hazard checklist** were identified for the designated machine/system (see p. 25 hazard assessment and description)

The machine-specific details, risk assessments and protective measures taken to reduce risk are described in the action sheets as part of a safety and operating concept (see p . 39 **safety** plan).

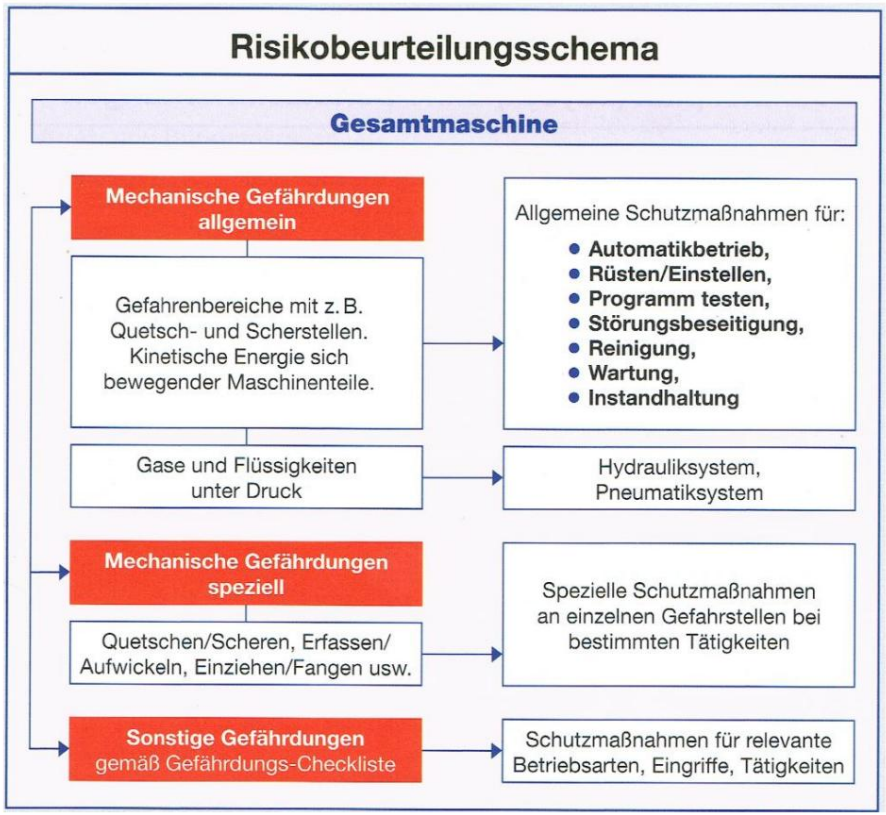
The information in the hazard checklist (columns 3 to 8) **and in the action sheets** (column 9) **serve in the sense of the EC Machinery Directive 2006/42/EC as a list of**

- **basic requirements of the Machinery** Directive • **standards and the**
- **other technical specifications,**

which were taken into account when designing the machine. The titles of the standards and other technical specifications are listed in the **list** of standards in this verification documentation and – where applicable – marked with a cross.

~~The required compliance with the basic requirements of all relevant internal market directives has been achieved. If this is not~~ possible due to the state of the art, this will be indicated in the **action sheets** (column 9) (residual risk).

The following assessment scheme shows the basic procedure.



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3. Description of the machine/plant

3.1. characteristics

Product:	**"Machine"** in the sense of the Machinery Directive 2006/42/EG Article 2 / point a
designation	Processing station with an assembly robot (movable industrial robot cell)
Manufacturer	even
type designation	
machine no.	0001
Construction year	2014
Type/shape/weight of the workpieces	The workpieces are fed via the smart integration environment, this module and the environment are coordinated.
quantity	
operating mode	see usage
Location	production hall
Space requirements (see installation plan)	3m x 3m
operating personnel	trained staff (see use)
Installer/Maintenance	Skilled workers, master craftsmen, engineers (see usage)
rated capacity	
Electrical connection	400 V three-phase current (TN-S system), no special requirements via a specified plug
Degree of protection	connection, IP20 6 bar to 8 bar, via a specified plug connection
pneumatic connection	
communication system	ProfiNet via a specified plug connection
Expected life of the asset	20 years
Inspection/Maintenance/Cleaning	see operating instructions
Applicable Documents	operating manual

3.2. Intended use, limits of the machine

3.2.1. Limits of **application**
Interface(s): Man/power supply man/machine Limits of use

Description		related documents
functional description		
Intended Use	The machine is intended for standalone operation or in an integrated manufacturing system. Only installation locations according to the specifications in the manual may be selected in a compatible integration environment. For programming, this machine may also be operated without a conveyor system at a specially set up place. At its destination, the machine is intended to take components from an associated magazine and to assemble them. *The product is intended to be supplied via a slide system in the integration environment. The magazine is loaded manually.*	Criteria for the intended Installation site (manual)
Foreseeable improper use (misuse/abuse)	Manual feeding of workpieces with/or without slides.	
Description of the machine:	The pluggable, portable assembly machine with assembly robot consists of a KUKA KR 6 R900 sixx industrial robot with the KR C4 controller. The integration into this assembly machine took place in accordance with the EC declaration of incorporation. The machine consists of a movable substructure in which the control cabinet with the local control is installed. A solid aluminum plate forms the conclusion on the upper side. The industrial robot is built on this, surrounded by the machine housing. The bolted housing of the machine also delimits the protected area and is therefore the separating safety device for it. This guard also represents the mechanical delimitation of the restricted space from the robot. *There is no access to the protected area except for dismantling the upper housing, which is the separating guard and mechanical delimitation.* All media are connected via a pluggable supply system.	
user modes		
process sequences		
Interfaces to other machines	If this machine is placed at a designated installation site/docking place and has been integrated into an integration infrastructure, interfaces to this integration environment are responsible here. When integrating into an integration infrastructure, a risk assessment must be carried out on the resulting interfaces. Indexing and stoppers of the integration infrastructure are controlled based on status reports from this assembly machine. The electrical and pneumatic energy supply is provided via the pluggable supply system provided by the integration infrastructure.	
Interfaces to energy supply		

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Interfaces for communication	The integration into the ProfiNet communication system for the transmission of status messages takes place via the provided pluggable supply system of the integration infrastructure. Product data is passed on via a built-in RFID chip in the slide.	
tools		
gear		
supply connections		
Manufacturer information, risk reduction measures applied		
Required power supply		
skills of the user		

3.2.2. Spatial limits Freedom

of movement, space required by people who handle the machine, e.g. during operation and maintenance

	associated documents/description
General drawing including parts list	see installation plan
Movement space of the machine	
Space for installation and maintenance	
Space for operator tasks and other interventions Reconfiguration properties	
(ISO 11161)	
Required Access	
foundations	
Space for supply and disposal facilities or equipment.	
Requirements/specifications	–
Technical description of performance	–
Description of structure and components in the operating instructions Chap. xxx technical	
data in the operating instructions chap. xxx	

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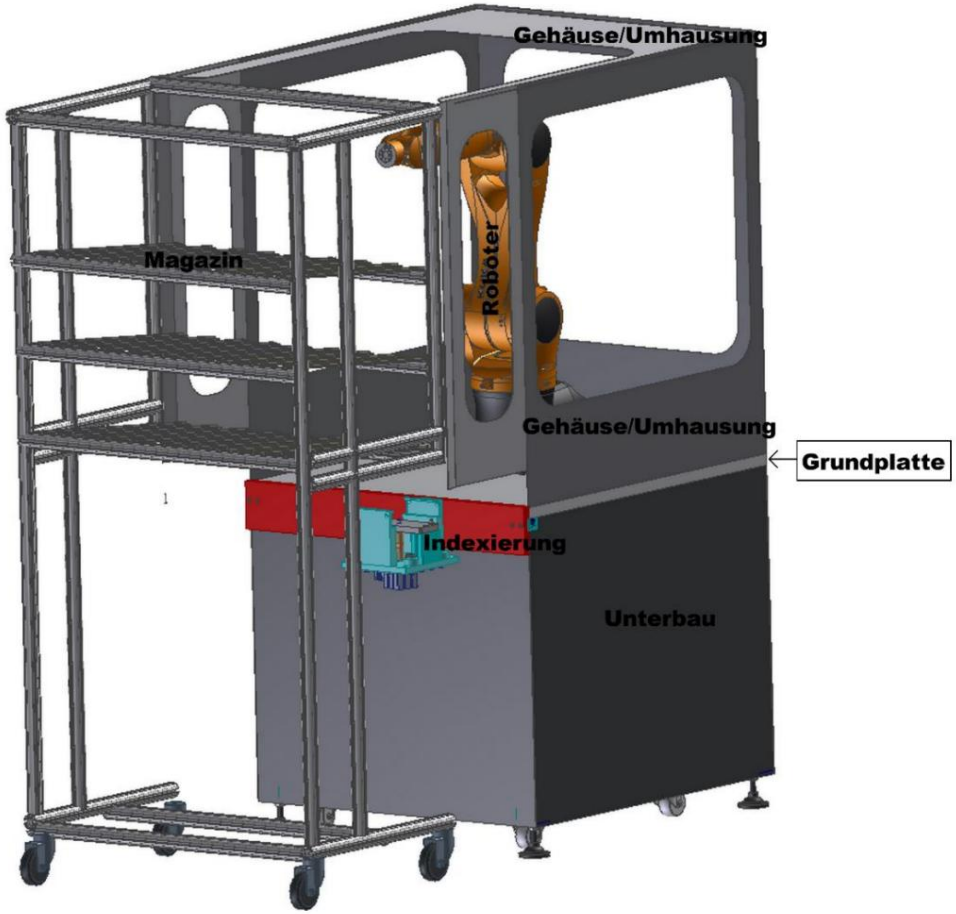
Machine overview (installation plan)



3.2.3. Temporal Boundaries

Limits of the service life of the machine / individual components, with intended use and foreseeable misuse Recommended maintenance intervals

Expected Machine Life	20 years
Service life of wearing parts (list)	
Process flow diagrams and timings	
Recommended maintenance intervals (list)	

3.2.4. More borders

Properties of the materials to be processed; required degree of cleanliness; minimum / maximum temperature in the environment / in the machine; Indoor/outdoor operation in dry/wet weather and in direct/indirect sunlight; Dust / moisture tolerant; Etc.

Materials being processed (list of hazards) Required degree of cleanliness Minimum/	
maximum temperature in the environment	normal industrial environment
Minimum/maximum temperature in the machine 18°C to 35°C in a production hall	18°C to 35°C
Indoor/outdoor operation	
in dry/wet weather in direct/	–
indirect sunlight	–
Dust/moisture compatible	dry environment, IP 20
dangerous ambient conditions none	
Findings from similar systems	–

3.3. Use

Environment of use	description		related documents
private Commercial,	no		
industrial use Yes, industrial use User groups Task The user			
groups, tasks and their qualifications life phases in the life of		Qualification/Impairments	life stage
phases section. Links to DIN EN ISO 10218-2:2012-06 can be found in the entries below.			

operating personnel, installers, foreman	integration of the machine	Knowledge of the integration pro cess	G
operating staff	Process control and monitoring	Plant and machine operators	D, J
	workpiece loading		Happens automatically
programmer, foreman, master	Programming and verification Expertise in standards		F H
	brief intervention by the operator without the need for dismantling		Not possible at the moment due to construction
operating personnel, installers, foreman	Setup, commissioning	Knowledge of the integration pro cess	C G
operating personnel, installers, foreman, master	debugging		I
Masters, professionals, programming re	Correction of malfunction(s) (e.g. B. jammed equipment, fallen parts, driving free and exceptional conditions)		K
Masters, professionals	Maintenance and repair Cleaning		M
	of equipment		L

3.4. materials

materials	material	use	related documents
dangerous substances			
hazardous materials			
hazardous processed materials			

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3.5. stages of life

Life phases of the machine/plant	Dangerous activities, interventions, situations	Group of people at risk
A build	Construction, assembly, test runs at the construction site	Fitters and designers of the operator and/or a representative, customer
B Transportation	Packing, loading and unloading, transporting, unpacking	Transport staff of the operator or the commissioned forwarding agent
C Assembly installation Installation	assemble, set up, connect, adjust, test, check, Measurements, test runs at each production site	assembly and maintenance personnel operator and/or a representative
Application/Use D to M		
D automatic mode automobile	Automatic processes The processing machine reads the RFID chip and processes the tasks that can be completed by it. Provides status messages.	operating staff
E ~~semi-automatic operation hand~~	~~Individual work steps are started manually and carried out at reduced speed.~~	
f Manual operation at reduced speed Tap	The robot is moved with the connected control panel in jog mode at low speed. protective device open	
G Setup/adjustment	Adapt the machine to the installation site. relearn controls.	wait staff, fitter, Programmer, Foreman, master
H programming, testing Manual operation with high speed	Entering/changing, testing new programs. Import of possible new configurations. With closed guards, manual operation at high speed is permitted. Eg removal of jammed workpiece carriers in the stroke indexing	
I Eliminate disturbances in workflow		
J Observing production processes	Observe near dangerous movements	Everyone, especially visitors
K Troubleshooting	Finding and eliminating the causes of malfunctions professional staff	Foremen, foremen, skilled workers
L Cleaning, maintenance	Cleaning, lubricating eg emptying the suction	Operating, cleaning and maintenance staff
M maintenance	Repairs such as exchanging the end effector	maintenance staff
N Decommissioning	Dismantling, dismantling, removal, disposal	Internal company staff or/and one specialist company

4. Identification of hazards

4.1. Hazards according to DIN EN ISO 10128-2

First, the hazards according to the applicable C standard for industrial robots were considered. Then, with the help of the hazard checklist, it was checked whether there were any other hazards in order to meet the requirements of DIN EN ISO 10128-2. Assuming that the robot was integrated into the machine in accordance with the EC declaration of incorporation and that the machine housing serves as a protective device, as explained in the machine description.

The table below is derived from ISO 12100 and represents the content of Appendix A of DIN EN ISO 10128-2:2012-06.

List of significant hazards — Sheet 1 of 4

Examples of hazards Ser. Type of hazard or group, no. Origin 1	Possible effects	Section Reference in ISO 10128-2 Yes	Applicable	Ref. No.	Life phase(s)
Mechanical hazards					
ÿ Movements of each part of the robotic arm (including back), des end effector or moving parts of the robot cell ÿ movement or rotation of a sharp tool on the end effector or similar that on external axes ÿ a part to be handled ÿ associated equipment ÿ rotation of all robot axes ÿ falling or ejected materials or products ÿ failure of the end effector (loss) ÿ loose clothing, long hair ÿ between the robot arm and any fixed object ÿ between the end effector and any fixed object (fence, Bar, etc.) ÿ between attachments (falling down); between shuttles, supply facilities ÿ no possibility to leave the robot cell (by Zel door) for a trapped operator in automatic mode ÿ Unexpected movement of the clamps or gripper ÿ Unexpected tool release ÿ Unexpected movement of machines or parts of the robot cell	ÿ crushing ÿ shearing ÿ cutting or severing ÿ grasping ÿ drawing in or catching ÿ impact ÿ Puncture or puncture ÿ Friction, abrasion ÿ Injection or spurting of liquids / gases under high pressure	4.1; 4.2; 4.2d) 6); 4.2(f); 4.3; 4.4; 4.4.1; 4.4.2d); 4.4.2 f); 4.5; 5.2; 5.2.1; 5.2.2; 5.2.3; 5.3; 5.3.2; 5.3.6; 5.3.7; 5.3.8.2; 5.3.9; 5.3.10; 5.5.1; 5.5.2; 5.5.3; 5.5.4; 5.6.4; 5.8; 5.9; 5.10.2; 5.10.3; 5.10.6.1; 5.10.6.2; 5.10.6.4; 5.10.7; 5.11; 5.11.4; 5.11.5.4	X	1	FM
			X	2	DM
			X	3	DM
			X	4	FM
during handling operations - inadvertent movement or actuation of an end effector or associated equipment (including robotic external axes, process specific to grinding wheels, etc.) - unexpected release of potential energy from storage sources			X	5	FM

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List of significant hazards						Sheet 1 of 4
running No.	Examples of hazards hazard type or group, origin	Possible effects	Section Reference in ISO 10128-2 Yes	Applicable	Ref. No.	Life phase(s)
2 Electrical hazards						
	ÿ Contact with live parts or connections (control cabinet, connection boxes, control panels on the machine) ÿ Confusion of different voltages within a system tems, control cabinet and connectors; ie drive energy, control energy (24 V vs. 110 V) ÿ contact with discrete components in the electrical (electronic) switch circuit, ie capacitors ÿ exposure to arc jet ÿ work processes under high voltage or high frequency, ie electro static painting induction heating ÿ high voltage welding	ÿ electrocution ÿ shock ÿ burn ÿ exposed molten particles	4.4.1; 5.3.2; 5.3.6; 5.3.7; 5.8.2; 5.10.6.1; 5.10.6.2; 5.10.7	X	6	
3 Thermal hazards						
	ÿ hot surfaces in connection with the end effector; or associated equipment or workpiece (e.g. welding torches, hot materials in forging presses, injection moulding, grinding and deburring processes) ÿ cold surfaces or objects (cryogenic processes) ÿ process-related explosive atmosphere, ie painting (sprayed particles, powder coating), flammable solvents, grinding and milling dust ÿ process-supporting extreme temperatures (molten plant fabrics; Ovens for cooking or heating (autoclaves); Freezers or refrigeration compressors, etc. ÿ combustible substances (in dust separator systems, cleaning tanks, sealing fabric applicators)	ÿ Burn (hot or cold) ÿ Radiation injury	5.3; 5.5.2; 5.5.4			
4 noise hazards						
	ÿ special, very noisy applications (e.g. water jet cutting der, embossing presses, pumps and valves; Machining with metal removal ÿ Noise level prevents hearing or understanding acoustic warning signals; furthermore, it is not possible for people to coordinate their actions via normal conversation	- hearing loss - loss of balance - loss of consciousness, clouding - other (e.g. mechanical) as a result of environmental conditions or distraction	Noise is within the scope of this Part of ISO 10218 excluded			

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List of significant hazards

Examples of hazards Ser. Type of hazard or group, no. Source 5	Possible effects	Section Reference in ISO 10128-2 Yes	Applicable Ref. No.	Life phase(s)
hazards from vibration ÿ direct contact with				
the source ÿ loosening of connections, fastenings, ÿ improper attachment of components or parts	- fatigue - neurological damage - vascular disease - shock	4.2, 4.3, 4.4, 4.5, 5.5.2, 5.5.9	X 7	
6 Radiation hazards ÿ Disturbance of				
proper robot system operation by electromagnetic interference ÿ Exposure to process related radiation, ie arc welding, laser **7 Hazards from materials and substances**	ÿ burns ÿ damage to eyes and skin ÿ related illness	4.2, 4.3, 4.4, 4.5, 5.5.2, 5.5.9		
ÿ Contact with components contaminated with harmful liquids ÿ Failures of mechanical and electrical components ÿ Corrosive vapors and dusts	ÿ sensitization ÿ fire ÿ chemical burns ÿ illness by inhalation			
8 Ergonomic hazards				
ÿ Poorly designed teaching pendant (HMI), touch screen or control panel (too far away or too high) ÿ Poorly designed loading and unloading station (e.g. long distance between the location of the parts container and the loading and unloading area) ÿ insufficiently designed enabling devices ÿ inappropriate location or inappropriate marking of the control elements (e.g. hard to reach) ÿ unsuitable location for components that require access (troubleshooting, repair, adjustment) ÿ hidden hazards, insufficient or blocked local controls lighting	ÿ unhealthy posture or similar of excessive exertion (Permanent load) ÿ Fatigue	4.2d); 4.3; 4.4; 4.5; 5.3.2; 5.3.13; 5.5; 5.5.2; 5.5.3; 5.9	X 8th	
9 Hazards related to the environment in which the machine is used				
ÿ Installation in earthquake zones ÿ Combustion ÿ Electromagnetic interference or surges in the power source ÿ Slipping, falling ÿ Moisture ÿ Respiratory tract damage ÿ Temperature ÿ Illness or (chronic) Illness		4.2; 4.3; 4.4; 4.5; 5.2; 5.3.10; 5.6.3.3; 5.8; 5.9; 5.9.1;		

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List of significant hazards					Sheet 1 of 4
	Examples of hazards Ser. Type of hazard or group, no. Origin 10	Possible effects	Section Reference in ISO 10128-2 Yes	Applicable Ref. No.	Life phase(s)
Combinations of hazards ÿ Robot system is					
	intended to be started by one person, but this operation is not expected by another person ÿ Hazards due to multiple failures/ situations ÿ Misinterpretation of the actual problem and thereby further problem through wrong or unnecessary actions ÿ action increases the severity of the injury; e.g. B. in order to avoid a sharp edge, contact is made with a hot surface instead ÿ unintentional loosening of holding devices, the movement under Allows residual forces (inertia, gravity, spring/energy storage medium) ÿ Failure of a protective device with regard to its expected function	ÿ any other effect of a Combination of hazards and hazardous situations	4.2; 4.3; 4.4; 4.5; 5.2; 5.3.10; 5.6.3.3; 5.8; 5.9; 5.9.1;	X ×10 ×11	9

4.2. Explanations for the use of the hazard checklist

In a risk assessment, possible hazards must be determined for all life phases of a machine/system. The still unsecured machine/system is assumed.

Exception: Safe old or new machines integrated in systems are considered in their already safe state. A risk assessment is only required for such machines with regard to the interfaces.

In the case of large machines and larger production plants, a risk assessment carried out for sub-machines or sub-areas improves the overview.
It can make sense to analyze and document individual phases of life separately.

The checklist can therefore be used for an **entire** machine (single machine or complex system), a **sub** - machine (machine of a complex system) or for a **subarea** of a machine/system. Risk assessments for sub-machines or sub-areas do not replace the risk assessment for a machine/system as a whole, insofar as this is necessary for the interaction of assemblies.

"Entire machine" is ticked in the following checklist , ie in this case the hazard checklist is used to identify hazards for the entire processing module (complete system). The intended use shows that this processing module works together with others, but **no entirety of machines** within the meaning of the Machinery Directive should result. Therefore, each processing module must be safe on its own. When combining modules, only the interfaces need to be considered with an additional risk assessment.

Columns **1** to **11** of the hazard checklist are explained below:

Column	running hazard number
1 Column 2	Possible hazards, hazardous situations and hazardous events in accordance with Annex B of DIN EN ISO 12100. The list in Annex B has been supplemented with "Other hazards", which can be entered if necessary. In the case of **mechanical hazards ,** a distinction is made between **general** and **special** hazards. The latter can occur at individual danger points during certain activities.
Column 3	**EC Machinery Directive Annex I No. ...,** with which agreement (conformity) must be established. Conformity is verified by appropriate measures are taken if the risk to the machine/system applies (see column 8).
Column 4	**Further internal market directives** are entered here, with which con formality must be established. Appropriate measures are taken to ensure conformity if the machine/system is at risk (see column 8).
Column 5	Number of the paragraph that deals with the passage in DIN EN ISO 12100. The descriptions are taken into account if this is stated in column 8 is marked as applicable.
Column 6	Applicable European standards (EN ...; pr EN ...) of type A and B and international standards (ISO). They are applied when applicable (see column 8).
Column 7	Applicable national standards and technical specifications (e.g. accident prevention regulations, DIN standards, VDE regulations, VDI guidelines) in case European standards are missing.

Column 8	Tick possible hazards. All life phases of the machine/plant (see 0 phases of life) to consider.
column 9	The position numbers of the installation plan (see ___) can be entered here where a corresponding risk is expected.
Column 10	All life phases of the machine/system (see 0 life phases) are entered here, in which a corresponding hazard is expected.

4.3. Hazard checklist in accordance with DIN EN ISO 12100 Hazard

Manufacturer	checklist Machine or system-	Sheet 1 of 6
even	**specific hazards Machine / system:** Processing station with an assembly	
	robot **Type:** - **Machine no.:** 0001 **Order no.:** - **Customer:** inIT Overall machine : Yes **Sub-**	**Responsible:**
	machine: No **Conformity produce with:** Applicable standards EN ISO 12100 further EN **Construction:**2014	Philip Kleen **Date:**
	phase(s) **National Ref. Life Directives Norms Rules Yes No** **Country:** Germany	05/12/2015
	Section: no	

running Hazards, no. hazardous situations, hazardous events	MRL Appendix I							
1	2	3	4	5	6	7	8th	9	10
1 Mechanical hazards General mechanical hazards from: ÿ **Machine parts, tools, workpieces, e.g.:**						TRBS 2111 BGI 5049 VDI 2854		see below	
a) Shape *(sharp edges, corners, points, etc.)*		1.3 1.3.4		6.2.2.1 6.2.2.2 6.2.3 a)					
b) Arrangement of moving parts *(hazardous areas with e.g. crushing and shearing points)*		1.3 1.3.8		6.2.3 b) 6.2.6 6.2.10					
c) mass and stability *(potential energy of parts moving under the influence of gravity: objects falling / toppling over / sinking, overturning of the machine)*		1.1.5 1.3 1.3.1 1.3.3 1.3.9		6.3.1 6.3.2 6.3.3 6.3.5.2 6.3.5.4	EN349 EN ISO 13857 11161	BGI **5123X20** _			A, C, FM
d) Mass and speed *(kinetic energy of parts in controlled or uncontrolled movement: contact with moving parts; objects flying away, e.g. workpieces, tools, chips, fragments, waste)*		1.3 1.3.7 1.3.7 1.3.8 1.4.1		6.3.5.5 6.3.5.6 6.4.1 6.4.3 6.4 .4 6.4.5			**x21** _		CM
e) insufficient mechanical strength *(risk of breakage or bursting); fragments,*		1.3 1.3.2 1.3.3 1.4.1							
ÿ **Accumulation of energy, eg** f) elastic elements *(springs);* g) liquids and		1.5.3; 1.6.3							
gases under pressure; Residual energy *(e.g. hydraulic/ pneumatic systems)* h) Negative pressure		1.3.2; 1.5.3 Pressure vessel directive 1.6.3 87/404/EEC 1.5.6		6.2.5 6.2.10	EN982 EN 983	BGR **237X22** _			DM
		Equipment Directive 97/23/EC	Observe all EC						
Identify all hazards		directives		Observe all relevant standards			see layout see table		

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Machine or system-specific hazards Serial. Hazards, no. hazardous situations, hazardous events		Establish conformity with : MRL further EG- EN ISO 12100 further EN- phase(s)		Hazard checklist Applicable standards/techn. Specifications National Ref. norms		Life Annex I Directives	Sheet 2 of 6 Applicable Rules	Yes No.	
1	2	3	4	5	6	7	8th	9	10
	Special mechanical hazards at individual hazardous points during certain activities 1.1 Danger of crushing					TRBS 2111 BGI 5049		see below	
		1.3							
1.2 Shearing Hazard		1.3							
1.3 Cutting or cutting hazard		1.3			EN 953 EN 999 EN1005-3 EN1088 EN574 EN1760 EN61496 **EN ISO 11161**	BGI 575 BGI 670 BGI 5123			
1.4 Entanglement or Entanglement Hazard		1.3							
1.5 Danger of being drawn in or caught		1.3							
1.6 Impact hazard		1.3							
1.7 Puncture or puncture hazard		1.3							
1.8 Friction or Abrasion Hazard		1.3							
1.9 Danger from the ingress or spurting of liquids under high pressure, broken pressure hoses being thrown about		1.3.2	Pressure Equipment Directive 97/23/EC		EN 982 BGR 237				
2 Electrical **hazards**						TRBS 2131		see below	
2.1 Direct contact of people with live parts		1.5.1; 1.6.3	Low voltage RL 2006/95/EC	6.2.9 6.3.2 6.3.3.2 6.3.5.4 6.4.4 6.4.5	EN 60204-1 BGV A3 EN 50178 BGR 132		x23		DM
2.2 Touching parts that have become live due to faults. 2.3 Approaching high-voltage parts		1.5.1					x24		DM
		1.5.1; 1.6.3							
2.4 electrostatic processes		1.5.2							
2.5 thermal radiation or processes such as the ejection of melted particles or chemical processes in the event of short circuits, overloads, etc.		1.5.1; 1.5.5							
Identify all hazards		Observe all EC directives		Observe all relevant standards			see layout see table		

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Machine or system-specific hazards Serial. Hazards, no. hazardous		Hazard checklist				Sheet 3 of 6		
situations, hazardous events	Establish conformity with : Applicable standards/techn. Specifications Applicable MRL further EG- EN ISO 12100 further EN- National Ref. Life standards Rules Yes No. phase(s) Appendix I Policies							
1	2	3	4	5	6	7	8th	9	10
3 Thermal hazards resulting in 3.1 burns and frostbite				6.2.4 b)				see below	
and other injuries through contact of persons with objects or materials at very high or low temperatures, through open flames or and also through radiation from heat sources		1.5.5	RL for gas appliances 93/68/EEC	6.2.8 c) 6.3.2.7 6.3.3.2.1 6.3.4.5					
3.2 Health damage due to hot or cold working environment **4 Noise hazards** resulting in		1.5.5							
			2003/10/EC "Phy. agents, noise"			LVArbSchV		see below	
4.1 hearing loss (deafness) *and other physiological Impairments (e.g. loss of balance, loss of attention)*		1.4.1 1.5.8		6.2.2.2; 6.2.3c) 6.2.4c); 6.2.8 c) 6.3.1; 6.3.2.1 b) 6.3.2.5.1; 6.3.3.2.1 6.3.4.2; 6.4.3 6.4.5.1 b) and c)	EN ISO 11688 11690 15667 EN1299				
4.2 Disruption of voice communication, disruption of acoustic signals, etc.		1.4.1 1.5.8							
5 hazards from oscillations (vibration)			2002/44/EC vibrations			LVArbSchV		see below	
5.1 Use of hand-held tools with the Er result of nerve and vascular disorders 5.2		1.5.9		6.2.2.2; 6.2.3 c) 6.2.8 c); 6.3.3.2.1 6.3.4.3 6.4.5.1 c)	CR1030 Guideline	VDI 2057 VDI 2062			
whole body vibration, especially in connection with forced postures		1.1.8 1.5.9			EN1032	VDI 3831			
6 Radiation Hazards			2006/25/EG phy. impacts		EN 12198	LVArbSchV		see below	
6.1 Low frequency, radio frequency, microwave (electromagnetic fields) radiation. 6.2 Infrared, visible and ultraviolet light		1.5.10		6.2.2.2 6.2.3 c)		BGV B 11 BGR B 11			
		1.5.10		6.3.3.2.1 ; 6.3.4.5 6.4.5.1 c)					
6.3 X-rays and gamma rays		1.5.10				X-rayV			
6.4 Alpha rays, beta rays, electron or ion beams, neutron beams 6.5 Laser beams		1.5.10 1.5.11				Radiation Protection Ordinance			
		1.5.12			EN 60825	BGV B 2 BGI 832			
Identify all hazards		Observe all EC directives		Observe all relevant standards				see layout see table	

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Machine or system-specific hazards Serial. Hazards, no. hazardous situations, hazardous events	Establish conformity with : Applicable standards/techn. Specifications further EG- EN ISO 12100		Hazard checklist further EN- National norms		Ref. Life Annex I Directives Rules	Sheet 4 of 6 Applicable MRL shows (s)	
1	2	3	4	5	6	7	8th	9	10
7 Hazards from materials and substances *(and through its components) processed or used by machines*	1.1 1.4.1		6.2.2.2 6.2.3 b) 6.2.3 c) 6.2.4 a) 6.2.4 b) 6.3.1 6.3.3.2.1 6.3.4.4 6.4.5.1 c); 6.4.5.1 g)		Danger substanceV		see below	
7.1 Dangers from contact with or inhalation of hazardous liquids, gases, mists, vapors and dusts **(hazardous substances);** lack of oxygen	1.1.3; 1.1.7 1.5.13 ; 1.6.5 1.5.6;			EN 626-1	VDI 2262			
7.2 **Fire or Explosion** Hazard	1.5.7 ExplProtection-RL 94/9/EG			EN1127-1 EN13478	TRBS 2152 BGR 104 VDI 2263 sheet 3			
7.3 biological or microbiological hazards (from viruses or bacteria)	1.1.3; 1.6.5, 2.1				BioStoffV BGR 143			
8 Dangers from neglecting ergonomic principles when designing the machine , such as dangers from 8.1 an unhealthy posture or excessive exertion				EN614 EN1005			see below	
	1.1.5; 1.1.6 1.6.2; 1.6.4		6.2.2.1 6.2.7; 6.2.8 6.2.11.8 6.3.2.1 6.3.3.2.1					
8.2 insufficient consideration of the anatomy of hand/arm or foot/leg	1.1.6 2.2 1.1.2d			EN614				
8.3 Provision of personal protective equipment (PPE) instead of technical protective measures					BGV A 8			
8.4 inappropriate local lighting; insufficient view of the workplace	1.1.4			EN1837				
8.5 mental overload or underload, stress	1.1.6							
8.6 Human error (e.g. circumventing protective devices, not wearing the necessary PPE or wearing PPE in violation of the ban, disregarding warnings	1.1.2c; 1.1.6 1.2.2; 1.2.5 1.5.4; 1.7				BetrSichV TRBS BGR 500	x31 _		
8.7 improper construction, placement or Identification of Controls 8.8 Improper	1.2.2							
Construction or Placement of optical or acoustic signals	1.7.1			EN842, 894, 981, 61310				
9 hazards d. Operating environment of the machine (e.g. temperature, wind, snow, moisture, lightning)	1.1.2a 1.2.1; 1.5.16		6.2.6; 6.2.11.11 6.3.2.1; 6.4.5.1 b)					
Identify all hazards	Observe all EC directives		Observe all relevant standards			see layout see table		

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Machine or system-specific hazards				Hazard checklist			Sheet 5 of 6		
running Hazards, no. hazardous situations, hazardous events		Make compliant with : MRL other EC Appendix I	guidelines 3	Applicable standards/techn. Specifications EN ISO 12100 other EN national standards Rules 7			Applicable Yes	Ref. phase(s) 10	Life No.
1	2		4	5	6		8th	9	
10 combinations of hazards *(Danger increase through the addition of risks)*		1.1.2a							
11 Unexpected start, unexpected Spinning / over-revving (accelerating) *or any comparable malfunction due to:* failure / malfunction		1.2		3.31	EN ISO 1037 EN ISO 11161 EN ISO 13849 EN ISO 13850 EN50178 EN 60204-1 EN61000 Part 6-1 to Part 6-4 EN62061			see below	
11.1	of the control / regulating circuit (see also serial no. 14)	1.2.1					x25 _		DM
11.2 Restoration of the energy supply after an interruption *(e.g. power failure and power recovery).* (see also item 12) 11.3 external influences on electrical equipment		1.2.6 1.6.3		6.2.11.7.1 6.2.11.7.2			x26 _		DM
	(e.g. line interference, electromagnetic radiation)	1.2.1 1.5.11	EMC Directive 2004/108/EC	6.2.11.1; 6.2.11.4: 6.3.2.5.2; 6.3.3.2.5; 6.3.5.2			x27 _		DM
11.4 other external influences *(gravity, wind, wet, lightning, etc.)*		1.2.1			EN60529				
11.5 Hardware and Software Errors		1.2.1				BGI 852-4			
11.6 Operating errors *(see also serial no. 8), eg unintentional switching on of the machine due to unsuitable command devices*		1.1.6; 1.2.1 1.2.2; 1.2.3, 1.2.5, 1.7			EN614				
12 Disturbance of the energy supply *(thereby e.g Danger of failure of protective devices, parts flying off or falling, non-execution of stop commands, change of machine parameters);*		1.2 1.2.6		3.31; 6.2.11.1 3.32; 6.2.10 3.33	see item 11		x28 _		DM
13 Inability to stop the machine under optimal conditions *(normal stop – operational stop – emergency stop)*		1.2; 1.2.1; 1.2.4;1.2.4.4 1.2.6; 1.3.5		6.2.11.1; 6.2.11.3 6.2.11.6; 6.2.11.8 & 9; 6.3.5.2	EN ISO 13850		x29 _		DM
14 Error in control / regulation circuit *(e.g. due to operational stress, external influences, hardware or software defects, logic errors, uncontrolled changes to safety-relevant machine parameters, interference in the control signals with wireless controls)*		1.2 1.2.1; 1.2.3, 1.2.4: 1.2.5, 1.6.3 Observe		6.2.11	see no. 11		x30 _		DM
Identify all hazards		all EC directives		Observe all relevant standards			see layout see table		

Machine or system-specific hazards Serial. Hazards, no. hazardous			Hazard checklist			Sheet 6 of 6		
situations, hazardous events	Establish conformity with : Applicable standards/techn. Specifications Applicable MRL further EG- EN ISO 12100 further EN- National Ref. Life standards Rules Yes No. phase(s) Appendix I Policies							
1	2	3	4	5	6	7	8th	9	10
15 Danger of circumventing protective devices *due to a lack of solutions for all operating states and necessary interventions in the machine, e.g. when setting up, checking programs (process monitoring), eliminating disruptions in the work process and troubleshooting, inspection, cleaning, maintenance, repair*	1.1.2a+c 1.2.5 1.4; 1.4.1 1.6; 1.6.4		6.2.11.1 6.2.13 6.3.3.1	EN1088	BGI 575 BGI 670	x31 _		GM
16 Assembly and disassembly work *Hazards such as handling/ transport of heavy components; incorrect assembly and connections; Test runs (see also serial no. 1c, 15,17,18 and 19)*	1.1.5; 1.3.1; 1.3.3; 1.3.9 1.5.4		5.4; 6.4.1.3; 6.4.5.1 b) 4; 5.4; 6.2.6; 6.4.1.3; 6.4.5.1					
17 Dangers during cleaning/maintenance , *eg due to maintenance work while the machine is running; unsafe access to points of intervention; lack of facilities for safe energy separation and discharge; Bypassing protective devices when troubleshooting; Remote maintenance (see also serial no. 1c, 15,16,18 and 19)*	1.3.1; 1.3.7 1.3.9; 1.5.15 1.6; 1.6.3		5.4; 5.5.3.2; 6.2.11.9; 6.3.2.4; 3.3; 5.3.2c); 5.3.3 b) ; 5.4; 5.5.2.3.1a); 5.5.3.2; 6.2.8e); 6.2.10; 6.2.11.9; 6.2.11.10; 6.2.11.12; 6.3.2.4; 6.3.3.1; 6.3.5.4; 6.4.5.1b); 6.4.5.1e); 6.4.5.1 h)					
18 Slipping, tripping or falling of people *during the assembly, operation, maintenance and dismantling of machines*	1.5.15 1.6.2		Annex B 6.3.5.6	EN ISO 14122	BGV A 1 BGR A1			
19 Danger of entering a machine / plant to be shut off *from the control panel, for example because the danger zones are unclear (especially with automatic start); Lack of escape routes, emergency call options and precautions for freeing and rescuing people.*	1.2.2; 1.2.3 1.5.14		6.3.5.3	EN ISO 11161				
20 Insufficient user information *(Signals, warning devices, operating instructions, etc.)*	1.1.2; 1.1.5 1.3.1; 1.3.2 1.3.7; 1.5.4; 1.7		6.4	EN62079		x32 _		valid for everyone
21 Other hazards *(additional risks in individual cases for all life phases of a machine/ system depending on their type and size as well as installation and usage conditions)*	Appendix I	all relevant EC directives		all relevant machines nominal norms	all relevant national rules	x33 _		B, C, GM
Identify all hazards	Observe all EC directives		Observe all relevant standards			see layout see table		

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4.4. Risk assessment and description

With the help of the hazard checklist, sheets 1 to 6, the following hazards were identified as applicable:

Product: Processing station with an assembly robot

Document number.:

Issued by: Philip Kleen

Document part no.:

Date: 05/12/2015

black area = high risk

gray area = medium risk white area = low risk

initial risk assessment: Yes

effects	extent se	Class Cl = (Fr+Pr+Av) 4	5 – 7	8-10	11-13	14-15	frequency Mrs	probability Pr	avoidance Av
Death, permanent loss of an eye or	4						ÿ 1h 5	very high 5	
arm, reversible loss of fingers,	3						< 1 h to ÿ 24 h 5	high 4	
reversible medical care, first aid	2						< 24 h to ÿ 2 w 4	medium < 2 w to ÿ 3	impossible 2 5
	1						1 a 3	low 2	negligible possible 1 3
							< 1 a		probable 1

ref No.	Type. vessel No.	Danger	se	Mrs	Pr	Av	class		
1	1	Movements of each part of the robotic arm	2	3	2	1	6	small risk	
2	1	Crushing between the robot arm and any solid object	2	5	3	3	11	high risk	
3	1	Squeezing between end effector and any solid object 1 unexpected move 1 unintentional	2	5	3	3	11	high risk	
4		move	2	3	2	1	6	low risk low risk	
5			1	3	2	3	8th	high risk	
6	2	contact with live parts 5 due to vibration;	4	2	3	3	8th		
7		releasing connections	1	3	2	3	8th	low risk low risk	
8th	8	Inappropriate location or marking	3	2	1	1	4		
9 10		Unexpected starting of the machine by a person	2	3	2	1	6	small risk	
10	10	due to multiple failures/situations 11	3	2	2	1	5	medium risk	
	10	Failure of a protective device	3	2	2	1	5	medium risk	
20	1c)	falling objects 21 1d) by	1	3	2	1	6	low risk medium	
clamping on the fixation			2	4	3	1	7	risk	

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22	1g)	Liquids and gases under pressure	3	3	2	3	8th	high risk	
23, 24	2	Electrical hazards	4	3	2	5	10	high risk	
25, 26, 27	11	Unexpected startup of the system	1	2	2	5	9	small risk	
28	12	Disturbance in the energy supply	1	2	2	5	9	low risk medium	
29	13	Stopping in an emergency	2	3	3	3	9	risk	
30	14	Control circuit error	1	2	2	5	9	small risk	
31	15	Bypassing protective devices	2	4	4	1	9	medium risk	
32	20	Insufficient user information	2	3	3	3	9	medium risk	

Details (description of the accident scenario) of Ref. No.

1	Crushing between the stationary and moving parts of the robot in jog mode with the housing open. Mainly through the intervention of another person.
2	Crushing between the robot arm and any solid object by engaging the machine loading opening.
3	Crushing between the end effector and any solid object by engaging the opening for loading the machine. 4 Unexpected movement of machines or parts of the robot cell during handling operations
5	inadvertent movement or actuation of an end effector or related equipment (including robotic external axes, process specific to grinding wheels, etc.)
6	Contact with live parts or connections (control cabinet, connection boxes, control panels on the machine)
7	During operation of the robot, vibrations are transmitted to the entire machine, but not necessarily to a person or other machines.
8	Unfortunate location selection can result in blocked or restricted access to the control equipment. This applies in particular to the emergency stop 20 When loosening the machine housing and possibly hacking out the side parts, these elements can fall out of the hand 21 jamming/crushing at the indexing, by reaching under the lifting plate, when reaching into the protected area, through the material feed opening .
22	Flexible indexing air hoses can rupture or detach and whirl around.
23, 24	If the electrical installation is not professional and due to operational stresses, there is a risk of electric shock when touching live parts. 25, In the event of failure/malfunction of the control system, power failure and recovery as well as electromagnetic interference, there is, among other things, the risk of an unexpected 26, 27 start-up of the systems or individual components
28	Protective devices can fail in the event of disruptions in the electricity network.
29	Despite all protective measures, emergency situations can arise for which precautions must be taken.
30	Component failures in the electronic control (standard PLC) can lead to dangerous situations, especially when the transfer belt unexpectedly runs faster or too fast.
31	Missing operating states for programming, protective devices that are difficult to remove. Dismantling of the housing necessary.
32	Risks that cannot or cannot be completely eliminated by technical measures can cause hazards if those who work on the system are not made aware of them. Lack of operating instructions with maintenance and operating instructions.
33	Further hazards from moving the machine must be ruled out in accordance with Appendix I of the Machinery Directive, Section 3.

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4.5. Other hazards with certain machines/plants

It is a mobile machine in accordance with MD Appendix I Paragraph 3. Rollers are attached for easier transport.

Further requirements: As

further protective measures, stability during transport must also be guaranteed and it must be possible to stop quickly and drive in a controlled manner.

According to the robot manual, the correct position of the manipulator must be observed.

Further measures:

This can be achieved by handling the machine and using instructions in the operating instructions. The stability must be checked constructively. The machine must have brakes for quick stopping.
The control elements should also be able to be attached to this machine so that they can be moved, so that the selection of the intended use is greater.

Retrofitting a button on the operating unit for the command "move to transport position" in the "setup" operating mode or implement an additional operating mode "transport" with additional properties (see operating concept). These could be the following: releasing the brakes, positioning and other safety-related connections to the integration environment, moving the manipulator to the home position.

5. Safety and operating concept For those identified with the
help of the hazard examples from DIN EN ISO 10128-2 (page 11) (see page 13ff) and the hazard checklist from DIN EN ISO 12100 (see page 19ff) and on the pages The risks described in sections 25 to 27 have already been assessed. Risk reduction measures must now be defined. Protective measures are selected as part of a security and operating concept.

The safety and operating concept consists of points 5.1 to 5.5.

The following is explained:

• to point 5.1 (see page 30)

Required protective measures (overview)

Consideration of all identified hazards as well as production and operating requirements in the safety and operating concept.
It is tabulated for all life phases of the machine/system whether protective measures are necessary according to the hazard checklist. It is also specified which production and operating requirements must be taken into account when selecting and describing the protective measures in the measure sheets. This is intended to prevent tampering with protective devices.

• to item 5.2 (see page 31)

Explanations for creating the action sheets Here it is recorded how the
action sheets are to be used and filled out. **The explanations were taken into account in this analysis.**

• to point 5.3 (see pages 32ff)

Measure sheets The
measure sheets (sheets 1 to 5) are used for the machine or system-specific risk assessment and description of protective measures for safety-relevant phases of life.

The following were taken into
account: ÿ All identified hazards according to the hazard checklist. ÿ Risk
assessment according to DIN ISO/TR 14121-2:2013-02 Section 6.5.2 and description of the hazards (see pages to 24) ÿ Basic health and safety requirements of the

EC Machinery Directive according to column 3 of the hazard checklist for hazards marked "applicable".

ÿ Requirements from other internal market directives according to column 4 of Hazard Checklist

ÿ Applicable standards/technical specifications according to columns 5 to 7 of Hazard Checklist

ÿ Necessary protective measures taking into account safety, Production and operation requirements (see pages 32ff) ÿ

Necessary measures according to the functional description on the pages 37ff.

- to point 5.4 (see pages 37ff)
  Functionality of the secured system In
  the course of the selection of protective measures in the measure sheets (pages 37 to 37), a description is given of how the secured system functions and is to be operated. The purpose of the description is to avoid selecting unsuitable protective measures. This ensures that the operator can carry out all necessary activities and interventions without unreasonable hindrances.

- to item 5.5 (see page 39)
  Safety plan The
  protective measures described in the measure sheets (pages 32ff) are assigned measure numbers. Their entry in the installation plan on page 8 provides an overview of the protective measures specified for the machine/system (page 39).

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5.1. Required protective measures (overview)

company itself	**Required protective measures (overview)**						Editor: Philip Kleen Date: 05/12/2015
Consideration of all identified hazards as well as important production and operating requirements in the safety and operating concept. available							
life stages of machine / plant object	**danger spots: Location / area / hazards:**		**Yes No**	**Necessary protective measures**	**Yes**	**No**	**Remarks**
A build	entire machine	All hazards according to hazard checklist	Yes	Special protective measures required?		X	Just general caution and care needed
B Transportation			Yes	See Other hazards associated with certain machines/ systems, page 27	X		
C Assembly / Installation			Yes	Special protective measures required?		X	
EN Automatic operation semi-automatic operation	entire machine	mechanical hazards (general)	Yes	Safeguarding of hazardous points • individually on each component? • only on certain components? Area security (e.g. fence, notices)?	X X	X	Due to the requirements of DIN EN ISO 190218-2, the housing is to be regarded as a fence
FK All modes with manual Control **(no automatic operation)**	entire machine	mechanical hazards (specific)	Yes				Application of the C DIN EN ISO 190218-2 standard
DK General operation of the machine / Attachment	entire machine or specific components areas, places	Non-mechanical hazard gene	Yes	Special protective measures required?	X		
LM cleaning, Maintenance, maintenance	entire Machine, suction	Mechanical hazards	Yes	Machine downtime possible? Special protective measures required?	X X		Regulation in the operating instructions. issuance of operating instructions.
N Decommissioning, dismantling, **see life cycle**	entire machine	All hazards according to the hazard checklist	Yes	Special protective measures required?		X	As far as foreseeable, only general caution and care necessary
table Hazards according to the hazard checklist				**See action sheets for details**			

5.2. Explanations for creating the action sheets For all machine or system-specific hazards identified with the help of the hazard checklist, the associated risks must be assessed and risk reduction measures defined on the basis of a safety and operating concept.

The risk assessment and description of protective measures can be documented with the help of measure sheets (sheets 1 to X).

In the case of large machines and larger production plants, a risk assessment carried out for sub-machines or sub-areas improves the overview. It can make sense to analyze and document individual phases of life separately.

The action sheets can therefore be used for an **overall** machine (single machine or complex system), a **sub** - machine (machine of a complex system) or for a **sub-area** of a machine/system.

Risk assessments for sub-machines or sub-areas do not replace the risk assessment for a machine/system as a whole, insofar as this is necessary for the interaction of assemblies.

It is already described in 4.2 Explanations for the use of the hazard checklist that it must be a complete machine. Ie the measure sheets 1 to ___ are used to document the risk assessment and description of protective measures for a complete system.

Columns **1** to **11** of the action sheets are explained below.

Column	running Numbers of the identified hazards from the hazard checklist.
1	Identified hazards from the hazard checklist.
Column	All hazardous points (named after location, area or object) at which identified hazards must be expected.
2	Position numbers of the respective system components *(see floor plan page 52).*
Column 3 Column 4 Column 5 Precise information as to when and where the relevant hazard occurs (hazardous situation, hazardous activity, cause of the hazard).	
column 6	Specification of the life phase(s) of the machine/system in which the corresponding hazard occurs (see life phases on page 12)
column 7	General risk assessment in accordance with DIN EN ISO 12100 "General design principles - risk assessment and risk reduction" (see risk assessment and description on page 25). Risk levels for the states before and after risk reduction (e.g. high/low) can be specified , which result from the risk graph contained in the table depending on risk factors.
column 8	The risk assessment for the machine control must be carried out in accordance with DIN EN ISO 13849-1. Alternatively, DIN EN 62061 can also be used for safety-related electrical, electronic and programmable electronic control systems. In the risk assessment according to DIN EN 13849-1, the required performance level (e.g. PLr=d) must be determined and entered in column 8 for each safety function required according to column 9 of the control to be designed. Appendix 1 contains explanations of the design and development process for a controller in accordance with DIN EN ISO 13849-1. Alternatively, for safety-related electrical, electronic and programmable electronic control systems, the safety integrity level (e.g SIL=2) and entered in column 8. Explanations can be found in Appendix 1.
Column 9 Formulated protection goals, description of protection measures, indication of residual risks and instructions for user information.	
Column 10 Action number for the security plan.	
Column 11 Space for test notes Annex 2	

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5.3. action sheets

Manufacturer	Sheet of **measures**			Sheet 1 of 5
even	**Machine or system-specific risk assessment and description of protective measures Machine /**			
	system: Processing station with an assembly robot **Type:** – **Machine no.:** 0001 **Customer:** inIT **Order**			**Responsible:**
	no.: – Entire machine : Yes **Sub-machine:** No **Danger** point		**Year of construction:** 2014	Philip Kleen **Date:** 05/12/2015
			Country: Germany	
			Section: no	

From hazard checklist running Hazards (short text)	Location / area / ref. object	No	Dangerous situation, life cause of danger	Hazardous activity, phase	risk assessment general no.	for the	Control	Protection goal(s) / protective measure test ver Residual risk No. Note	Measures	information
1	2	3	4	5	6	7	8	9	10	11
1 Mechanical hazards										
squeeze through movement of robot arm	robot	1	In jog mode, another observing person can be caught by the robot arm.		FM low	risk		speed of the robot as in the Reduce C standard	1	
	between robot arm and fixed object	2	by opening the equipment manual operating modes, with another person		DM	high risk		**Objective:** Prevent access to the operating room **Measure:** Installation of a tunnel according to ISO 13857, possible access options Query that a magazine is employed Pay attention to information about	2 4	
					FM low	risk		other people	3	
	between end effector and solid object	3	by opening the equipment manual operating modes, with another person		DM	high risk		**Objective:** Prevent access to the operating room **Measure:** Attach a tunnel according to ISO 13857, possibly obtain access options Query that a magazine is employed Pay attention to	2 4	
					FM low	risk		other people, no manual fixing of components **Measure:** Prevent unexpected	5	
unexpected be move	of machines or parts of the robot cell , **see** floor plan	4	during handling operations		FM low	risk		movement through reliable certified components min. PLr =d	6	
See hazard checklist			**All identified hazards. note**		**see table see**	**risk graphics**		**All EC directives, EN standards, techn. spec. note**		**Rod.**

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Manufacturer	Measures sheet Machine or system-specific risk assessment and description of protective measures							Sheet 2 of 5	
From hazard checklist running Hazards Location (short text)	danger point area / item Hazardous activity, general phase No. object	No cause of danger	Dangerous situation, life risk assessment		my	for the steering	Protection goal / protection measure residual risk user information	dimensions no _	test ver
1	2	3	4	5	6	7	8th	9	10	11
	unintentional movement or activity	End effector o the associated gear	5 during handling operations		FM low	risk		**Measure: •** Two-hand operation, one gives renewed release, the other can be used in jog mode at reduced speed. • Round off edges and corners as far as possible.	7	
	falling from objects edges and corners	Upper housing parts	20	When disassembling and assembling the side parts, which also represent a protective device, they can slide out of the hand. Access to the protected area 21 By reaching into	A, C, FM	low risk		• Note in the operating instructions: work with several people. • General caution and care necessary • Wear safety shoes and gloves	8th 9 10 11	
1d) mass and speed, To squeeze	indexing		the operating area via the workpiece feed, it is then possible to reach under the lifting plate		CM medium	risk		Attaching a tunnel according to ISO 13857, possibly maintaining access options so that there is no crushing between these and the workpiece.	12	
1g) accumulation of Energy, air under pressure	compressed air hoses	22	bursting or loosening of compressed air hoses		All	high risk		**Measures: •** Fixie hoses at short intervals ren • Limit pressure	13 14	
2 Electrical hazards	entire machine	6 23 24	contact with live parts Defective components, poor insulation		DM	high risk		Design, installation and use of electrical equipment in accordance with EN 60204-1 and BGV A3, including electrical testing by a qualified electrician. • Plug connections with attachment to the counterpart, • Tension spring	15	
5 Vibration hazard	Links, fortifications	7	Loosening these components		DM low	risk		clamps for electrical installation • Fix the screws with glue if necessary	16 17 18	
See hazard checklist	**see installation plan**		**All identified hazards. note**		**see table see**	**isk graphics**		**All EC directives, EN standards, techn. spec. note**		**Rod.**

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Manufacturer	Measures sheet Machine or system-specific risk assessment and description of protective measures						Sheet 2 of 5		
From hazard checklist running Hazards (short text)	Location / area / item / object	danger point Hazardous activity, general No.	Dangerous situation, life No cause of danger	risk assessment phase my	for the steering	Protection goal / protection measure residual risk user information	dimensions no _	test ver
1	2	3	4	5	6	7	8th	9	10	11
8 Ergonomic Danger	controls		8	Unsuitable location, no quick action possible; possibly unhealthy posture	DM low	risk		Movable controls or Note that this must be taken into account when choosing a location	19	
10 combination of hazards										
unexpected Start through third	entire machine		9	machine is said to be from one Person to be started, but this process will be done by someone else person not expected	DM low	risk		• The machine is small and the environment is manageable. • Machine has no remote access, otherwise release for this • Possibly key switch as start operation	20 21 22	
Hazards due to multiple failures/ unexpected	entire machine		10	It can be used by anyone risk of encountering these hazards, especially when troubleshooting	DM	medium res risk		EMERGENCY STOP devices, disconnecting the plugged-in supply system	23	
situations behavior	failure of one protective measure		11	When claiming the Protective measure can these failures and that risk increases	DM	medium res risk		At least as required by the C standard PLr= d with category 3 with a second switch-off way	24	
11 Unexpected start, unexpected spin/overspeed (accelerating)								Preventing injuries from Failure of control components and power supply after an interruption		
Control system failure/ malfunction	entire machine		25	use/use: Self-starting of the machine or individual components	DM low	risk		Run the security functions of the Control according to min PL = d Compliance with EN 1037, EN 60204-1, EN ISO 11161 and VDI 2854 Validation according to EN ISO 13849-2	25	
Energy supply after an interruption	entire machine		26		DM low	risk				
External influences on electrical operating resources	entire machine		27	Electromagnetic Interference	DM low	risk		Ensuring electromagnetic compatibility in accordance with EN 61000-6-1/2 (immunity to interference) and EN 61000-6-3/4 (emission of interference).	26	
See hazard checklist	see installation plan			All identified hazards. note	see table	see risk graphics		All EC directives, EN standards, techn. spec. note		s. Tab.

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Manufacturer	Measures sheet Machine or system-specific risk assessment and description of protective measures						Sheet 2 of 5		
From hazard checklist running Hazards Location (short text)	danger point area / item Hazardous activity, general phase No. object		No cause of danger		my	for the steering	Protection goal / protection measure residual risk user information	dimensions no _	test ver
1	2	3	4	5	6	7	8th	9	10	11
12 Sudden malfunctions	entire machine		28 Application/Use: • Automatic start-up of components • Changing machine parameters Failure of protective devices, etc		DM low	risk		Prevention of injuries caused by power failure and recovery: Measures according to measure no. 25, 26, 27, 28		
13 Shutdown in emergencies	entire machine		29 Use		DM medium	risk		Prevention of personal injury, damage to property and damage to the environment in emergencies and incidents: EMERGENCY STOP switching devices on the control panel and on the machine with an effect on the entire system (including the connected processing machines) in compliance with EN ISO 13850 and EN 60204 -1 (stop category 0)	27	
14 errors in control /loop Unexpected operational disruptions	entire machine		30 Application/Use: • Automatic start-up of components • Non-execution of stop commands • Changing machine parameters Failure of protective devices, etc		DM low	risk		Prevention of injuries caused by the failure of control components: Execution of the safety functions according to PL = d Release of the PLC from safety responsibility through an additional control with contacts.	28	
15 Incorrect operating mode	entire machine		31 Starting the automatic mode drive without checking the protective device		DM medium	risk		Easy access, with query to start, up to the service room Start only possible with closed housing	29	
See hazard checklist	see installation plan		All identified hazards. note		see table	see risk graphics	All EC directives, EN standards, techn. spec. note			S. Tab.

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Manufacturer	Measures sheet Machine or system-specific risk assessment and description of protective measures						Sheet 2 of 5		
From hazard checklist running Hazards Location (short text)	danger point area / item Hazardous activity, general phase No. object		Dangerous situation, life risk assessment No cause of danger		my	for the steering	Protection goal / protection measure residual risk user information	dimensions no _	test ver
1	2	3	4	5	6	7	9	10	11
20 insufficient user information residual risks	In total attachment		20 Deployment/Use		DM medium risk		Prevention of injuries due to residual risks and incorrect operation of the system: Unavoidable residual risks are pointed out by conspicuous safety markings on the system and understandable operating instructions. In addition, the operating instructions are issued.	30	
21 by mobile machines **see hazard checklist**	entire machine		22 Use		GM low risk		Note on transport in the operating instructions.	31	
	see installation plan		**All identified hazards. note**		**see table see risk graphics**		**All EC directives, EN standards, techn. spec. note**		**Rod.**

5.4. Functionality of the protected machine/system

The safety, production and operating functions described below are specified for the machine/system, taking into account all the requirements and basic protective measures provided in accordance with the required protective measures (overview). The implementation details are contained in the action sheets.

Automatic mode:

The switch-on operations prescribed for automatic mode are made as follows: • Connect to a suitable processing station • Configure machine control (teaching) • Housing/safety device of the machine closed • Magazine pushed to the machine • Persons are aware of the residual risk • Unlock compressed air • Acknowledge error • Start with the push button (automatic)

The machine must not be unplugged during operation. If it is unintentionally unplugged, other connected machines will come to a safe stop. This machine comes to a controlled stop. Restoring automatic operation requires the operator to proceed in the same way as previously mentioned, the machine must be put into operation again. By taking the key (pin) that is used to configure the safety-relevant machine control with them, the operating personnel can prevent a second person from inadvertently configuring the configuration again.

By opening or removing a safety guard, the robot and the rest of the machine immediately come to a safe stop. Restoring automatic mode requires the following actions by the operating personnel in this specific order: • Reattach the safety devices, close them • Acknowledge the error with the pushbutton • Start with the pushbutton Removing the component magazine leads to a safe stop of the machine. Restoring automatic mode requires the operating personnel to take the following actions in this order. • Push the newly loaded magazine back in. • Acknowledge errors with the pushbutton • Start with the pushbutton **Eliminate malfunctions in the workflow**

Malfunctions must not be removed in automatic mode; it must be ensured that the industrial robot does not pose any danger.
To do this, the manual operating mode with reduced speed must be selected. The indexing can now be moved manually using a push button. The removal or opening of protective devices is now also permitted in order to carry out necessary interventions.

Setting up, adjusting, testing, troubleshooting and troubleshooting This processing machine is intended for quick and easy use in an integrated production. To do this, the pluggable supply bus must be plugged into a compatible machine that is also intended for integration and secured against loosening.
These must be configured accordingly so that safety-related communication can be established. This is triggered by pressing a button on one of these machines (teaching). The teaching must be carried out again each time the integrated manufacturing system is changed. Regardless of whether the position has been changed. It is therefore a switch-on operation for automatic operation.
The machine has an automatic mode in which no further intervention is required. For troubleshooting and settings, the manual operating mode must be selected and the protective devices can be opened. The industrial robot can be moved at reduced speed by touching and pressing the release button via an additional control panel that can be plugged in.

Cleaning, maintenance, repairs

This work can be carried out when the system is at a standstill with the energy system secured against being switched on. The exact procedure can be found in the operating instructions.

Transport

For transport, select the "Transport" operating mode and set it using the operating mode selector switch. The manipulator must be moved to the prescribed transport position using the home position button. After that, the safety devices that are used to check the proper integration can be removed without consequences. In the last step, the integration environment is informed via the stop button that this safety controller will soon no longer be available. The Plug and Produce connector must be removed within 20 seconds.

Emergency stop functions

Emergency stop protective devices are required at every control point on the machine, each affecting the entire safety area of integrated production. In the same way, the actuation of an emergency stop on another machine in the safety area leads to a standstill of this processing machine. Disconnecting this processing machine in automatic mode leads to a safe standstill of this machine and to the safe stop of all associated machines in the respective safety area.

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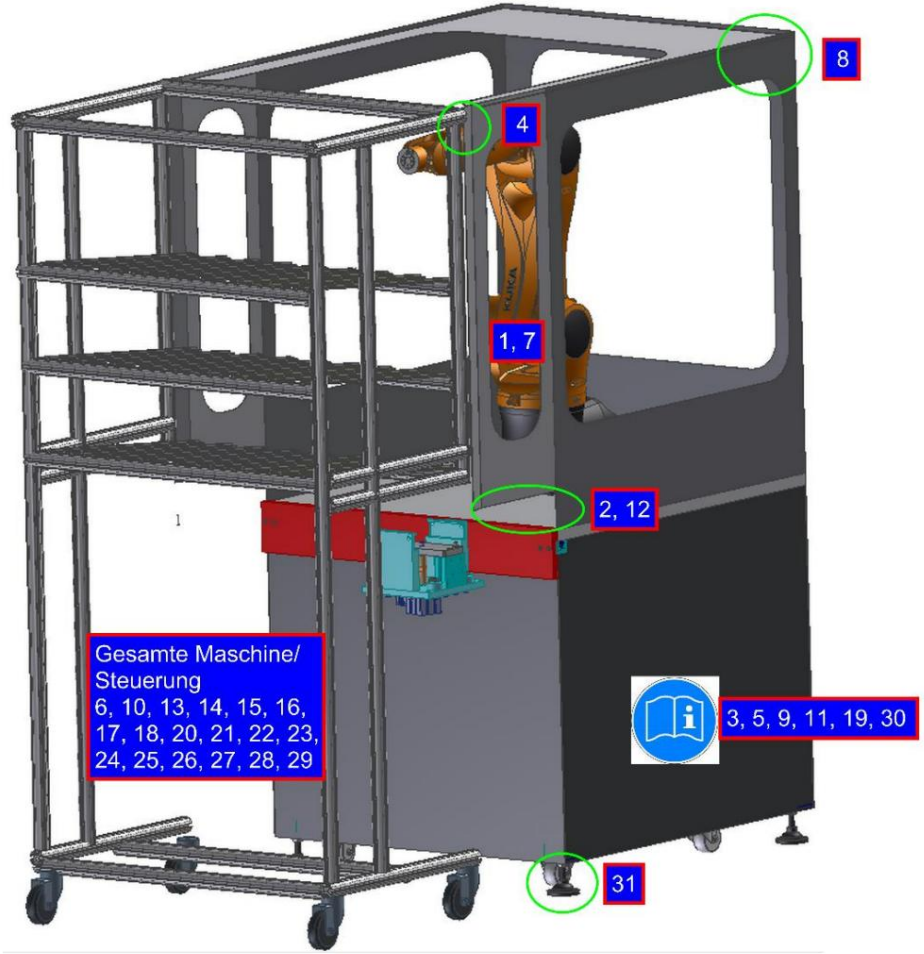
5.5. security plan

The risk assessment has shown that, based on the identified hazards and the assessed risks, risk reduction measures must be implemented. All risk reduction details are described in columns 9 and 10 of the action sheets. Each measure is provided with a measure number, which is entered in the safety plan.

The safety plan clarifies at which points or components of the machine/system risk reduction measures are required.

~~*The machine/system was designed and built taking this risk assessment into account.*~~ **All risk reduction measures have been implemented and checked according to the notes in column 11 of the** action sheets .
~~*The conformity of the machine/system with the guidelines is certified in the EC declaration of conformity.*~~



6.

Attachments Attachment 1 – Risk assessment As part of a comprehensive risk assessment, a risk assessment and evaluation must be carried out for each identified hazard. This serves the purpose of selecting suitable risk reduction measures.

Assessment and evaluation criteria are contained in:

EN ISO 12100	General design principles – Risk assessment and risk reduction
EN ISO 13849-1	Safety-related parts of controls – Part 1: General design principles
EN 62061	Security of machines - Functional safety of safety-related electrical, electronic and programmable electronic control systems

The general assessment of risks according to DIN EN ISO 12100 can be carried out with the help of Table 1, taking into account four risk factors. The level of risk is determined using a matrix of class and extent.

The risk is all the higher, the greater the possible extent of damage and/or the frequency, avoidance and probability of damage occurring.

Table 2 contains indications for risk assessment and risk reduction measures. The higher the identified risk, the more carefully suitable protective measures must be selected.

The risk assessment for safety-related parts of controls can be carried out using the risk graphs on pages 32ff. This also determines their contribution to risk reduction. Figure 1 on page 43 can be used to determine the required **performance level according to DIN EN ISO 13849-1 .**
The risk assessment for safety-related electrical, electronic and programmable electronic control systems can be carried out using the numerical evaluation, as in the assessment of hazards, and the matrix on page 46. This determines the contribution to risk reduction. With this, the required **safety integrity level according to DIN EN 62061** can be determined.

The design of the safety-related parts of controls can be found in DIN EN ISO 13849-1 or DIN EN 62061, depending on the application.

The validation (analysis and testing) of the intended safety function can be carried out according to DIN EN ISO 13849-2 or DIN EN 62061. The risk assessment should be limited to one of the two standards.

General assessment of risks in the event of possible personal injury, taking into account DIN EN ISO 12100. The mixed form of instruments was used according to the example of DIN ISO/TR 14121-2:2013-02 Section 6.5.2 with the following form.

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Table 1: Risk assessment form

Product: _____

Issued by: _____

Date: _____

Document number.:

Document part no.:

black area = high risk

gray area = medium risk white area = low risk

initial risk assessment: Yes

effects	extent Se	Class Cl = (Fr+Pr+Av) 4		8-10	11-13	14-15	5-7	frequency Mrs	probability Pr	avoidance Av
Death, permanent loss of an eye or	4							ÿ 1 h 5 very high < 1 h to ÿ 24 h		
arm, reversible loss of fingers,	3							5 high < 24 h to ÿ 2 w 4 medium		
reversible medical care, first aid	2 1							< 2 w to ÿ 1 a 3 low 2 negligible	5 4 3	5
									impossible	3
								< 1 a	2 possible 1 probable	1

ref No.	Type. vessel No.	Danger	se	Mrs	Pr	Av	class		
1									
2									
3									

Details (description of the accident scenario) of Ref. No.

1	
2	
3	

Possible risk reduction measures by the manufacturer of a machine

Measures 1 to 3 listed below have priority over measures 4 to 6 and 7 to 11. This applies in particular to high and medium risks. Measures 4 to 11 are not a substitute for possible measures according to 1 to 3.

Concrete risk reduction measures must be specified for each individual machine or system, taking into account all circumstances and safety regulations.

Table 2: Indications for risk-reducing measures

1. **Safety concept** for all life phases of the machine/plant and **all necessary interventions** by the operator set up serving staff	**EN ISO 12100** 6. Risk Mitigation 6.2 Inherently safe construction 6.3 Technical Protection Measures 6.4 User Information
2. **Eliminate hazards or reduce risks through** • lower-risk processes, • less hazardous substances and materials, • **constructive measures,** • suitable **technical protective measures.**	
3. Carry out **additional protective** measures	
4. Create understandable **operating** instructions with information about residual risks	
5. **Attach hazard and safety notices** to the machine/system	
6. **Provide signals and warning** systems	
7. Require **personal protective equipment** to be worn where appropriate	
8. Specify the use of qualified **personnel**	
9. Offer specific **training** measures	
10. **Require** staff training	
11. Recommend issuing **operating** instructions	

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Determination of the performance level (PLO for safety-related parts of controls according to DIN EN ISO 13849-1

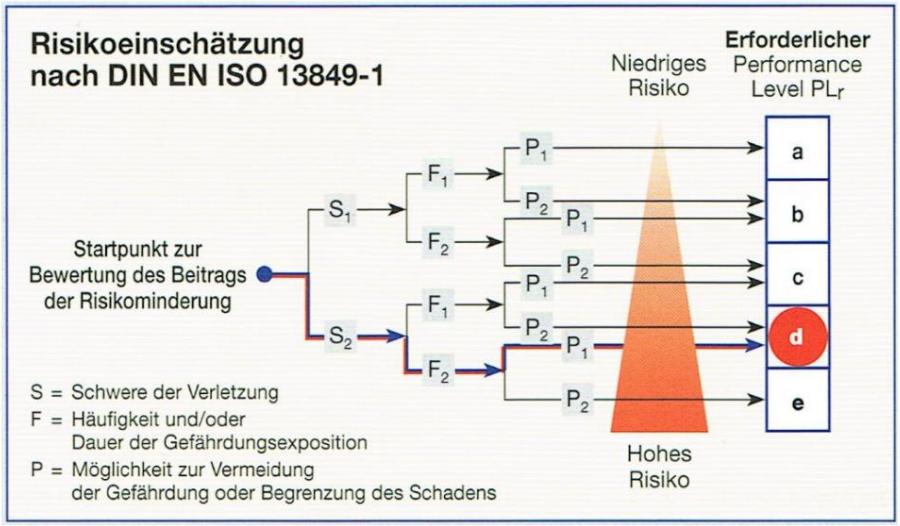

Figure 1: Determination of the required performance level PLr.

The safety-related parts of a controller can include its hardware and software. According to the new European **standard DIN EN ISO 13849-1 ,** published in February 2007, with the risk parameters known from DIN EN 954-1 , a control category no longer has to be determined **for each safety** function of a machine control, but a so-called **performance level (PLr) .**

The performance level represents the ability of a safety-related part of a controller to carry out a safety function in order to achieve the required risk reduction, ie for the quality of the risk-reducing measures.

The performance levels are divided into **5 levels from a -** e. They reflect different residual risks - expressed in the probability of a dangerous failure per hour.

The individual **risk parameters (S, F and P)** have remained the same compared to the withdrawn DIN EN 954-1. For the example in Figure 1, the risk parameters S2, F2 and P1 result in a required performance level of PLr = d.

The performance levels determined in this way for the individual safety functions can be achieved when designing a controller if, in addition to the previous controller categories, additional requirements, ie specific **reliability parameters,** are taken into account. DIN EN ISO 13849-1 contains further explanations.

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Risk parameters according to DIN EN ISO 13849-1

(For selection information, see Appendix A of the standard)

S Schwere der Verletzung	F Häufigkeit und/oder Dauer der Gefährdungsexposition	P Möglichkeit zur Vermeidung der Gefährdung oder Begrenzung des Schadens
S1 leichte (üblicherweise reversible Verletzung)	**F1** selten bis weniger häufig und/oder die Zeit der Gefährdungsexposition ist kurz	**P1** möglich unter bestimmten Bedingungen
S2 ernste (üblicherweise irreversible Verletzung einschl. Tod)	**F2** häufig bis dauernd und/oder die Zeit der Gefährdungsexposition ist lang	**P2** kaum möglich

Figure 2: Risk parameters according to DIN EN 'so 13849-1

Unfortunately, the standard does not provide any information on what is to be understood by "reversible" and "irreversible injury". There is also no information on what is meant by "rarely to little" or what is meant by "frequently to constantly".

In practice, the approach has proven itself that reversible injuries are those that heal without long-term consequences. Examples include slight bruises and abrasions as well as first-degree burns.

In the recent past, what was rated as common was anything that happened more than once per shift or lasted more than an hour.

However, it turned out that these values may not be practical.

According to the current state of discussion, something that occurs at most once every 10 minutes should be rated as "rarely" or something that occurs more than 6 times an hour should be rated as "often".

Anything that lasts longer than an hour should be rated as "continuous".

However, a final statement from the responsible technical authorities is not yet available. Designers are therefore well advised if the "sharper pace" of the past can be used at reasonable cost. If this is not appropriate, the deviation must be justified.

Kategorien	Anforderungen (Kurzfassung)	Systemverhalten	Prinzip
B	Die sicherheitsbezogenen Teile von Steuerungen und/oder ihre Schutzeinrichtungen als auch ihre Bauteile müssen in Übereinstimmung mit den zutreffenden Normen so gestaltet, gebaut, ausgewählt, zusammengestellt und kombiniert werden, dass sie den zu erwartenden Einflüssen standhalten.	Das Auftreten eines Fehlers kann zum Verlust der Sicherheitsfunktion führen.	überwiegend durch die Auswahl von Bauteilen charaktersiert
1	Die Anforderungen von B müssen erfüllt sein. Bewährte Bauteile und bewährte Sicherheitsprinzipien müssen angewendet werden.	Das Auftreten eines Fehlers kann zum Verlust der Sicherheitsfunktion führen, aber die Wahrscheinlichkeit des Auftretens ist geringer als in Kategorie B.	
2	Die Anforderungen von B und die Verwendung bewährter Sicherheitsprinzipien müssen erfüllt sein. Die Sicherheitsfunktion muss in geeigneten Zeitabständen durch die Maschinensteuerung geprüft werden.	Das Auftreten eines Fehlers kann zum Verlust der Sicherheitsfunktion zwischen den Prüfungen führen. Der Verlust der Sicherheitsfunktion wird durch die Prüfung erkannt.	überwiegend durch die Struktur charakterisiert
3	Die Anforderungen von B und die Verwendung bewährter Sicherheitsprinzipien müssen erfüllt sein. Sicherheitsbezogene Teile müssen so gestaltet sein, dass 1. ein einzelner Fehler in jedem dieser Teile nicht zum Verlust der Sicherheitsfunktion führt und, 2. wann immer in angemessener Weise durchführbar, der einzelne Fehler erkannt wird.	Wenn der einzelne Fehler auftritt, bleibt die Sicherheitsfunktion immer erhalten. Einige, aber nicht alle Fehler werden erkannt. Eine Anhäufung unerkannter Fehler kann zum Verlust der Sicherheitsfunktion führen.	
4	Die Anforderungen von B und die Verwendung bewährter Sicherheitsprinzipien müssen erfüllt sein. Sicherheitsbezogene Teile müssen so gestaltet sein, dass 1. ein einzelner Fehler in jedem dieser Teile nicht zum Verlust der Sicherheitsfunktion führt und, 2. der einzelne Fehler bei oder vor der nächsten Anforderung an die Sicherheitsfunktion erkannt wird, oder, wenn dies nicht möglich ist, eine Anhäufung von Fehlern dann nicht zum Verlust der Sicherheitsfunktion führen darf.	Wenn Fehler auftreten, bleibt die Sicherheitsfunktion immer erhalten. Die Fehler werden rechtzeitig erkannt, um einen Verlust der Sicherheitsfunktion zu verhindern.	

Determination of the safety integrity level (SIL) for safety-related electrical, electronic and programmable electronic control systems in accordance with DIN EN 62061

The procedure is described in detail in Appendix A of DIN EN 62061. It is striking that it is very similar to the general risk assessment used here. It differs only in the matrix for evaluating the numerical assessments.

Table 3 below shows at the intersection of the row severity (S) with the applicable column (K) whether there is a need for action. The black-colored area shows the specified SIL as a target for the SRCF. The lighter shaded areas should be considered as a recommendation that other measures (AM) be applied.

Table 3: Matrix for determining the SIL

Severity (S)	Class (K)				
	4	5 to 7	8 to 10	11 to 13 14	to 15
4	SIL 2	SIL	SIL 2	SIL 3	SIL 3
3		(AT THE)	SIL	SIL 2	SIL 3
2			(AT THE)	SIL	SIL 2
1				(AT THE)	SIL 1

Using Table 3, this results in a one SIL assignment for the SRCF intended to mitigate the particular hazard.

Appendix 2 - Control Measures

company	control measures	Page 1 of 1
XXXXXXXXX		

1. Safety checklist (effectiveness check)

Each selected risk reduction measure (here: column 9 in the measure sheets) must be evaluated in order to decide whether sufficient safety has been achieved or further risk reduction measures are required. **Sufficient safety is only given if all questions on the safety checklist can be answered with "yes".**

N	Safety Checklist	Yes	No	Comments
° 1	Have all the operating conditions and intervention procedures been taken into account?			
2	Were the protective measures selected according to the "3-step method"?			
3	Have all risks been eliminated or reduced to an acceptable level?			
4	Is it ensured that the measures taken do not create any new, unexpected hazards or problems?			
5	Are the users sufficiently informed about remaining residual risks?			
6	Do the measures taken allow easy handling of the Ma machine (user-friendly design)?			
7	Are all protective measures compatible with each other?			
8	Has the impact of non-commercial/non-industrial use of a machine designed for commercial/ industrial purposes been adequately considered?			
9	Is it ensured that the intended use of Ma machine is not impaired and there are no functional restrictions?			

If one of the questions is answered with **"No" ,** further or different protective measures must be taken. If necessary, the entire safety and operating concept for the machine/system must be changed.

If other risk reduction measures are selected, the process of risk assessment and evaluation must be carried out for any new risks that may arise. The selection of suitable protective measures and the risk assessment must be repeated until sufficient safety is achieved. Details on this are specified in DIN EN ISO 12100.

2. Tests (implementation control)

A check must be carried out on the finished machine/system to determine whether the selected protective measures are in place and effective. A separate test form or column 11 of the **action sheets** can be used as a checklist for this. The table shows a selection of possible tests.

Type of test Test basis Test of calculation documents Calculations Test	abbreviation
before initial operation Safety concept E EG type examination EN standards EG test for electrical safety DIN EN 60204-1 E DIN	B
for electromagnetic compatibility Technical standards EMC functional test (with or without workpiece)	
Safety concept F	
Measurement of technical standards M Trial run (practical test under practical conditions)	
Safety concept P Visual	
inspection of safety concept S Checking circuit diagrams (electrical/hydraulic/pneumatic diagrams)	
Wiring diagrams Sch Software	
testing Safety concept So Validation of safety-related parts of controls DIN EN ISO 13849-2 V Testing of laying conditions (e.g.	
pressure, load, material, stability test.) Specialist standards ZU	

– List of standards This list of standards contains standards and technical specifications that are listed in the hazard checklist. The specified EN standards are available as national DIN EN standards.

The checked standards and technical specifications were used in the construction of this machine/system (see hazard checklist columns 3 to 8 and action sheets column 9).

European and international standards (short title)	
Standards (EN, prEN, EN ISO, ISO)	**applied**
EN 349 Minimum distances EN 574 Two-hand controls EN 614 Ergonomic design EN 626 Hazardous substances EN 842 Visual hazard signals EN 894 Design of displays/controls EN 953 Separating protective devices Visual and acoustic signals EN 1005-3 Human physical performance (force limits)	
CR 1030 Hand-Arm Vibration (Guide) EN 1032 Whole-body vibrations EN 1037 Avoidance of unexpected start-up EN 1088 Interlocking devices EN 1127-1 Explosion protection EN 1299 Vibration isolation EN 1760 Pressure-sensitive protective devices EN 1837 Machine-integrated lighting EN 4413 Hydraulics EN 4414 Pneumatics EN ISO 6385 Ergonomics of work systems EN ISO 11161 Integrated manufacturing systems EN ISO 11688 Construction of low-noise machines EN ISO 11690 Low-noise workplaces EN ISO 12100 Safety of machines - general design principles risk assessment and risk reduction EN 12198 Emitted radiation EN 13478 Fire protection EN ISO 13849-1 Controls (design)	
	X
EN ISO 13849-2 controls (validation)	
EN ISO 13850 Emergency stop EN ISO 13855	X
Arrangement of protective devices with regard to the approach speed Safety distances Noise protection through silencers	X
EN ISO 13857	Stationary accesses Noise protection encapsulation Electronic
EN ISO 14163	equipment Explosion protection Electrical equipment Housing
EN ISO 14122	protection types Laser devices Low-voltage switchgear
EN 150 15667	Electromagnetic compatibility (EMC)
EN 50178 EN	
60079 EN	
60204-1 EN	X
60529 EN	
60825 EN	
60947 EN	
61000 Part 6-1 to 6-4 DIN	
EN 61241-14 Electrical equipment for use in areas with combustible dust EN 61310 Displays, labels, operating elements EN 61496 Non-contact protective devices EN 61508 El. programmable systems EN 62046 presence detection of people EN 62061 functional safety of controls EN ISO 10218-2 robotic systems and integration	
	X

BG regulations (BGV) - rules (BGR) - information (BGI)		applied
BGV A 1	Principles of Prevention	
BGV A 3	Electrical systems and equipment	
BGV A 8	safety marking	
BGV B 2	laser radiation	
BGV B 11	electromagnetic fields	
BGR 104	Explosion Protection Rules	
BGR 109	Grinding, brushing, polishing aluminum	
BGR 143	Activities with cooling lubricants	
BGR 237	hydraulic hose lines	
BGR 500	operation of work equipment	
BGI 575	Electromechanical locking devices	
BGI 670	Proximity switches in locking devices	
BGI 852-4	software	
BGI 5049	Security concepts and protective devices	
BGI 5123	industrial robot	
BGR 5127	Avoidance of ignition hazards due to electrostatic charging	
more rules		
BetrSichV	Ordinance on Industrial Safety and	
OStrV	Health Artificial optical radiation	
TRBS 2111	Mechanical hazards Hazards from	
TRBS 2121	falling Hazardous explosive	
TRBS 2152	atmosphere Ordinance on Hazardous Substances	
Hazardous Substance Ordinance	of 26 December 2010 Noise and Vibration Occupational	
LVArbSchV	Safety Ordinance Impact of mechanical vibrations Vibration	
VDI 2057	isolation Air quality at the workplace Dust fires and dust	
VDI 2062	explosions Dust separator Automated production systems	
VDI 2262	Pressure relief of dust explosions Mechanical vibrations	
VDI 2263	(protective measures)	
VDI 2264		
VDI 2854		
VDI 3673		
VDI 3831		