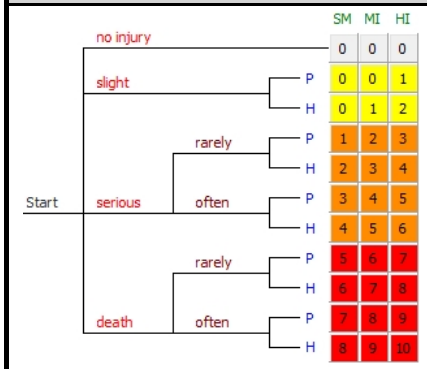
Risk assessment

Cobotlift

Project data			
Project name	Cobotlift	**Created by**	Kristensen Mads E.
Project number	O210747	**Created on**	01-06-2021
Product / Article	Cobot Lift	**Last change**	14-12-2021 22:41
Function	The process in general is: 1. Robot with tool move above pickup position. 2. Once sack is detected, move vertically down and turn on vacuum gripper. 3. Once vacuum is achieved perform a vertical lift that is high enough to prevent crushing hazards when moving away from the pickup position. 4. Transport the sack to a pre-position above the set down point. This is to ensure transport path is always the same. Maintain clearance to any fixed components to prevent crushing between fixed components and robot or sack. 5. Move above specific setdown position. 6. Move vertical downwards to place the sack. 7. Release vacuum. 8. Repeat from 1.	**Printed**	14-12-2021
Type			
Order			
Commercial name			
Model	Sack Solution		
Machine number			
Serial number			

Print options			
View	Hazards - Hazard zones - Phases of the machinery life	**Display**	Yes (hazard occurs)

Legend



Safexpert risk graph

V = Value (0 - 10):
- 0 = Lowest Risk
- 10 = Highest Risk

SH = Severity of the harm:
- N = no injury
- SL = slight injury
- SE = serious injury
- D = death

DS = Duration of stay in hazard zone:
- R = rarely to more often
- O = often to continuously

RA = Possibility of recognition and avoidance:
- P = Possible under certain circumstances
- H = Hardly possible

PO = Probability of occurence:
- SM = Small (improbable)
- MI = Middle (will probably occur a number of times during the life)
- HI = High (will happen often)

Control engineering

Cat. = Category
PLr = Performance level required (before)
PL = Performance level (after)
SILr = Safety integrity level required (before)
SIL = Safety integrity level (after)

Types of measure

ISD = Inherently safe design measure
SCP = Safeguarding / complementary protective measure
PPE = Personal protection equipment
PIC = Note on the machinery (Pictogram, ...)
OI = Note in the Operating instruction

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
1.3 - crushing	Robot working area	Normal operation

Hazard description

Risk of crushing (quasi-static contact) between fixed elements and robot/tool/part

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	O	P	MI	**4**		1	Parts on tool have large surfaces to reduce pressure in impact. The suspension of tool has two flexible links, that in the event of collision, will flex and reduce impact force.	ISD	SL		P	MI	**0**	

Reason for this valuation

IN:
Crushing between fixed parts of tool with small surfaces may result in high pressure situations.

OUT:
Larger surfces on tool reduce pressure.
Flexible links further reduce the quasi static pressure

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

1.3 - crushing	Robot working area	Reasonably foreseeable misuse

Sack solution delivers sack on top of operators hand or arm in the palletizing area

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SL		P	HI	**1**		1	The design of the system and the limit in weight of parts of 45 kg. prevents a dangerous situation.	SCP	SL		P	HI	**1**	

Reason for this valuation

IN:
If a sack is placed on top of part of an operator being in the robot working area, does not cause any risk.
Most likely the robot program will fail, due to not reaching the desired position. In this case the sack will still be lifted by the lifting tool.
Slider on tool prevents hard contact.

OUT:
No further actions required

SL		P	HI	**1**		2	The robots working area is reduced and operators are informed to stop the robot before entering the robots working area.	OI	SL		P	SM	**0**	

Reason for this valuation

OUT:
Probability is reduced by informing the operators.

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
1.4 - cutting or severing	Robot working area	Assembly, installation

Hazard description

The system is installed in an environment where fixed parts produce risk of cutting or severing.

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	O	P	MI	**4**		1	The system can only be installed in environment without sharp or pointy objects.	OI	SL		P	MI	**0**	

Reason for this valuation

IN:
If end user install the system in an environment with sharp or pointy parts, there's a risk of breaking bones or penetrating skin during eg. pickup of parts.

OUT:
It is advised in the manual, that end user must asses potential contact situations in eg. pick up and delivery positions, and make sure there is no sharp or pointy objects.

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

1.8 - impact	Robot working area	Normal operation

Hazard description

Operator receives impact from robot, tool or sack, during transport between pick-up and delivery positions.

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	O	P	MI	**4**		1	Parts on tool have large surfaces to reduce pressure in impact. The suspension of tool has two flexible links, that in the event of collision, will flex and reduce impact force.	ISD	SE	O	P	SM	**3**	
SE	O	P	SM	**3**	PLr d	2	Limit speed of robot using UR safety function	SCP	SL		P	SM	**0**	PL d
SL		P	HI	**1**		3	Limiting the working envelope of CobotLift to reduce probability of impacts. Limits can be set both vertical to reduce footprint and vertical to prevent impact in head height.	OI	SL		P	SM	**0**	

Reason for this valuation

IN: Robot accelerating to high speed without sack

Out:
Speed is limited to dgr/s according to weight
Se table in user manual for speed vs. weight os tool and part.

Reason for this valuation

IN:
Impact in head region is possible and should be prohibited if possible in the application.

OUT:
Propability of impact in head height is reduced

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
1.12 - stabbing or puncture	Robot working area	Assembly, installation

Hazard description

The system is installed in an environment where fixed parts produce risk of cutting or severing.

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	O	P	MI	**4**		1	The system can only be installed in environment without sharp or pointy objects.	OI	SL		P	MI	**0**	

Reason for this valuation

IN:
If end user install the system in an environment with sharp or pointy parts, there's a risk of breaking bones or penetrating skin during eg. pickup of parts.

OUT:
It is advised in the manual, that end user must asses potential contact situations in eg. pick up and delivery positions, and make sure there is no sharp or pointy objects.

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

4.1 - discomfort	Vacuum tube lifter	Normal operation

Noise from parts of the vacuum system

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
N			MI	**0**		1	Frequency converter is installed on vacuum pump to reduce the noise from vacuum flow in the suction cup. When installed in mobile Cobotlift, the vacuum pump is installed compartment with noise reducing materials.	SCP	N			MI	**0**	

Reason for this valuation

IN:
Without any measures the noise measured 1 m. from the suction cup is 69 db with release valve open. If release valve is closed the value is 72 db. This is within normal noise in industrial application.

OUT:
When CobotLift is running without product, the speed of the vacuum pump can be reduced which also reduces the airflow and the noise caused.

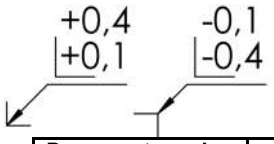
Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
12.2 - Contact with sharp edges and corners, protruding parts	Entire machine	In all phases of the "life"

Hazard description

Risk of cutting on sharp parts or edges eg. on machined parts.

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SL		H	HI	**2**		1	All edges and corners are chamferred to remove the risk of cuts. 	ISD	N			HI	**0**	

Document number	Title	Section
EN ISO 12100:2010-11	Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)	6.2.2.1 c)

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
Hazard description		

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
Risk adequately reduced No / Yes							Name	Date						
14.1 - Falling or ejection of objects							Robot working area		Malfunctioning					
Risk of dropping sack in case of power failure or if sack breaks during lifting eg. from damage or not being strong enough.														
SE	R	H	MI	**3**		1	Operators are advised to not crawl underneath the sacks that are transported.	OI	SL		H	MI	**1**	
							Reason for this valuation IN: If a sack is dropped on the back of an operator, this may cause musclotary bruise. It is unlikely, that operators should have major body parts underneath the sacks. There's no obvious incentive for this. OUT: Not being underneath the sacks, reduces the risk to dropping sacks on feet of the operator.Dropping a sack on the feet is not considered to cause injury.						
SL		H	MI	**1**		2	Operators must wear safety shoes.	PPE	N			MI	**0**	
							Reason for this valuation OUT: With safety shoes the severity is reduced.							
SL		H	MI	**1**		3	In the event of power failure, this is monitored and a program sequence lowers the sack slowly. Audio and visual signal is given in the event of power failure to the vacuum pump. If the application has high risk in the evnt of power failure, power back-up can be added to the robot - avialble as purchase from CobotLift.	SCP	SL		P	MI	**0**	
							Reason for this valuation OUT: If power failure occurs, the sack is not dropped, and therefore the impact reduced.							
Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021														

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
15.1 - Loss of stability	Lifting crane	Assembly, installation

Hazard description

Poor installation could cause the crane to tip or break

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	R	H	SM	**2**		1	Crane is delivered with decleration of conformity for relevant standards. The crane is mounted as described by manufacturer.	ISD	N			MI	**0**	

Reason for this valuation

IN:
Break in crane could cause serious injury.

OUT:
No risk of breaking

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

15.1 - Loss of stability	Mobile installation	Normal operation

Mobile platform tipping over from COG moving outside base of platform

SE	R	H	MI	**3**		1	Weight is applied in the mobile platform to maintain the stability. It has been tested with applying 165 kg. to the lifting tool in the robot working range.	ISD	N			MI	**0**	

Reason for this valuation

IN:
Tipping platform and crane may cause serious injury

OUT:
The platform cannot tip during usage within the listed weight range.

N			MI	**0**		2	When manual tool is used the working range of the crane is increased. Test has been done and the extended range does not cause loss of stability with payloads in the range of the system.	PIC						

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 14-12-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
16.1 - Break-up during operation	Entire machine	Commissioning, adjustments

Hazard description

Risk of dropping parts if maintenance is not carried out eg. bolts loosening over time

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SL		H	MI	**1**		1	User manual has instructions on preventive maintenance. Service is also offered through service partners.	OI	N			MI	**0**	

Reason for this valuation

IN:
eg. sack is dropped

OUT:
By correct maintenance loosened bolts will be secured again.

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

16.1 - Break-up during operation	Lifting crane	Malfunctioning

Risk of crane breaking

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
SE	R	H	SM	**2**		1	Crane is delivered with decleration of conformity for relevant standards. The crane is mounted as described by manufacturer.	ISD	N			MI	**0**	

Reason for this valuation

IN:
Break in crane could cause serious injury.

OUT:
No risk of breaking

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
Hazard description		

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
Risk adequately reduced No / Yes							Name	Date						

16.1 - Break-up during operation	Tool	Malfunctioning
Risk of link between vacuum tube and suction cup breaks		

SL		H	MI	1		1	Link is made with high weight capacity.	ISD	N			SM	0	
							Reason for this valuation IN: Sack is dropped on feet of operator OUT: Link is highly over dimensioned, it will not break from normal usage.							

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

18.1 - Direct contact	Entire machine	Normal operation
Risk of touching live electrical circuits		

D	R	P	SM	5		1	Parts in cabinet are minimum IP2X and special key is needed to prevent acces to layman according to EN-60204-1	ISD	N			SM	0	
							Reason for this valuation IN: The level of power on the supply to the machine can be deadly OUT: The IP class reduces risk of unexpected contact and only skilled personel can gain acces to the cabinet.							

Risk adequately reduced ☐ No ☑ Yes Kristensen Mads E. 09-06-2021

Limit of the machine: Use-, space-, time- and other limits

Hazard	Hazard zone	Phase of the machinery life
Hazard description		

Risk IN (before measure)						No.	Measures for risk reduction	Type	Risk OUT (after measure)					
SH	DS	RA	PO	V	PLr / SILr		Applied documents, attached images and files		SH	DS	RA	PO	V	PL / SIL
Risk adequately reduced No / Yes							Name	Date						
18.5 - Indirect contact						Entire machine		Malfunctioning						
Risk of machine part having electrical circuit in case of failure on encapsulation														
D	R	P	SM	**5**		1	Machine frame is connected to PE and overload equipment will shot of in case of connection to ground.	ISD	N			SM	**0**	
							Reason for this valuation IN: The level of power on the supply to the machine can be deadly OUT: The power is shut when connection is made or before reaching dangerous level							
Risk adequately reduced ☐ No ☑ Yes							Kristensen Mads E.	09-06-2021						

19.1 - Dropping or ejection of a moving part of the machine						Robot working area		Teaching, programming						
Poor programming may cause that sacks are dropped unexpectedly														
SE	O	P	SM	**3**		1	Programming must be carried out by skilled personnel and program must be tested before put into operation. Process of putting into operation is described in user manual acc. to 10218-2:7.2.4		N			MI	**0**	
Risk adequately reduced ☐ No ☑ Yes							Kristensen Mads E.	09-06-2021						