

## RASWIN Module HRNf Collaborative projects

## Index

Step 0: Previous knowledge

Step 1: Opening HNRf

Step 2: Add Quasi-Static Corrective Measure

Step 3: Define the corrective measure

Step 4: Define the PLr of Safety Function

Step 5: Define the Safety Function

Step 6: Recalculate HRN

Step 7: Add Transient Corrective measure

Step 8: Define the corrective measure

Step 9: Define Safety Function and Recalculate HRN

Step 10: Add Electrical Corrective measure

Step 11: Export to Excel

Step 12: Export to Word

Video demonstration

# How to do Risk Assessment with RASWin?

*Previous knowledge requirements: HRNi*

Access point image: [Image of a collaborative robot]

General image: [Image of a collaborative robot with access points A01 and A02 highlighted]

Assesment by Tasks

Access point: A02 - Collaborative Robot

Task Type List:

- 1 - Loading task

Job Task List:

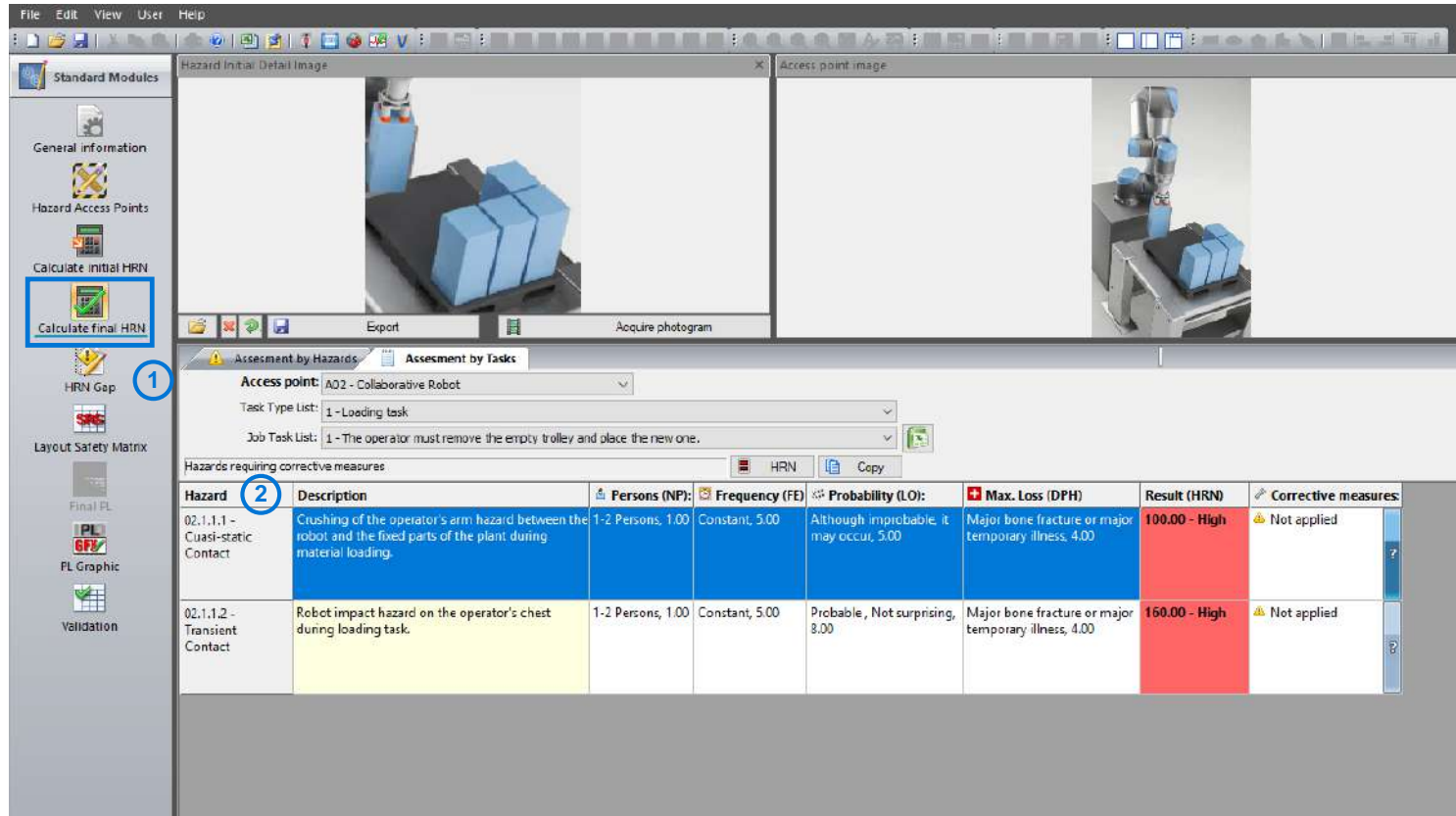
- 1 - The operator must remove the empty trolley and place the new one.

Hazard	Description	Applicable	Persons (NP):	Frequency (FE)	Probability (LO):	Max. Loss (DPH)	Result (HRN)
02.1.1.1 - Cuasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during material loading.	<input checked="" type="checkbox"/>	1-2 Persons, 1.00	Constant, 5.00	Although improbable, it may occur, 5.00	Major bone fracture or major temporary illness, 4.00	100.00 - High
02.1.1.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	<input checked="" type="checkbox"/>	1-2 Persons, 1.00	Constant, 5.00	Probable, Not surprising 8.00	Major bone fracture or major temporary illness, 4.00	160.00 - High

Step 0: Previous knowledge

# How to do Risk Assessment with RASWin?

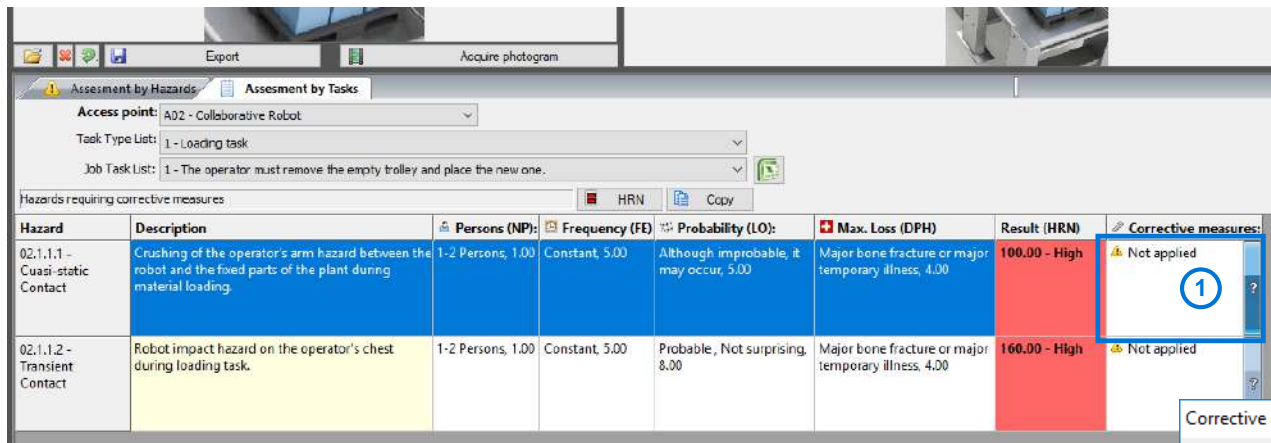
## HRNf Module



Step 1: Open HRNf Module

# How to do Risk Assessment with RASWin?

## HRNf Module

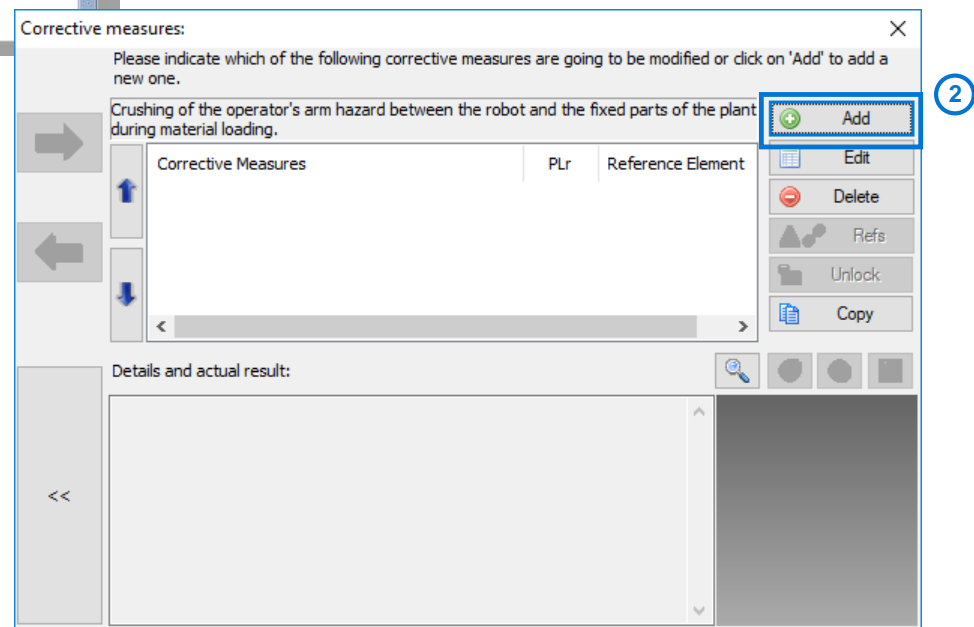


The screenshot shows the RASWin HRNf Module interface. At the top, there are tabs for 'Assessment by Hazards' and 'Assessment by Tasks'. Below these, there are dropdown menus for 'Access point' (set to 'A02 - Collaborative Robot'), 'Task Type List' (set to '1 - Loading task'), and 'Job Task List' (set to '1 - The operator must remove the empty trolley and place the new one.'). Below the dropdowns, there is a table titled 'Hazards requiring corrective measures'. The table has columns for 'Hazard', 'Description', 'Persons (NP)', 'Frequency (FE)', 'Probability (LO)', 'Max. Loss (DPH)', 'Result (HRN)', and 'Corrective measures:'. The first row is highlighted in blue and has a circled '1' next to the 'Corrective measures' column. The second row is highlighted in yellow.

Hazard	Description	Persons (NP)	Frequency (FE)	Probability (LO)	Max. Loss (DPH)	Result (HRN)	Corrective measures:
02.1.1.1 - Quasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during material loading.	1-2 Persons, 1.00	Constant, 5.00	Although improbable, it may occur, 5.00	Major bone fracture or major temporary illness, 4.00	100.00 - High	Not applied
02.1.1.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	1-2 Persons, 1.00	Constant, 5.00	Probable, Not surprising, 8.00	Major bone fracture or major temporary illness, 4.00	160.00 - High	Not applied

1. Double click on hazard's corrective measures column.

2. Add a new corrective measure.



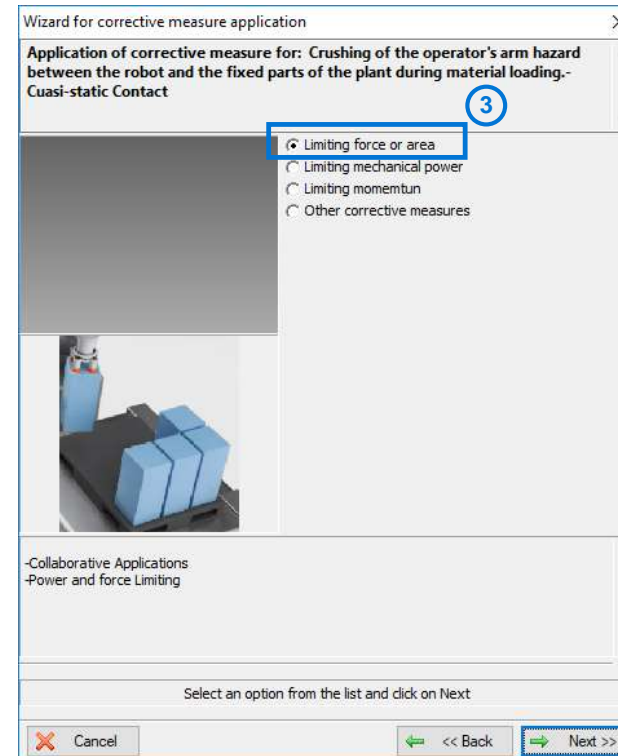
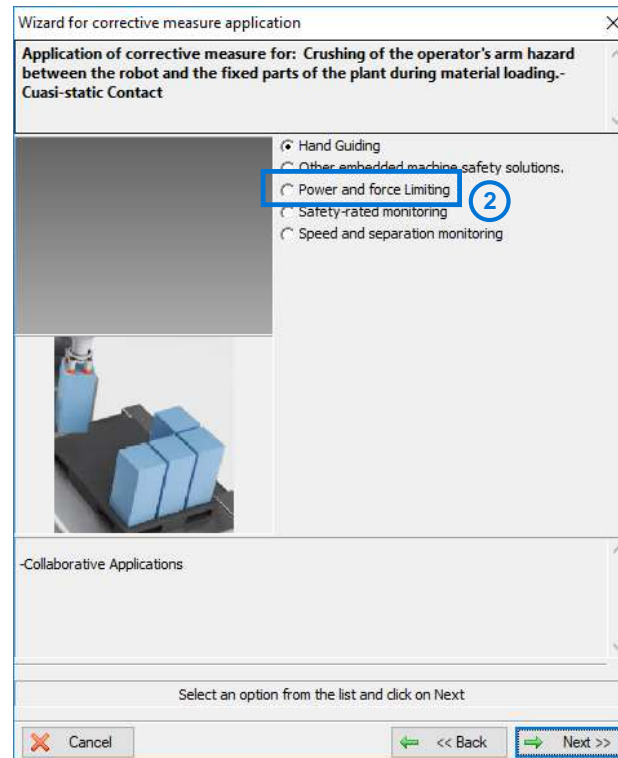
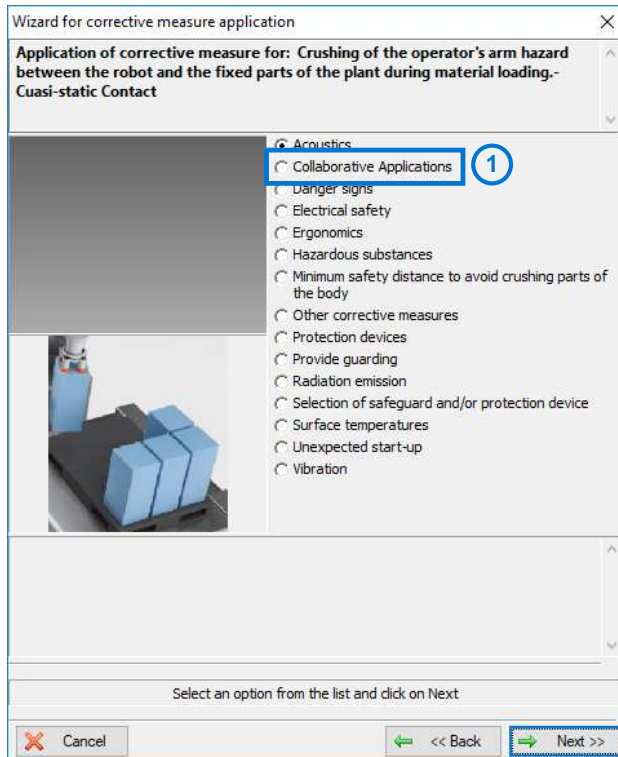
Step 2: Add a Quasi-Static contact  
Corrective Measure

# How to do Risk Assessment with RASWin?

## HRNf Module

## Step 2: Add a Quasi-Static contact Corrective Measure

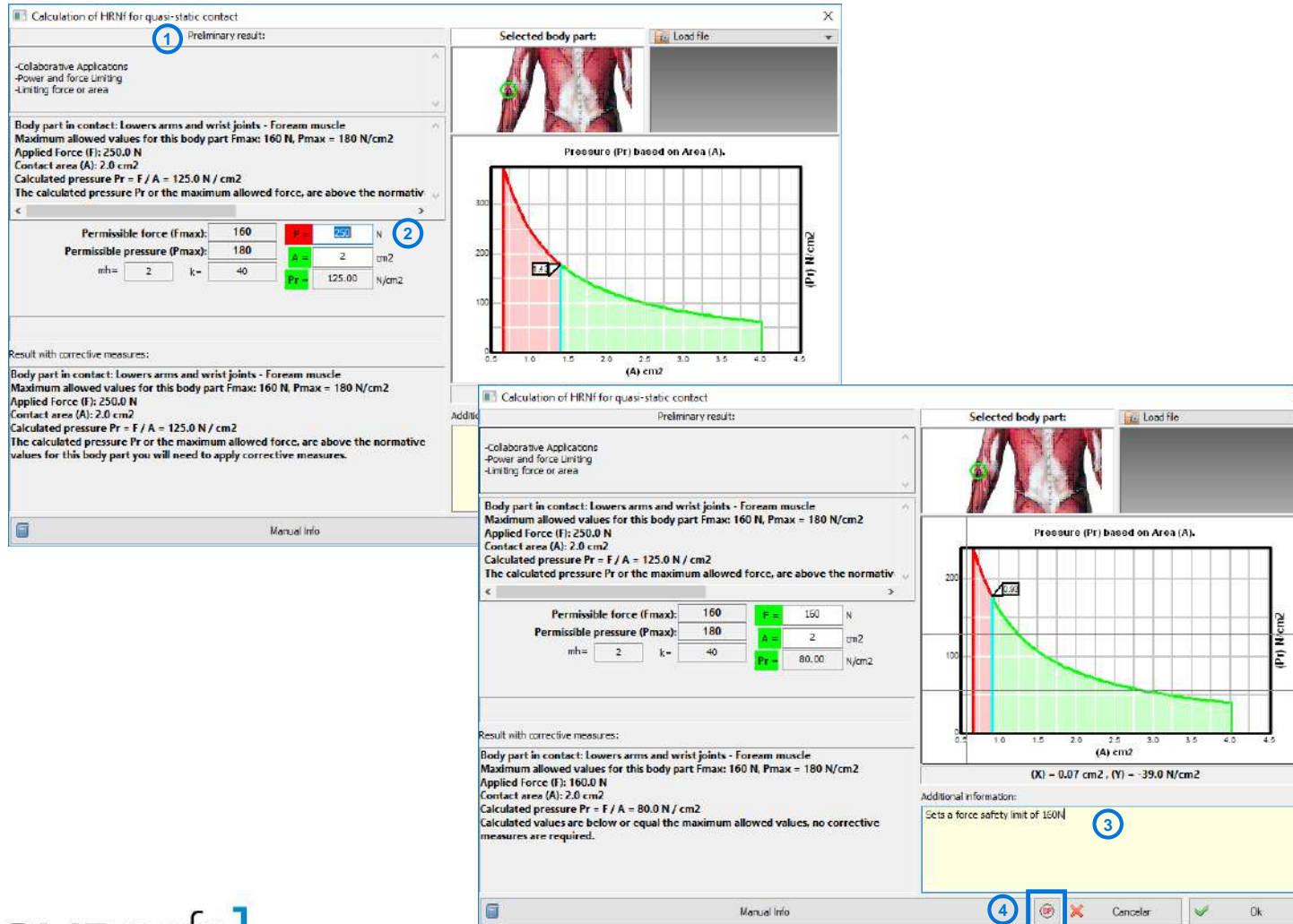
1. Select “Collaborative Applications”.
2. Select “Power and force Limiting”.
3. Select “Limiting force and area”.





# How to do Risk Assessment with RASWin?

## HRNf Module



1. The attached Collaborative information, of the hazard, has been loaded.
2. Set the configuration of the robot, in order to have a permissible contact.
3. Write a description of the configured parameters.
4. Define a “Safety Function” of the corrective measure.

# How to do Risk Assessment with RASWin?

## HRNf Module

The image displays three sequential screenshots of the RASWin HRNf Module interface, illustrating the steps to define the PL required of the Safety Function.

**Step 1:** The first screenshot shows the 'PLr selection' dialog box. The 'Injury seriousness' dropdown is set to 'Serious injury (usually irreversible), including fatality'. The 'Exposure to the danger frequency and/or time' dropdown is set to 'From frequent to continuous and/or long exposure times'. The 'Possibility of avoiding the danger' dropdown is set to 'Possible under certain conditions'. The 'Persons (NP)' field is set to '1-2 Persons, 1.00'. The 'Frequency (FE)' field is set to 'Constant, 5.00'. The 'Probability (LO)' field is set to 'Although improbable, it may occur, 5.00'. The 'Maximum loss (DPH)' field is set to 'Major bone fracture or major temporary illness, 4.00'. The 'Not applicable' checkbox is unchecked.

**Step 2:** The second screenshot shows the 'PLr selection' dialog box with the same settings as Step 1. The 'Persons (NP)' field is set to '1-2 Persons, 1.00'. The 'Frequency (FE)' field is set to 'Constant, 5.00'. The 'Probability (LO)' field is set to 'Although improbable, it may occur, 5.00'. The 'Maximum loss (DPH)' field is set to 'Major bone fracture or major temporary illness, 4.00'. The 'Not applicable' checkbox is unchecked.

**Step 3:** The third screenshot shows the 'PLr selection' dialog box with the same settings as Step 1. The 'Persons (NP)' field is set to '1-2 Persons, 1.00'. The 'Frequency (FE)' field is set to 'Constant, 5.00'. The 'Probability (LO)' field is set to 'Although improbable, it may occur, 5.00'. The 'Maximum loss (DPH)' field is set to 'Major bone fracture or major temporary illness, 4.00'. The 'Not applicable' checkbox is unchecked.

**Step 4:** The fourth screenshot shows the 'PLr selection' dialog box with the same settings as Step 1. The 'Persons (NP)' field is set to '1-2 Persons, 1.00'. The 'Frequency (FE)' field is set to 'Constant, 5.00'. The 'Probability (LO)' field is set to 'Although improbable, it may occur, 5.00'. The 'Maximum loss (DPH)' field is set to 'Major bone fracture or major temporary illness, 4.00'. The 'Not applicable' checkbox is unchecked.

1. Select the Injury seriousness.
2. Select the Exposure frequency.
3. Select the possibility of the operator to avoid the danger..
4. Press "Ok".

Step 4: Define the PL required of the Safety Function

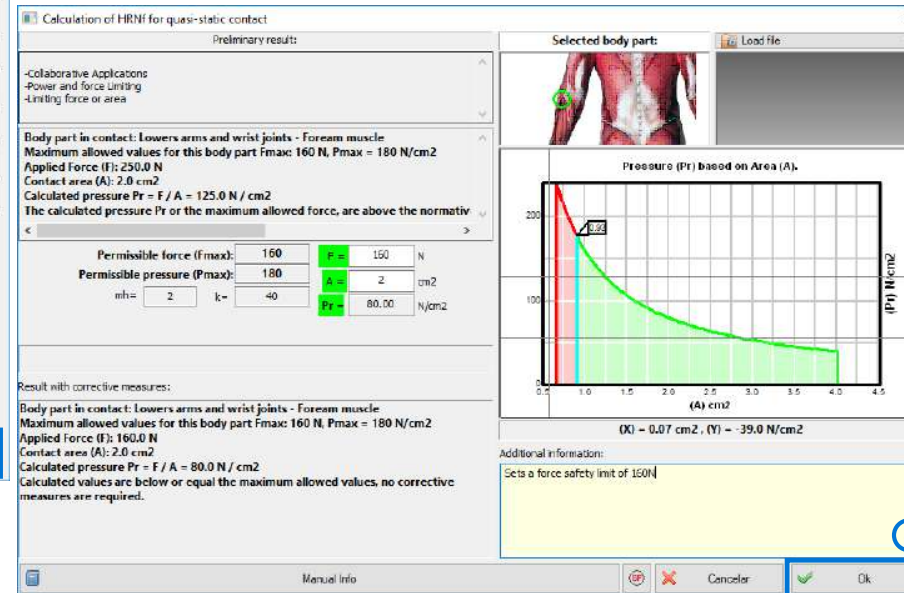
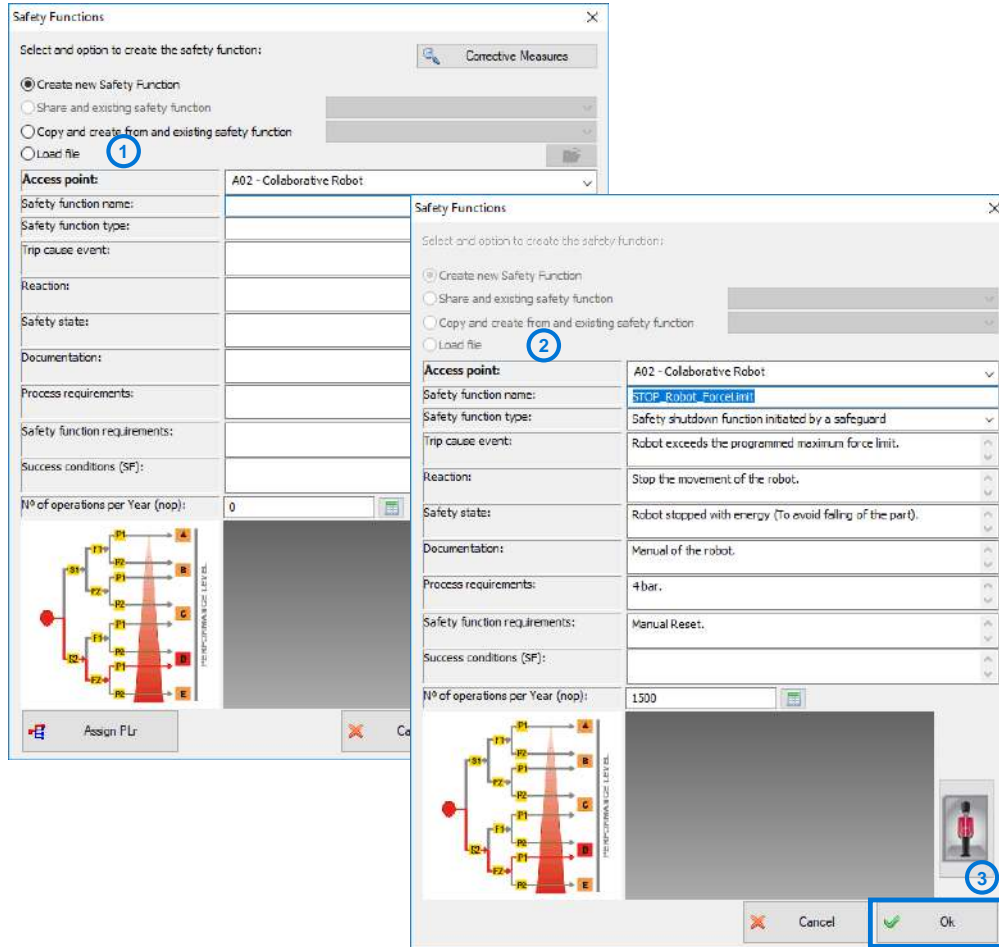


# How to do Risk Assessment with RASWin?

## HRNf Module

## Step 5: Define the Safety Function

1. Create a new Safety Function.
2. Define the parameters of the Safety Function.
3. Press "Ok".
4. Press "Ok".



# How to do Risk Assessment with RASWin?

## HRNf Module

HRN calculation : Crushing of the operator's arm hazard between the r... X

Enter the new hazard conditions after applying the corrective measure:

Persons (NP):	1-2 Persons 1.00
Frequency (FE)	Constant 5.00
Probability (LO):	Although improbable, it may occur 5.00
Max. Loss (DPH)	Major bone fracture or major temporary illness 4.
Result (HRN)	100.00-High

Cancel Ok

HRN calculation : Crushing of the operator's arm hazard between the r... X

Enter the new hazard conditions after applying the corrective measure:

Persons (NP):	1-2 Persons 1.00
Frequency (FE)	Constant 5.00
Probability (LO):	Although improbable, it may occur 5.00
Max. Loss (DPH)	Scratch, bruise 0.10
Result (HRN)	2.50-Negligible

Cancel Ok

1. The HRN Calculation pop up, will appear.
2. Recalculate the HRN, once the corrective measure has been defined.
3. The HRN of the hazard, has been modified.
4. The HRN of the hazard, has been modified.

File Edit View User Help

Standard Modules

General information

Hazard Access Points

Calculate initial HRN

Calculate final HRN

HRN Gap

Layout Safety Matrix

Final PL

Hazard Initial Detail image

Access point image

Export Acquire photograph

Assessment by Hazards Assessment by Tasks

Access point: A02 - Collaborative Robot

Task Type List: 1 - Loading task

Job Task List: 1 - The operator must remove the empty trolley and place the new one.

Hazards requiring corrective measures

Hazard	Description	Persons (NP)	Frequency (FE)	Probability (LO)	Max. Loss (DPH)	Result (HRN)	Corrective measures
Q2.1.1.1 - Quasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during	1-2 Persons, 1.00	Constant, 5.00	Although improbable, it may occur, 5.00	Scratch, bruise, 0.10	2.50 - Negligible	Collaborative Applications
Q2.1.1.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	1-2 Persons, 1.00	Constant, 5.00	Probable, Not surprising, 8.00	Major bone fracture or major temporary illness, 4.00	160.00 - High	Not applied

# How to do Risk Assessment with RASWin?

## HRNf Module

Assessment by Hazards | Assessment by Tasks

Access point: A02 - Collaborative Robot

Task Type List: 1 - Loading task

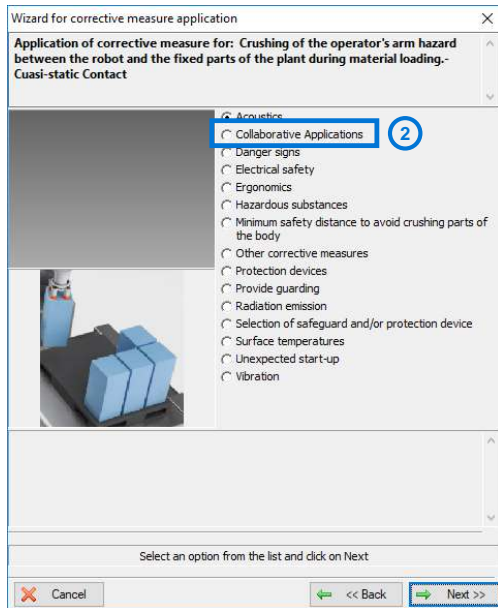
Job Task List: 1 - The operator must remove the empty trolley and place the new one.

azards requiring corrective measures

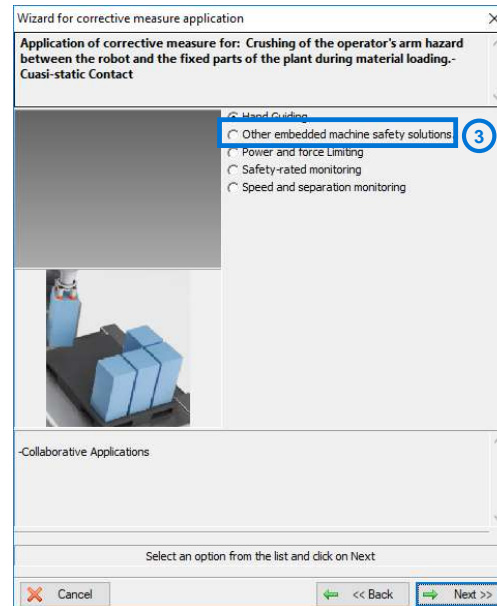
hazard	Description	Persons (NP):	Frequency (FE)	Probability (LO):	Max. Loss (DPH)	Result (HRN)	Corrective measures:
2.1.1.1 - quasi-static contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during	1-2 Persons, 1.00	Constant, 5.00	Although improbable, it may occur, 5.00	Scratch, bruise, 0.10	2.50 - Negligible	Collaborative Applications
2.1.1.2 - transient contact	Robot impact hazard on the operator's chest during loading task.	1-2 Persons, 1.00	Constant, 5.00	Probable, Not surprising, 8.00	Major bone fracture or major temporary illness, 4.00	160.00 - High	Not applied

1

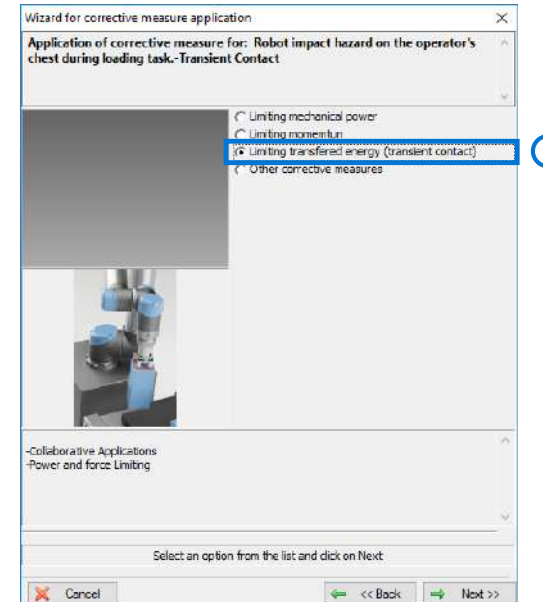
1. Add a new corrective measure.
2. Select "Collaborative Applications".
3. Select "Power and force Limiting".
4. Select "Limiting transferred energy".



2



3



4

Step 7: Add a Transient contact  
Corrective Measure

# How to do Risk Assessment with RASWin?

## HRNf Module

### Step 8: Define the Corrective Measure

1. The attached Collaborative information, of the hazard, has been loaded.
2. Set the configuration of the robot, in order to have a permissible contact.
3. Write a description of the configured parameters.
4. Define a "Safety Function" of the corrective measure.

**Determination of HRNf for collaborative hazards:**

**Preliminary result:**

- Collaborative Applications
- Power and force limiting
- Limiting transferred energy (transient contact)

**Body part in contact:** Chest - Pectoral muscle  
Maximum allowed values for this body part Fmax: 280 N, Pmax = 13.51Kg, mL = 2.50Kg, mR= 9.25Kg, u= 7.51Kg, vRel = 300  
Contact area (A): 2.0 cm²  
Applied Force (F): 1300.3 N  
Calculated pressure  $Pr = F / A = 650.2 \text{ N/cm}^2$   
Calculated Energy Er: 33.8 J

**Selected body part:** Load file

**Force based on Speed (vRel)**

**Result with corrective measures:**

**Body part in contact:** Chest - Pectoral muscle  
Maximum allowed values for this body part Fmax: 280 N, Pmax = 340 N/cm²  
M= 13.5Kg, mL = 2.5Kg, mR= 9.3Kg, u= 7.5Kg, vRel = 3000mm/sec, k= 25N/mm  
Contact area (A): 2.0 cm²  
Calculated Force (Ft): 1300.3 N  
Calculated pressure  $Pr = F / A = 650.2 \text{ N/cm}^2$   
Calculated Energy Er: 33.8 J  
Either calculated pressure Pr, Er or Ft exceed the normative values

**Additional information:**

**Speed vs Force**

**Body part in contact:** Chest - Pectoral muscle  
Maximum allowed values for this body part Fmax: 280 N, Pmax = 340 N/cm²  
M= 13.5Kg, mL = 2.5Kg, mR= 9.3Kg, u= 7.5Kg, vRel = 645mm/sec, k= 25N/mm  
Contact area (A): 2.0 cm²  
Calculated Force (Ft): 279.6 N  
Calculated pressure  $Pr = F / A = 139.8 \text{ N/cm}^2$   
Calculated Energy Er: 1.6 J  
Calculated values are below or equal the maximum allowed values, no corrective measures are required.

**Additional information:**

Maximum Speed Limit: 645 mm/s

**Manual Info**



## How to do Risk Assessment with RASWin?

### HRNf Module

PLr selection:

Applicable corrective measures: **Minimum Project PLr: d** (1)

Description: Robot impact hazard on the operator's chest during loading task.

Injury seriousness: Serious injury (usually irreversible), including fatality

Exposure to the danger frequency and/or time: From frequent to continuous and/or long exposure times

Possibility of avoiding the danger: Possible under certain conditions

Persons (NP): 1-2 Persons, 1.00

Frequency (FE): Constant, 5.00

Probability (LO): Probable, Not surprising, 8.00

Maximum loss (DPH): Major bone fracture or major temporary illness, 4.00

☐ Not applicable

Cancel

Safety Functions

Select an option to create the safety function:

☒ Create new Safety Function

☐ Share an existing safety function

☐ Copy and create from an existing safety function

☐ Load file

Access point: A02 - Collaborative Robot

Safety function name: STOP\_Robot\_SpeedLimit (2)

Safety function type: Safety shutdown function initiated by a safeguard

Trip cause events: Robot exceeds the programmed maximum force.

Reactions: Stop the movement of the robot.

Safety states: Robot stopped with energy (To avoid falling of the part).

Documentation: Safety manual of the robot.

Process requirements: 4 bar

Safety function requirements: Manual reset.

Success conditions (SF):

N° of operations per Year (nop): 1255

Cancel

Ok

1. Define the PL required of the Safety Function.
2. Define the Safety Function.
3. Recalculate the HRN of the hazard
4. Hazard HRN has been recalculated.

HRN calculation : Robot impact hazard on the operator's chest during ...

Enter the new hazard conditions after applying the corrective measure:

Persons (NP): 1-2 Persons 1.00

Frequency (FE): Constant 5.00

Probability (LO): Probable, Not surprising 8.00

Max. Loss (DPH): Scratch, bruise 0.10 (3)

Result (HRN): 4.00 - Negligible

Cancel

Ok

Access point: A02 - Collaborative Robot

Task Type List: 1 - Loading task

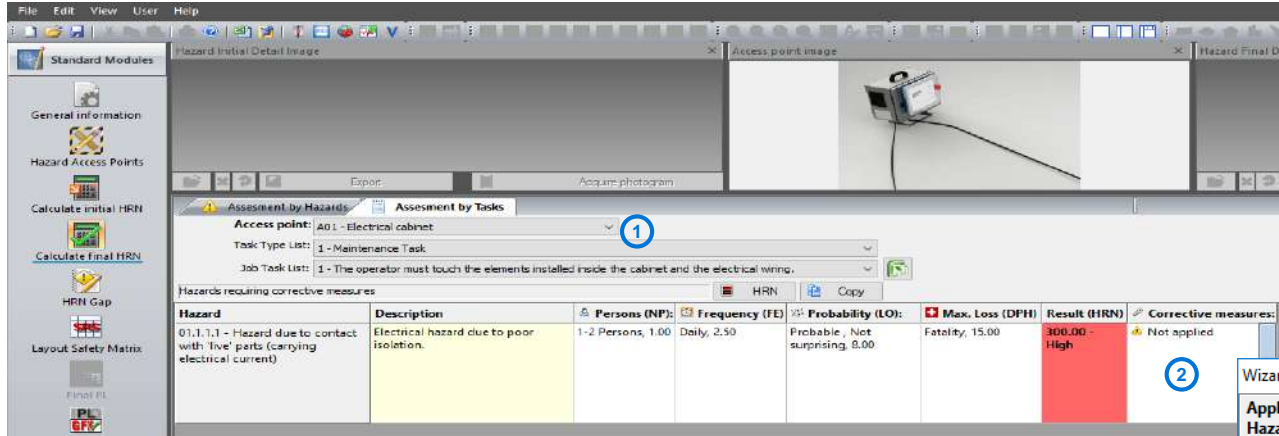
Job Task List: 1 - The operator must remove the empty trolley and place the new one.

Hazards requiring corrective measures

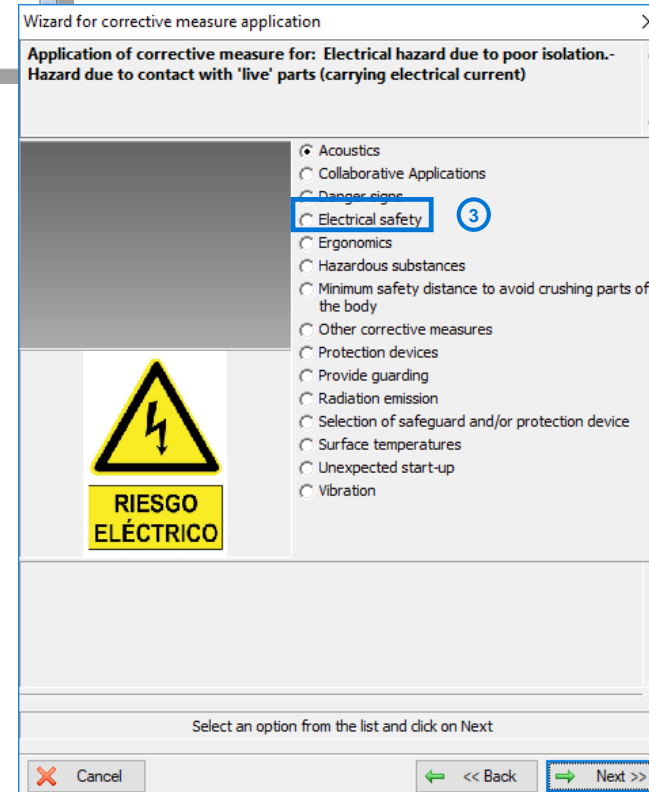
Hazard	Description	Persons (NP)	Frequency (FE)	Probability (LO)	Max. Loss (DPH)	Result (HRN)	Corrective measures
02.1.1.1 - Quasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during material loading.	1-2 Persons, 1.00	Constant, 5.00	Although improbable, it may occur, 5.00	Scratch, bruise, 0.10	2.50 - Negligible	Collaborative Applications
02.1.1.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	1-2 Persons, 1.00	Constant, 5.00	Probable, Not surprising, 8.00	Scratch, bruise, 0.10	4.00 - Negligible (4)	Collaborative Applications

# How to do Risk Assessment with RASWin?

## HRNf Module



1. Select the access point, the task and the job task of the electrical hazard.
2. Add a new corrective measure.
3. Select "Electrical safety".



Step 10: Add an Electrical hazard  
Corrective Measure

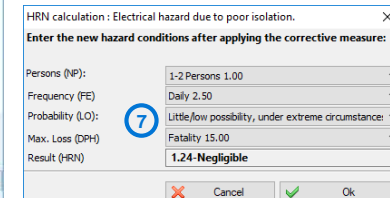
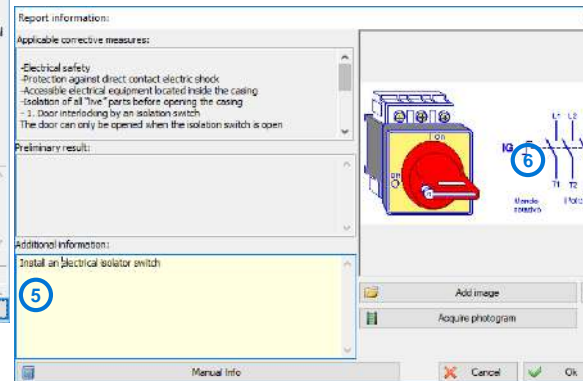
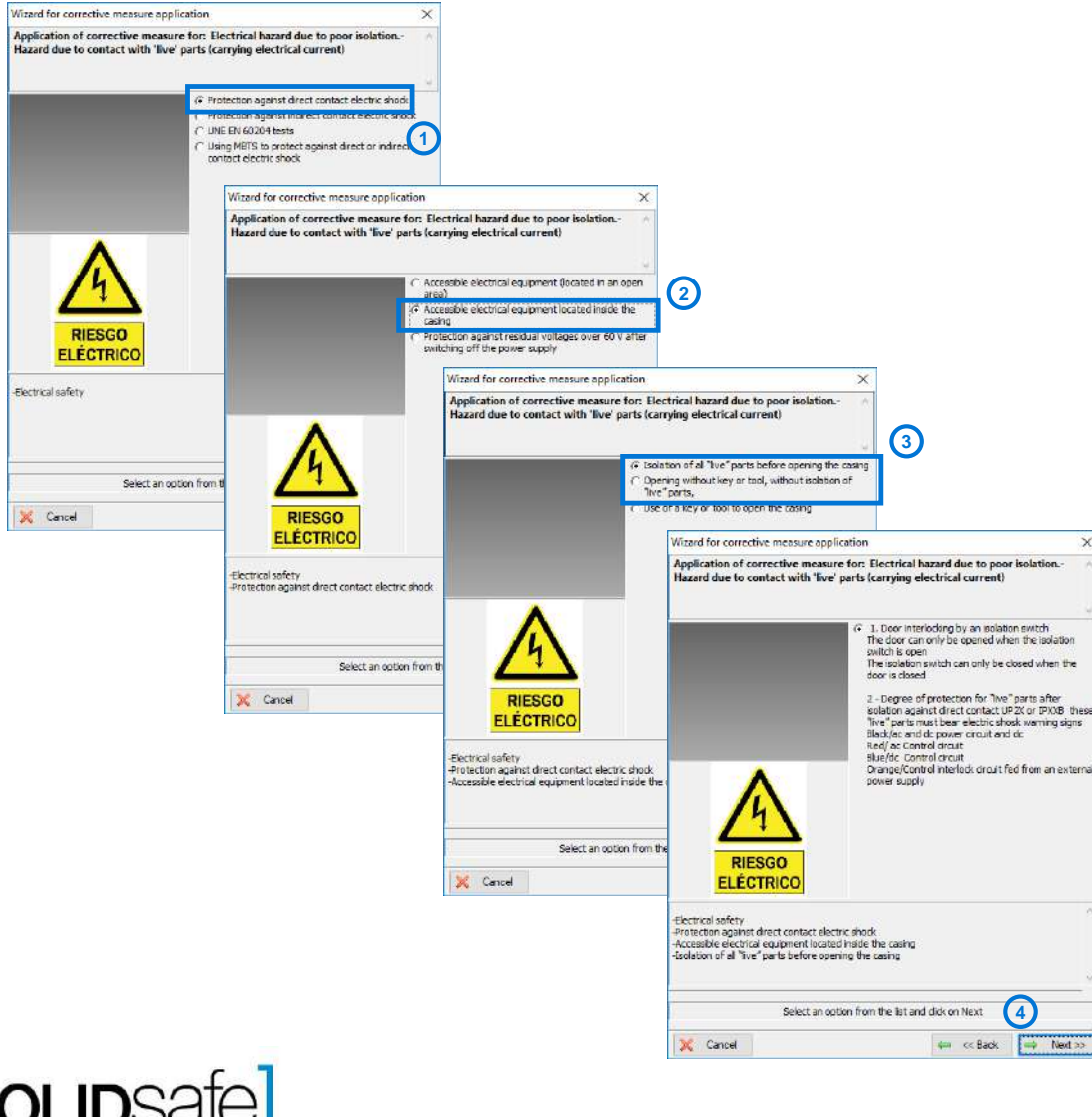


# How to do Risk Assessment with RASWin?

## HRNf Module

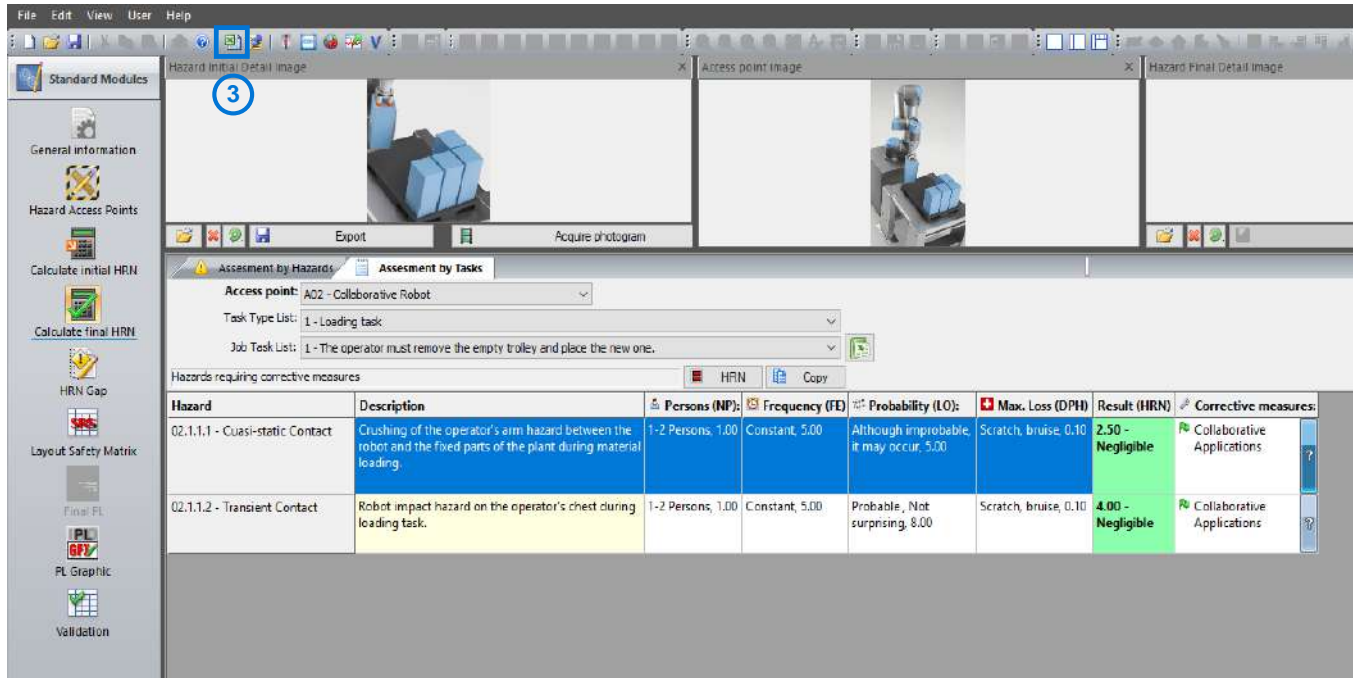
## Step 10: Add an Electrical hazard Corrective Measure

1. Select "Protection against direct contact".
2. Select "Equipment located inside the casing".
3. Select "Isolation of live parts before opening the casing".
4. Press "Next".
5. Add a description of the case isolation system.
6. Add an image of the system and press "Ok".
7. Recalculate the HRN of the hazard.



# How to do Risk Assessment with RASWin?

## HRNf Module

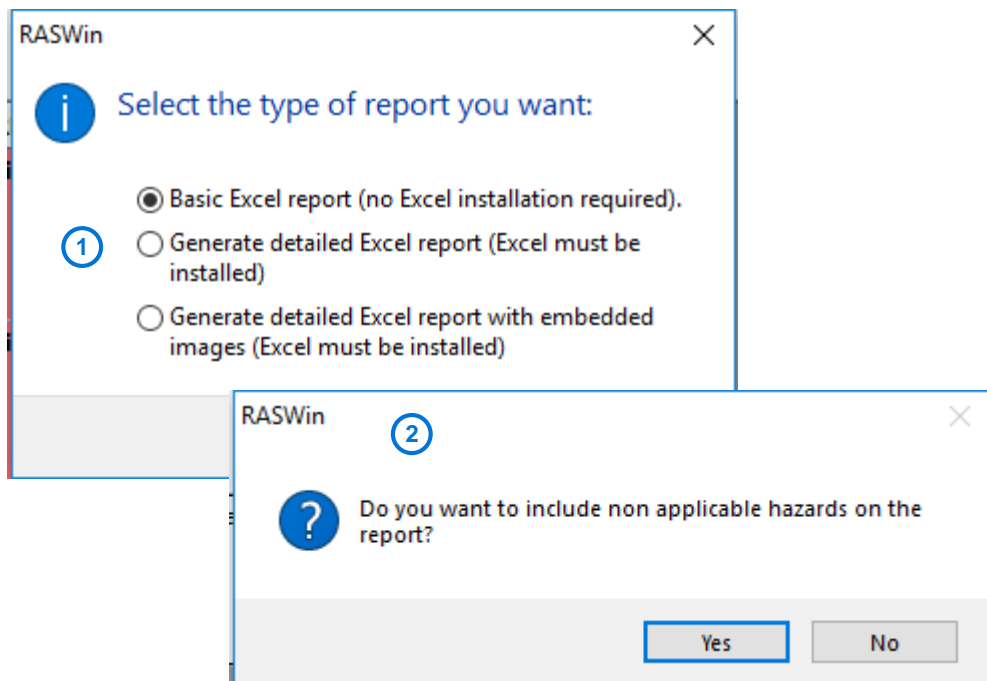


1. Click on “Export generic hazard” to create an excel report.

Step 11: Export the HRNf to Excel

# How to do Risk Assessment with RASWin?

## HRNf Module



1. Select the detailed Excel report as type of report.

a) Basic Excel report: If Excel is not installed on your computer.

a) Detailed Excel report: Initial Risk Assessment report, in excel format, without images.

b) Detailed Excel report with embedded images: Initial Risk Assessment report, in excel format, with images.

2. Select “No”.

3. The excel report has been created.

3	Access point	Mode:	Task type:	Hazard:	Description	Number of exposed persons (NP):	Exposure frequency (FE):	Probability (LO):	Probable maximum loss (DPH):	Level	Result (HRN):
	A01 - Electrical cabinet	The operator must touch the elements installed inside the cabinet and the electrical wiring.	Maintenance Task	01.1 - Hazard due to contact with 'live' parts (carrying electrical current)	Electrical hazard due to poor isolation.	1-2 Persons, 1,00	Daily, 2,50	Probable , Not surprising, 8,00	Fatality, 15,00	High	300,00
	A02 - Collaborative Robot	The operator must remove the empty trolley and place the new one.	Loading task	02.1 - Cuasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during material loading.	1-2 Persons, 1,00	Constant, 5,00	Although improbable, it may occur, 5,00	Major bone fracture or major temporary illness, 4,00	High	100,00
	A02 - Collaborative Robot	The operator must remove the empty trolley and place the new one.	Loading task	02.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	1-2 Persons, 1,00	Constant, 5,00	Probable , Not surprising, 8,00	Major bone fracture or major temporary illness, 4,00	High	160,00

# How to do Risk Assessment with RASWin?

## Excel Reporting: Risk Assessment tag

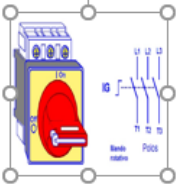
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1. Jobs of the operator in each task.
2. Description of the hazard.
3. Initial HRN Calculation
4. Corrective measures code.
5. Safety function code and PLr definition.
6. Final HRN Calculation.

Step 11: Export the HRNf to Excel

# How to do Risk Assessment with RASWin?

## Excel Reporting: Corrective measures tag

2	Title:	Corrective measures			
3	Generated On:	mi. feb. 28 17:20:29 2018			
4	Reference	SF	Description	Additional information:	
5	MC01.Z02.H01 	1	Electrical safety Protection against direct contact electric shock Accessible electrical equipment located inside the casing Isolation of all "live" parts before opening the casing 1. Door interlocking by an isolation switch The door can only be opened when the isolation switch is open The isolation switch can only be closed when the door is closed  2 - Degree of protection for "live" parts after isolation against direct contact UP2X or IPXXB these "live" parts must bear electric shock warning signs Black/ ac and do power circuit and do Red/ ac Control circuit Blue/ do Control circuit Orange/Control interlock circuit fed from an external power supply	Install an electrical isolator switch	
6	MC01.Z02.H01	1	202.1 Collaborative Applications Power and force Limiting Limiting force or area Body part in contact: Lower arms and wrist joints - Forearm muscle Maximum allowed values for this body part Fmax: 160 N, Pmax = 180 N/cm2 Applied Force (F): 160.0 N Contact area (A): 2.0 cm2 Calculated pressure $P_r = F / A = 80.0 \text{ N / cm}^2$ Calculated values are below or equal the maximum allowed values, no corrective measures are required.	Force safety limit: 160N.	
7	MC01.Z02.H02	1	202.2 Collaborative Applications Power and force Limiting Limiting transferred energy (transient contact) Body part in contact: Chest - Pectoral muscle Maximum allowed values for this body part Fmax: 280 N, Pmax = 340 N/cm2 M= 13.5Kg, mL = 2.5Kg, mR= 9.3Kg, u= 7.5Kg, vRel = 645mm/sec, k= 25N/mm Contact area (A): 2.0 cm2 Calculated Force (F): 279.6 N Calculated pressure $P_r = F / A = 139.8 \text{ N / cm}^2$ Calculated Energy Er: 1.6 J Calculated values are below or equal the maximum allowed values, no corrective measures are required.	Maximum Speed Limit: 645 mm/s	
8					
9					
10					
11					
12					

Project information

Access Points

1\_HRNi\_

Corrective measures

Safety Functions

View HRN Scoring

Hoja1

+

1. Image of the Corrective measure.

2. Attached Safety Function.

3. Description of the corrective measure.

4. Additional information

*This Sheet, is linked with HRN sheet.*

*By click in a Corrective measures code on HRN Sheet, you will be redirected to the corresponding corrective measure on "Corrective measures" Sheet.*



# How to do Risk Assessment with RASWin?

## Excel Reporting: Safety Function tag

2	Title:	Safety Functions								
3	Generated On:	mi. feb. 28 17:20:27 2018								
4	① Code	PLr	Description ②	Type	Trip cause event:	Reaction:	Safety status:	Documentation:	Process requirements:	Safety function requirements:
5	Z02.1	d	STOP_Robot_ForceLimit	Safety shutdown function initiated by a safeguard	Robot exceeds the programmed maximum force limit.	Stop the movement of the robot.	Robot stopped with energy (To avoid falling of the part).	Manual of the robot.	4 bar.	Manual Reset.
6	Z02.2	d	STOP_Robot_SpeedLimit	Safety shutdown function initiated by a safeguard	Robot exceeds the programmed maximum force.	Stop the movment of the robot.	Robot stopped with energy (To avoid falling of the part).	Safety manual of the robot.	4 bar	Manual reset.
7										
8										
9										
10										

Project information

Access Points

1\_HRNi\_

Corrective measures

Safety Functions

View HRN Scoring

Hoja1

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1. Code of Safety function.
2. Name or description of the safety function.

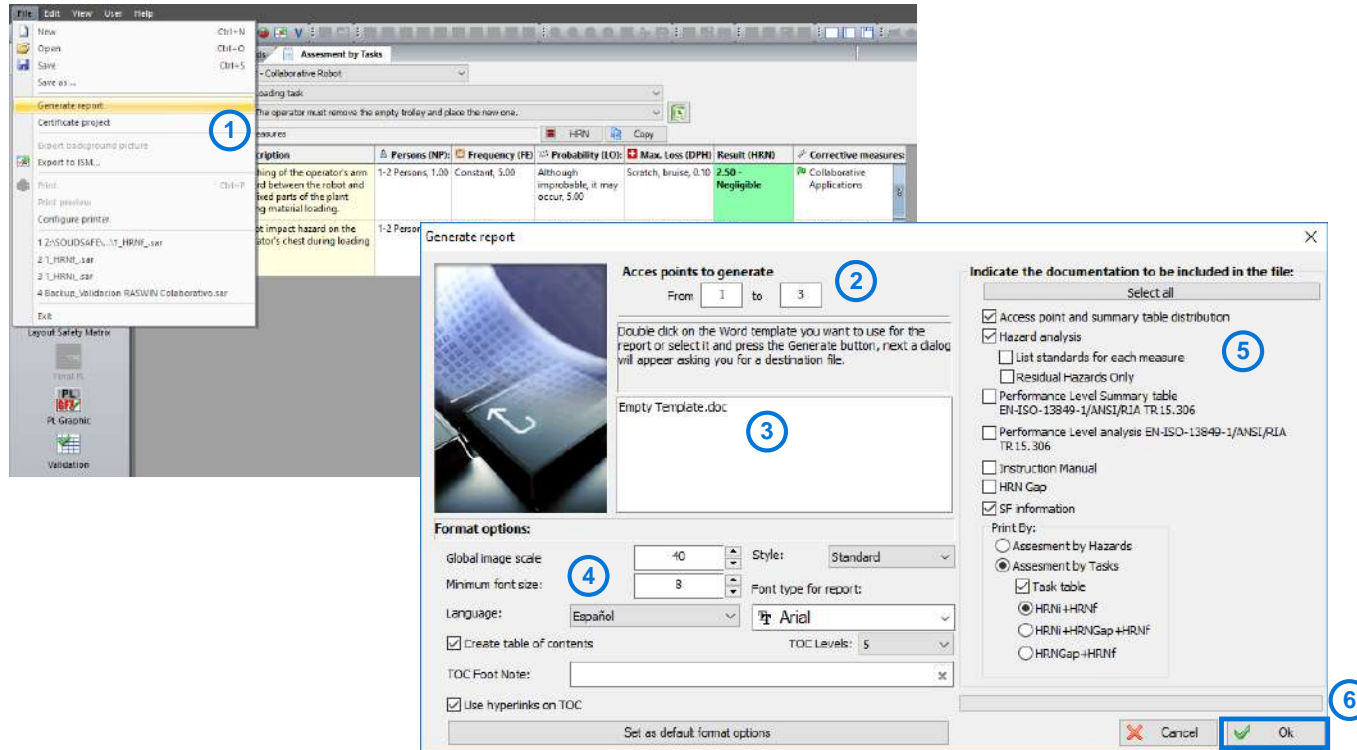
*This Sheet, is linked with HRN sheet.*

*By click in a SF code on HRN Sheet, you will be redirected to the corresponding corrective measure on "Corrective measures" Sheet.*



# How to do Risk Assessment with RASWin?

## Word Reporting: Safety Function tag



1. Click on “File” and “Generate report”.
2. Select the Access points to be reported.
3. Select the report template.
4. Select the desired format options.
5. Select the documentation to report.
6. Click “Ok”.

*You can add your own template to generate the report.*

# How to do Risk Assessment with RASWin?

## Word Reporting: Project information

1

Project information:

Project data:	
Project name:	Training Machine
Company in charge of project:	Solidsafe
Project author:	Jaume Gracia
Project date:	07/09/2017
Filename:	1_HRNF_sar
Last modification:	26/02/2018
Print date:	01/03/2018
Software version:	4.0.0.0
Standard version:	UNE-EN ISO 13849-1:2015; UNE-EN ISO 13849-2:2013; UNE-EN ISO 12100:2012
Machine data:	
Model and serial num:	-
Description:	
Manufacturer's name:	
Manufacture date:	2017

1. Project information

2. Layout image.

3. Risk Assessment summary.

2



3

Access point A01: Electrical cabinet					
Description: Perform maintenance work					
Task 0: Maintenance Task	Step:	Hazard	Description	UEGN1	UEGNf
	The operator must touch the elements installed inside the cabinet and the electrical wiring.	A01.1 - Hazard due to contact with 'live' parts (carrying electrical current)	Electrical hazard due to poor isolation.	500.00	1.24
Access point A02: Collaborative Robot					
Description: The operator must feed the robot with the parts to be treated.					
Task 0: Loading task	Step:	Hazard	Description	UEGN1	UEGNf
	The operator must remove the empty trolley and place the new one.	A02.1 - Quasi-static Contact	Crushing of the operator's arm hazard between the robot and the fixed parts of the plant during material loading.	100.00	2.60
		A02.2 - Transient Contact	Robot impact hazard on the operator's chest during loading task.	160.00	4.00

## Word Reporting: Risk Assessment summary by task table

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1. Task table (Risk Assessment by task).
2. Detailed HRNi Calculation.
3. Defined corrective measures.
4. Detailed HRNf Calculation.

# How to do Risk Assessment with RASWin?

## Word Reporting: Corrective measures information

1. Explanation of electrical hazard and Corrective measures taken.
2. Explanation of Collaborative hazard and Corrective measures taken.
3. Safety Function definition.

A01		Access point: A01 Electrical cabinet	
Task type: Maintenance Task		Perform maintenance work	
Step:		The operator must touch the elements installed inside the cabinet and the electrical wiring.	
Initial hazard evaluation		Hazard level: High	
A01.1 - Hazard due to contact with 'live' parts (carrying electrical current)		Electrical hazard due to poor isolation	
Probability (LO): Probable, Not surprising, 8.00			
Exposure frequency (FE): Daily, 2.50			
Probable maximum loss (DPH): Fatality, 15.00			
Number of exposed persons (NP): 1-2 Persons, 1.00			
Hazard level (HRNF): 300.00			
Corrective measures			
Corrective measure No: 1 Electrical safety Protection against direct contact electric shock Accessible electrical equipment located inside the casing Isolation of all 'live' parts before opening the casing 1. Door interlocking by an isolation switch The door can only be opened when the isolation switch is open The isolation switch can only be closed when the door is closed 2 - Degree of protection for 'live' parts after isolation against direct contact UP2X or IPXXB: these 'live' parts must bear electric shock warning signs Black/ac and dc power circuit and dc Red/ac Control circuit Blue/dc Control circuit Orange/Control interlock circuit fed from an external power supply			
Additional information: Isolation on electrical isolator switch			
Final Hazard evaluation		Hazard level: Negligible	
A01.1 - Hazard due to contact with 'live' parts (carrying electrical current)		Electrical hazard due to poor isolation	
Probability (LO): Little/low possibility, under extreme circumstances, 0.03			
Exposure frequency (FE): Daily, 2.50			
Probable maximum loss (DPH): Fatality, 15.00			
Number of exposed persons (NP): 1-2 Persons, 1.00			
Hazard level (HRNF): 1.24			

A02		Access point: A02 Collaborative Robot	
Task type: Loading task		The operator must load the robot with the parts to be tested.	
Step:		The operator must remove the empty trolley and place the new one.	
Initial hazard evaluation		Hazard level: High	
A02.1 - Quasi-static Contact		Crushing of the operator's arm between the robot and the fixed parts of the plant during material loading.	
Probability (LO): Although improbable, it may occur, 5.00			
Exposure frequency (FE): Constant, 5.00			
Probable maximum loss (DPH): Major bone fracture or major temporary illness, 4.00			
Number of exposed persons (NP): 1-2 Persons, 1.00			
Hazard level (HRNF): 100.00			
Corrective measures			
Corrective measure No: 1 Collaborative Applications Power and force Limiting Limiting transferred energy (transient contact)			
Result of the (MC): Body part in contact: Chest - Pectoral muscle Maximum allowed values for this body part $E_{max}$ : 280 N, $E_{max}$ : 340 N/cm <sup>2</sup> $M$ : 13.5Kg, $m_L$ : 2.5Kg, $m_R$ : 9.3Kg, $u$ : 7.5Kg, $v_{Rel}$ : 645mm/sec, $k$ : 25N/mm Contact area (A): 2.0 cm <sup>2</sup> Calculated Force (F): 279.6 N Calculated pressure $P_t = F / A = 139.8$ N / cm <sup>2</sup> Calculated Energy $E_t$ : 1.5 J Calculated values are below or equal the maximum allowed values, no corrective measures are required. Assigned PL <sub>t</sub> level = d, The operator must remove the empty trolley and place the new one. A02.2 PL <sub>t</sub> = d			
Safety function name: A02.02 - STOP_Robot_SpeedLimit			
Additional information: Maximum Speed Limit: 645 mm/s			

REQUIRED PERFORMANCE LEVEL (PL <sub>t</sub> ):	
S2 = Serious injury (usually irreversible), including fatality F2 = From frequent to continuous and/or long exposure times P1 = Possible under certain conditions	
PL <sub>t</sub> = d	