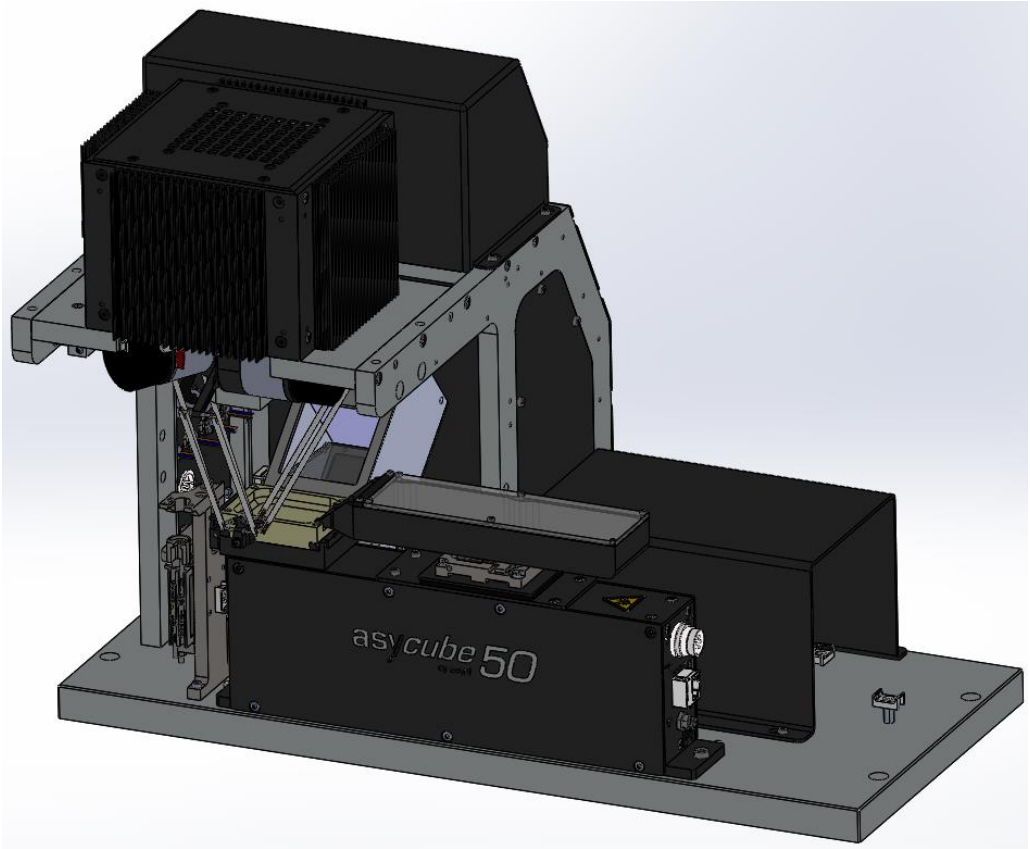
asyril Experts in Flexible Feeding Systems

Asyfeed Module

User Guide



Document	*Asyril_MODULE_ASYFEED_User_Guide_EN* *000.100.511*		
Version	D2	**Date**	16.04.2020

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1. Introduction

1.1. Generalities

The following document is the property of Asyril S.A. and may not be copied or circulated without permission. The information contained in this document is subject to change without notice for the purpose of product improvement. Before operating your product, please read this document to ensure a correct use of the product. Nevertheless, if you meet difficulties during the operation or the maintenance, please, feel free to contact Asyril customer service.

In this manual, the safety precautions that you must respect are classified as: “Danger”, “Warning” and “Note”; the following symbols are used:

DANGER!

Failure to observe the instruction may result in death or serious injury.

DANGER!

Failure to observe the instruction may result in electrocution or serious injury due to electric shock

WARNING!

Failure to observe the instruction may result in injury or property damage.

NOTE :

The user should read carefully this information to ensure the correct use of the product, although failure to do so would not result in injury.

REFER TO …

For more information on a specific subject, the reader should read another manual, or refer to another paragraph.

WARNING!

Asyril shall not be liable whatsoever for any loss or damage arising from a failure to observe the items specified in “Safety Precautions.” The customer is responsible to provide the necessary instruction to the persons concerned.

NOTE :

All dimensions in this document are expressed in millimeters

1.2. Related manuals

As described in the Table 1-1, this manual is an integral part of the Asyfeed Pocket Module documentation set. This manual describes the main functionalities of the machine and the standard P&P and calibration cycles.

Manual Title	Manual reference	Description of the content
Operating manual	MODULE_ASYFEED_Operating_Manual_EN	Technical description of the product, electrical and mechanical interfaces, maintenance and transport information
HMI manual		Accessible directly via the HMI
Programming Guide	MODULE_ASYFEED_Programming_Guide_EN	Description of the ARL instructions
User Guide	MODULE_ASYFEED_User_Guide_EN	THIS MANUAL
User Guide	SMARTSIGHT_User_Guide_EN	Describes how to configure the feeding and the vision detection

Table 1-1 : Related manuals

2. General information

The document describes the different parameters of the pick&place process as well as the procedures to calibrate the different machine frames. It describes also the main functionality and general use of the machine.

The process (ARL program) delivered with this machine and explained within this document is implemented in the way of having a sufficient level of flexibility to make pick&place operations with most of parts and applications.

Thanks to the flexibility of the ARL programming language as well as because this program is included in the recipe, customer can modify it on its own for more complex cases.

2.1. Structure of recipe and machine parameters

Depending the application and components to manipulate several parameters might be tuned. The machine parameters (tools, frames, robot controller, etc.) are saved within the robot and are then independent of the recipes. The recipes contain all parameters linked to the components to manipulate (asycube vibrations, vision model configuration, pick&place process, etc.). The general structure of recipes is explained in Figure 2-1.

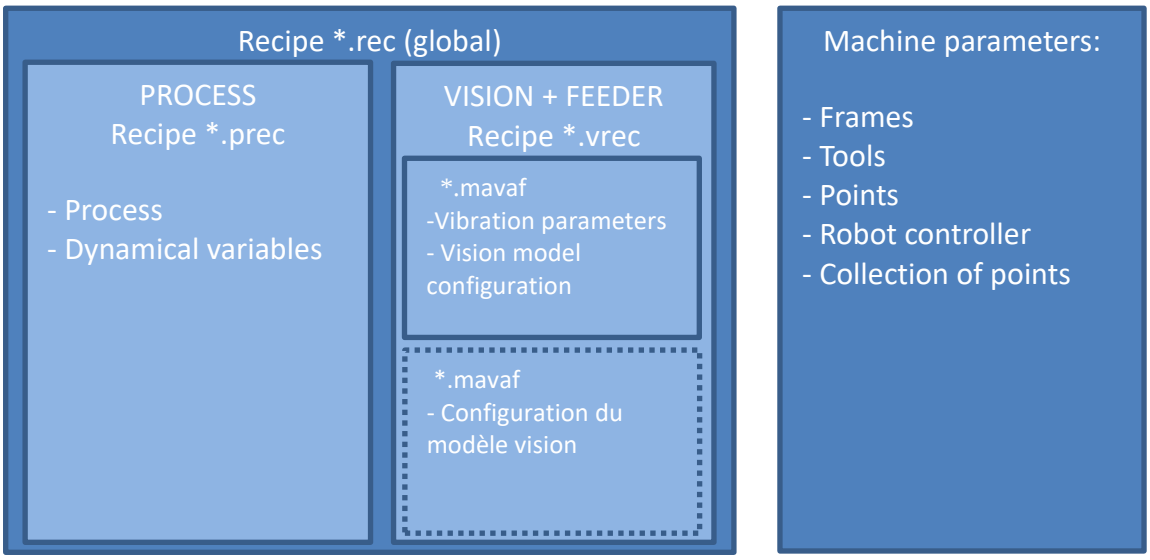

Figure 2-1 : Description of the recipe structure

As explained here above, a recipe *.rec has two separates parts: a *.vrec part which contains one file *.mavaf and the second one *.prec which contains the pick&place process parameters and its dynamical variables.

A *.mavaf file contains all parameters for the configuration of a vision system and of the corresponding asycube. If no feeder is connected to a camera, the *.mavaf contains of course only the vision parameters (for ex. In case of a control camera).

The procedure and the different parameters to manage the asycube and the vision are described in the document SMARTSIGHT_User_Guide_EN.

2.2. Description of machine states

The Asyfeed unit can be controlled using the following buttons:

Button	Description
	This "start" button is used to start production if a recipe has already been loaded. It also enables production to be resumed if the "pause" button was pressed beforehand. (when production is in process, this button adopts the function of a "pause" button).
	The "pause" button enables production to be in "pause" mode. When production is paused, this button adopts the function of a "start" button. When a pause request is made, the pause button turns grey whilst production is paused. **DANGER!** **Pressing the "pause" button does not necessarily stop movement. In fact, depending on the program compiled by the integrator, the robot may still move (move to a safe height, etc.). However, it is not advisable to include movements in this program section.** **The only way to stop the robot and associated processes is by pressing the emergency stop button.**
	This "stop" button enables production to be halted. The robot and associated processes will be stopped. **DANGER!** **Pressing the "stop" button does not necessarily stop movement. In fact, depending on the program compiled by the integrator, the robot may still move (place the tool, move to a safe height, etc.).** **The only way to stop the robot and associated processes is by pressing the emergency stop button.**
	The "stop" button is greyed out when it is impossible to stop production (for example, when production has already stopped).
	This "clear" button is only available from the alarm tab. It is used to clear the alarm. When no alarm has occurred, this button is greyed out. **DANGER!** **Pressing the "clear" button may result in a series of robot movements (place a tool, move to a safe height, etc.)**

Table 2-1 : Description of the Start / Stop buttons states

The Asyfeed unit is programed to operate according to the following states:

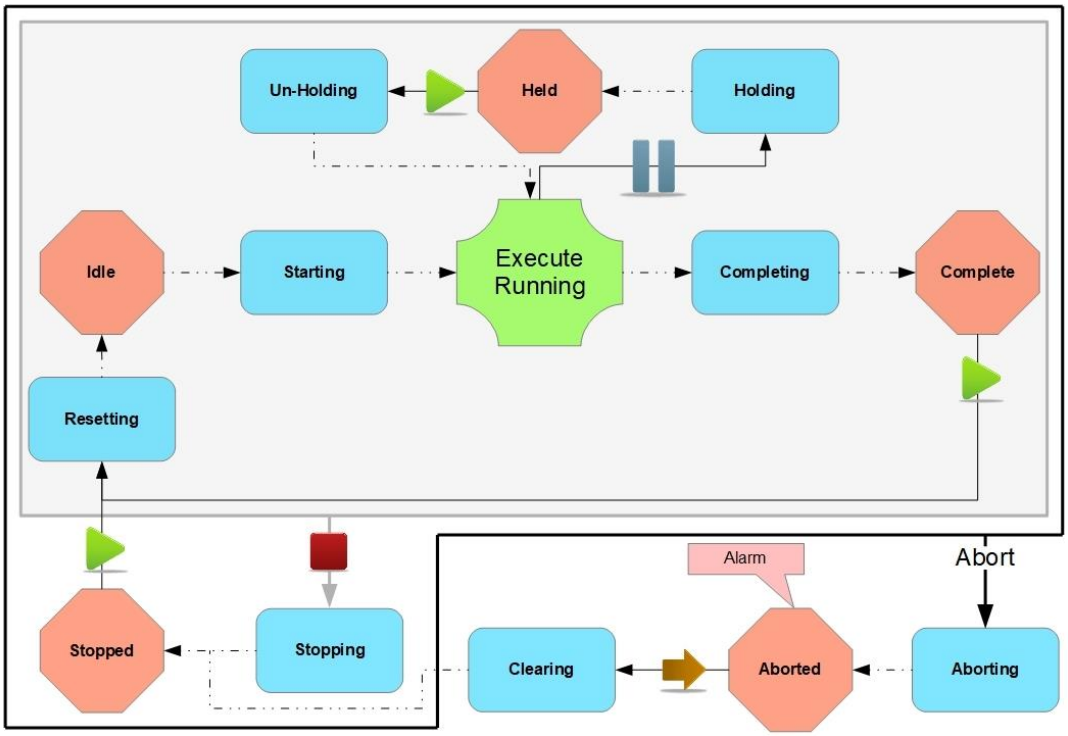

Figure 2-2: Asyfeed unit machine states

The dotted arrows represent automatic states transition without the need of the intervention of the user.

The states represented in blue rectangles are transition states to a final state (red hexagons). These states also correspond to an executable and modifiable ARL program (e.g. turning on a red light when passing through the "Stopping" state).

The states represented by a red hexagon are final states whose ARL program cannot or should not be modified. Except for "Idle", a user action is required to exit these states.

Depending on the state in which the Asyfeed unit is in at a particular point in time t, the operator has the following options available:

Current state	Action	Next state
Stopped	Press START	Running
Paused	Press START	Running
Alarm	Press CLEAR	Stopped
Running	Press STOP	Stopped
	Press PAUSE	Held

Table 2-2 : State transitions

2.3. Tool changing procedure

The Asyfeed Pocket Module is equipped with a semi-automatic tool changer that enables a tool to be loaded and unloaded from the robot's platform.

DANGER!

The procedure must be performed by a single person (risk of a hand injury when loading or unloading the tool if another person gives the order whilst the adjuster is installing the tool in the zone).

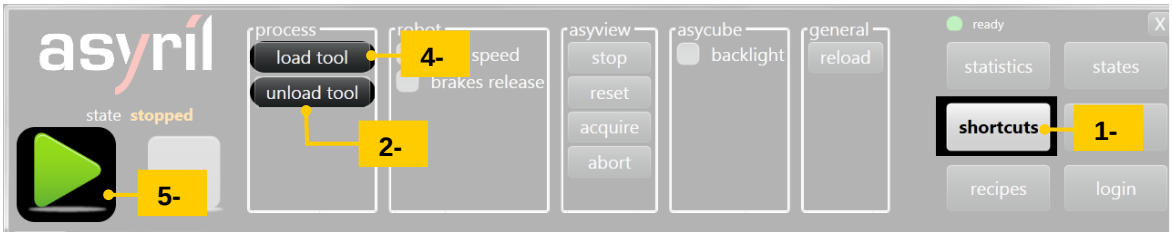

Figure 2-3: Procedure for changing the tool

To change the tool, please respect the following steps.

Step 1	Press the "Shortcuts" button to display the "Shortcuts" screen.
Step 2	Press the "unload tool" button and wait until the unload procedure is complete.
Step 3	Change the tool in the tool changer.
Step 4	Press the "load tool" button and wait until the load procedure is complete.
(Step 5)	Press the "Start" button to start production

EQUIPMENT DANGER!

When the unit is stopped (switched off), no tool must be loaded onto the platform or tool holder. Failure to observe this regulation may result in the robot being damaged during the next initialization procedure.

2.4. Releasing the brakes

EQUIPMENT DANGER!

When the brakes are released, the robot's platform is no longer held by any force; it is therefore essential to secure it to prevent the platform or tool from crashing.

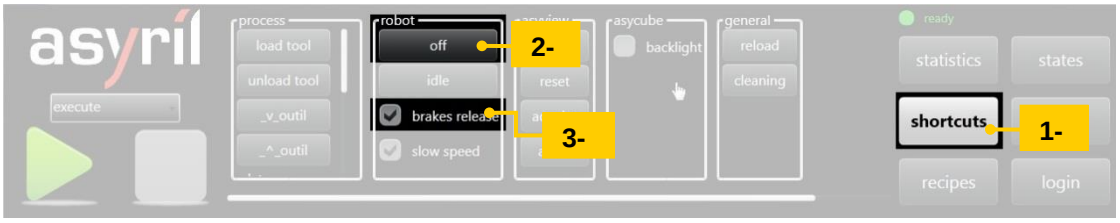

Figure 2-4: Procedure for releasing the brakes

To release the brakes of the robot, please respect the following steps

Step 1	Press the "Shortcuts" button to display the "Shortcuts" screen.
Step 2	Press the "off" button to switch off the motors. The brakes are then automatically applied to prevent a robot crash.
Step 3	Tick the "brakes release" box to release the brakes of the robot.
Step 4	Once the desired operations have been done, tick again the “brakes release” box to tighten again the brakes. You can then release the robot platform.

3. Pick'n'Place Block diagram

This diagram describes the cycle of the pick and place recipe.

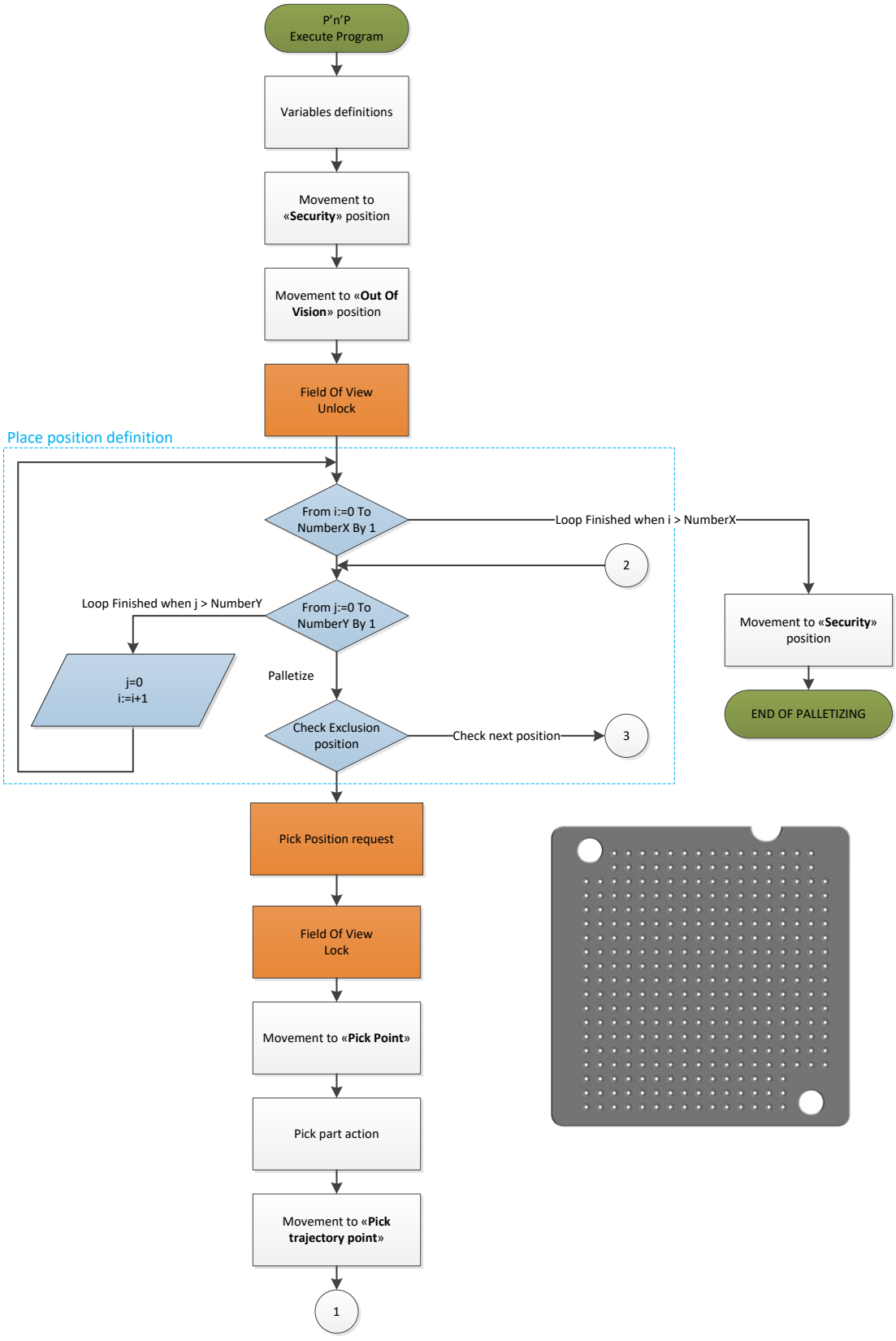

Figure 3-1 : Pick and place block diagram part 1/2

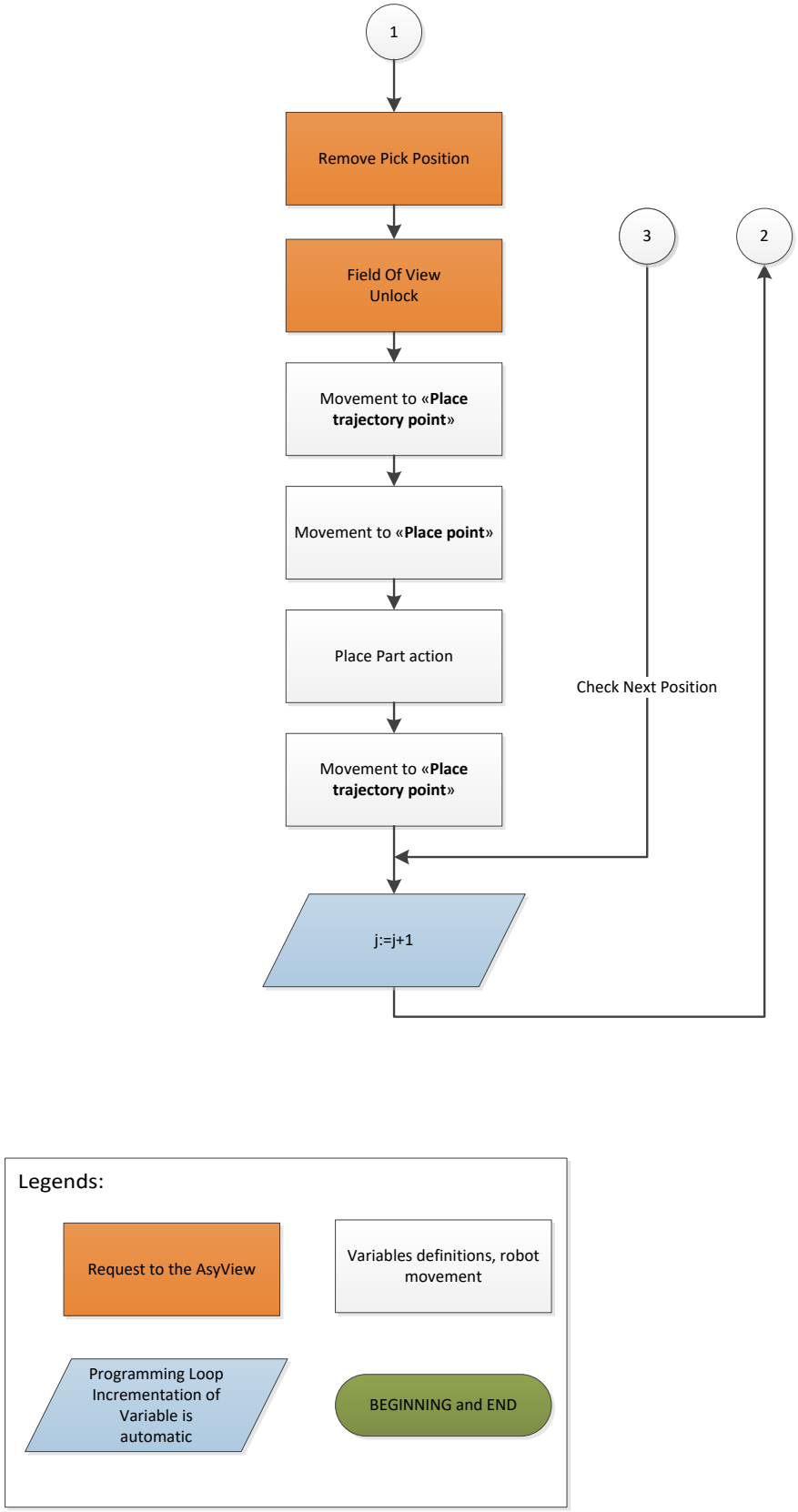

Figure 3-2 : Pick and place block diagram part 2/2

4. Cycle description

4.1. Schema

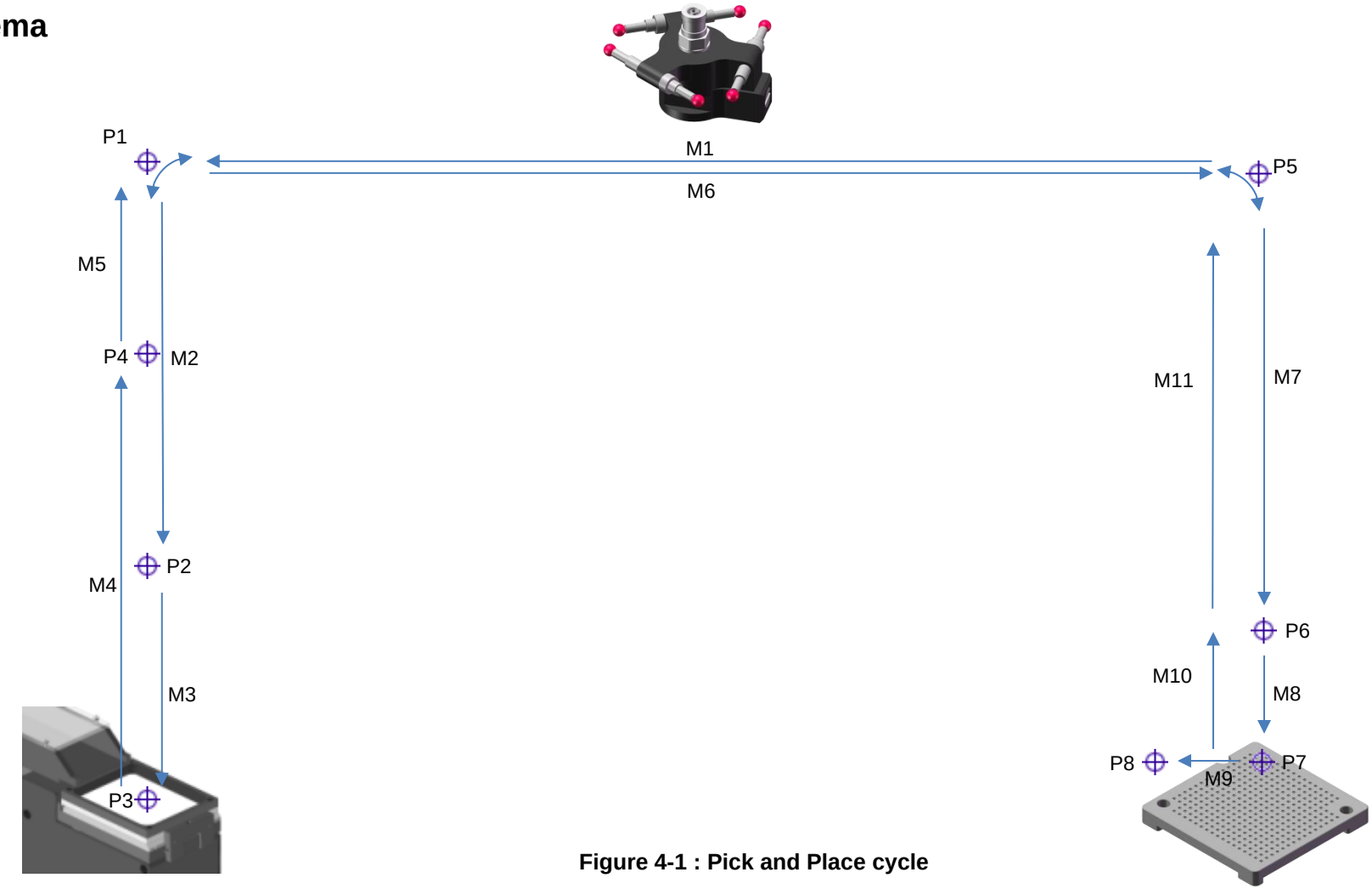

Figure 4-1 : Pick and Place cycle

4.2. Points of the cycle description

Point	Description
P1	Pick trajectory point
P2	Pick approach point
P3	Pick point
P4	Pick vertical escape
P5	Place trajectory point
P6	Place approach point
P7	Place point
P8	Place lateral escape point

Table 4-1 : Points of the cycle

4.3. Description of the movements

Movement	Description	Target Position	Speed	Other Parameters
M1	Lateral movement to reach picking area	Z: P1b→Pick trajectory height X-Y: Vision position	High speed	Trajectory blend
M2	Vertical movement to approach pick position	Z: P2b→Pick approach height X-Y: Vision position	P2a→Pick approach speed	Trajectory blend
M3	Pick movement	Z: P3b→Pick height X-Y: Vision position	P3a→Pick speed	P3c→Wait before pick P3d→Wait after pick
M4	Vertical movement after pick	Z: P4b→Pick vertical escape X-Y: Vision position	P4a→Pick vertical escape speed	
M5	Vertical movement to trajectory pick height	Z: P1b→Pick trajectory height X-Y: Vision position	High speed	Trajectory blend
M6	Lateral movement to reach placing area	Z: P5b→Place trajectory height X-Y: Calculated position on tray	High speed	Trajectory blend
M7	Vertical movement to approach place position	Z: P6b→Place approach height X-Y: Calculated position on tray	P6a→Place approach speed	Trajectory blend
M8	Place movement	Z: P7b→Place height X-Y: Calculated position on tray	P7a→Place speed	P7c→Wait before place P7d→Wait after place P7e→Blow while escaping
M9	Optional lateral escape movement	Z: P7b→Place height X-Y: Calculated position on tray + P8b→Place lateral escape distance	P8a→Place lateral escape speed	
M10	Vertical movement to place approach position	Z: P6b→Place approach height X-Y: Calculated position on tray + P8b→Place lateral escape distance	P6a→Place approach speed	Trajectory blend
M11	Vertical movement to place trajectory position	Z: P5b→Place trajectory height X-Y: Calculated position on tray	High Speed	Trajectory blend

Table 4-2 : Moves of the cycle

4.4. Remarks and information

- Each “Pick” heights (P2, P3 and P4) are calculated relatively to the height of the part : “D°°Part height”. If the part height is unknown the value should be set to 0.
- Each “Place” height (P6 and P7) are calculated relatively to the length of the part out of the tool : “E°°Part length out of tool”. If the length is unknown the value should be set to 0.If the Pick Leave Movement (M4) is not essential (hence the robot moves straight up at high speed to the trajectory pick position P1), simply put the “P4b→Pick vertical escape” to the same value as “P3b→Pick height” and the “P4a→Pick vertical escape speed” to the same value as “L°°High speed”.
- If the lateral escape movement after place (M9) is not essential (hence the robot moves straight up at high speed from the place position P7 to the place approach position P6), simply put the “P8b→Place lateral escape distance” to 0 and the “P8a→Place lateral escape speed” to the same value as “ L°°High speed”.
- The “P7e→Blow while escaping” variable can be set to true or false. If set to true, the robot will blow while moving from point P7 to P6 and the P8 will not be reached. If is set to false, the robot will start to blow when it reached P7 and stop to blow when it starts to move to point P8. See the below diagram for further information.

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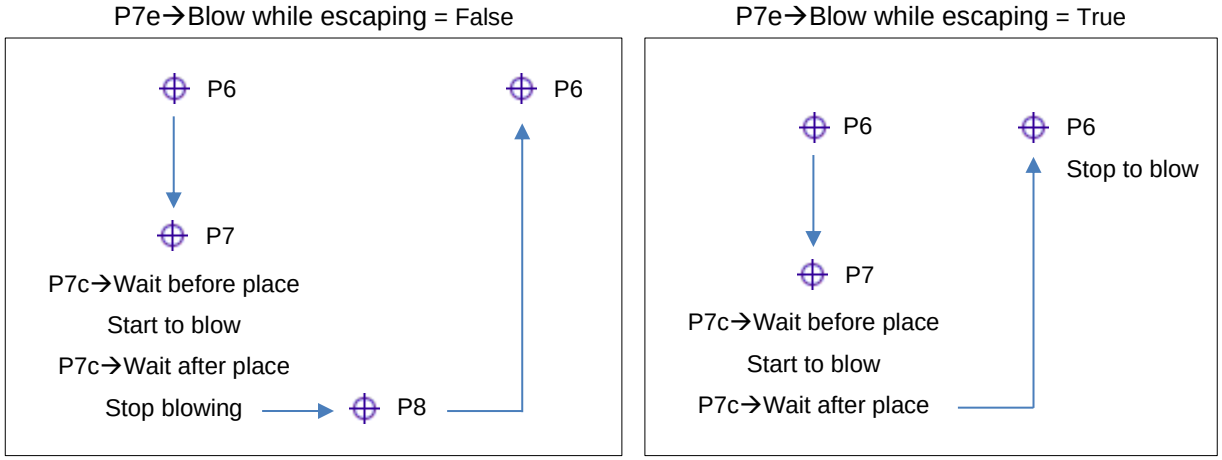


Figure 4-2 : Blow while escaping

5. Pick&Place cycle parameters

This program is generic for many cells configurations, many parameters may not exist in your program. Indeed, certain functionalities make sens only with a specific mechanical configuration.

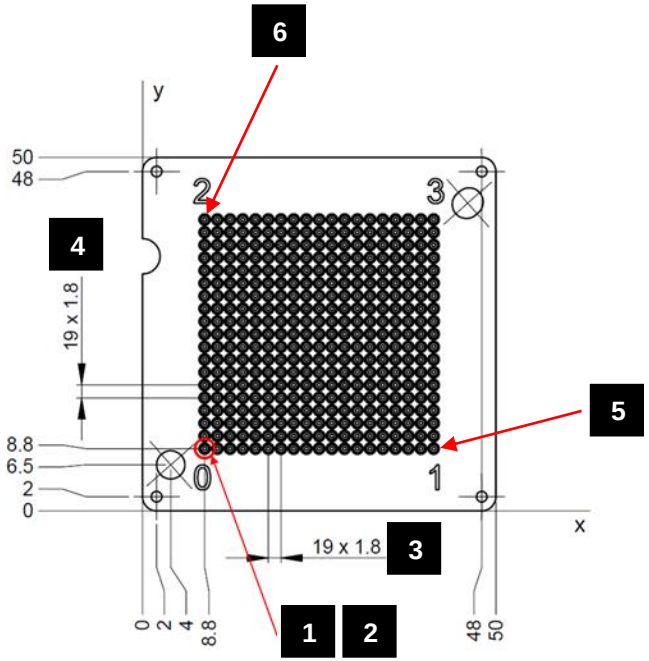
5.1. Program parameters

Name of parameter	Unit	Description
A°°slow_speed_[T/F]	bool	Set if the robot moves with high speed or not.Set the robot to slow speed (True) or normal speed (False)
B°°live_values_update_[T/F]	bool	Set if the variables Px to Py can be changed during production cycle.
C°°tool_[n°]	nb	Identification number of the tool being used.
D°°part_height_[mm]	mm	Height of the part on the platform.
E°°part_length_out_of_tool_[mm]	mm	Length of the part that sticks out of the tool once picked.
F°°first_place_position_X_[mm]	mm	First place position in X.
G°°first_place_position_Y_[mm]	mm	First place position in Y.
H°°step_X_[mm]	mm	Distance between to place points in X.
I°°step_Y_[mm]	mm	Distance between to place points in Y.
J°°number_of_parts_X_[nb]	nb	Number of parts that needs to be placed in X.
K°°number_of_parts_Y_[nb]	nb	Number of parts that needs to be placed in Y.
L°°high_speed_[%]	%	Set the value of the high speed (100 % is the highest).
P1·b→pick_trajectory_height_[mm]	mm	Height of the trajectory pick point (high speed movement).
P2·a→pick_approach_speed_[%]	%	Speed to go from P1 to P2.
P2·b→pick_approach_height_[mm]	mm	Height of the pick approach.
P3·a→pick_speed_[%]	%	Speed to go from P2 to P3.

P3·b→pick_height_[mm]	mm	Height at which the part will be picked.
P3·c→wait_before_pick_[ms]	ms	Time for the robot to stabilize before picking a part.
P3·d→wait_after_pick_[ms]	ms	Time that the robot will wait after having picked the part.Time for the robot to wait after picking a part.
P4·a→pick_vertical_escape_speed_[%]	%	Speed to go from P3 to P4.
P4·b→pick_vertical_escape_[mm]	mm	Height of the vertical escape.
P5·b→place_trajectory_height_[mm]	mm	Height of the trajectory place point (high speed movement).
P6·a→place_approach_speed_[%]	%	Speed to go from P5 to P6.
P6·b→place_approach_height_[mm]	mm	Height of the place approach.
P7·a→place_speed_[%]	%	Speed to go from P6 to P7.
P7·b→place_height_[mm]	mm	Hight at which the part will be place.
P7·c→wait_before_place_[ms]	ms	Time for the robot to stabilize before placing a part.
P7·d→wait_after_place_[ms]	ms	Time that the robot will wait after having placed the part.Time for the robot to wait after the part is placed.
P7·e→blow_while_escaping_[T/F]	bool	Set if the robot must keep blowing while reaching P6.
P8·a→place_lateral_escape_speed_[%]	%	Lateral escape speed, from P7 to P8.
P8·b→place_lateral_escape_distance_[mm]	mm	Distance in X direction for the lateral escape.

Table 5-1 : Program parameters

5.2. Placing tray parameters



N°	Name	Description	Example
1	F°°first_place_position_X_[mm]	Position in X of the first part to place	8.8 mm
2	G°°first_place_position_Y_[mm]	Position in Y of the first part to place.	8.8 mm
3	H°°step_X_[mm]	Distance between two positions in X.	1.8 mm
4	I°°step_Y_[mm]	Distance between two positions in Y.	1.8 mm
5	J°°number_of_parts_X_[nb]	Maximum number of parts on one line in X.	20
6	K°°number_of_parts_Y_[nb]	Maximum number of parts on one line in Y.	20

5.2.1.1. Remarks and information

- To work correctly with those parameters, the place frame has to be defined in mm unit and with the 0/0 reference of the tray in the corner as seen in the above drawing.
- Offsets X and Y of the first position must be given with the right polarity, which must correspond to the frame axis.

6. Machine parameters – Calibration

6.1. PX / mm Calibration

6.1.1. Aim

Create a relation between the pixel of the vision sensor and a metric system (mm).

6.1.2. Advantages

The system will work with a metric system. That means part model and exclusion zones will be Millimeter based.
Vision Recipes are interchangeable between two machines (attention: illumination parameters have sometimes to be adapted).
Optic defects (distortion) can be “corrected” – quality of results increases
The calibration of the Feeder will be done at the same time with the Pixel/Millimeter Calibration.

6.1.3. Disadvantages

The correction of the image will take some time. If the application is extrem time critical (each ms counts), then the usage of this calibration should be pondered.

6.1.4. When performing px/mm calibration

The pixel/millimeter calibration is a “one-shot” calibration, that means it must be executed normally only once (once again if camera or optic have changed).

This calibration must be done before all others operations (calibration, teaching, ..) to ensure correct behavior.

6.1.5. How performing px/mm calibration

A. Preparation:

- Set calibration plate
- Evaluate correct exposure time

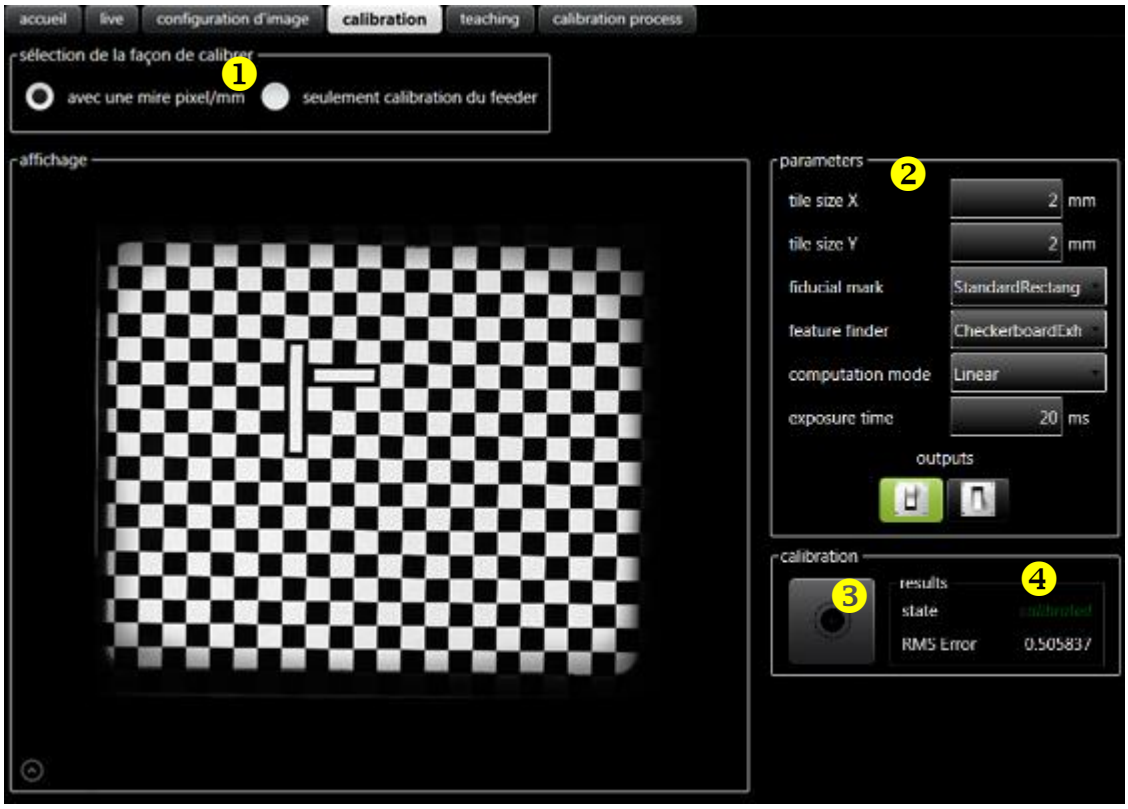


Figure 6-1 : px / mm calibration

B. Calibration:

1. Select px / mm target
2. Set parameters
3. Calibrate
4. Verify result

Note:

Optimal value of RMS are close to 0, but real value depend on the use case. Absolute value depends on the scale of the uncalibrated image, but error may come from nonlinear distortion (due to optics quality), quality of image (focus, contrast), size of tile (>15 pixels).

6.2. Calibration of the pick frame (asycube)

6.2.1. Aim

Create a relation between the robot/manipulator and the vision sensor
The robot system can be in any unit (increments, meter, frame, …)
After the calibration the result positions are given in the coordinate system of the robot

6.2.2. Facts

The vision system needs 4 points pairs (X,Y) to create a relation between vision coordinates and robot coordinates.
To calibrate the system a configured recipe is needed to detect correctly the targets

6.2.3. Options

It is possible to calibrate only one of the two frames by choosing in the Process – programming tab. Don't forget to Apply the changes

6.2.4. How performing process calibration

The main procedure is the following (automatic calibration):

1. Load the calibration recipe
2. Load the calibration tool
3. Place the calibration platform on the Asycube
4. Start the program
5. Verify the message at the end of the program execution.

Here below explains the detail of these steps as well as the manual robot frame teaching.

6.2.5. Vision

To calibrate the Asycube "Robot – Vision" system, respect the following steps:

Step 1	Load the calibration tool onto the Robot

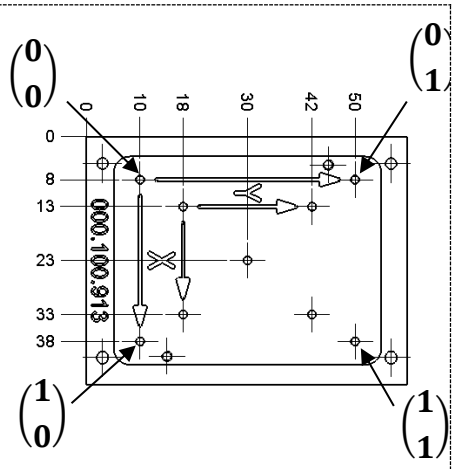
Step 2	Load the calibration platform onto the Asycube *For more information about the procedure to change the platform, please refer to the Asycube Operating Manual* Remove the hopper of the Asycube before executing the calibration	

Figure 6-2: Calibration platform

Figure 6-3: Calibration recipe: Loading the calibration recipe

Step 3	Click on the "Recipes" button
Step 4	Click on the "Home" tab
Step 5	Click on the "Select" button and choose the "Calibration_vX.X_camYMp.rec" recipe

NOTE:

This recipe, which is preconfigured by Asyril, is saved under D:\AsyrilData\Recipes

Step 6	Click on the "Load" button

	The HMI state will change to "Working"
Step 7	Wait until the HMI state returns to "Ready"

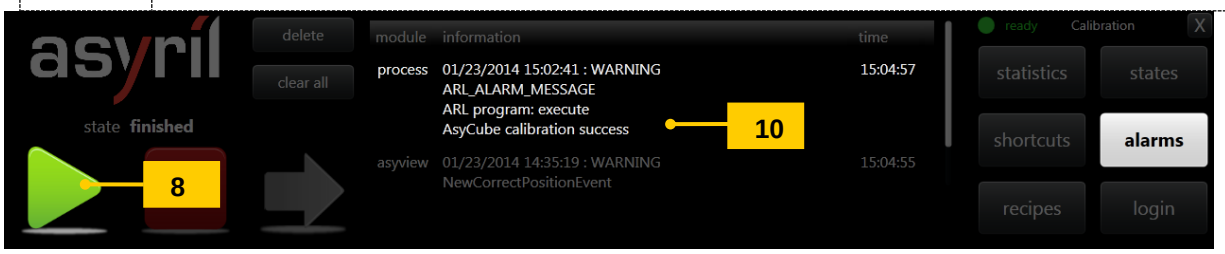


Figure 6-4: Vision-Calibration: Calibration success

IMPORTANT!

The calibration program can only work if Asycube frame has already been taught before. This frame is taught by Asyril during setup of the module.

Step 8	Click on the start button to start the calibration
Step 9	The robot will learn the calibration points and the camera will be calibrated
Step 10	Wait until the calibration procedure is complete. A message “Asycube calibration success” will appear.

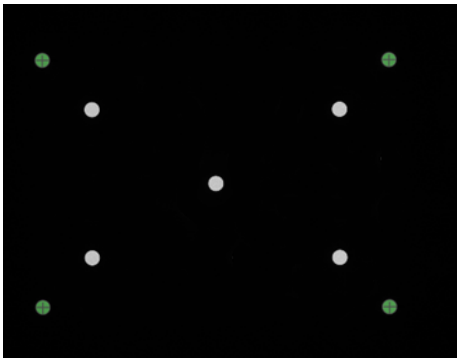


Figure 6-5 : vision calibration: results of calibration

Step 11	Click on the "Vision" button
Step 12	Click on the « Acquire and process »
Step 13	Check that the green circles are correctly situated in the calibration holes as shown on the figure above
Step 14	Check that values correspond to the table. Theoretical values are following : Point 0 : 0 0 Point 1 : 1 0 Point 2 : 0 1 Point 3 : 1 1 If the values correspond to the theoretical values, the system is correctly calibrated.

6.2.6. Picking Robot frames

Step 1	Load the calibration tool onto the Robot
Step 2	Load the calibration plate onto the Asycube

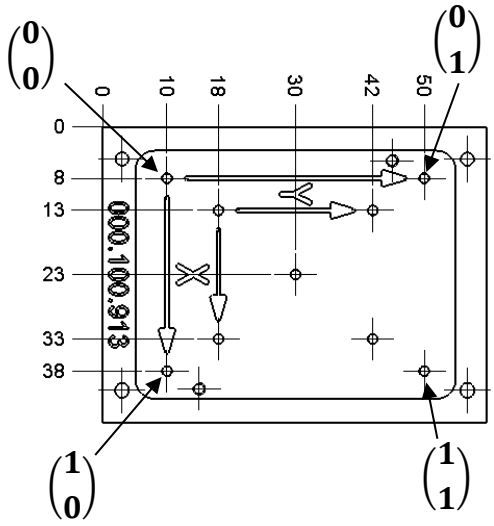


Figure 6-6: Calibration plate

Step 3	Release the robot brakes using the HMI (shortcut screen)

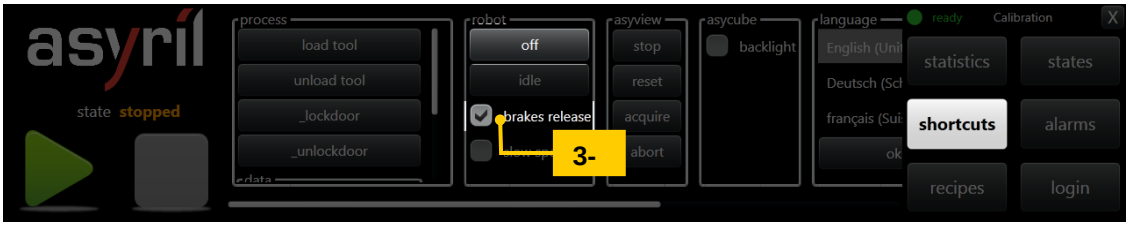


Figure 6-7: Procedure for releasing the brakes

Step 4	Move the robot to the 1st calibration point	 **Figure 6-8: Teaching of point 1**

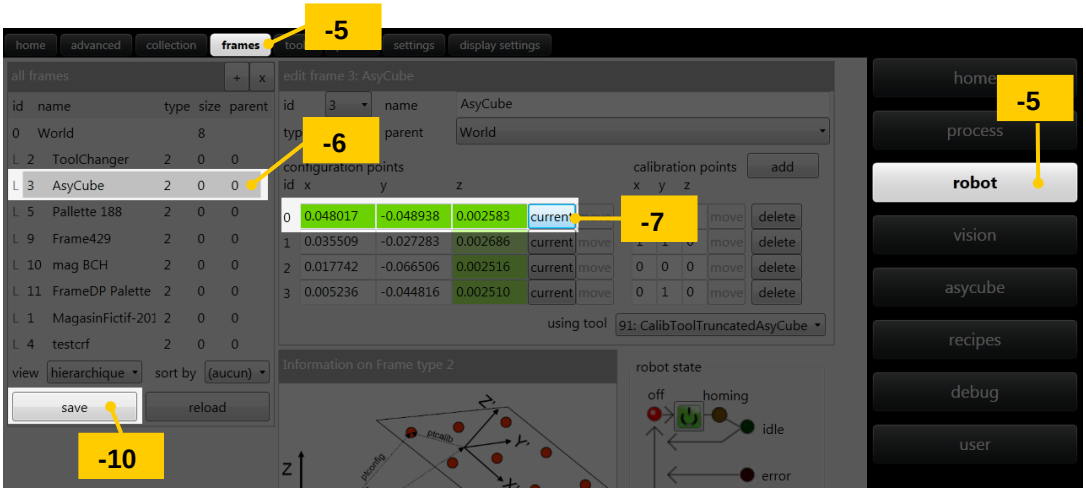


Figure 6-9: Robot-frames: Managing references and sub-references

Step 5	Click on the "Robot" button on the HMI then on the "Frame" tab
Step 6	Select the "Asycube" frame, "*world*" parent and "*CalibToolTruncatedAsycube*" tool. **NOTE:** The name of the frame and its identifier may vary depending on your specific application.
Step 7	Insert the current position of the robot in position 0 by clicking on the "Current" button **NOTE:** The colour of the text fields varies according to the proximity of the robot with the input coordinates (in the parent frame and with the tool selected): Proximity is defined by: $\boldsymbol{Proximity} = \left\lvert \boldsymbol{X}_{\boldsymbol{act,Frame_A,Tool\_B}} - \boldsymbol{X}_{\boldsymbol{value}} \right\rvert$ The table below summarises the colour of the box according to proximity: **Between 0 and 10µm** **Between 10 and 50µm** **Between 50 and 100µm** **Between 100 and 200µm** **Between 200 and 500µm** **Over 500µm**
Step 8	Repeat steps 4 and 7 for each calibration point.
Step 9	Click on the "save" button to apply the modifications

6.3. Calibration of the place frame

Step 1	Load the calibration tool.
Step 2	Place the calibration pallet on the 1st location of the rotating disk table (if any)
Step 3	With a rotating disk table: click on « _init_table ». This program initializes the rotating disk table and turns it on position n°1.

Figure 6-10 : program for initialization of the rotating disk table

Step 4	Hold the robot with your hand, press on OFF and then on release the breaks.

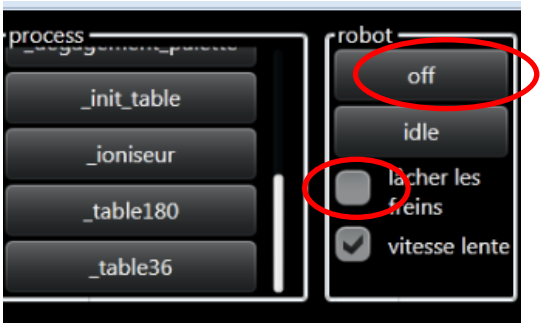


Figure 6-11 : release the robot breaks

Step 5	Place the robot in the hole n°0

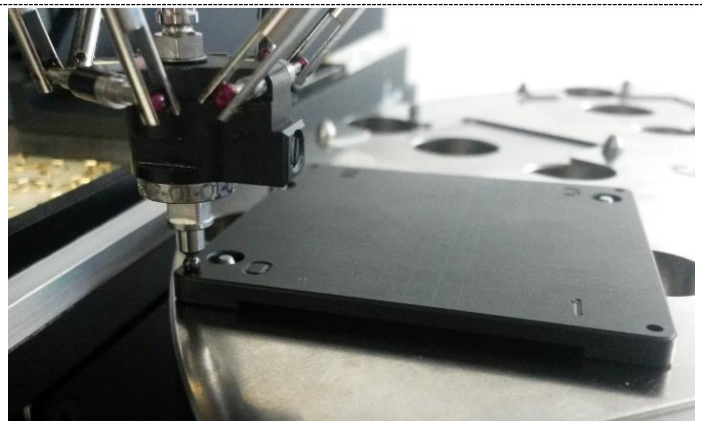


Figure 6-12 : teach the calibration points positions

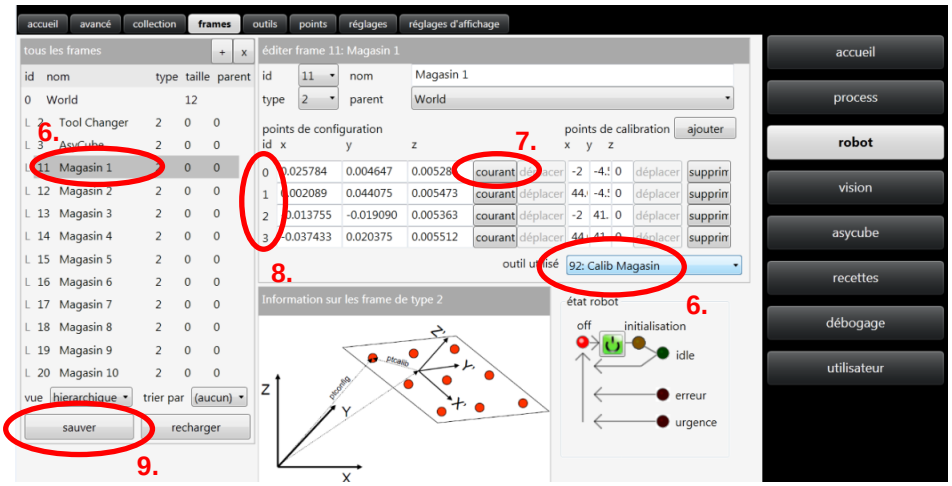


Figure 6-13 : Place frame teaching

Step 6	Select the desired frame and the corresponding tool
Step 7	Insert the robot position in the point id. (if the robot is located in hole n°0, teach the position ID 0 by clicking on « current »)
Step 8	Do again step 7 for holes 1, 2 and 3
Step 9	Press on « save » to learn and save the frames (this action can only be done when the robot is in state OFF)
Step 10	Place the robot in a safe position, click on « release breaks »
Step 11	With a rotating disk table: click on the program allowing to go to the next positon (_table36 in this example).

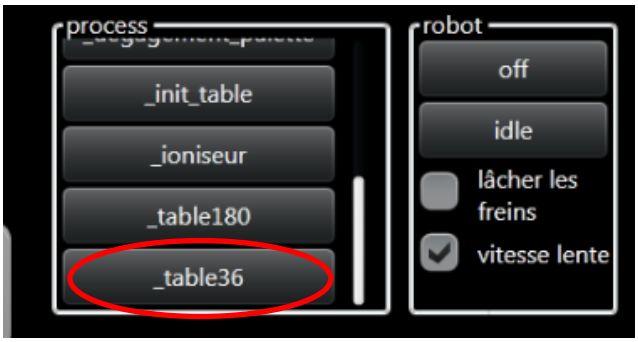


Figure 6-14 : Select the next rotating disk table position

Step 12	Place the calibration pallet on the next position
Step 13	Do again the same operations than before with the corresponding frame ID.

6.4. Calibration of the tool changing frame

Step 1	Load manually the calibration tool
Step 2	Release the robot breaks and place the robot in the 1st hole of the tool changer (see picture)

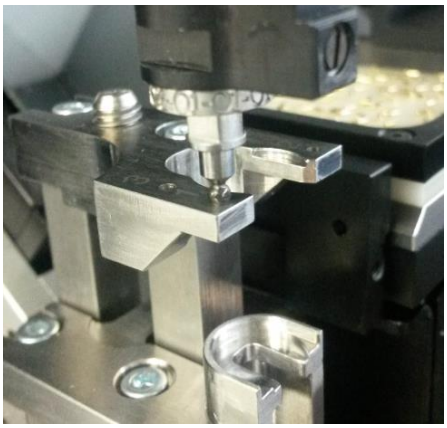


Figure 6-15 : Teach the calibration points on the tool changer

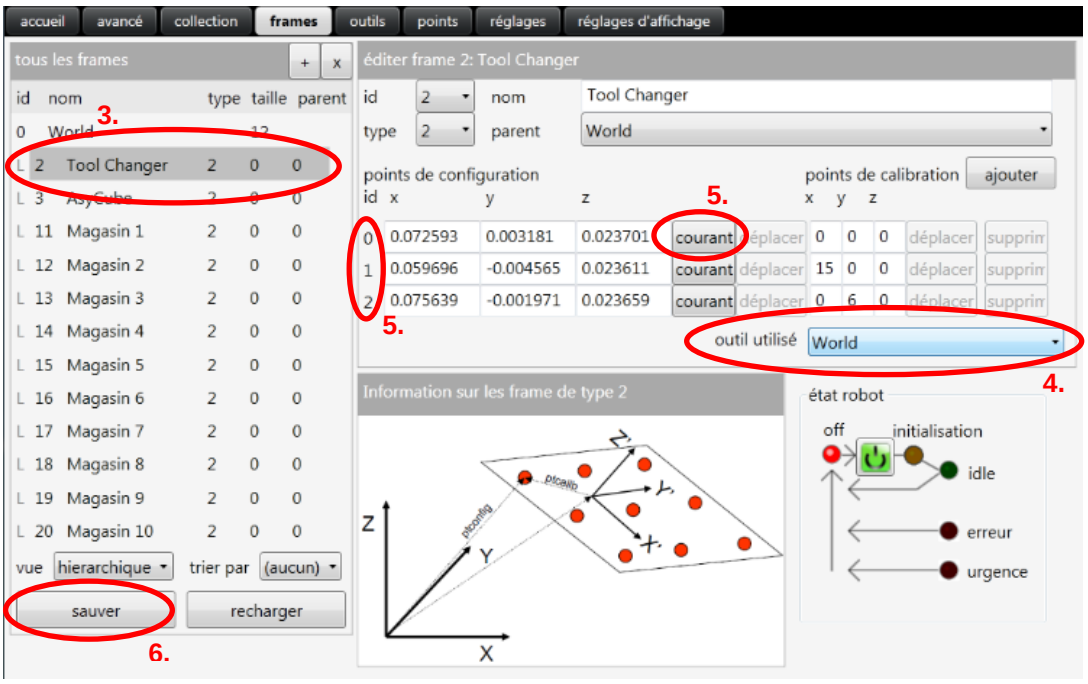


Figure 6-16 : Tool changer frame teaching

Step 3	Choose the frame « changeur d'outil / tool changer »
Step 4	Select the corresponding tool (« world » or « calibration tool changer »)
Step 5	Teach the 3 points by placing the robot in position and press on « current » for each of them
Step 6	Save the frame

6.5. Tool calibration

Step 1	Press on IDLE (the robot needs to initialized once before calibrating)
Step 2	Hold the robot with your hand, press on OFF and then on release the breaks. Place the tool holder on a flat and rigid surface. **WARNING** The tool holder and NOT the pin must touch the flat surface.

Figure 6-17 : changing the robot state (OFF, IDLE)

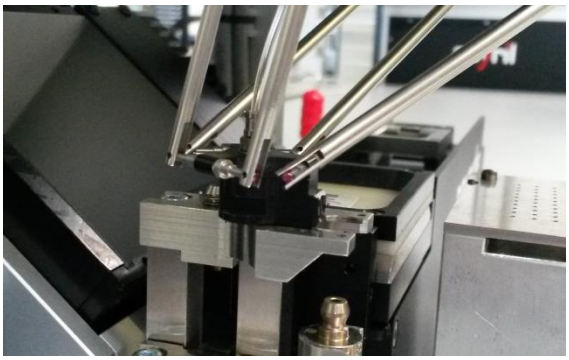


Figure 6-18 : tool holder (without tool) on a flat rigid surface

Step 3	On the Robot tab -> tools: press on « World » and then « + ».
Step 4	Fill in the following parameters: ID / Name / Parent with the corresponding information to the calibrated tool (« Parent » takes always the parameter « world » unless specified by Asyril)
Step 5	Press on « current » on the line « without tool»

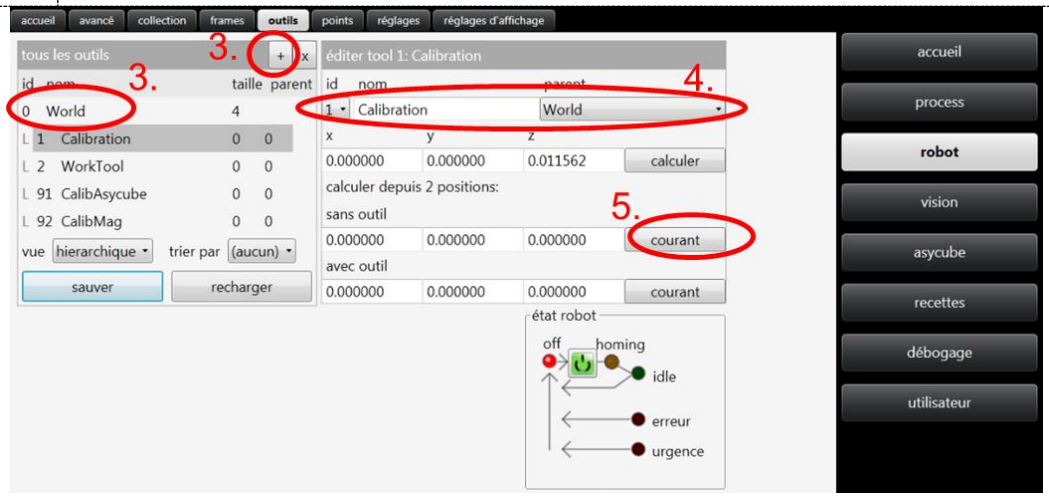


Figure 6-19 : tool creation and parameterization; teaching of the "without tool" length

Step 6	Load the tool to calibrate and place then the robot (with tool) on the same surface.
Step 7	Press on « current » on the line « with tool»
Step 8	Press on « calculate » and then replace the values « x » and « y » by « 0 » **WARNING** Nonzero values in « x » and « y » will define a lateral offset of the tool.
Step 9	Press on « save »

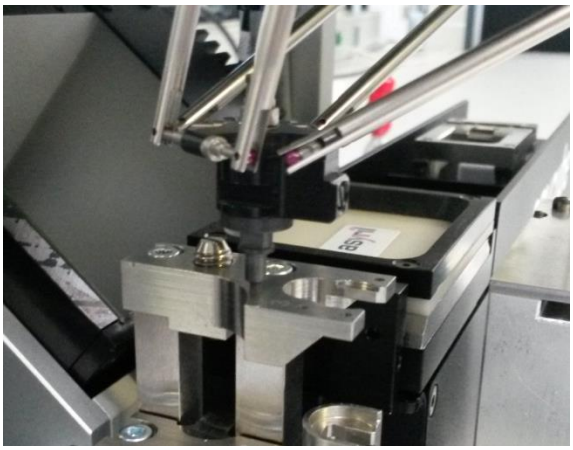


Figure 6-20 : tool holder « with tool » on the flat surface

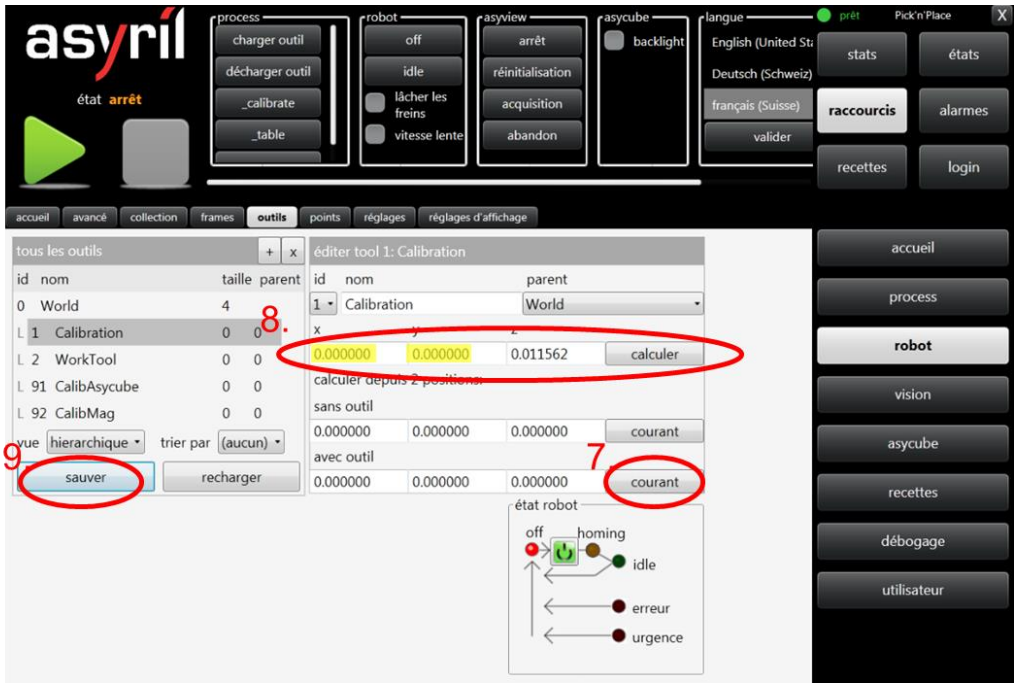


Figure 6-21 : teaching of the « with tool » length and calibration of the tool

6.5.1. Definition of the tools

By convention, the calibration tool has the ID 90 and the « truncated » calibration tools have the following IDs. The definition of the truncated calibration tools is necessary to calibrate the frames with the correct height: the 0-plane must fit the pick / place surface height.

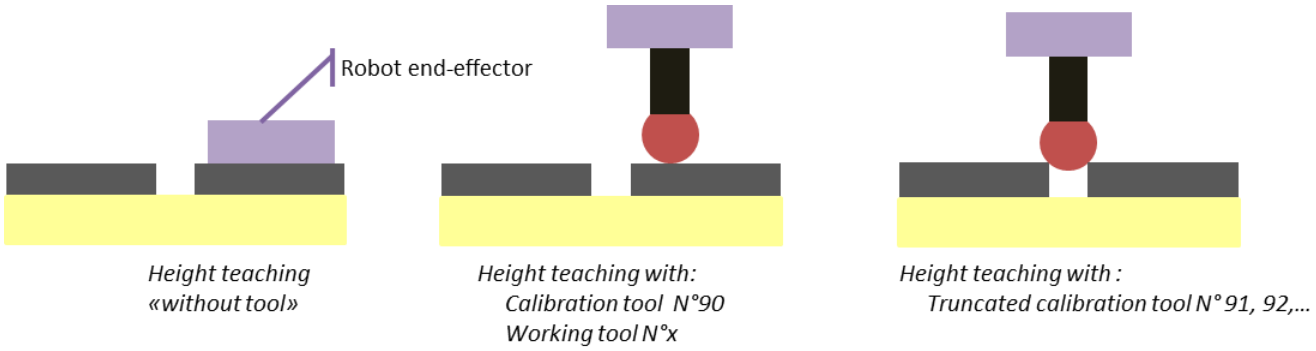


Figure 6-22 : teaching the length of the calibration and of the truncated calibration tools.

Revision table

Rev.	Date	Author	Comments
A2	15.10.2013	HsJ	Initial version
B	30.11.2015	DaM	Add calibration chapter, tool changing and introduction.
B1	15.01.2016	MaL	Standardization of variable names.
C	24.06.2016	MaL	Add pick and place block diagram chapter, add some informations for the calibration px / mm and process
D	25.07.2017	DaM	Modification for robot/Asycube 50 calibration platform
D1	06.04.2018	HsJ	Update for new Asyview v4.0.2
D2	26.02.2020	ScL	Modification to fit the new pick and place standard recipe.

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