

Polvo Line 4 OP025 Project

Revision 1

Client:



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1. Revision Control

Revision	Description	Author	Date
1	Document created.	M.A.	2014-09-15
2	Several modifications after project meeting with Polvo.	M.A	2014-10-06

2. System overview

The project consists on the supply of an automated conveying system (OP025) for the Line 4 of Polvo AB. The conveyor system will connect the storage system with both robots of car engine assembly cells.

A turnkey system will be provided including all the elements needed to perform the required job. The system will be fully automated, controlled by a PLC, and operated from an operator panel. The interface with the storage and robots will be done using regular I/Os.

The system will be able to handle two different types of cylinder blocks coming from the storage, and deliver each type to the appropriate robot. According to the project specification, the conveyor system will be able to deliver from the storage to the robots 60 products/hour. In the same way, the system will be designed to provide an availability over 98%.

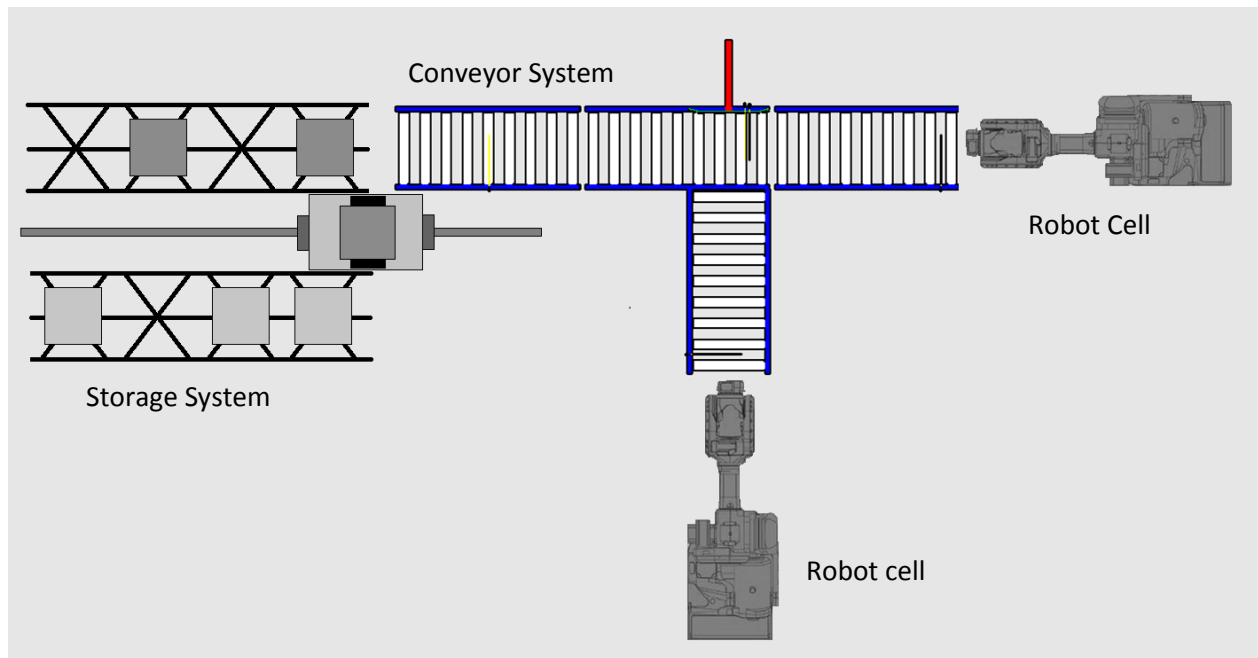


Figure 1: OP025 System overview

3. Functional description

The system will handle two product references (cylinder blocks), Type A and Type B. They only differ in dimension, being Type B bigger than Type A. The product type can be determined just by measuring the vertical dimension when placed on a conveyor.

The product flow is always in just one direction, coming from the automated storage and then transferred to the appropriate robot cell depending on the type.

The system is divided in four sub-operations SOP010 to SOP013 represented by four conveyors. Products coming from the storage are placed in SOP010 randomly (Type A or B). Then the products are transferred to SOP011 and measured using a regular capacitive sensor. Once the product type is determined, Type A products are transferred to SOP012 and Type B to SOP013. The transfer from SOP011 to SOP013 is done with help of a pneumatic cylinder. Finally the robot picks up the product and a new product can be deposited from the storage.

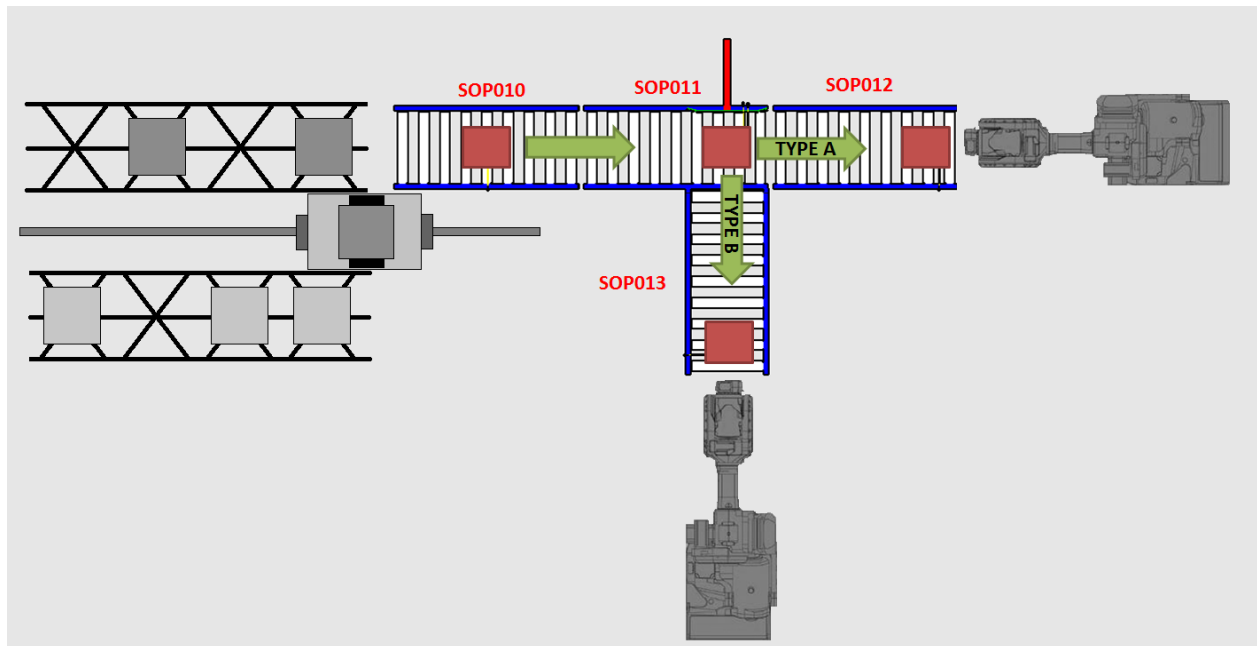
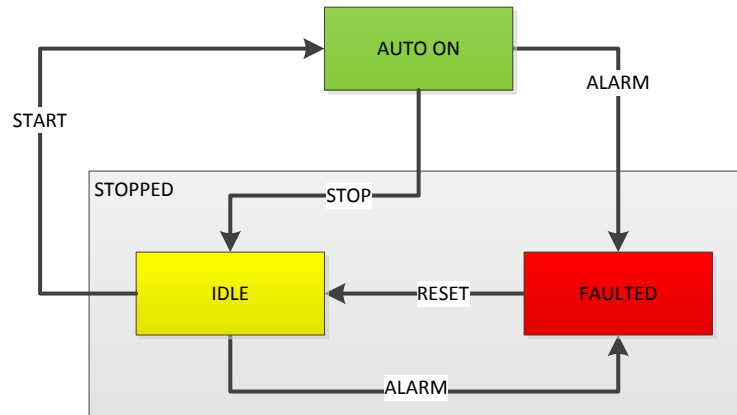


Figure 2: OP025 System Flow

3.1 System operation modes

The system has two different modes:

- Auto on: Is the mode in which the system is running under normal production.
- Stopped: Is the mode in which no movements are allowed.



• Figure 3: System mode state diagram

The system will be fully automated when in auto mode (No manual mode is delivered).

The system is set in Auto mode from the operator panel, equipped with three buttons. The system goes back to Stop mode (Idle) by pressing the Stop button or when an alarm occurs (Faulted). Alarms will be generated when equipment failure is detected.

The buttons in the operator panel are:

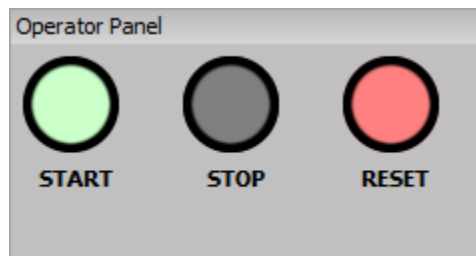


Figure 4: Operator panel

- Start button (Green button with green light): Pressing the button for three seconds starts the Auto on mode. The light is switched on while in Auto on mode.
- Stop button (Grey button, normally closed): By pressing the button the system goes directly to Stop mode (Idle).
- Reset button (Red button with red light): The light blinks when an alarm is active (Faulted). Pressing the button the alarm can be reseted if the conditions allow doing it.

3.2 Equipment

Conveyor motors are commanded using motor contactors and they run in single constant speed. Each conveyor is equipped with capacitive sensors to position the product during the transfer. SOP011 has an extra sensor to determine the product type. Transfer from SOP011 to SOP013 is done using a pneumatic double-acting cylinder equipped with two sensors to detect the cylinder position. The PLC and electric elements will be installed in a scope, and pneumatic elements will be installed in a separated scope.

3.3 Interlocks

Interlock signals with the storage and robots are handled using regular PLC outputs:

- “Deposit Ok” signal to allow the storage to place a new product in SOP010. In case of a product is detected without permission, the signal is not active, an alarm will be generated.
- “Pick Up Ok” signals for each robot to allow them to pick the product up from the conveyor. Timeout alarms will be generated if the product is not picked up within a predefined time interval.

3.4 Flowchart

The next picture shows the system general flowchart:

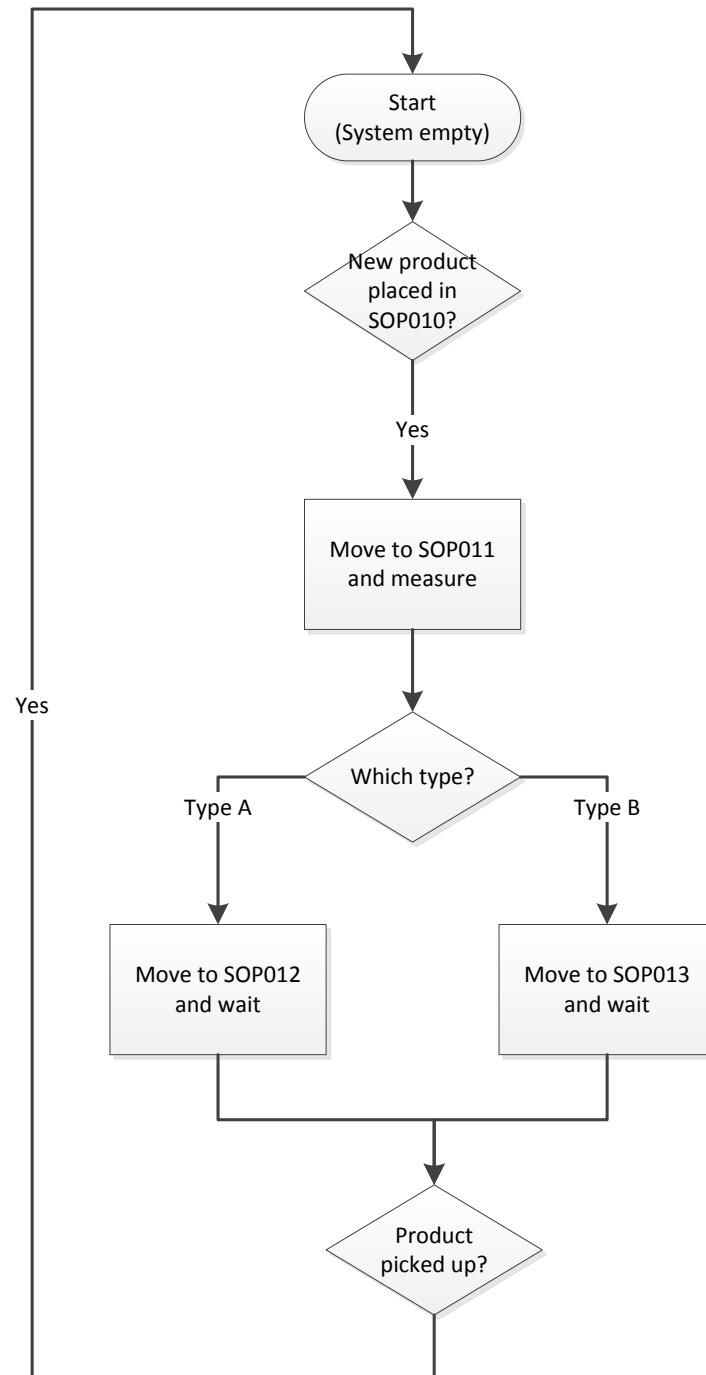


Figure 5: System flowchart

4. Layout

The layout below shows the conveyors included in the system with the sub-operation (SOP) numbers and the position of the sensor in each sub-operation.

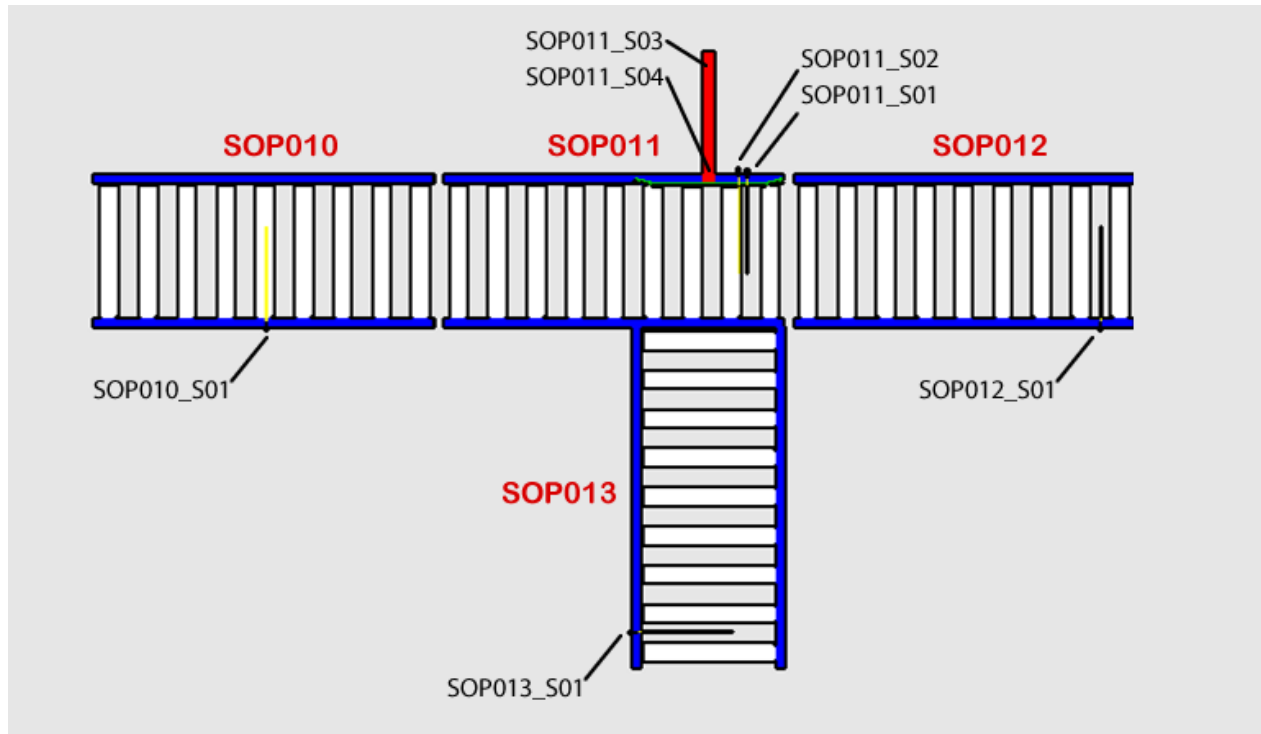


Figure 6: System layout

5. IO List

Inputs:

Name	Address	Description
Input Card 1	IB0	Onboard input
SOP010_B01	IX0.0	Auto start button
SOP010_B02	IX0.1	Auto stop button
SOP010_B03	IX0.2	Reset alarm button
SOP010_S01	IX0.3	Load in position
SOP011_S01	IX0.4	Load in position
SOP011_S02	IX0.5	Load is type 2
SOP011_S03	IX0.6	Cylinder retracted
SOP011_S04	IX0.7	Cylinder expanded
SOP012_S01	IX1.0	Load in position
SOP013_S01	IX1.1	Load in position

Outputs:

Name	Address	Description
Output Card 1	QB0	Onboard output
SOP010_K01	QX0.0	Conveyor move forward
SOP010_L01	QX0.1	Auto lamp On
SOP010_L02	QX0.2	Alarm lamp On
SOP010_I01	QX0.3	Storage Deposit Ok
SOP011_K01	QX0.4	Conveyor move forward
SOP011_V01	QX0.5	Cylinder expand
SOP011_V02	QX0.6	Cylinder retract
SOP012_K01	QX0.7	Conveyor move forward
SOP012_I01	QX1.0	Robot Pick Up Ok
SOP013_K01	QX1.1	Conveyor move forward
SOP012_I01	QX1.2	Robot Pick Up Ok

6. Alarm List

Alarm Code	Description	Troubleshooting
1	Product deposit without permission	Check the communication with the Storage system.
5	Conveyor movement timeout SOP010 to SOP011	Check if the load has fastened in between and correct it if needed. Reset and start again. Check that the conveyors move properly and the sensor SOP011_S01 is not broken.
6	Conveyor moving when cylinder not retracted	Retract the cylinder, reset and start again.
7	Cylinder expand movement timeout	Check the movement of the cylinder and if the sensor SOP011_S04 is not broken.
8	Cylinder retract movement timeout	Check the movement of the cylinder and if the sensor SOP011_S03 is not broken.
9	Cylinder sensor mismatch	Check the sensors SOP011_S03 and SOP011_S04 are not broken or displaced.
15	Conveyor movement timeout SOP011 to SOP012	Check if the load has fastened in between and correct it if needed. Reset and start again. Check that the conveyors move properly and the sensor SOP012_S01 is not broken.
16	Robot Pick up timeout SOP012	Check the communication with the Robot.
20	Conveyor movement timeout SOP011 to SOP013	Check if the load has fastened in between and correct it if needed. Reset and start again. Check that the conveyors move properly and the sensor SOP013_S01 is not broken.
21	Robot Pick up timeout SOP013	Check the communication with the Robot.

7. Appendix

An automated system project may require the completion of many other documents, for example:

- Detailed CAD drawings of the system
- Electrical drawings
- Pneumatic and hydraulic drawings
- Part list
- User manual (including alarm list).
- Preventive maintenance documentation
- Spare parts list
- ...