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Grado en Ingeniería Electrónica Industrial y Automática

CONCEPTUAL DESIGN OF AN AUTOMATIC SYSTEM FOR FEEDING BOARDS AND RECEIVING LAMELLAS IN BAND SAW PROCESS LINE.

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TFG REALIZADO EN PROGRAMA DE INTERCAMBIO

TÍTULO:	Conceptual design of an automatic system for feeding boards and receiving lamellas in band saw process line.
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UNIVERSIDAD:	University of Applied Sciences Nysa (Polonia)
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RESUMEN

Durante el último siglo, el sector industrial ha ido evolucionando, de tal forma que se ha ido buscando la máxima automatización en las líneas de producción, así como la optimización de recursos materiales, económicos…

En este trabajo se ha elaborado una línea de producción, cuya finalidad es cortar de forma longitudinal tablas de madera de roble que inicialmente tenían un espesor de 40mm, de tal forma que se obtengan láminas cuyo espesor final sea de 5mm. Dicha línea está totalmente automatizada, por lo que los palés entran en ella llenos de tablas de madera, y salen llenos de láminas, sin intervención humana alguna. Para ello, se hace uso de la máquina de cortar las tablas, dos robots industriales antropomórficos, una mesa elevadora y sensores. También, se han tenido que diseñar varios transportadores de rollos, transportadores de cadena y cintas transportadoras, así como dos sistemas neumáticos.

PALABRAS CLAVE

Línea de producción, industria, láminas de madera, automatización, optimización.

ABSTRACT

During the last century, the industrial sector has developed, in such a way that maximum automation has been sought in production lines, as well as the optimization of material resources, economic ones...

In this work, a production line has been developed, the purpose of which is to longitudinally cut oak wooden boards that initially had a thickness of 40mm, in such a way that lamellas whose final thickness is 5mm are obtained. This line is fully automated, so the pallets enter it full of wooden boards, and leave full of lamellas, without any human intervention. To do this, we use a cutting machine, two anthropomorphic industrial robots, a lifting table and sensors. Also, several roll conveyors, chain conveyors and belt conveyors have had to be designed, as well as two pneumatic systems.

KEYWORDS

Production line, industry, wooden lamellas, automation, optimization.

PAŃSTWOWA WYŻSZA
SZKOŁA ZAWODOWA W NYSIE

UNIVERSITY OF APPLIED SCIENCES IN NYSA

DEGREE IN PRODUCTION MANAGEMENT AND ENGINEERING

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A mis padres, por mostrar siempre su apoyo y amor incondicional.

A mi hermano Marcos, por ser siempre un ejemplo a seguir.

A mis amigos, simplemente por ser como son.

To Tomasz Wanat, my Polish promotor, and to Segismundo, my Spanish tutor, for being there offering always their help.

To all the great people that I have met during this amazing experience and have made me grow as a person and to live unforgettable experiences. See you soon…

INDEX

1. INTRODUCTION

During the last years, technological development has increased the desire to seek innovative solutions aimed at improving production processes. These improvements can be: increase production efficiency, eliminate errors in products, improve their quality, or increase automation, that is, reduce the amount of workforce in production. To achieve this, it is necessary to develop machines and devices, adapted to these objectives, which will depend on the specific process. Companies constitute the basis of this evolution in industrial production, although not all of them have the same level of technological development in industry. Despite this, the trend is always to improve, due to competition between them.

This drive towards automation can be seen in all industrial sectors, including industries based on the use of natural resources. One of them, on which we are going to focus, is the wood industry that is responsible for its processing. Wood is considered timeless, since despite the constant appearance on the market of new materials that seek to compete or replace it in case of shortage, there is still demand for them. Therefore, the development of automation and machine support for the wood processing industry is justified and rational.

The development mentioned above is not only observed in the industry itself, but also in development tools. Currently, technical design is largely computer-aided, using software that allows the three-dimensional visualization of concepts, that is, CAD programs (Computer Aided Design).

There are several types of CAD programs that will be used depending on the specific needs at all times. The basic categories into which these programs can be divided are shown below (Oleszek, 2020).

Type	Characteristics
LOW-END	• the least extensive in terms of functions. • it is primarily used to prepare 2D schematics.
MID-RANGE	• intermediate, taking into account the functions. • meets greater requirements of designers than low-end software, with lower hardware requirements than in the case of high-end. • gives the opportunity to prepare flat diagrams and three-dimensional models. • enables intuitive interaction with other software.
HIGH-END	• advanced, extensive and versatile in terms of functions. • support the entire design process from the general concept to the development of comprehensive technical documentation. • enable the integration of the design stage with the manufacturing stage. • is characterized by a comprehensive approach to the production process. • its use is associated with relatively higher costs and hardware requirements.

Table 1. Categories of CAD programs.

1.1 Autodesk Inventor as a design tool

To the design of the line I worked in Autodesk Inventor, an Autodesk software for 3D mechanical design, simulation, visualization and documentation. The program has many useful options and modules that support the design, including, for example:

- Parametric modeling: allows you to create three-dimensional models.
- Assembly modeling: allows you to integrate designed or downloaded models and parts, and control their interaction.
- Creation of drawing documentation: allows the creation of useful documents in the production process (dimensioning of parts and creation of assembly drawings…)
- The module for the preparation of sheet metal structures: facilitates the design of sheet metal parts thanks to the functions folding...
- Content Center: allows you to download typical items adapted to relevant standards from the material library, such as bolts, sections and parts of shafts.
- Design Accelerator: includes a set of professional wizards and calculation functions that greatly facilitate and accelerate the mechanism design process, such as…
    - Stress Analysis: allows you to test parts or assemblies for tensile strength at various stages of the design.
    - Generation of axes.
    - Chain generator.

1.2 Devices, mechanisms and elements producers

Designing machines, devices and complete technological lines requires a prior orientation in the offer of the producers of components necessary for the implementation of a given project. These elements must be carefully selected to satisfy the needs and requirements of the tasks to be carried out by the machine, as well as to guarantee efficiency and safety of use. During the development of the project, the offer of various manufacturers was thoroughly known and, on the basis of catalogs, parts suitable to the needs were selected.

As we will see along this memory, these producers are mainly:

COMPANY NAME	DESCRIPTION	LOGO
SICK	Based in Germany, it is a global manufacturer of sensors and sensor solutions for industrial applications. The company is active in the areas of factory and logistics automation and process automation.	SICK Sensor Intelligence.

NORD	Since 1965, it is a supplier of mechanical and electronic drive technology (gear units, electronic motors and drive electronics).	
INTERROLL	It is a manufacturer of products for unit-load handling systems, internal logistics and automation.	
FAMAD	It is an industrial machines and devices factory, with headquarters in Paczków. It produces high quality machines and devices with modern design solutions.	
WINTERSTEIGER	It is a mechanical engineering company specialized in niche markets, such as ski service, field test technology, wood thin-cutting and wood surface repairs, as well as straightening technology.	
ABB	It is a Swedish–Swiss multinational corporation headquartered in Zürich, Switzerland,[7] operating mainly in robotics, power, heavy electrical equipment, and automation technology areas.	
PIAB	It provides gripping skills to robots, intelligent flow to materials, and lifting power to humans.	
SMC	It is an international corporation based in Japan that deals with the supply of products for automation. The company is a leader in the development of pneumatic technology. It has around 12,000 base products and many varieties.	

Table 2. Producers.

2. THE PRODUCTION LINE

2.1 Global vision of the production line

In the following images the final model for the production line, created with Autodesk Inventor, are shown from different views.

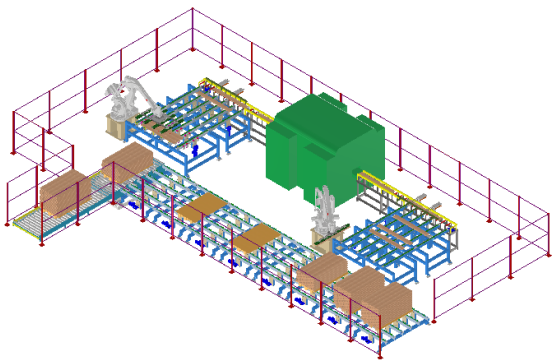


Figure 1. Line production model (I).

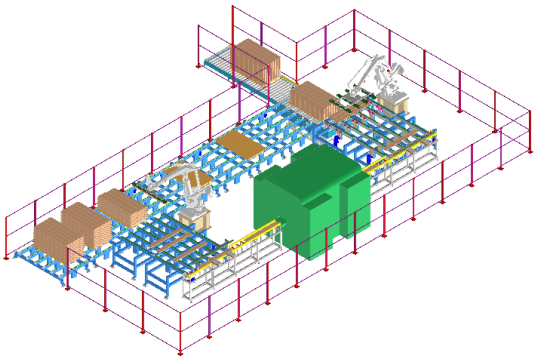


Figure 2. Line production model (II).

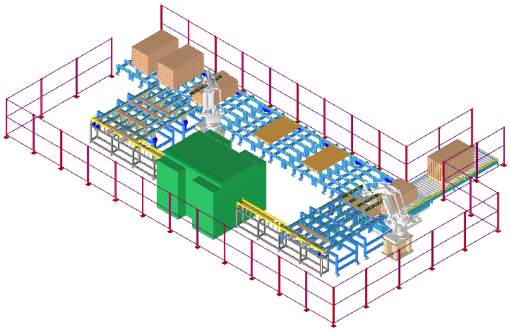


Figure 3. Line production model (III).

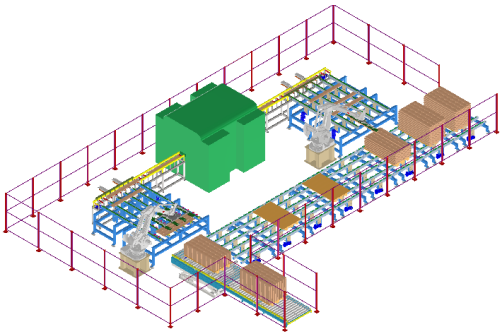


Figure 4. Line production model (IV).

After showing the production line in a general way, it is necessary to explain what is the way that the pallets, boards and lamellas follow during the process. In the next image we can understand easily that directions.

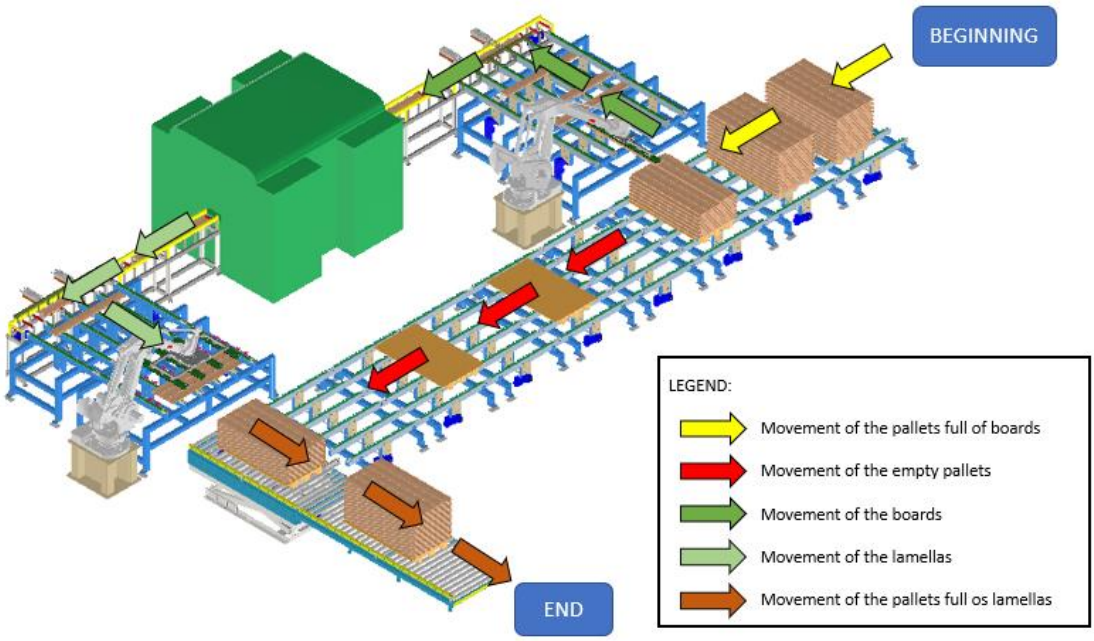


Figure 5. Line production directions.

First at all, the pallets, with 100 wood boards each one, come into the line through the “BEGINNING”, following the yellow arrows. Then the first robot will take the boards one by one, so they will follow the dark green arrows. In the other hand, the empty pallets will go in the red arrow direction.

After the cutting machine, the lamellas follow the light green arrows, until the robot take them to stack them in the empty pallets. Once the pallets are full again, with 500 lamellas each, they go in the orange arrow direction, ending the process in “END”.

During this memory, the process will be explained deeply, talking about every machine and their functions, one by one.

2.2 Detailed analysis of the production line

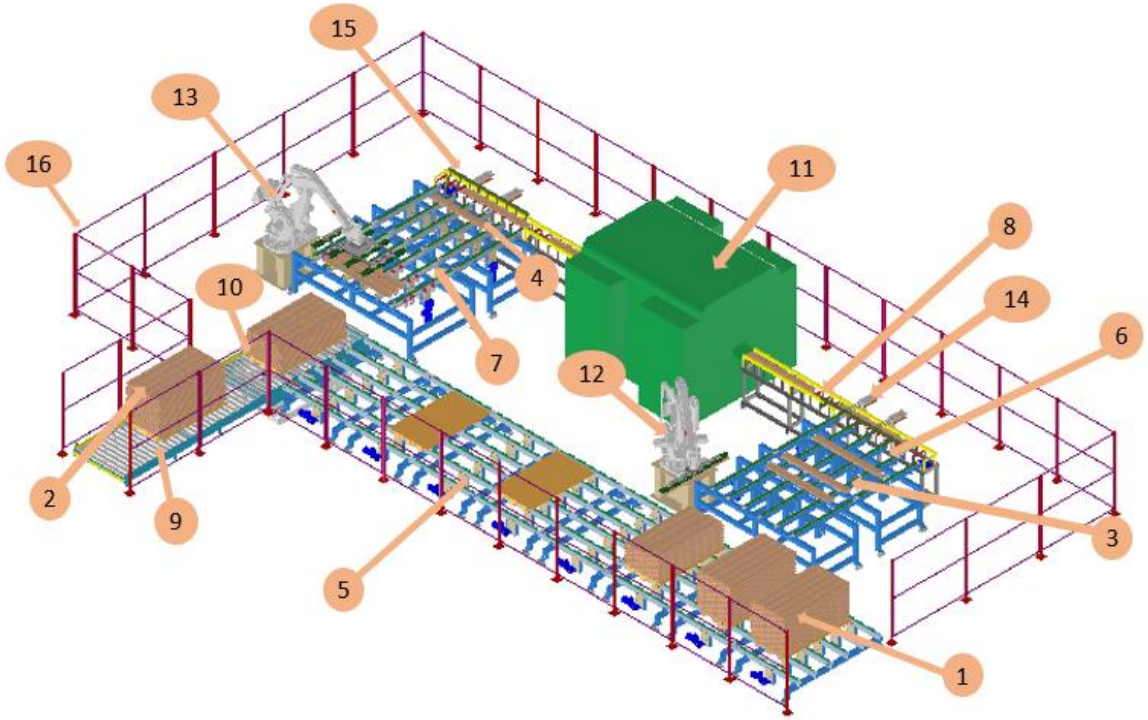


Figure 6. Divided line production.

NUMBER	ELEMENT
1	Input pallets
2	Output pallets
3	Boards
4	Lamellas
5	Chain conveyor
6	Belt conveyor
7	Belt conveyor with stoppers
8	Roller conveyor to transport boards and lamellas
9	Roller conveyor to transport pallets
10	Lifting table
11	Cutting machine
12	Robot A
13	Robot B
14	Pneumatic system A
15	Pneumatic system B
16	Security border

Table 3. Production line elements.

1) INPUT PALLETS

These are the pallets that come into the production line. As it was said before, each pallet is holding 100 boards, what it means 20 rows and 5 columns.

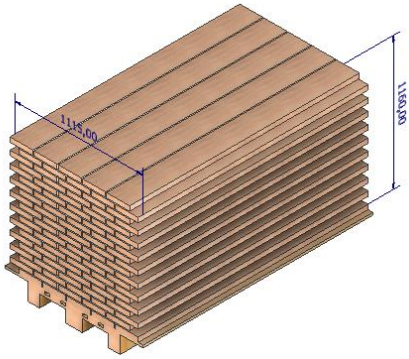


Figure 7. Input pallets.

It is possible to calculate roughly its weight, knowing that 1m^3 of oak weights 800 kg.

$$800\frac{kg}{m^3}\cdot\frac{1m^3}{10^9mm^3}\cdot(1115mm\cdot 1160mm\cdot 2000mm)=2069{,}44\ kg\approx 2t$$

Where:

- 1115 mm is the width
- 1160 mm is the height
- 2000 mm is the length

2) OUTPUT PALLETS

In this case, the pallets are holding lamellas, 500 in total (100 rows and 5 columns). These pallets are the final product of the line.

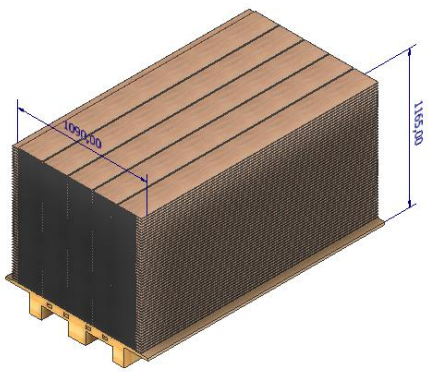


Figure 8. Output pallets.

As in the case before, we can do an approach of its weight:

$$800\frac{kg}{m^3}\cdot\frac{1m^3}{10^9mm^3}\cdot(1090mm\cdot 1165mm\cdot 2000mm)=2031{,}76\ kg\approx 2t$$

Where:

- 1090 mm is the width
- 1165 mm is the height
- 2000 mm is the length

3) BOARDS

The board is the raw material of this process. From one board, six lamellas will be obtained, cutting it longitudinally. The dimensions of this initial board are shown in the following picture.

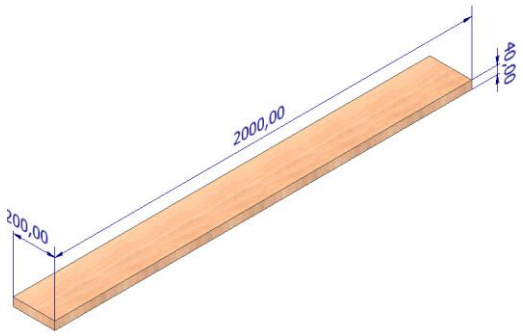


Figure 9. Board.

As it is done with the pallets, it is possible to know the weight of the board.

$$800\frac{kg}{m^3}\cdot\frac{1m^3}{10^9mm^3}\cdot(200mm\cdot 40mm\cdot 2000mm)=12{,}8kg$$

Where:

- 200 mm is the width
- 40 mm is the height
- 2000 mm is the length

4) LAMELLAS

The lamellas are the product that we obtain after cutting the boards. The length and the width are the same as in the boards, but the height in this case is different (5 mm).

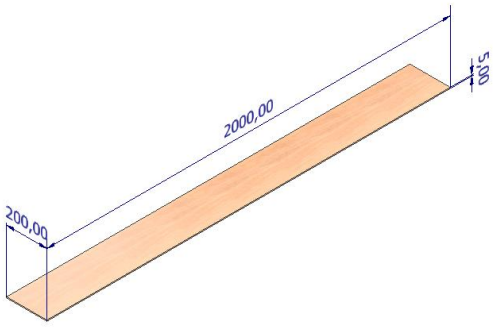


Figure 10. Lamella.

Repeating the process to know how much a lamella weights.

$$800\frac{kg}{m^3}\cdot\frac{1m^3}{10^9mm^3}\cdot(200mm\cdot 5mm\cdot 2000mm)=1{,}6kg$$

Where:

- 200 mm is the width
- 5 mm is the height
- 2000 mm is the length

5) CHAIN CONVEYOR

In the production line there are eight chain conveyors, that are used to transport the pallets from the beginning until the lifting table. In the following picture, their positions are shown.

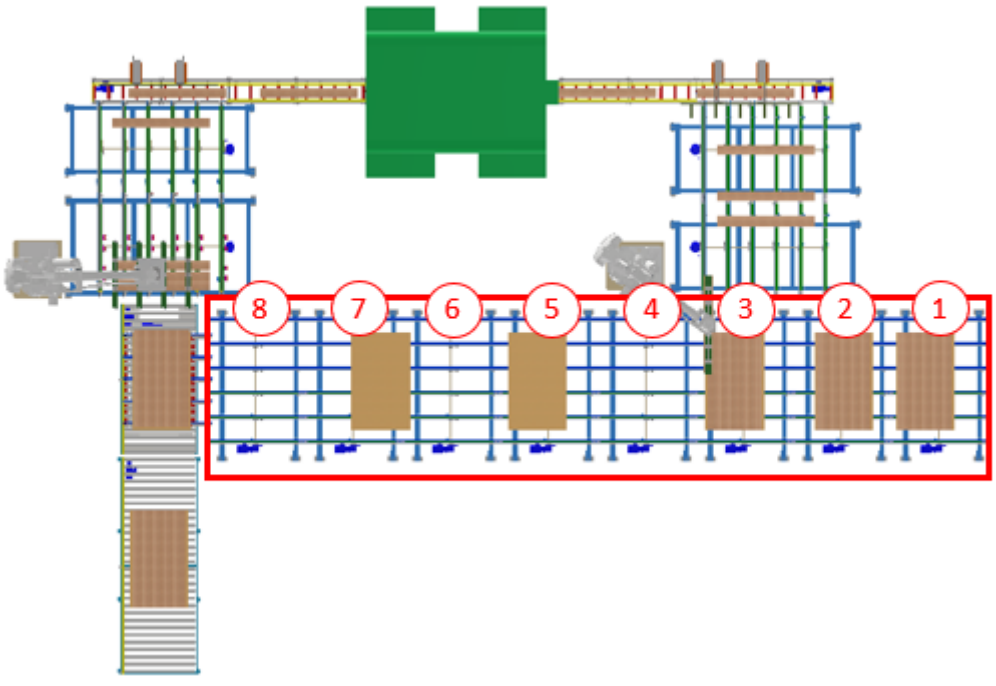


Figure 11. Chain conveyors in the line.

The decision of taking chain conveyor instead of belt conveyors is due to the pallets weight, because the chain conveyors can transport heavier materials better than the belt ones.

As we can see in the following picture, each chain conveyor is made-up by six similar chains, but all of them are moved by the same motor.

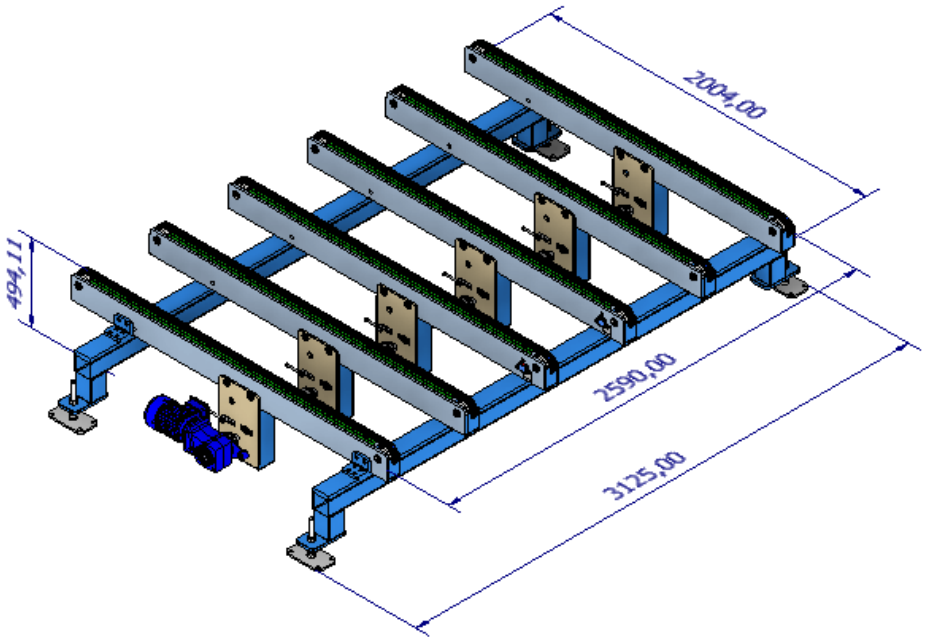


Figure 12. Chain conveyor.

Let's analyze deeply the chain mechanism, looking the following images.

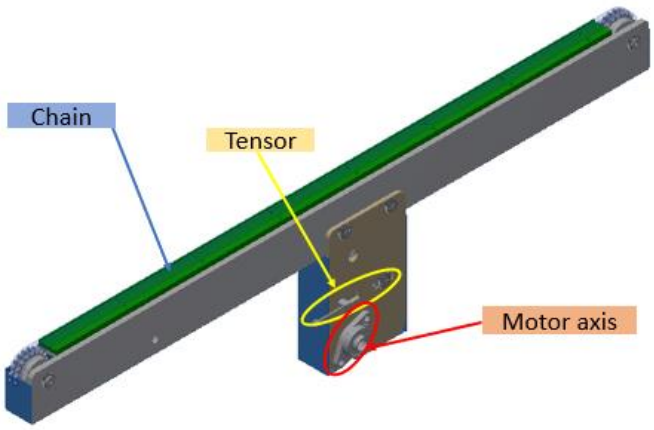


Figure 13. Chain mechanism (I).

As we can see in the figure 14, there is a gear to tense the chain in case this is loose. It is shown in detail in the figure 15. There is too a hollow gear where the motor axes cross.

If we open the mechanism, we will see the following picture.

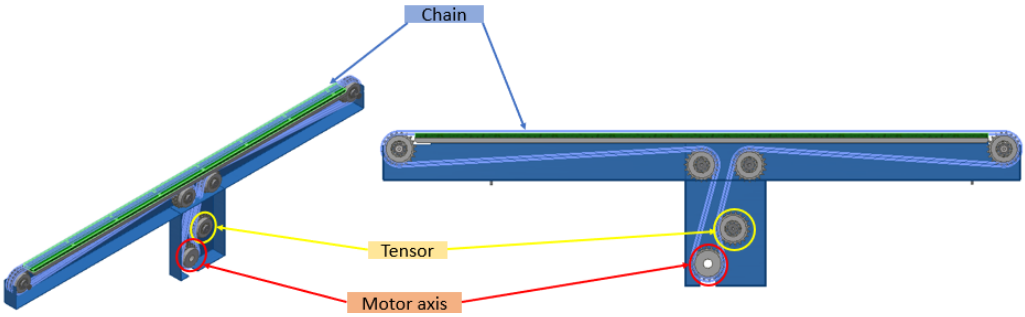


Figure 14. Chain mechanism (II).

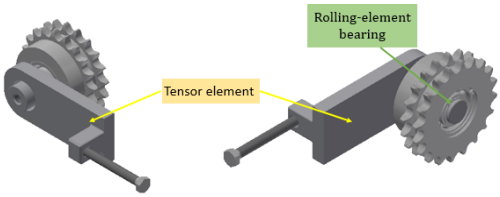


Figure 15. Tensor.

As we can see, the mechanism is formed by six gears and the chain, that follows that gears movement.

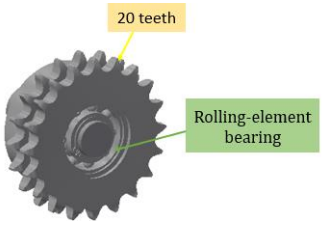


Figure 16. Gear.

All the gears in the mechanism are similar, except the one which transmits the movement to the chain, that doesn´t have rolling-element bearing.

As it was said before, there is one motor in each chain conveyor. This motor is from Nord Company[1], and its characteristics are appropriate for the work it will do.

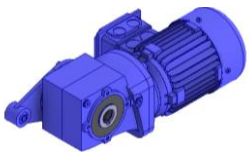


Figure 17. Chain conveyor motor.

[1] *Nord. (n.d.). Recovered from https://www.nord.com/en/home-es.jsp on 24th March, 2021.*

It is necessary to distinguish between the chain conveyors 1 to 3, and the others. This is because these three have to bear the pallets full of boards, while the others must hold only the empty pallet. Both type of motors will be SK 93172.1AD - 80SH/4 TF model (look ANNEX II. MOTOR OF THE CHAIN CONVEYOR I, DATASHEET and ANNEX III. MOTOR OF THE CHAIN CONVEYOR II, DATASHEET), but in the first case the power is 0,75 kW, and in the second one is lower (0,55 kW).

To control that the movement of the pallets is correct, there are two detection photocells on object at the beginning of each chain conveyor. They are from Sick Company[2], and their characteristics are shown in the ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET.

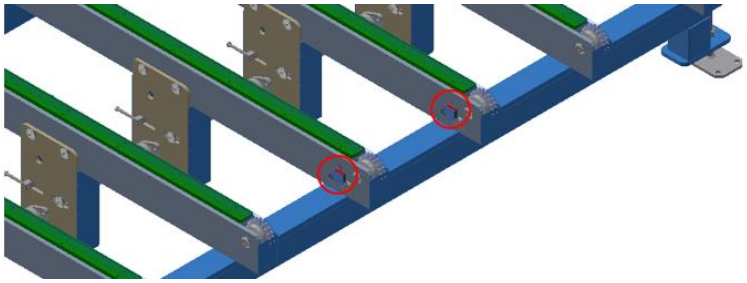


Figure 18. Photocells in the chain conveyor.

6) BELT CONVEYOR

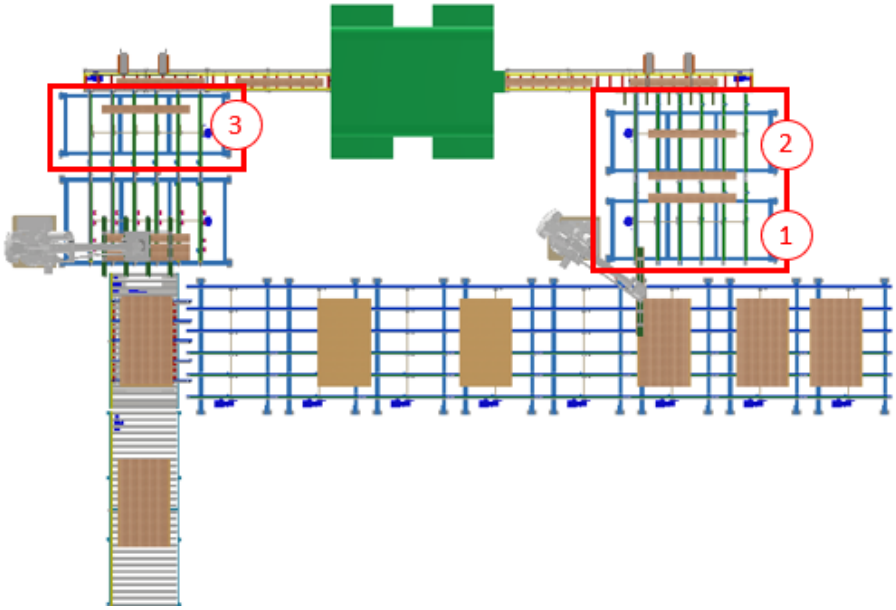


Figure 19. Belt conveyors in the line.

[2] *Sick. (n.d.). Recovered from https://www.sick.com/es/en/ on 9th June, 2021.*

In the line there are four belt conveyors, but one of them is special because it has stoppers, so we will analyze it later. The other three are shown in the figure 20. As the boards and lamellas aren't as much heavy as the pallets, we can use belts instead of chains, but the mechanism is so similar, as we can see in the following image.

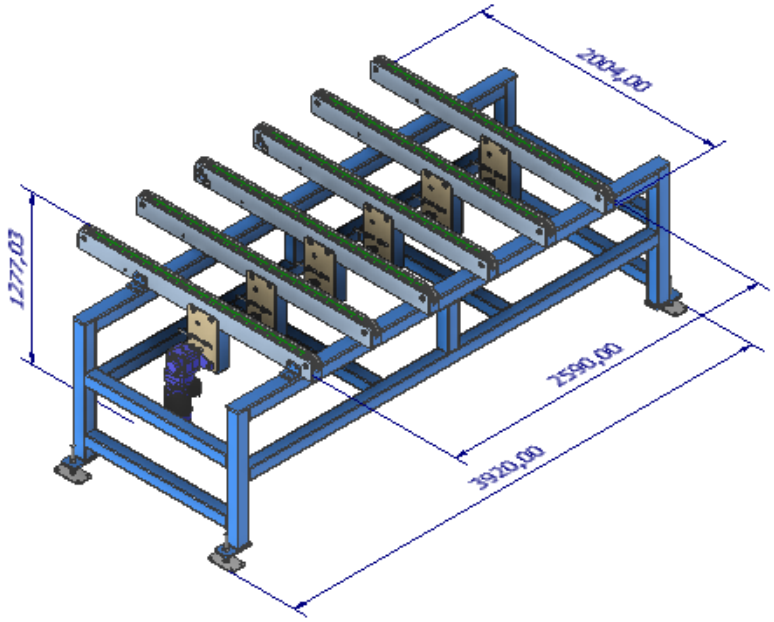


Figure 20. Belt conveyor.

As I have said before, the structure of the belt and chain is so similar, but let's see the inside of the mechanism.

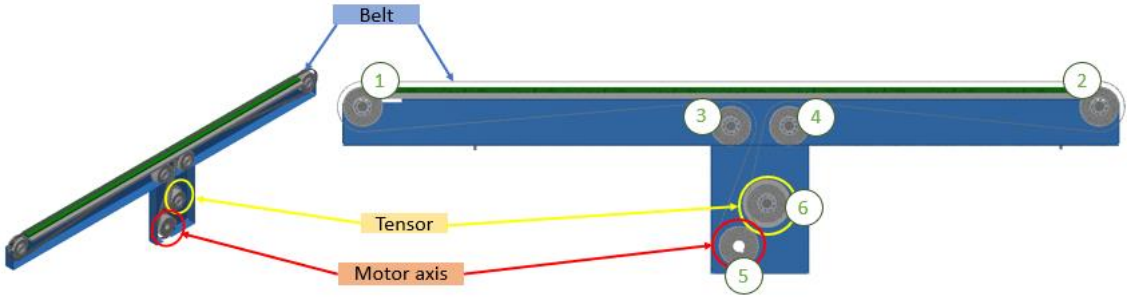


Figure 21. Belt mechanism.

Now there is not gears, so wheels with small teeth instead. The 1, 2, 3 and 4 wheels have rolling-element bearing, as we can see in the figure 22. In the other side, the wheel 5, which is the one that transmits the motor rotation, is similar but it doesn't have rolling-element bearing.

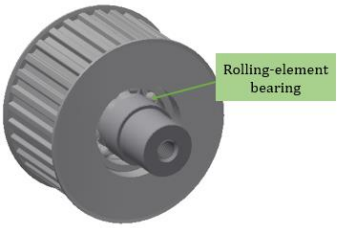


Figure 22. Wheel with teeth.

The wheel number 6, which is the one that can tense the belt if it is necessary, doesn´t have teeth, but it has rolling-element bearing.

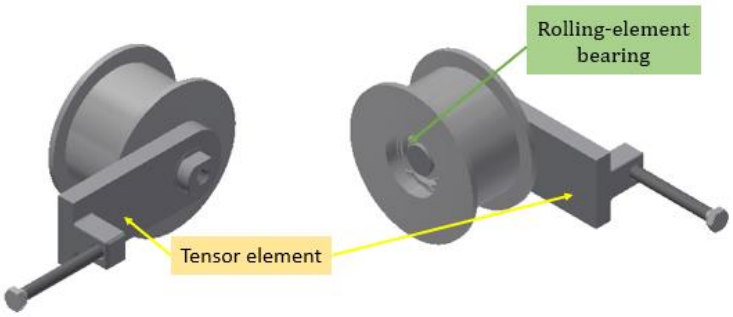


Figure 23. Wheel without teeth.

The motor to generate the movement is similar to the chain conveyor one. It is from Nord too, and the model is SK 93172.1AD - 80LH/4 TF. Its gear ratio of the reducer is 20,67 mm, and the power 0,75 kW. To see more details about it go to ANNEX III. MOTOR OF THE CHAIN CONVEYOR II, DATASHEET.

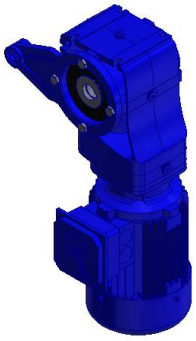


Figure 24. Belt conveyor motor.

In the belt conveyor it is necessary to check the good motion of the elements. That's why, as in the chain conveyor, two detection photocells on object from Sick Company are disposed at the end of the structure (see ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET).

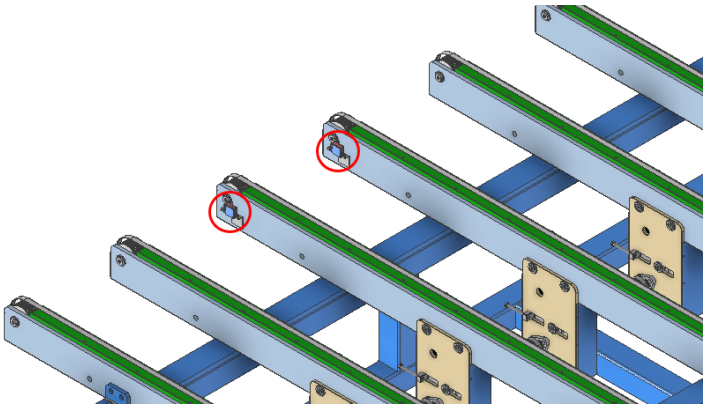


Figure 25. Photocells in the chain conveyor.

When the sensors of the belt conveyor number 2 detect that the board is there, is when the pneumatic system A can acts (the way will be explained in 14_ PNEUMATIC SYSTEM A). In the same way, the sensors of the belt conveyor number 3 are so important, because they send the information to the stoppers of the belt conveyor with stoppers, that is after it.

7) BELT CONVEYOR WITH STOPPERS

It is a normal belt conveyor, as the previous one, that has been added a stoppers system, to let the lamellas located in the correct position, that later will be taken by the robot B.

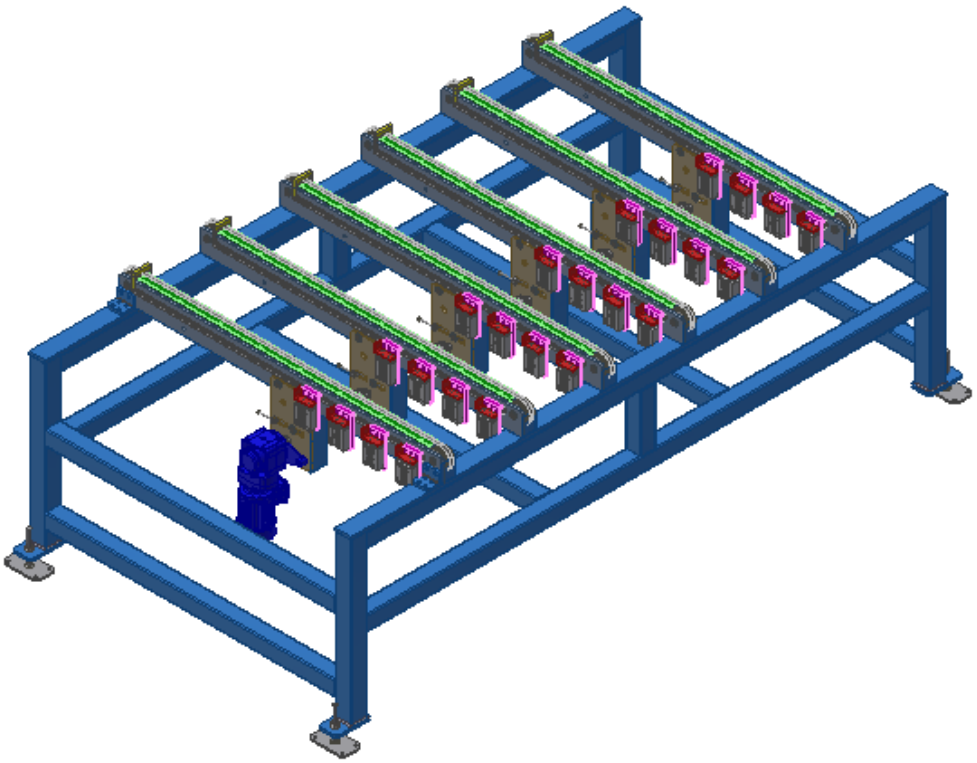


Figure 26. Belt conveyor with stoppers.

It is situated just after the belt conveyor number 3, as we can see in the figure 27:

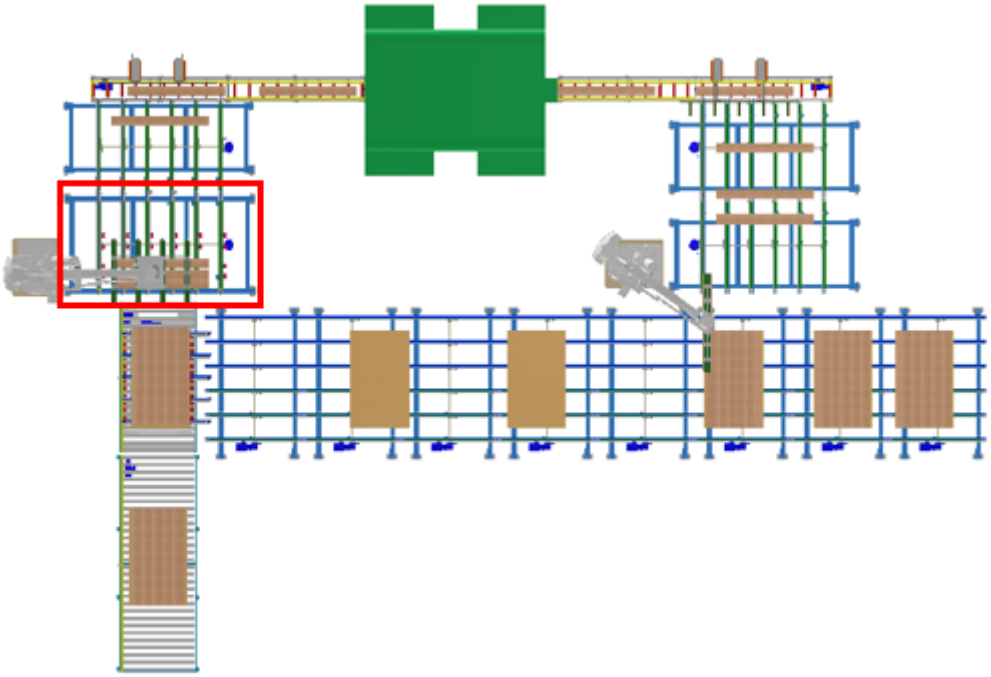


Figure 27. Belt conveyor with stoppers in the line.

First, the first group of lamellas go until the first stopper, that are only a small fixed elements that don't allow the lamellas go out of the conveyor.

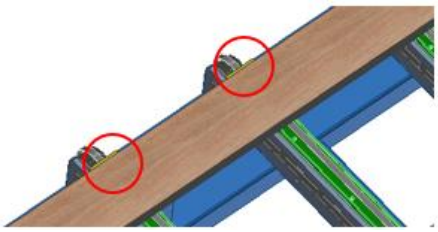


Figure 28. First stoppers.

Then, when the sensor of the third belt conveyor mentioned in the previous headland detects that the second group of lamellas is passing through it, the second stopper (the first mobile one) goes up, and guide the lamellas until their final position in the conveyor, that is next to the first lamellas group but with a small distance between them. With the third, fourth and fifth group, it will the same process.

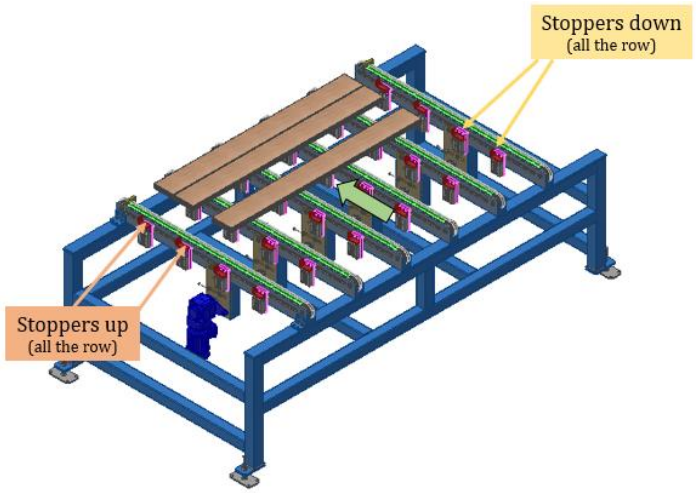


Figure 29. Stoppers working.

Finally, when the robot B finish its work and leaves the belt conveyor empty, all the stoppers go to their initial position, as it is shown in the figure 26.

To go up and down the stoppers have a small pneumatic system.

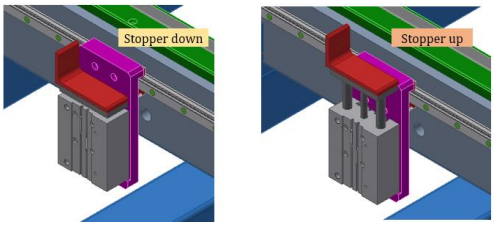


Figure 30. Pneumatic system of the stoppers.

These cylinders have been taken from SMC Company[3]. Its type is MGPL, what it means ball bushing (see ANNEX XIII. PNEUMATIC CYLINDERS MGP, DATASHEET). As they don't have to stand so much weight, the bore is 25 mm size. Their stroke is 50 mm long, and the piston rod diameter is 10 mm.

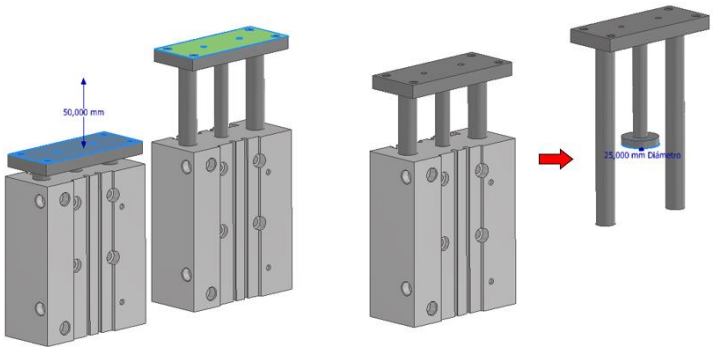


Figure 31. Cylinders of the stoppers' measures.

[3] *SMC. (n.d.). Recovered from https://www.smc.eu/en-eu on 5th May, 2021.*

Knowing these dimensions, it is possible to calculate the cylinders characteristics[4]:

Piston diameter	25	mm						
Piston rod diameter	10	mm						
Pressure	6	bar						
Piston surface area	4.909	cm2						
Force on the piston side	0.295	kN	=	0.03	vol =	30.033	kg	
Surface area on the piston rod side	4.123	cm2						
Force from the side of the piston rod	0.247	kN	=	0.025	vol =	25.228	kg	

Figure 32. Stoppers' cylinders characteristics.

Furthermore, they have position sensors, that allow them to know if the cylinder is up or down.

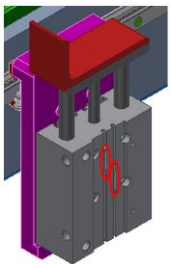


Figure 33. Position detectors of the stoppers.

It is possible to represent the pneumatic system of the stoppers through a scheme[5] (Croser, Thomson, Ebel, 2020).

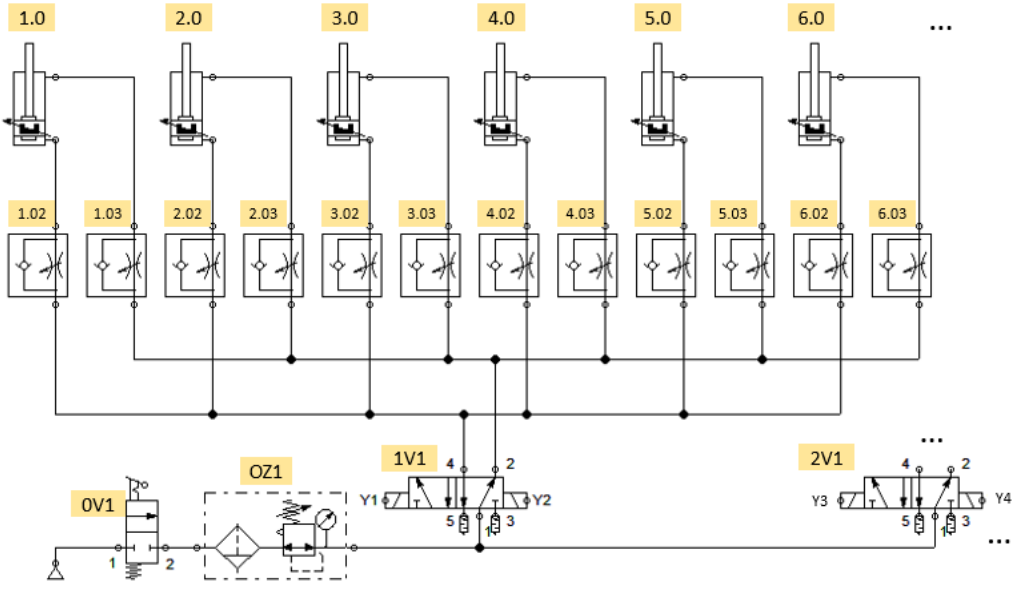


Figure 34. Stoppers' pneumatic system scheme.

[4] *Artom. (n.d.). Recovered from https://www.artom.com.pl/Pneumatyka/001.htm on 5th May 2021.*

[5] All the pneumatic schemes of the project have been done with FluidSIM program.

As there are a lot of stoppers, all the cylinders, solenoid valves and the non-returned valves are not represented. In the following table there are indicated all of them.

SOLENOID VALVES	NON-RETURNED VALVES	CYLINDERS
1V1	1.02	1.0
	1.03	
	2.02	2.0
	2.03	
	3.02	3.0
	3.03	
	4.02	4.0
	4.03	
	5.02	5.0
	5.03	
	6.02	6.0
	6.03	
2V1	7.02	7.0
	7.03	
	8.02	8.0
	8.03	
	9.02	9.0
	9.03	
	10.02	10.0
	10.03	
	11.02	11.0
	11.03	
	12.02	12.0
	12.03	
3V1	13.02	13.0
	13.03	
	14.02	14.0
	14.03	
	15.02	15.0
	15.03	
	16.02	16.0
	16.03	
	17.02	17.0
	17.03	
	18.02	18.0
	18.03	
4V1	19.02	19.0
	19.03	
	20.02	20.0
	20.03	
	21.02	21.0
	21.03	
	22.02	22.0
	22.03	
	23.02	23.0
	23.03	
	24.02	24.0
	24.03	

Table 4. Stoppers' pneumatic system elements

To go left and right, the stoppers are guided by a rail, as we can see in the figure 35.

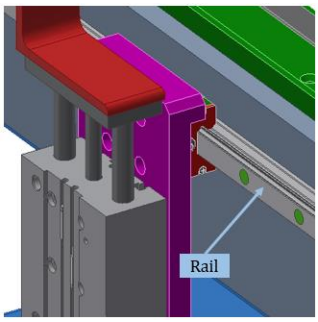


Figure 35. Stoppers' rail.

8) ROLLER CONVEYOR TO TRANSPORT BOARDS AND LAMELLAS

In this production line, there are two types of roller conveyors. One of the types is to transport boards and lamellas. For that reason, they are tighter than the other type ones, which are to transport pallets (they will be explained later).

This roller conveyors are located to allow the input of boards into the cutting machine, and to allow the output of lamellas from the same machine. The only difference between them two are the borders that secure the correct direction of the wood elements (they are in mirror position).

In the following picture we can see where are this roller conveyors located in the production line.

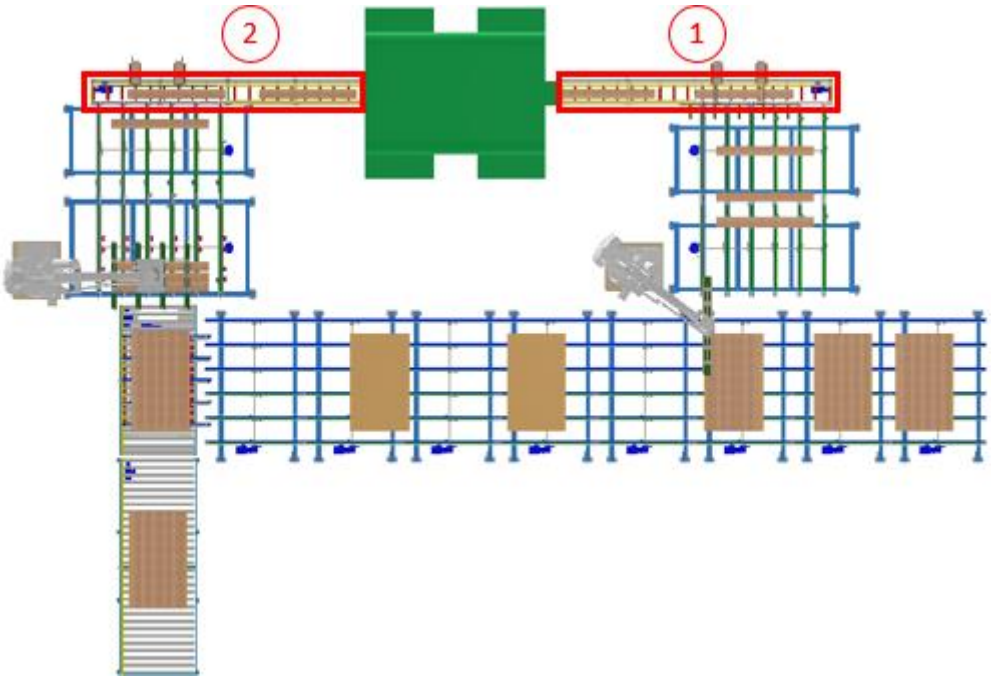


Figure 36. Roller conveyors to transport boards and lamellas in the line.

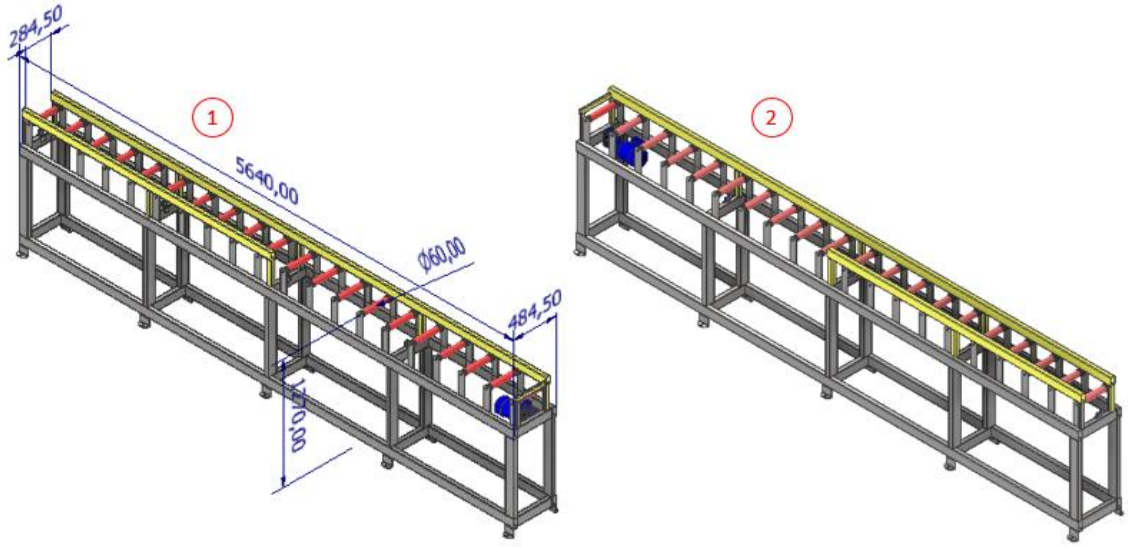


Figure 37. Roller conveyors to transport boards and lamellas.

This roller conveyor has been designed, taking first at all the correct roller from Interroll Company[6], and designing a suitable structure after that, taking into account the dimensions required (Cervera, Blanco, 2014). The rollers used are the series 3500 light, because they are appropriate in chain-driven unit load handling for conveying lightweight materials with compact dimensions, such as the boards and lamellas the line is working with. All the details about these rollers are in ANNEX VI. ROLLERS SERIES 3500 LIGHT, DATASHEET.

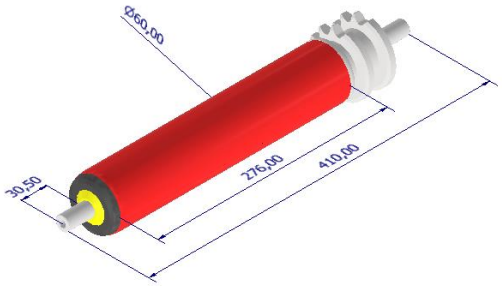


Figure 38. Roller series 3500 light, Autodesk Inventor model.

To make the rollers work at the same time, there is a motor that generates the rotative movement. As in the previous cases, it is from Nord Company (all its characteristics are in ANNEX V. MOTOR OF THE ROLLER CONVEYOR I, DATASHEET). The model is SK 1SI50 - IEC80 - 80LP/4 B14 C120 TF.

This is connected to the first roll by a chain, as it is shown in the figure 39, so they will move coordinated.

[6] *Interroll. (n.d.). Recovered from https://www.interroll.com/ on 2nd March, 2021.*

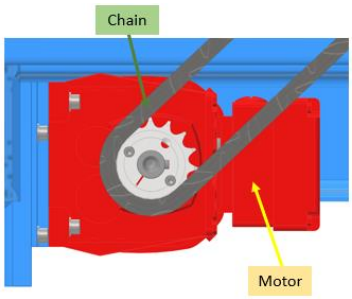


Figure 39. Motor performance in the roller conveyor.

Then, as all the rollers must have the same movement, they will be connected by a chain, two by two, as in the following image.

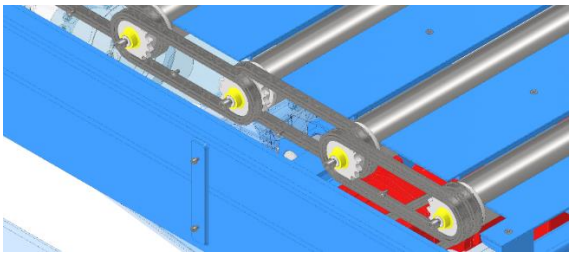


Figure 40. Rollers' connection in the roller conveyor.

In the same way as in the chain and belt conveyor, it is important to control in every moment the elements that are transported. That is why there are four detection photocells on object (ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET) in each roller conveyor of this type.

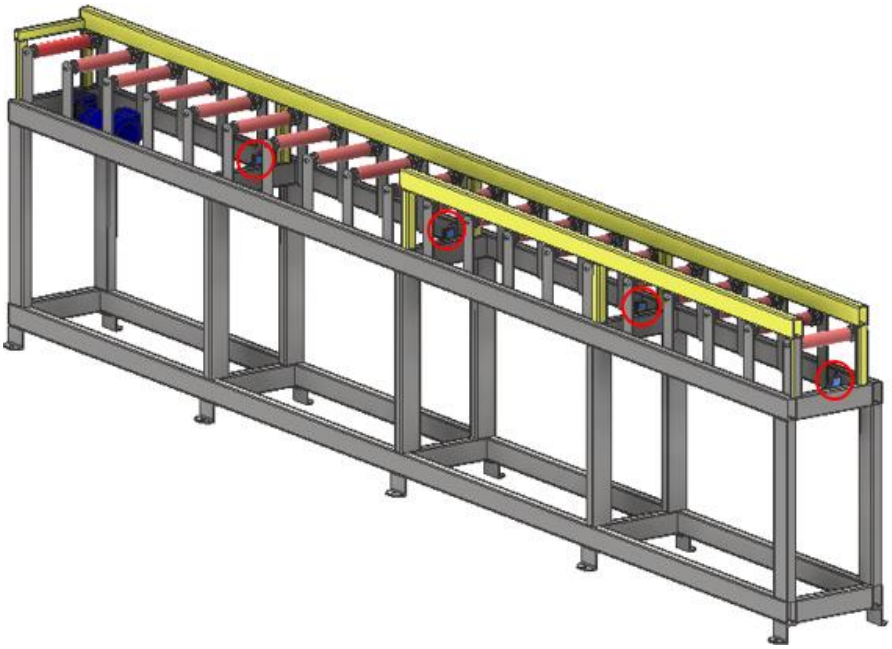


Figure 41. Photocells in the roller conveyors to transport boards and lamellas (I).

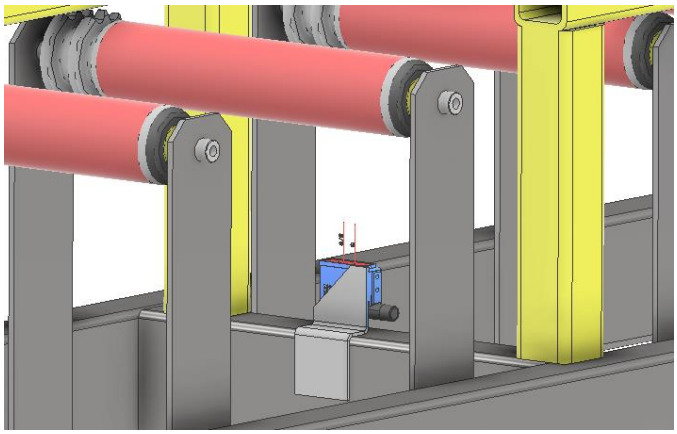


Figure 42. Photocells in the roller conveyors to transport boards and lamellas (II).

In this chain conveyor 2, the sensors are responsible to send the information to the pneumatic system B, and inform it when it has to act (see later 15_ PNEUMATIC SYSTEM B).

9) ROLLER CONVEYOR TO TRANSPORT PALLETS

As I mentioned before, there are two types of roller conveyors in this line. Now the one to transport pallets is going to be analyzed. It corresponds to the final part of the production line.

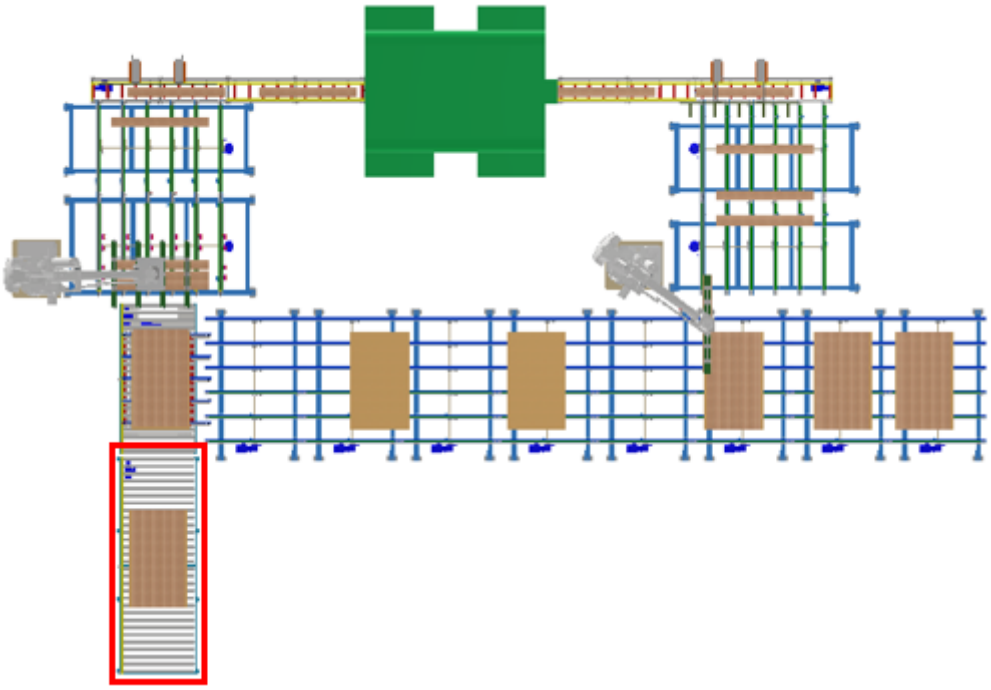


Figure 43. Roller conveyors to transport pallets in the line.

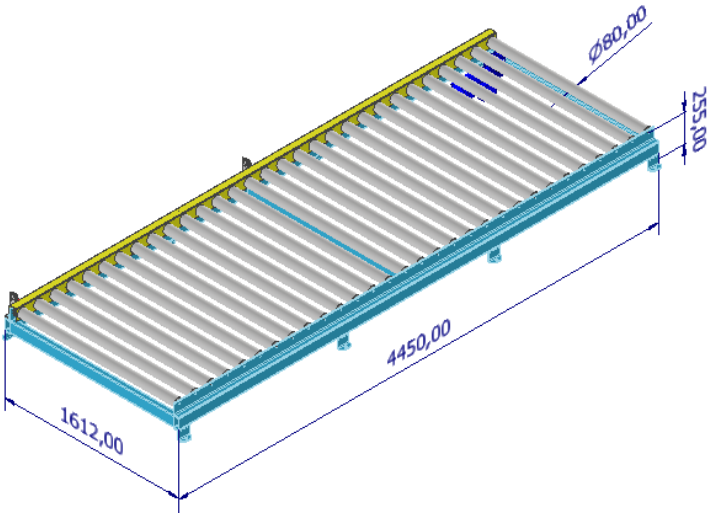


Figure 44. Roller conveyor to transport pallets.

The process to design this roller conveyor is the same as the one explained before, first it is necessary take the correct rollers and then, depending on the dimensions, the structure is created (Cervera, Blanco, 2014).

As the weigh that the roller has to transport is bigger than in the previous case, the Series 3800 from Interroll Company were selected (view technical data in ANNEX VIII. ROLLERS SERIES 3800, DATASHEET).

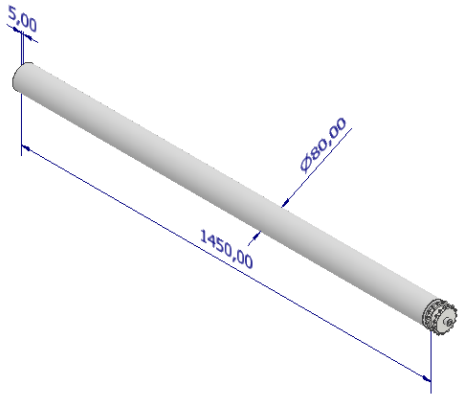


Figure 45. Roller series 3800, Autodesk Inventor model.

The performance of the roller is the same as in the other one. Thanks to the chains connected between the motor and the different rolls, the movement all along the machine is possible. About the motor, it is similar to the previous one too (model SK 1SI50 - IEC80 - 80LP/4 B14 C120 TF). See all the parameters in ANNEX VI. MOTOR OF THE ROLLER CONVEYOR II, DATASHEET.

Again, it is necessary to have a control over the pallets, so two detection photocells on object are installed (see ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET).

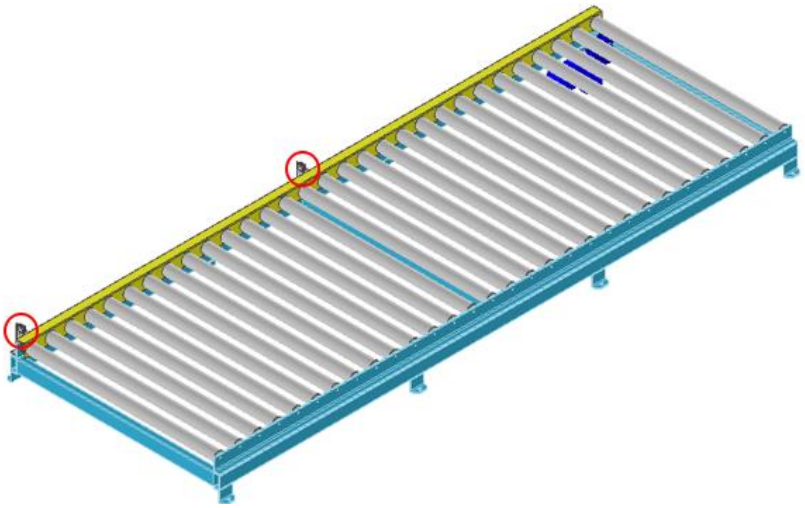


Figure 46. Photocells in the roller conveyor to transport pallets (I).

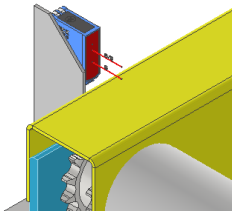


Figure 47. Photocells in the roller conveyor to transport pallets (II).

10) LIFTING TABLE

There is a lifting table in the production line. It is the place where the pallets wait for the robot B to stack the lamellas on it. It is situated in the following place.

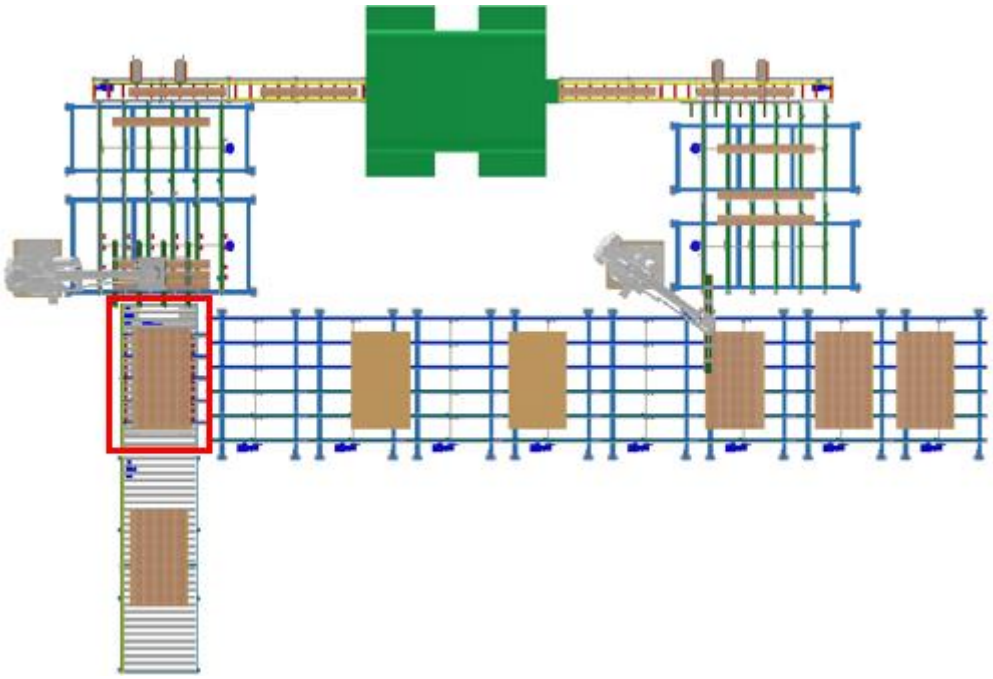


Figure 48. Lifting table in the line.

If we see the floor of the production line, there is a rectangle hole in it, where the lifting table is placed. It enables the correct positioning of it.

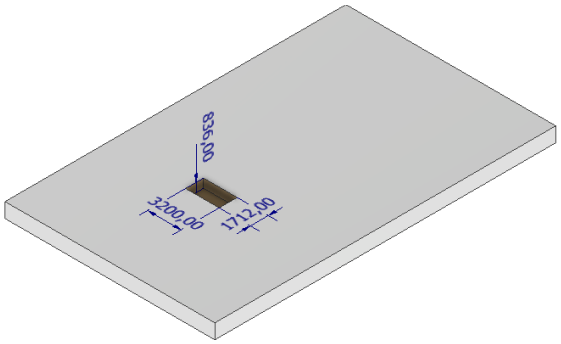


Figure 49. Lifting table hole.

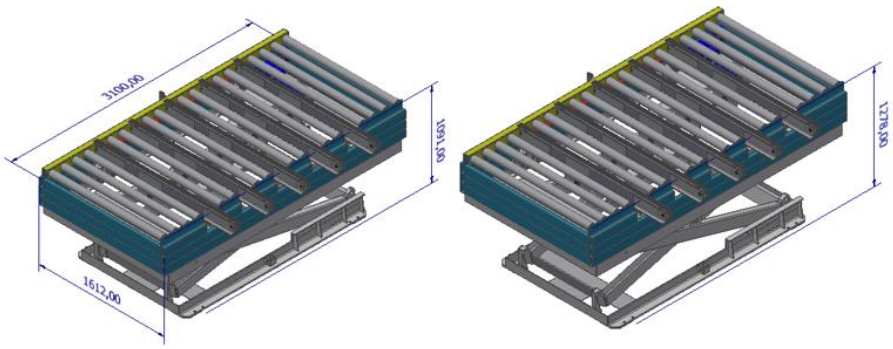


Figure 50. Lifting table.

The lifting table is formed by the mechanism of the table, which allows it to go up and down through a hydraulic mechanism. This lifting table is taken from FAMAD[7] Company and its characteristics are specified in ANNEX IX. FAMAD SCISSORS LIFT DBNA, DATASHEET.

In the upper part there is a roller conveyor to transport the pallets to the final roller conveyor of the line. It is mixed with a chain conveyor that allows the movement in the opposite direction. That is because the pallets do the following trajectory in that part of the line.

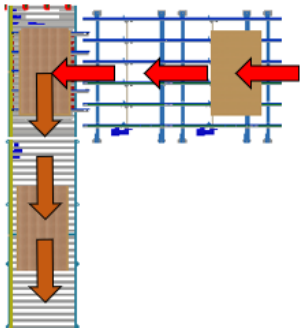


Figure 51. Pallets' trajectory in the lifting table.

[7] *Famad. (n.d.). Recovered from http://www.famad.com.pl/en/ on 27th April, 2021.*

When the machine has to take the empty pallets, it takes the respective height, and the chain conveyor goes upper than the rollers, thanks to a pneumatic system. In the other hand, when the pallets must go out of the line, the chain conveyor goes down. In the picture below, the three main positions of the lifting table are shown.

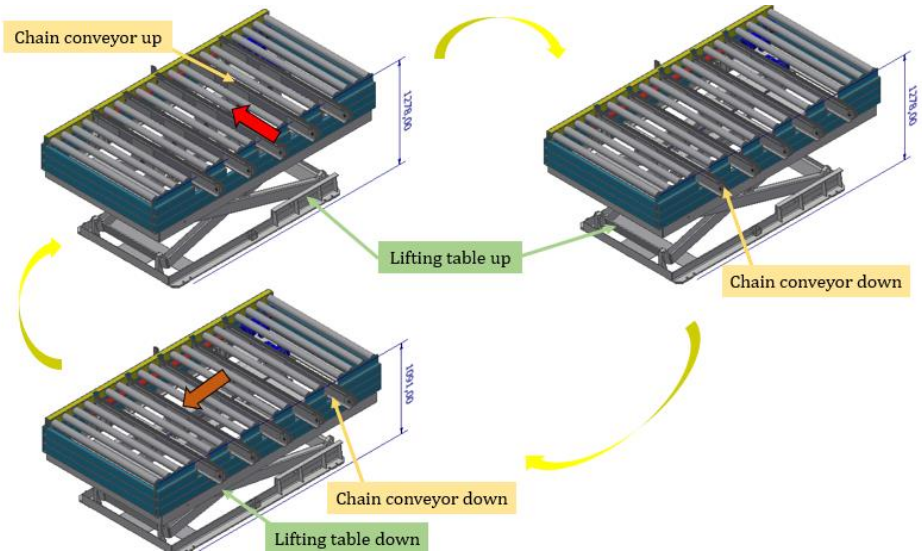


Figure 52. Positions of the lifting table.

First at all, the lifting table is up, with the chains up too, waiting for a pallet. When the detection photocell on object (ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET) detects a pallet, the chains go down. The pallet stops waiting for the robot to put 100 rows of lamellas on it. The programming of the robot is connected with the lifting table one, so after 100 robot movements, the lifting table goes down and the rolls start to rotate, taking the pallet out of the lifting table. After few seconds the sensor doesn't detect it the mechanism of the scissors and the chains go up, waiting for another pallet.

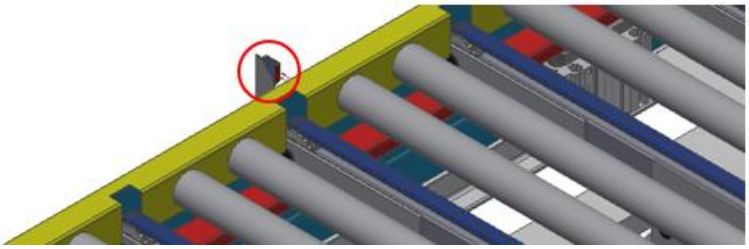


Figure 53.Photocell in the lifting table.

As we can see in the pictures above, the roller conveyor part is similar to the roller conveyor to transport pallets one. The main difference is that there are five rollers left, where the chains are placed. Because of the chain conveyor between the rolls, it is not possible to connect the rolls with chains as it was showed in the figures 39 and 40, so it was necessary to create a mechanism as in the picture below.

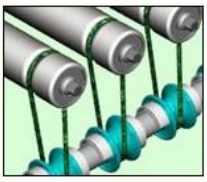


Figure 54. Rollers of the lifting table connection mechanism.

This is connected by thermoplastic polyurethane (TPU) round belting cord.

The chains are the same as in the chain conveyor ones, but in this case, a pneumatic system is added.

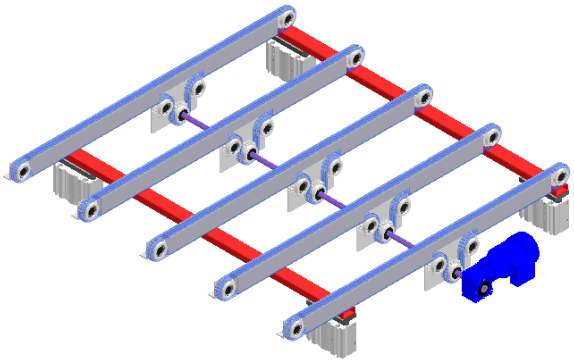


Figure 55. Chain conveyor part of the lifting table.

About the pneumatic cylinders selected, four of them are the same ones. They are from SMC Company and we will use them for the pneumatic system A and B (up-down cylinders) (it will be explained deeply in that headland).

To know how this pneumatic system works, we can see the pneumatic system below (Croser, Thomson, Ebel, 2020).

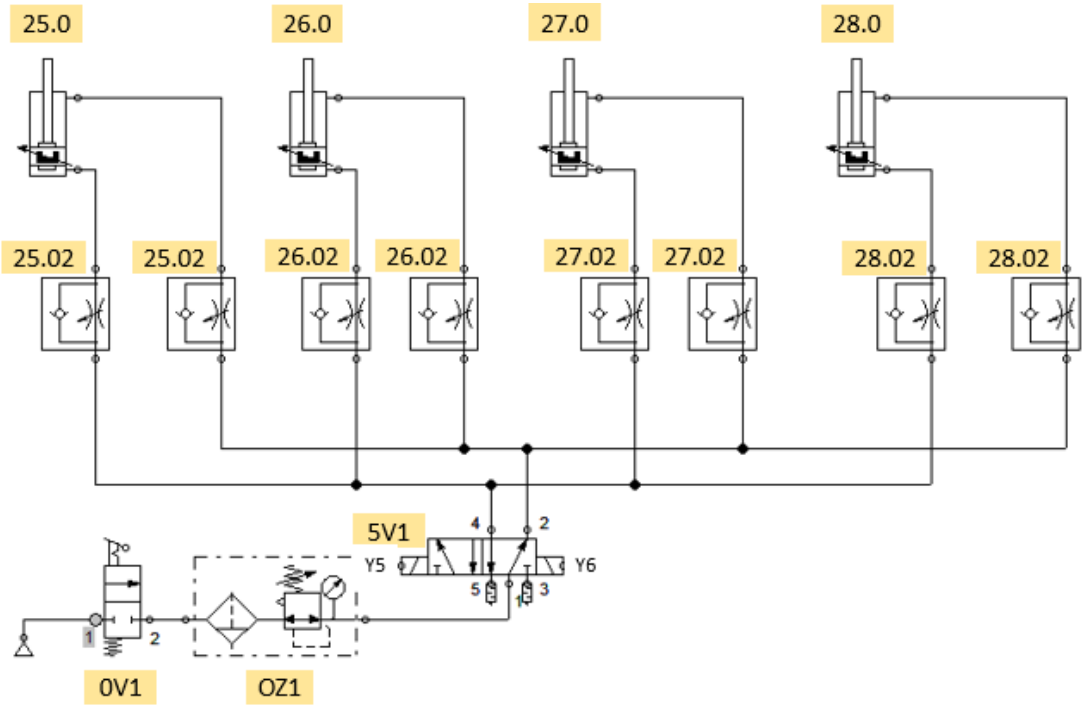


Figure 56. Lifting table pneumatic scheme.

As there are two conveyors in one machine, two motors will be required. They are, as always, from Nord. In the chains part, the motor is the one of the ANNEX III. MOTOR OF THE CHAIN CONVEYOR II, DATASHEET, while in the rollers part it is the one corresponding to ANNEX VI. MOTOR OF THE ROLLER CONVEYOR II, DATASHEET.

Furthermore, as it is important to know when the empty pallet is already in the lifting table, and so the chains must stop and go down, there is a detection photocell on object (ANNEX I. PHOTOELECTRIC SENSORS, DATASHEET).

11) CUTTING MACHINE

The cutting machine is the central element of the production line.

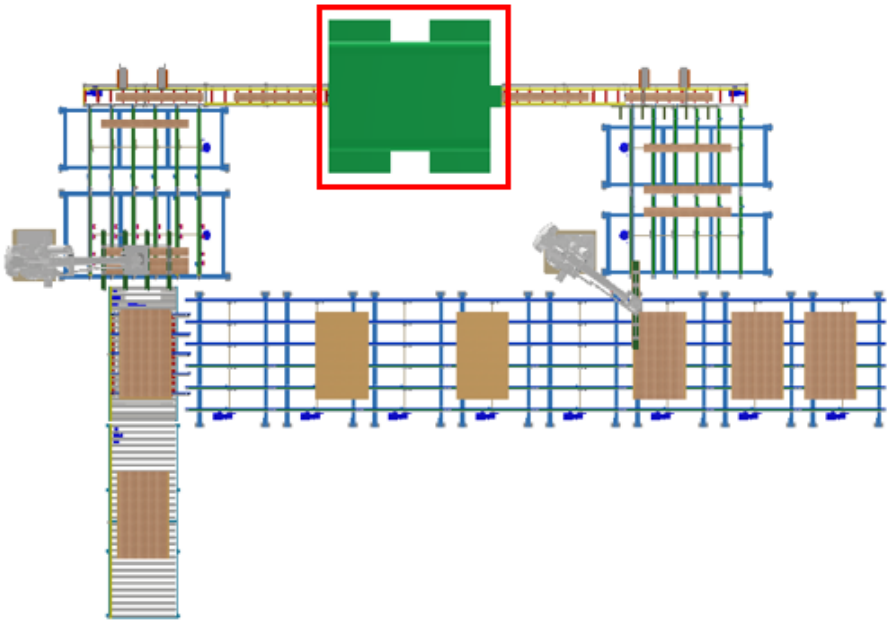


Figure 57. Cutting machine in the line.

The boards, that are 40 mm wide, go into it and they are cut. They leave the machine as a group of six lamellas, 5 mm wide. Only 6 lamellas are obtained because in the cutting process, some material is lost.

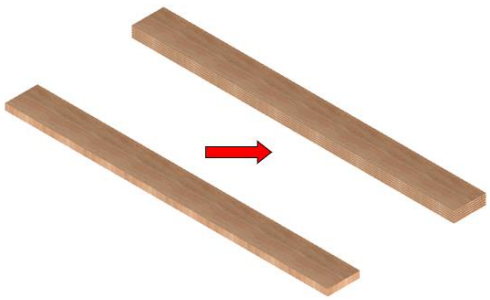


Figure 58. Boards transformation to lamellas.

Wintersteiger[8] is the company that is going to provide that machine (see ANNEX X. CUTTING MACHINE DSB TWINHEAD NG XM, DATASHEET). It is designed as a set of modules. Each module can have two blades. As in this project we are obtaining 6 lamellas, 5 blades will be necessary, what means that the machine will have three modules.

Figure 59. Cutting machine with three modules.

The heigh in which the boards enter into the machine is 1300 mm. That is why most of the production line heigh is that one.

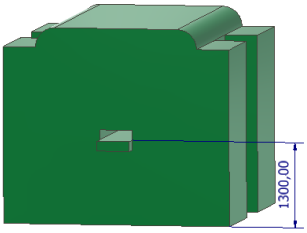


Figure 60. Cutting machine in Autodesk Inventor.

12) ROBOT A

There are two industrial robots in the production line, that ease the functioning of it. Both of them are from ABB Company[9], model IRB 760 (see ANNEX XI. ROBOT IRB 760, DATASHEET) and they have been programed to make their work, with the corresponding parameters. Their location has been chosen to enable them reach all the positions they must do (Karabegović, Banjanović-Mehmedović, 2020). The difference between them is the final vacuum griper, that is designed depending on the functionality.

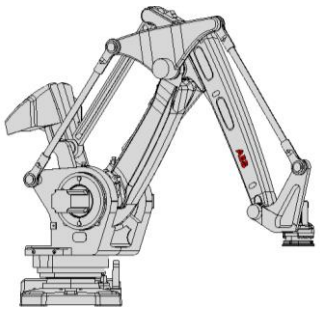


Figure 61. Industrial robot ABB, model 760.

[8] *Wintersteiger. (n.d.). Recovered from https://www.wintersteiger.com/en/Group on 3rd May, 2021.*
[9] *ABB. (n.d.). Recovered from https://new.abb.com/uk on 14th April, 2021.*

For both of them, a base has been designed, to place them in the correct height.

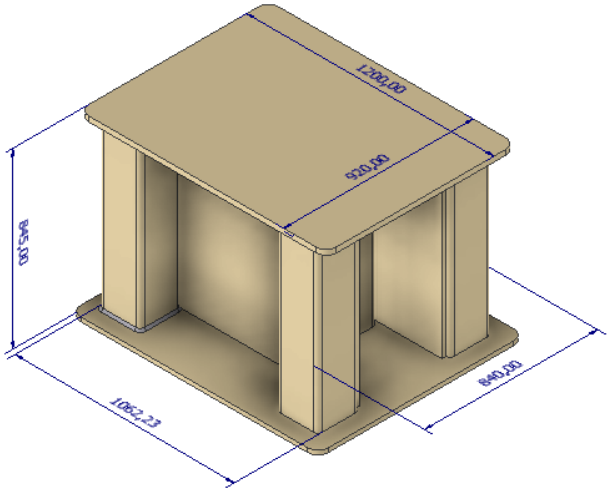


Figure 62. Robot base.

Now, let's analyze the final tool of robot A, that is the one placed where the following figure indicates.

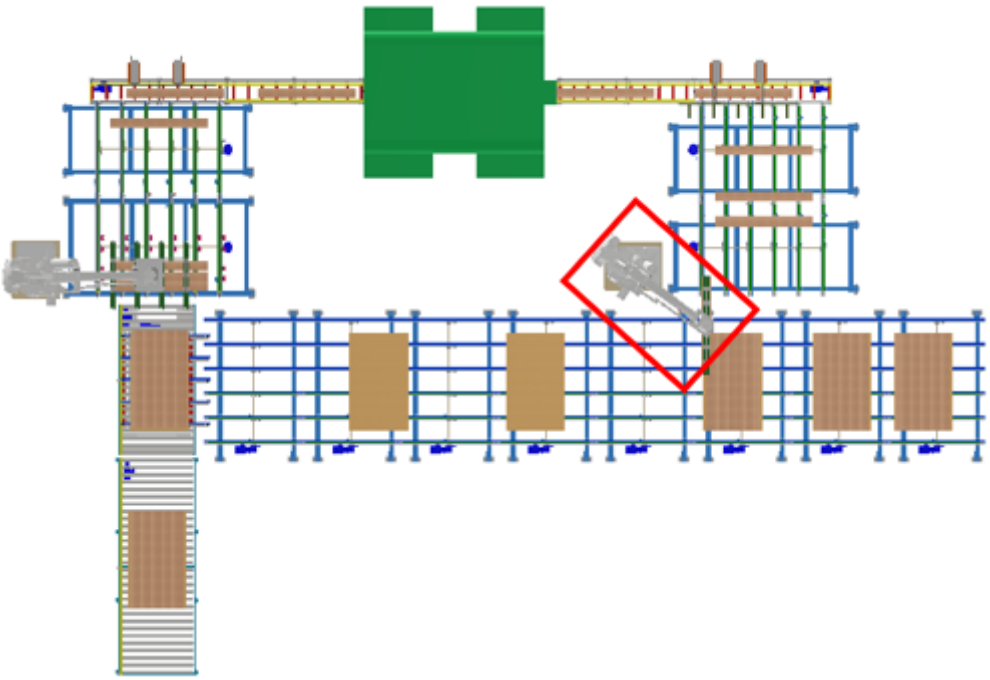


Figure 63. Robot A in the line (I).

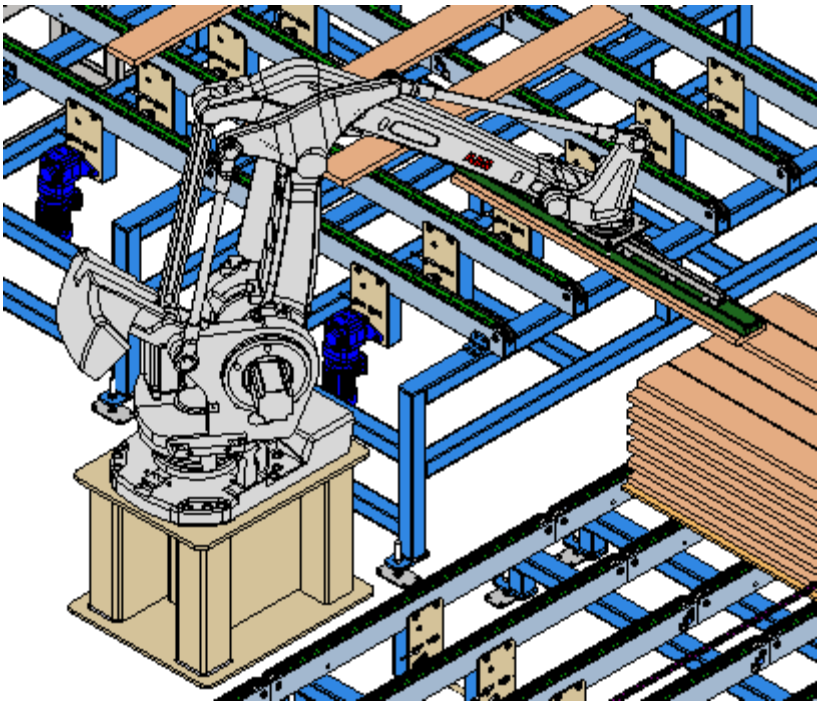


Figure 64. Robot A in the line (II).

This robot has to take the boards from the input pallets, one by one, and place them into the belt conveyor next to it. That is why at the end of the robot, the tool is a vacuum griper with the following dimensions.

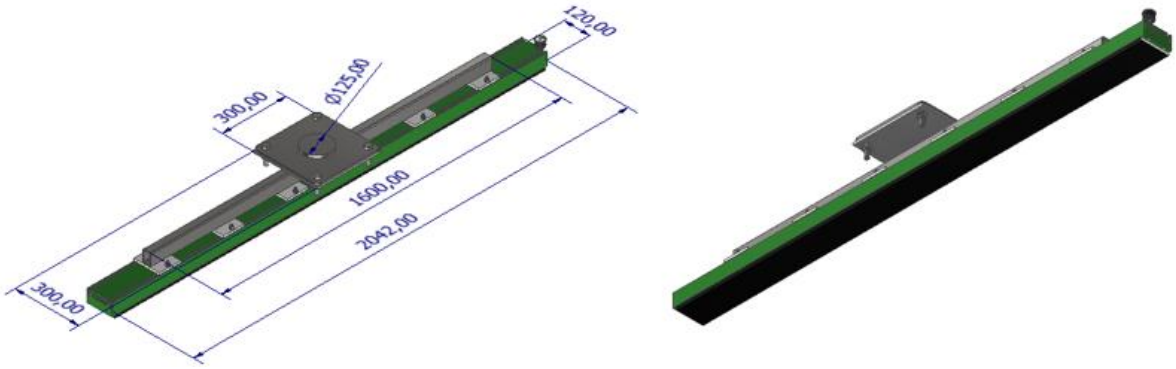


Figure 65. Vacuum griper robot A.

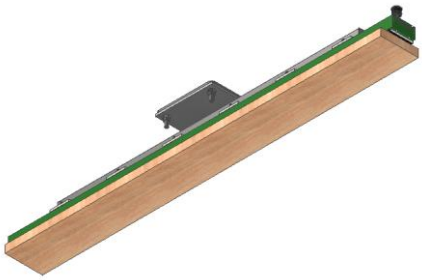


Figure 66. Vacuum griper robot A taking a board.

The vacuum griper was taken from Piab Company[10], model KVG60 (see details in ANNEX XII. VACUUM GRIPER PIAB KVG60 SERIES, DATASHEET). It was necessary to design a structure to fixed it into the robot, according to the dimensions (Cervera, Blanco, 2014).

13)ROBOT B

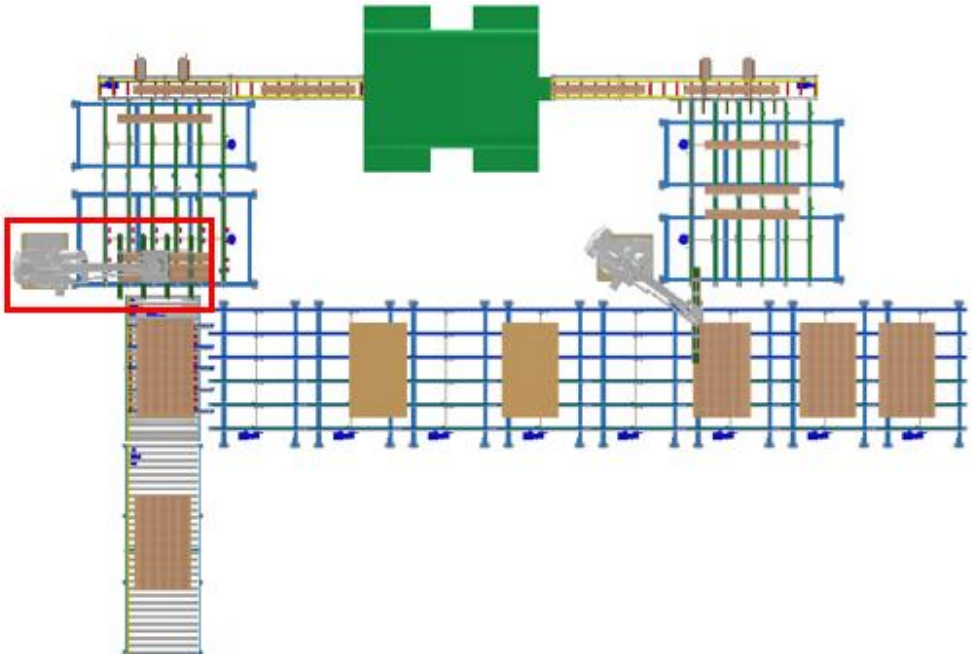


Figure 67. Robot B in the line (I).

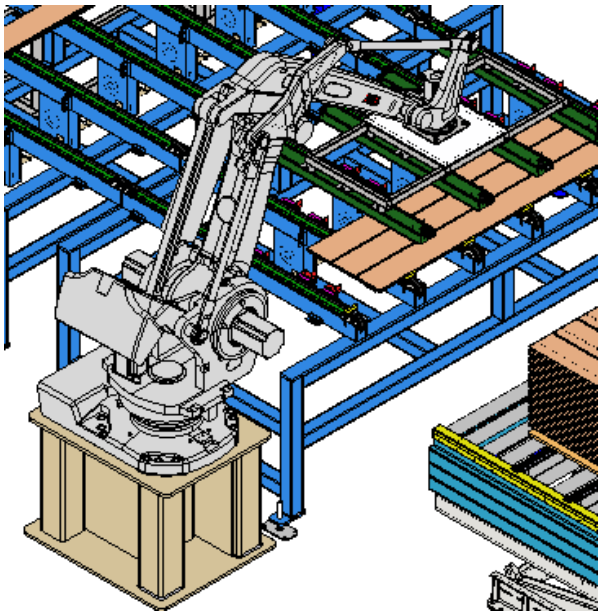


Figure 68. Robot B in the line (II).

[10] *Piab. (n.d.). Recovered from https://www.piab.com/ on 14th April, 2021.*

As it was said before, the different aspect in this robot is the vacuum griper tool, and its respective structure (Cervera, Blanco, 2014). We can see it in the following figure.

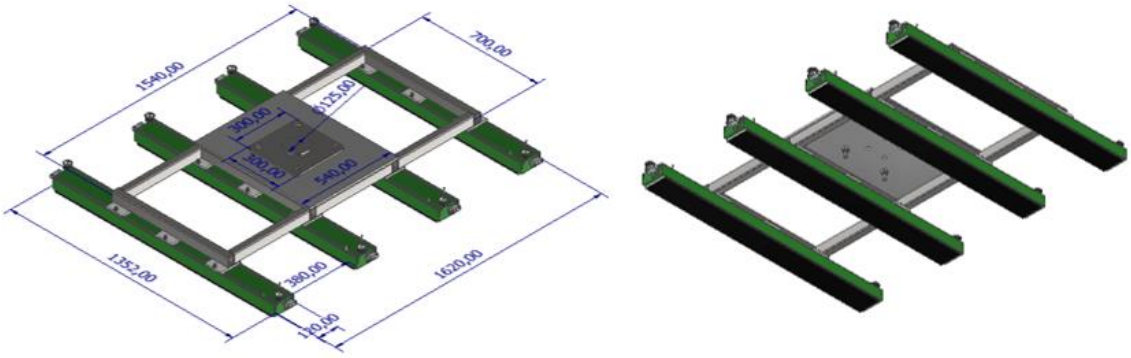


Figure 69. Vacuum griper robot A.

Comparing this construction with the one of the robot A, we can see that there are four vacuum gripers instead of only one, but the model is the same one (see ANNEX XII. VACUUM GRIPER PIAB KVG60 SERIES, DATASHEET) The lengths are different too. As in the other case, the structure is designed according to the functionality.

This robot is the one which has to take a group of five lamellas and stack them in the output pallet. The lamellas will have always the same distance between them, and the correct position thanks to the stoppers of the belt conveyor. In the following picture we can see how this robot has to take the lamellas.

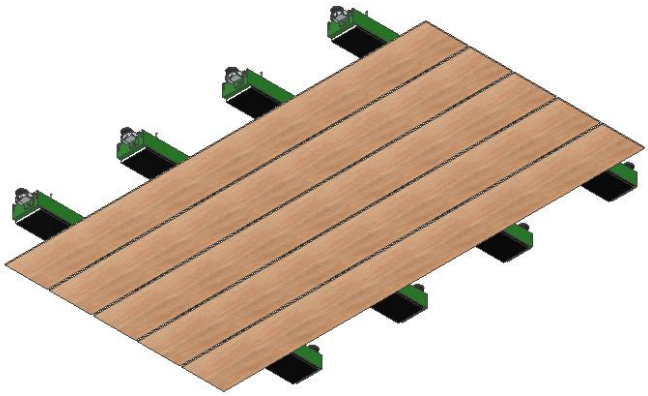


Figure 70. Vacuum griper robot A taking the final lamellas.

14) PNEUMATIC SYSTEM A

In this line there are two pneumatic system, that are in charge of pushing the boards (o lamellas) when their movement change the direction.

In the case of the first pneumatic system, it is located where the following figure shows.

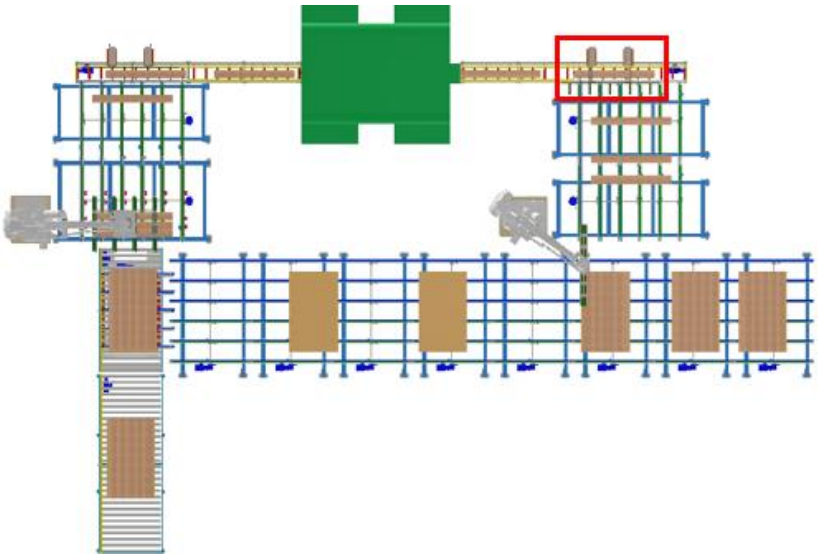


Figure 71. Pneumatic system A in the line.

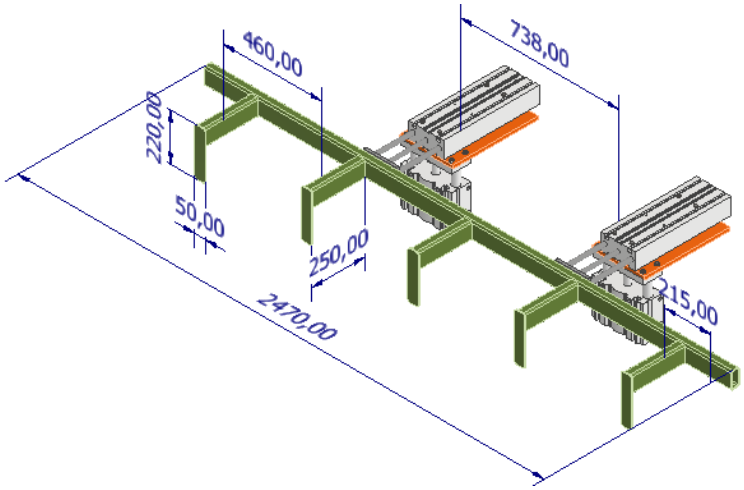


Figure 72. Pneumatic system A dimensions.

The boards are pushed by the pneumatic system A, from the belt conveyor to the roller conveyor that allows the input into the cutting machine.

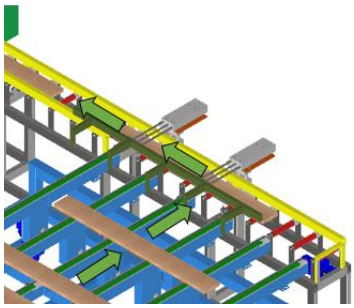


Figure 73. Pneumatic system A, change of direction.

If we analyze the system deeply, there are four pneumatic cylinders: two of them allows the up and down movement, and the other two the forward and backward movement.

When a board is arriving close to the roller conveyor, the system goes up and forward, then it goes down and backward, as we can see in the picture.

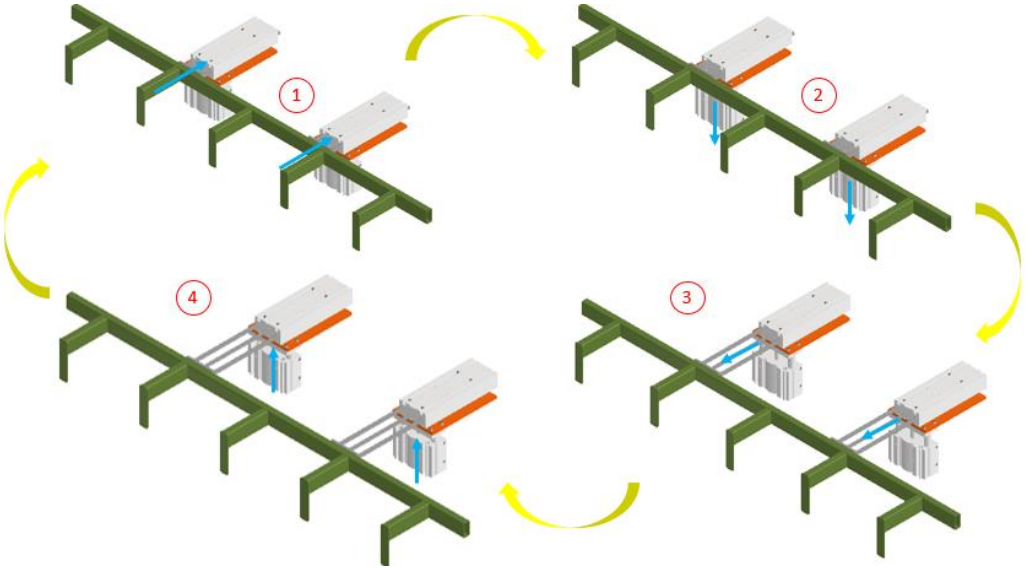


Figure 74. Pneumatic system A functioning.

The pneumatic scheme of this system is the one shown in the image below (Croser, Thomson, Ebel, 2020).

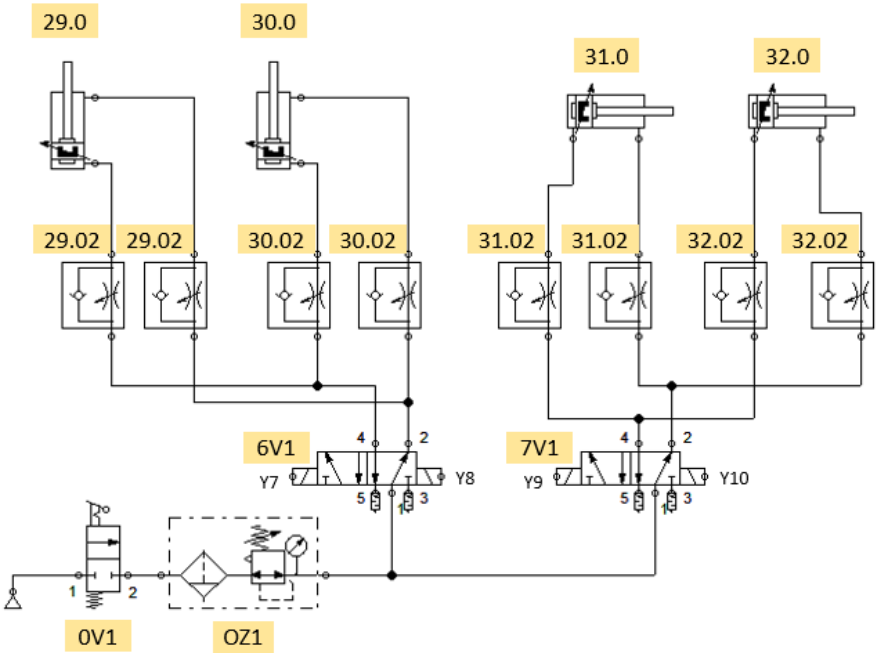


Figure 75. Pneumatic system A scheme.

The cylinders are from SMC Company, and they have end lock mechanism. To choose their characteristics it is necessary to select the bore size, that it is the cylinder diameter, and the stroke, that is the distance that the cylinder does when

it moves. To see more details, go to ANNEX XIII. PNEUMATIC CYLINDERS MGP, DATASHEET.

Attending to these characteristics, the up-down cylinders have a 100 mm bore size, and a 50 mm stroke. The piston rod diameter is 30mm. They are MGPM type, what means slide bearing.

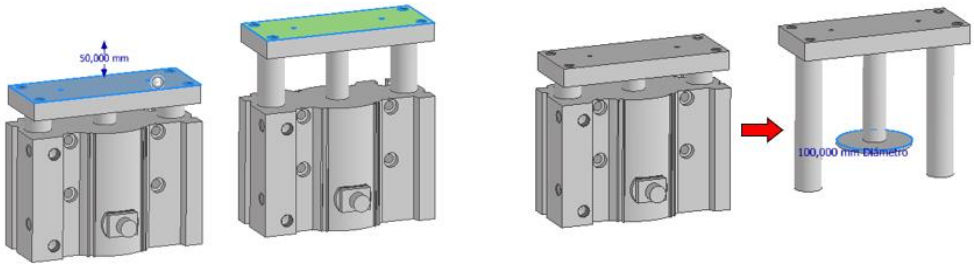


Figure 76. Up-down cylinder, pneumatic system A.

With this data, there are more parameters that we can calculate, and that are important to know, to choose the correct size [11].

Piston diameter	100	mm						
Piston rod diameter	30	mm						
Pressure	6	bar						
Piston surface area	78.54	cm2						
Force on the piston side	4.712	kN	=	0.481	vol =	480.53	kg	
Surface area on the piston rod side	71.471	cm2						
Force from the side of the piston rod	4.288	kN	=	0.437	vol =	437.282	kg	

Figure 77. Up-down cylinder characteristics, pneumatic system A.

In the other hand, the forward-backward cylinders have a 63 mm bore size, and a 400 mm stroke. The piston rod diameter is 18 mm. Its type is ball bushing (MGPL).

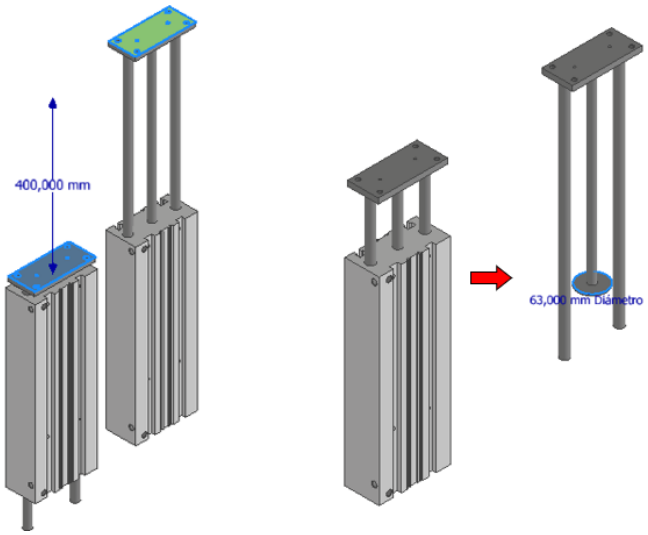


Figure 78. Forward-backward cylinder, pneumatic system A.

Piston diameter	63	mm						
Piston rod diameter	18	mm						
Pressure	6	bar						
Piston surface area	31.172	cm2						
Force on the piston side	1.87	kN	=	0.191	vol =	190.722	kg	
Surface area on the piston rod side	28.628	cm2						
Force from the side of the piston rod	1.718	kN	=	0.175	vol =	175.153	kg	

Figure 79. Forward-backward cylinder characteristics, pneumatic system A.

15) PNEUMATIC SYSTEM B

As it was said before, there are two pneumatic systems. The second one is situated in the roller conveyor that allows the output of lamellas from the cutting machine, to push them into the next belt conveyor. Its mechanism is the same as the A one, but the structure to push the wood elements it is not.

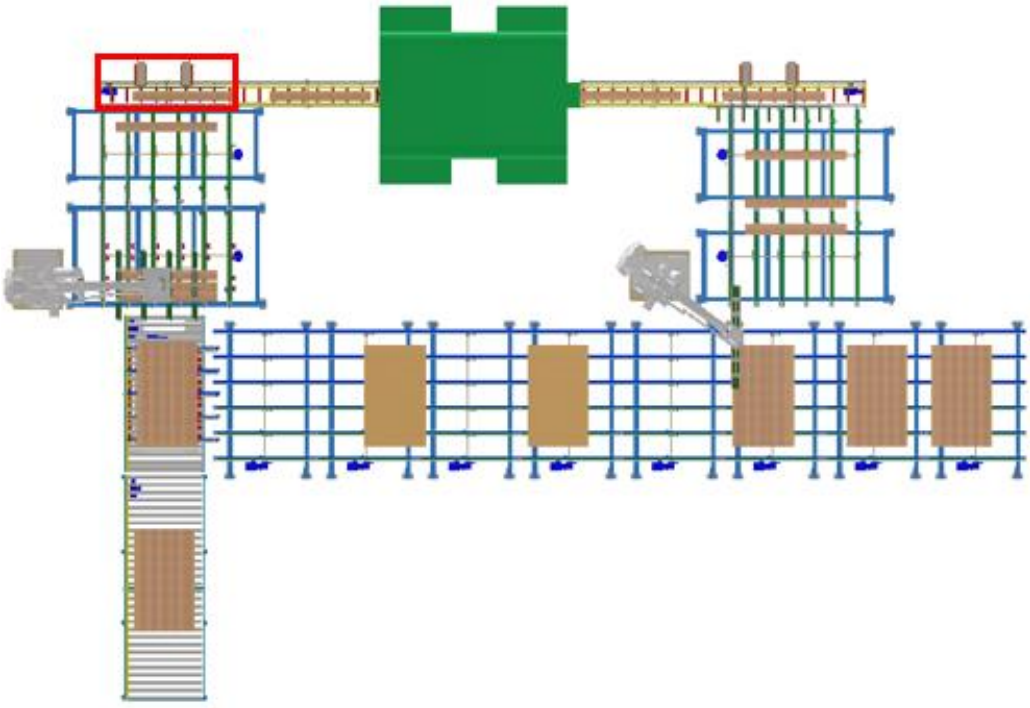


Figure 80. Pneumatic system B in the line.

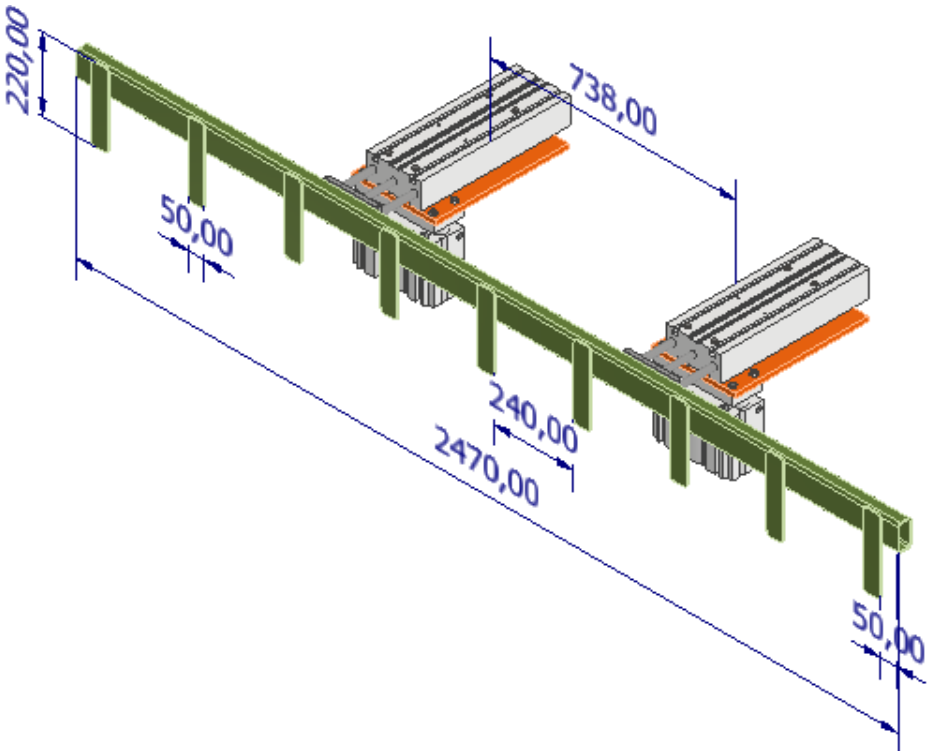


Figure 81. Pneumatic system B dimensions.

As we can see, there are so many similarities between both pneumatic systems.

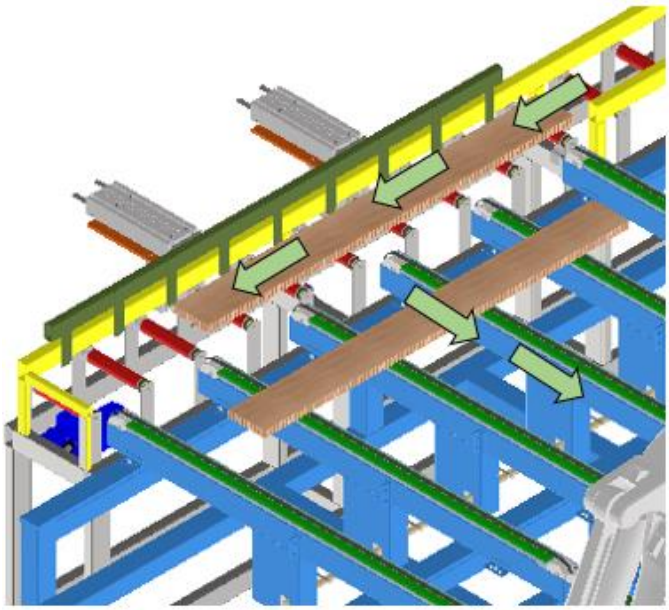


Figure 82. Pneumatic system B, change of direction.

As in the previous case, this system has four positions. When the lamellas must change their direction, the system goes down and forward, and later it goes up and backwards, as we can see in the next diagram.

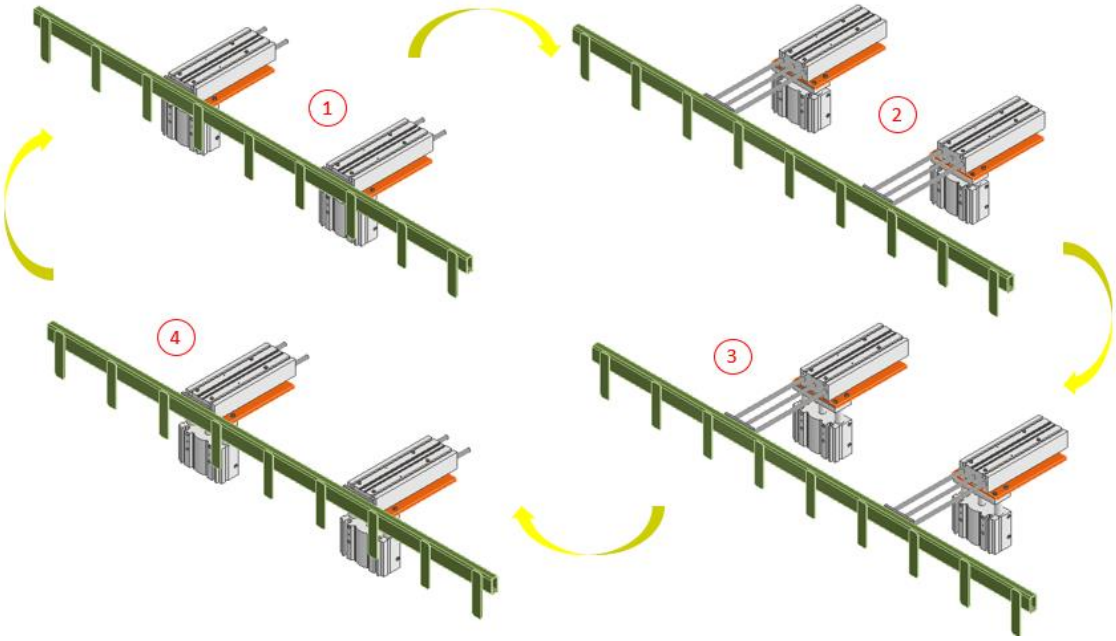


Figure 83. Pneumatic system B functioning.

About the cylinders used in both systems are the same ones.

If we see the pneumatic scheme of the system, it is the same as in the pneumatic system A. It is the one below (Croser, Thomson, Ebel, 2020).

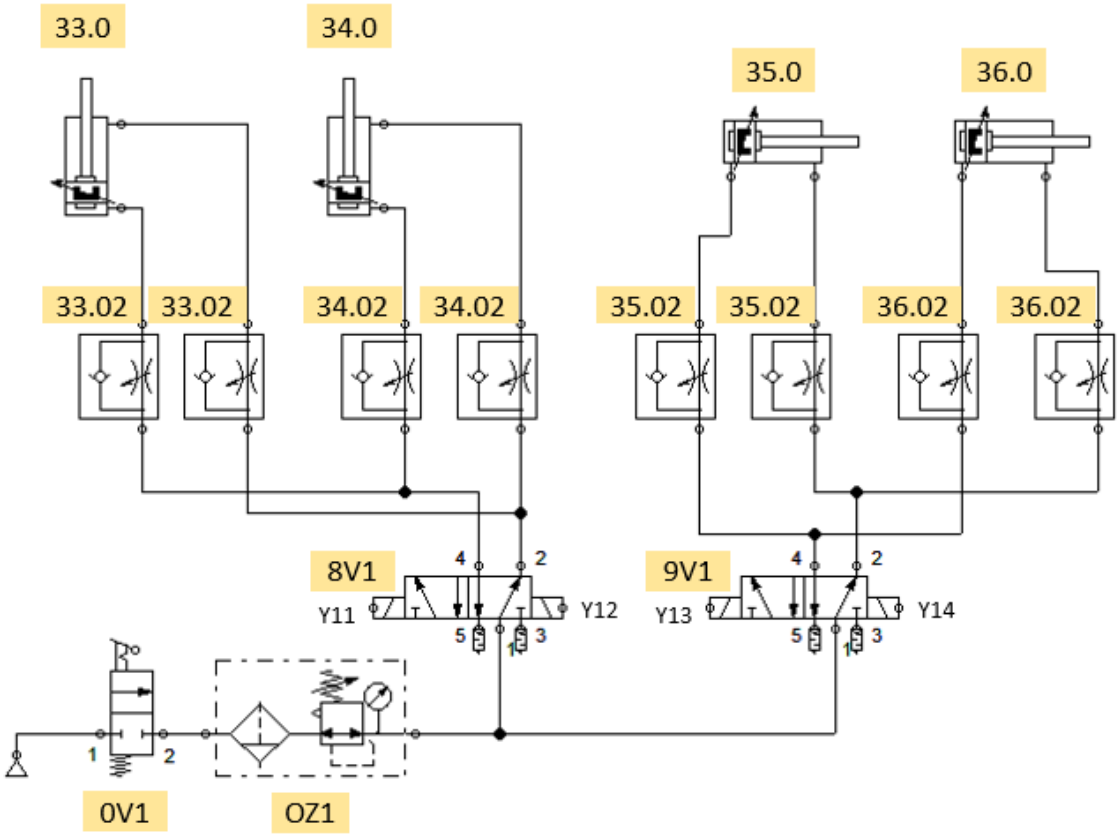


Figure 84. Pneumatic system B scheme.

16) SECURITY BORDER

Once the production line is designed, it is important too to surround the zone with a security border, to protect the workers.

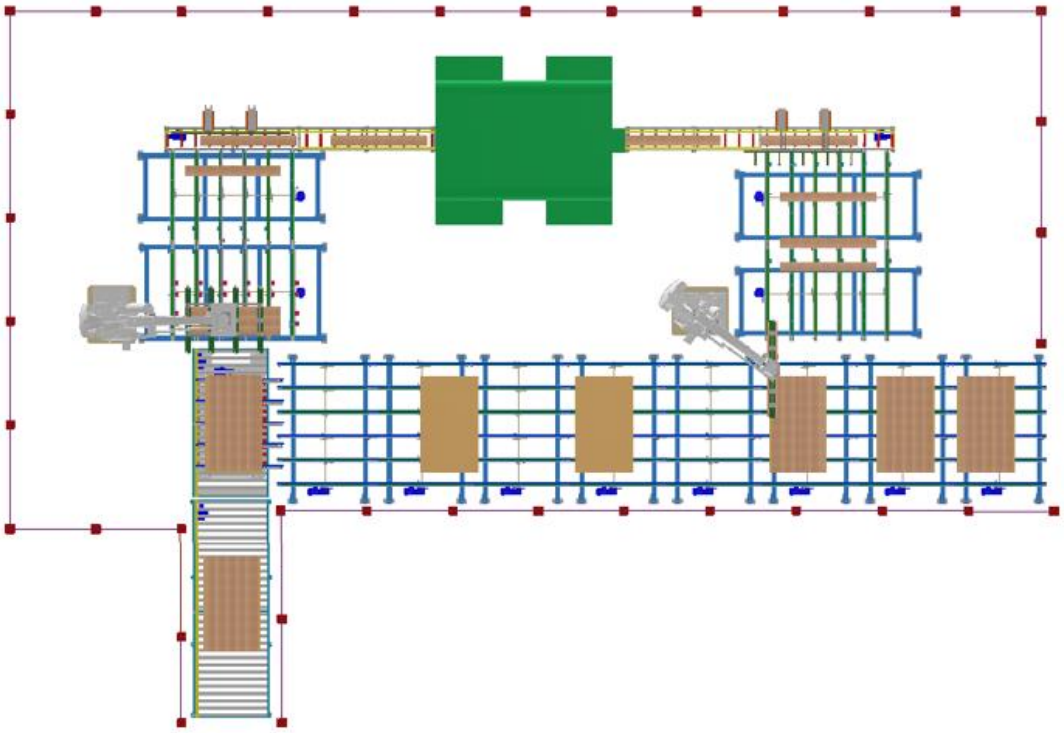


Figure 85. Security border.

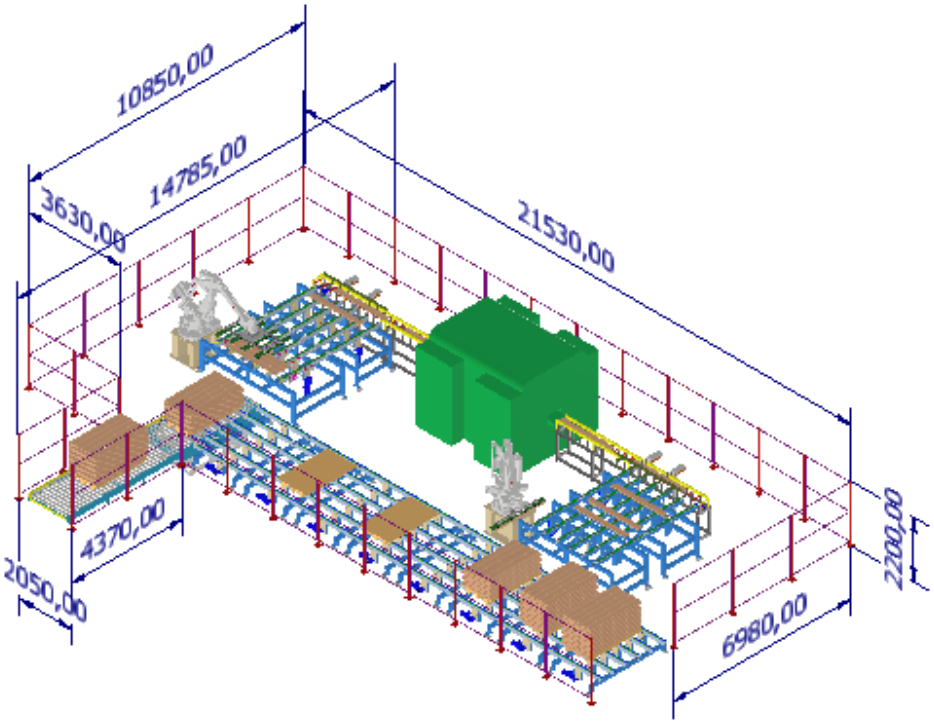


Figure 86. Security border dimensions.

3. SUMMARY

The objective of this project was to make the conceptual design of an automatic system for feeding boards and receiving lamellas in band saw process line, so it was necessary to create a 3D model using Autodesk Inventor software. In that way, it was possible to check and improve the knowledge about process lines, as well as the tool used to do it.

The theorical part of the work shows the importance of the automation for actual industry, and it briefly presents the possibilities that the new tools offer for the design of machines, devices and other elements necessary in the production line.

The hardest part of the project was the preparation of the production line model, due to the difficulties found during the design (Anaya, 2016). We have to take into account that between the big number of solutions possible to solve the different issues of the line, it was necessary to choose the optimal ones in every case. This is a hard task because for each part of the line, specific and individual requirements are needed. As a result, after choosing an element, sometimes you realized that you had to do some changes, such as change a motor, the placement of a sensor, the dimensions of a conveyor… That is why the optimal final line is a result of a first idea that has suffered a lot of changes during its process.

In summary, it should be highlighted the difficulty of the work done. The implementation of the project makes you realize how hard is the Laboral life of the designer.

4. INDEX OF FIGURES

5. INDEX OF TABLES

6. REFERENCES

Anaya Tejero J.J. (2016). *Organización de la producción industrial. Un enfoque de gestión operativa en fábrica*. ESIC.

Cervera Ruiz, M., Blanco Díaz, E. (2014). *Mecánica de estructuras*. CIMNE. Recovered from http://cervera.rmee.upc.edu/libros/Mec%C3%A1nica%20de%20Estructuras.pdf

Croser P., Thomson J., Ebel F. (February, 2000). *Fundamentos de neumática*. FESTO. Recovered from https://www.festo-didactic.com/ov3/media/customers/1100/095003_leseprobe.pdf

Karabegović, I., Banjanović-Mehmedović, L. (2020). *Industrial robots*. Nova Science Publishers Inc.

Oleszek S. (5th August, 2020). *Multi-CAD data management in a PLM environment*. TRANSITION. Recovered from https://ttpsc.com/en/blog/multi-cad-data-management-in-a-plm/

Sánchez, C. (24th January, 2020). Referencias APA. Normas APA (7ª edición). Recovered from https://normas-apa.org/referencias/

ANNEXES

I) PHOTOELECTRIC SENSORS, DATASHEET
II) MOTOR OF THE CHAIN CONVEYOR I, DATASHEET
III) MOTOR OF THE CHAIN CONVEYOR II, DATASHEET
IV) MOTOR OF THE BELT CONVEYOR, DATASHEET
V) MOTOR OF THE ROLLER CONVEYOR I, DATASHEET
VI) MOTOR OF THE ROLLER CONVEYOR II, DATASHEET
VII) ROLLERS SERIES 3500 LIGHT, DATASHEET
VIII) ROLLERS SERIES 3800, DATASHEET
IX) FAMAD SCISSORS LIFT DBNA, DATASHEET
X) CUTTING MACHINE CUTTING MACHINE DSB TWINHEAD NG XM, DATASHEET
XI) ROBOT IRB 760, DATASHEET
XII) VACUUM GRIPER PIAB KVG60 SERIES, DATASHEET
XIII) PNEUMATIC CYLINDERS MGP, DATASHEET

Product data sheet

WTB12-3N1011S42

W12-3

SMALL PHOTOELECTRIC SENSORS

SICK
Sensor Intelligence.

Illustration may differ

Ordering information

Type	Part no.
WTB12-3N1011S42	1044101

Other models and accessories ➔www.sick.com/W12-3

Detailed technical data

Features

Sensor/ detection principle	Photoelectric proximity sensor, Background suppression
Dimensions (W x H x D)	15.6 mm x 48.5 mm x 42 mm
Housing design (light emission)	Rectangular
Sensing range max.	20 mm ... 150 mm [1]
Sensing range	20 mm ... 150 mm [2]
Type of light	Infrared light
Light source	LED [3]
Light spot size (distance)	200 mm
Wave length	850 nm
Adjustment	None
Special features	Sensing range pre-set: 150 mm

[1] Object with 90 % reflectance (referred to standard white, DIN 5033).
[2] Preset sensing range.
[3] Average service life: 100,000 h at T_U = +25 °C.

Mechanics/electronics

Supply voltage	10 V DC ... 30 V DC [1]
Ripple	< 5 V_{pp} [2]
Current consumption	55 mA [3]
Switching output	NPN
Switching mode	Light switching
Signal voltage NPN HIGH/LOW	Approx. VS / < 2.5 V
Output current $I_{max.}$	≤ 100 mA
Response time	≤ 330 µs [4]
Switching frequency	1,500 Hz [5]
Connection type	Cable with AMP connector, 0.32 m [6]
Cable material	PVC
Conductor cross-section	0.85 mm²
Circuit protection	A [7] C [8] D [9]
Protection class	III
Weight	200 g
Special device	✓
Housing material	Metal
Optics material	Plastic, PMMA
Enclosure rating	IP66 IP67 IP69K
Ambient operating temperature	-40 °C ... +60 °C
Ambient temperature, storage	-40 °C ... +75 °C
UL File No.	NRKH.E181493 & NRKH7.E181493

[1] Limit values when operated in short-circuit protected network: max. 8 A.
[2] May not exceed or fall below U_V tolerances.
[3] Without load.
[4] Signal transit time with resistive load.
[5] With light/dark ratio 1:1.
[6] Do not bend below 0 °C.
[7] A = V_S connections reverse-polarity protected.
[8] C = interference suppression.
[9] D = outputs overcurrent and short-circuit protected.

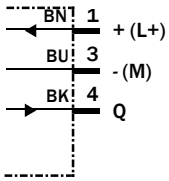
Classifications

ECl@ss 5.0	27270904
ECl@ss 5.1.4	27270904
ECl@ss 6.0	27270904
ECl@ss 6.2	27270904
ECl@ss 7.0	27270904
ECl@ss 8.0	27270904
ECl@ss 8.1	27270904

ECl@ss 9.0	27270904
ECl@ss 10.0	27270904
ECl@ss 11.0	27270904
ETIM 5.0	EC002719
ETIM 6.0	EC002719
ETIM 7.0	EC002719
UNSPSC 16.0901	39121528

Connection diagram

Cd-045



NORD NAPEDY SP. Z O.O.

Member of the NORD DRIVESYSTEMS Group

NORD Napędy sp. zo.o., Zakrzów 414, 32-003 Podłęże

myNORD - Guest PL

Technical Data Sheet

Number | Date	U42X4X.0 | 23/06/2021
Customer Account No.	
Created by	Verónica Sánchez
Created on	23/06/2021
Field representative	Agro
Phone	+48-0122889900
Email	biuro@nord.com

Pos.	Description	Material	Quantity
1	**Helical Bevel Gearmotor SK 93172.1AD - 80SH/4 TF**		1

Product Name	Helical Bevel Gears NORDBLOC.1
Input Speed	1420 1/min
Motor Inverter Speed Range	Standard Line Powered - Inverter Capable
Ratio	28.24
Output Speed	50 1/min
Service Factor	1 -
Output torque	104 Nm
Overhung load	4.7 kN
Axial Load	11.6 kN
Power	0.75 kW
Voltage	230/400 V
Frequency	50 Hz
Efficiency Class	IE2
Current 1	2.44 A
Current 2	1.41 A
Cosinus	0.7 -
Motor Duty	S1 - Continuous
Enclosure	IP55
Insulation	F -
Mounting Pos	M3
Type of housing	Face Flange
Output Shaft	Hollow Keyed
Output Shaft Dia	30H7 mm
Output Shaft Material	Standard
Gearbox Breather Options	Autovent
Gearbox Sealing Options	Standard
Gearbox Options	Torque Arm
Bearing Design	Standard Bearings
Torque Arm Side	A Side (Torque Arm)
Torque Arm Angle	Torque Arm at 180 Degrees
Motor Cooling	TEFC - Totally Enclosed Fan Cooled
Terminal Box Pos	1
Conduit Entry Loc	I
Cable Glands	None
Motor Option	Thermistor

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Lubricant	Mineral oil CLP 220 (Standard)
Lubricant Qty	0.94 l
Sealed Surface Conversion	No Surface Sealing Conversion
Paint Coating	not painted (F 0)
Base Weight	17.0 kg

Wymiary gabarytowe, przekroje, wykazy czesci zamiennych i inne parametry konstrukcyjne towaru jak i wymogi dotyczace obsługi i konserwacji zawarte sa w odpowiednich katalogach oraz w instrukcjach obsługi i konserwacji dostepnych na stronie internetowej producenta / producentów. Szczególna uwage nalezy zwrócic na dopuszczalne warunki obciazenia czopu wału zdawczego reduktora momentem obrotowym jak i siłami osiowymi lub/i poprzecznymi. O ile zapisy ujete powyzej nie stanowia inaczej dopuszczalna maksymalna wartosc oporowego czynnego momentu obrotowego na wale silnika wynosi Mn, gdzie Mn stanowi moment znamionowy silnika, a pozostałe dopuszczalne parametry obciazenia momentem obrotowym wynikaja z diagramu (fbmin), który ujety jest w katalogu na stronie www.nord.com/cms/media/documents/bw/G1000_IE2_PL_4213.pdf z tym zastrzezeniem, ze dopuszczalna maksymalna wartosc rozruchów i hamowan (Z) nie uwzglednia ograniczen wynikajacych z dopuszczalnej obciazalnosci cieplnej silnika i hamulca.

W zakresie nieokreslonym w niniejszym dokumencie zastosowanie maja przepisy okreslone w dokumencie oznaczonym jako Ogólne Warunki Sprzedazy (OWS), które stanowia integralna czesc dokumentu oznaczonego jako Potwierdzenia Zamówienia lub Oferta Sprzedazy. Sprzedawca (Nord Napedy Sp. z .o.o.) oswiadcza, ze tresc dokumentu OWS dostepna jest na stronie http://www2.nord.com/cms/media/documents/forms/ows_pl.pdf oraz moze byc przesłana Kupujacemu w dowolny sposób, na kazde zadanie Kupujacego. Kupujacy przyjmujac Potwierdzenie Zamówienia lub Oferte Sprzedazy oswiadcza, ze zapoznał sie z OWS. W przypadku kiedy wystepuja róznice w zapisach ujetych w niniejszym dokumencie z zapisami ujetymi w dokumencie OWS, instrukcjach lub katalogach wiazace sa zapisy ujete w niniejszym dokumencie.

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NORD Napędy sp. zo.o., Zakrzów 414, 32-003 Podłęże

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Motor Inverter Speed Range	Standard Line Powered - Inverter Capable
Ratio	28.24
Output Speed	50 1/min
Service Factor	1 -
Output torque	104 Nm
Overhung load	4.7 kN
Axial Load	11.6 kN
Power	0.55 kW
Voltage	230/400 V
Frequency	50 Hz
Efficiency Class	IE2
Current 1	2.44 A
Current 2	1.41 A
Cosinus	0.7 -
Motor Duty	S1 - Continuous
Enclosure	IP55
Insulation	F -
Mounting Pos	M3
Type of housing	Face Flange
Output Shaft	Hollow Keyed
Output Shaft Dia	30H7 mm
Output Shaft Material	Standard
Gearbox Breather Options	Autovent
Gearbox Sealing Options	Standard
Gearbox Options	Torque Arm
Bearing Design	Standard Bearings
Torque Arm Side	A Side (Torque Arm)
Torque Arm Angle	Torque Arm at 180 Degrees
Motor Cooling	TEFC - Totally Enclosed Fan Cooled
Terminal Box Pos	1
Conduit Entry Loc	I
Cable Glands	None
Motor Option	Thermistor

NORD NAPEDY SP. Z O.O.
Member of the NORD DRIVESYSTEMS Group

Lubricant	Mineral oil CLP 220 (Standard)
Lubricant Qty	0.94 l
Sealed Surface Conversion	No Surface Sealing Conversion
Paint Coating	not painted (F 0)
Base Weight	17.0 kg

Wymiary gabarytowe, przekroje, wykazy czesci zamiennych i inne parametry konstrukcyjne towaru jak i wymogi dotyczace obsługi i konserwacji zawarte sa w odpowiednich katalogach oraz w instrukcjach obsługi i konserwacji dostepnych na stronie internetowej producenta / producentów. Szczególna uwage nalezy zwrócic na dopuszczalne warunki obciazenia czopu wału zdawczego reduktora momentem obrotowym jak i siłami osiowymi lub/i poprzecznymi. O ile zapisy ujete powyzej nie stanowia inaczej dopuszczalna maksymalna wartosc oporowego czynnego momentu obrotowego na wale silnika wynosi Mn, gdzie Mn stanowi moment znamionowy silnika, a pozostałe dopuszczalne parametry obciazenia momentem obrotowym wynikaja z diagramu (fbmin), który ujety jest w katalogu na stronie www.nord.com/cms/media/documents/bw/G1000_IE2_PL_4213.pdf z tym zastrzezeniem, ze dopuszczalna maksymalna wartosc rozruchów i hamowan (Z) nie uwzglednia ograniczen wynikajacych z dopuszczalnej obciazalnosci cieplnej silnika i hamulca.

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NORD NAPEDY SP. Z O.O.

Member of the NORD DRIVESYSTEMS Group

NORD Napędy sp. zo.o., Zakrzów 414, 32-003 Podłęże

myNORD - Guest PL

Technical Data Sheet

Number | Date	U42X4X.0 | 23/06/2021
Customer Account No.	
Created by	Verónica Sánchez
Created on	23/06/2021
Field representative	Agro
Phone	+48-0122889900
Email	biuro@nord.com

Pos.	Description	Material	Quantity
1	**Helical Bevel Gearmotor SK 93172.1AD - 80LH/4 TF**		1

Product Name	Helical Bevel Gears NORDBLOC.1
Input Speed	1415 1/min
Motor Inverter Speed Range	Standard Line Powered - Inverter Capable
Ratio	20.67
Output Speed	68 1/min
Service Factor	1 -
Output torque	105 Nm
Overhung load	4.7 kN
Axial Load	11.6 kN
Power	0.75 kW
Voltage	230/400 V
Frequency	50 Hz
Efficiency Class	IE2
Current 1	3.05 A
Current 2	1.76 A
Cosinus	0.75 -
Motor Duty	S1 - Continuous
Enclosure	IP55
Insulation	F -
Mounting Pos	M3
Type of housing	Face Flange
Output Shaft	Hollow Keyed
Output Shaft Dia	30H7 mm
Output Shaft Material	Standard
Gearbox Breather Options	Autovent
Gearbox Sealing Options	Standard
Gearbox Options	Torque Arm
Bearing Design	Standard Bearings
Torque Arm Side	A Side (Torque Arm)
Torque Arm Angle	Torque Arm at 180 Degrees
Motor Cooling	TEFC - Totally Enclosed Fan Cooled
Terminal Box Pos	1
Conduit Entry Loc	I
Cable Glands	None
Motor Option	Thermistor

NORD NAPEDY SP. Z O.O.
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Lubricant	Mineral oil CLP 220 (Standard)
Lubricant Qty	0.94 l
Sealed Surface Conversion	No Surface Sealing Conversion
Paint Coating	not painted (F 0)
Base Weight	18.0 kg

Wymiary gabarytowe, przekroje, wykazy czesci zamiennych i inne parametry konstrukcyjne towaru jak i wymogi dotyczace obsługi i konserwacji zawarte sa w odpowiednich katalogach oraz w instrukcjach obsługi i konserwacji dostepnych na stronie internetowej producenta / producentów. Szczególna uwage nalezy zwrócic na dopuszczalne warunki obciazenia czopu wału zdawczego reduktora momentem obrotowym jak i siłami osiowymi lub/i poprzecznymi. O ile zapisy ujete powyzej nie stanowia inaczej dopuszczalna maksymalna wartosc oporowego czynnego momentu obrotowego na wale silnika wynosi Mn, gdzie Mn stanowi moment znamionowy silnika, a pozostałe dopuszczalne parametry obciazenia momentem obrotowym wynikaja z diagramu (fbmin), który ujety jest w katalogu na stronie www.nord.com/cms/media/documents/bw/G1000_IE2_PL_4213.pdf z tym zastrzezeniem, ze dopuszczalna maksymalna wartosc rozruchów i hamowan (Z) nie uwzglednia ograniczen wynikajacych z dopuszczalnej obciazalnosci cieplnej silnika i hamulca.

W zakresie nieokreslonym w niniejszym dokumencie zastosowanie maja przepisy okreslone w dokumencie oznaczonym jako Ogólne Warunki Sprzedazy (OWS), które stanowia integralna czesc dokumentu oznaczonego jako Potwierdzenia Zamówienia lub Oferta Sprzedazy. Sprzedawca (Nord Napedy Sp. z .o.o.) oswiadcza, ze tresc dokumentu OWS dostepna jest na stronie http://www2.nord.com/cms/media/documents/forms/ows_pl.pdf oraz moze byc przesłana Kupujacemu w dowolny sposób, na kazde zadanie Kupujacego. Kupujacy przyjmujac Potwierdzenie Zamówienia lub Oferte Sprzedazy oswiadcza, ze zapoznał sie z OWS. W przypadku kiedy wystepuja róznice w zapisach ujetych w niniejszym dokumencie z zapisami ujetymi w dokumencie OWS, instrukcjach lub katalogach wiazace sa zapisy ujete w niniejszym dokumencie.

NORD NAPEDY SP. Z O.O.

Member of the NORD DRIVESYSTEMS Group

NORD Napędy sp. zo.o., Zakrzów 414, 32-003 Podłęże

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Technical Data Sheet

Number | Date	LZ3C27.0 | 23/06/2021
Customer Account No.	
Created by	Verónica Sánchez
Created on	23/06/2021
Field representative	Agro
Phone	+48-0122889900
Email	biuro@nord.com

Pos.	Description	Material	Quantity
1	**Flexbloc Gearmotor with NORD IEC Motor** **SK 1SI50 - IEC80 - 80LP/4 B14 C120 TF**		1

Product Name	Worm Gears UNIVERSAL SI
Input Speed	1415 1/min
Motor Inverter Speed Range	Standard Line Powered - Inverter Capable
Ratio	20
Output Speed	71 1/min
Service Factor	1.1 -
Output torque	76.4 Nm
Overhung load	4.8 kN
Axial Load	4.9 kN
Power	0.75 kW
Voltage	230/400 V
Frequency	50 Hz
Efficiency Class	IE3
Current 1	3.1 A
Current 2	1.79 A
Cosinus	0.72 -
Motor Flange	B14 C120
Motor Duty	S1 - Continuous
Enclosure	IP55
Insulation	F -
Mounting Pos	M3
Type of housing	Universal (Base and Face Flange)
IEC Motor Adapter	IEC80
Shaft dimension	25mm Hollow Keyed Shaft Worm Module
Flexbloc Shaft Design	Hollow Keyed Shaft
Output Shaft Dia	25H7 mm
Output Shaft Material	Standard
Gearbox Breather Options	No vent
Gearbox Sealing Options	Standard
Bearing Design	Standard Bearings
Motor Cooling	TEFC - Totally Enclosed Fan Cooled
Terminal Box Pos	1

NORD NAPEDY SP. Z O.O.
Member of the NORD DRIVESYSTEMS Group

Conduit Entry Loc	I
Cable Glands	None
Motor Option	Thermistor
Lubricant	Synthetic oil (Polyglycol) CLP PG 680
Lubricant Qty	0.095 l
Sealed Surface Conversion	No Surface Sealing Conversion
Paint Coating	not painted (F 0)
Base Weight	16.0 kg

Wymiary gabarytowe, przekroje, wykazy czesci zamiennych i inne parametry konstrukcyjne towaru jak i wymogi dotyczace obsługi i konserwacji zawarte sa w odpowiednich katalogach oraz w instrukcjach obsługi i konserwacji dostepnych na stronie internetowej producenta / producentów. Szczególna uwage nalezy zwrócic na dopuszczalne warunki obciazenia czopu wału zdawczego reduktora momentem obrotowym jak i siłami osiowymi lub/i poprzecznymi. O ile zapisy ujete powyzej nie stanowia inaczej dopuszczalna maksymalna wartosc oporowego czynnego momentu obrotowego na wale silnika wynosi Mn, gdzie Mn stanowi moment znamionowy silnika, a pozostałe dopuszczalne parametry obciazenia momentem obrotowym wynikaja z diagramu (fbmin), który ujety jest w katalogu na stronie www.nord.com/cms/media/documents/bw/G1000_IE2_PL_4213.pdf z tym zastrzezeniem, ze dopuszczalna maksymalna wartosc rozruchów i hamowan (Z) nie uwzglednia ograniczen wynikajacych z dopuszczalnej obciazalnosci cieplnej silnika i hamulca.

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NORD NAPEDY SP. Z O.O.

Member of the NORD DRIVESYSTEMS Group

NORD Napędy sp. zo.o., Zakrzów 414, 32-003 Podłęże

myNORD - Guest PL

Technical Data Sheet

Number | Date	LZ3C27.0 | 23/06/2021
Customer Account No.	
Created by	Verónica Sánchez
Created on	23/06/2021
Field representative	Agro
Phone	+48-0122889900
Email	biuro@nord.com

Pos.	Description	Material	Quantity
1	**Flexbloc Gearmotor with NORD IEC Motor** **SK 1SI50 - IEC80 - 80LP/4 B14 C120 TF**		1

Product Name	Worm Gears UNIVERSAL SI
Input Speed	1415 1/min
Motor Inverter Speed Range	Standard Line Powered - Inverter Capable
Ratio	20
Output Speed	71 1/min
Service Factor	1.1 -
Output torque	76.4 Nm
Overhung load	4.8 kN
Axial Load	4.9 kN
Power	0.75 kW
Voltage	230/400 V
Frequency	50 Hz
Efficiency Class	IE3
Current 1	3.1 A
Current 2	1.79 A
Cosinus	0.72 -
Motor Flange	B14 C120
Motor Duty	S1 - Continuous
Enclosure	IP55
Insulation	F -
Mounting Pos	M3
Type of housing	Universal (Base and Face Flange)
IEC Motor Adapter	IEC80
Shaft dimension	25mm Hollow Keyed Shaft Worm Module
Flexbloc Shaft Design	Hollow Keyed Shaft
Output Shaft Dia	25H7 mm
Output Shaft Material	Standard
Gearbox Breather Options	No vent
Gearbox Sealing Options	Standard
Bearing Design	Standard Bearings
Motor Cooling	TEFC - Totally Enclosed Fan Cooled
Terminal Box Pos	1

NORD NAPEDY SP. Z O.O.
Member of the NORD DRIVESYSTEMS Group

Conduit Entry Loc	I
Cable Glands	None
Motor Option	Thermistor
Lubricant	Synthetic oil (Polyglycol) CLP PG 680
Lubricant Qty	0.095 l
Sealed Surface Conversion	No Surface Sealing Conversion
Paint Coating	not painted (F 0)
Base Weight	16.0 kg

Wymiary gabarytowe, przekroje, wykazy czesci zamiennych i inne parametry konstrukcyjne towaru jak i wymogi dotyczace obsługi i konserwacji zawarte sa w odpowiednich katalogach oraz w instrukcjach obsługi i konserwacji dostepnych na stronie internetowej producenta / producentów. Szczególna uwage nalezy zwrócic na dopuszczalne warunki obciazenia czopu wału zdawczego reduktora momentem obrotowym jak i siłami osiowymi lub/i poprzecznymi. O ile zapisy ujete powyzej nie stanowia inaczej dopuszczalna maksymalna wartosc oporowego czynnego momentu obrotowego na wale silnika wynosi Mn, gdzie Mn stanowi moment znamionowy silnika, a pozostałe dopuszczalne parametry obciazenia momentem obrotowym wynikaja z diagramu (fbmin), który ujety jest w katalogu na stronie www.nord.com/cms/media/documents/bw/G1000_IE2_PL_4213.pdf z tym zastrzezeniem, ze dopuszczalna maksymalna wartosc rozruchów i hamowan (Z) nie uwzglednia ograniczen wynikajacych z dopuszczalnej obciazalnosci cieplnej silnika i hamulca.

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ROLLERS
SERIES 3500 LIGHT
Fixed drive conveyor roller

Application area
Driven unit handling conveying, transport of cardboards or containers with small dimensions. Suitable in the packaging industry, in assembly machines or for implementing machine chains.

Flexible design
The product is available in numerous chain drive versions. This allows implementing wrapping and tangential chain drives.

High-quality bearing
Sealed precision ball bearings of type 689 2Z are used.

Lateral loading
The tube ends are rounded, thereby allowing materials to be easily moved on from the side. Axial forces are removed through ball bearings and seals.

Small roller pitches
Small roller pitches can be implemented by using rollers with a diameter of 30 mm.

ROLLERS
SERIES 3500 LIGHT
Fixed drive conveyor roller

Technical data

General technical data	
Platform	1700
Max. load capacity	150 N
Max. conveyor speed	0.5 m/s
Temperature range	–5 to +40 °C
Material	
Tube	Zinc-plated steel, stainless steel
Shaft	Uncoated steel, zinc-plated steel, stainless steel
Bearing housing	Polyamide, RAL9005 (jet black)
Drive head	Uncoated steel (the sprocket heads including tube are zinc-plated after welding them on)
Seal	Polyamide on drive side each in RAL1021 (rape yellow)
Bearing version	Precision steel ball bearing 689 2Z, greased

Design versions

Tube sleeves	PVC sleeve (page 22)
Anti-static version	(<10^6 Ω) Standard design for rollers with grooves or tube sleeves
Shafts	The following are available in addition to the variants listed in the load capacity tables: • With variable length • Different design of both shaft ends

ROLLERS
SERIES 3500 LIGHT
Fixed drive conveyor roller

Load capacities of series 3500 light

The load capacity table refers to a temperature range of +5 to +40 °C.
Valid for the following shaft designs: female thread or male thread.

Bearing: 689 2Z.

Tube material	Ø Tube/thickness [mm]	Drive element	Ø Shaft [mm]	Maximum static load [N] for installation length [mm]		
				200	400	600
Steel	30 x 1.2	Welded steel sprocket head 3/8", T12	8	150	150	150
		Welded steel double sprocket head 3/8", T12	8	150	150	150

T = Number of teeth

Dimensions

A sufficient axial play is already taken into account, so that the actual lane width between side profiles is required. The dimensions of the conveyor roller depend on the shaft version and the drive element.
Ordering dimensions for tube sleeves, e.g. PVC sleeves, see page 23.

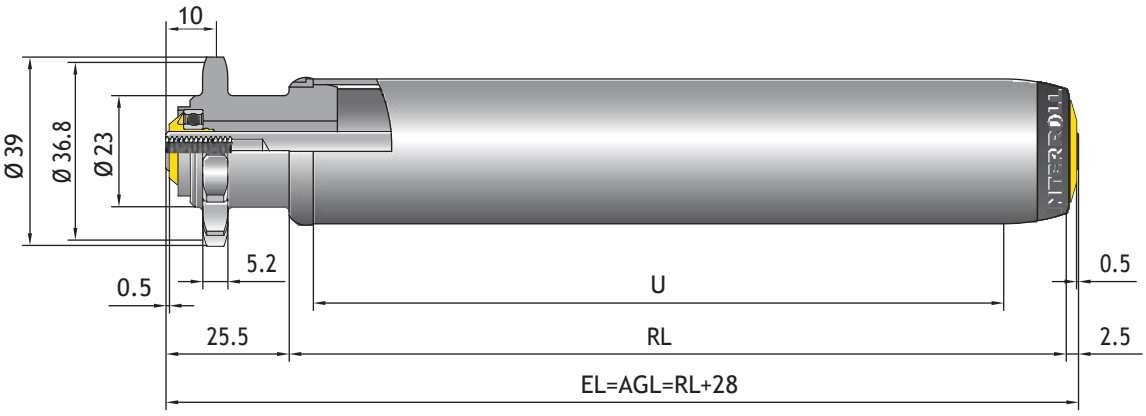
RL = Reference length/ordering length
EL = Installation length, inside diameter between side profiles
AGL = Total length of shaft
U = Usable tube length: Length without bearing housing and for flanged metal tube without length of flanging

Ø Tube [mm]	Tube material	Ø Shaft [mm]	Drive element	EL [mm]	AGL [mm]	U [mm]
30 x 1.2	Steel	8	Welded steel sprocket head 3/8", T12	RL + 28	RL + 28	RL – 21
			Welded steel double sprocket head 3/8", T12	RL + 48	RL + 48	

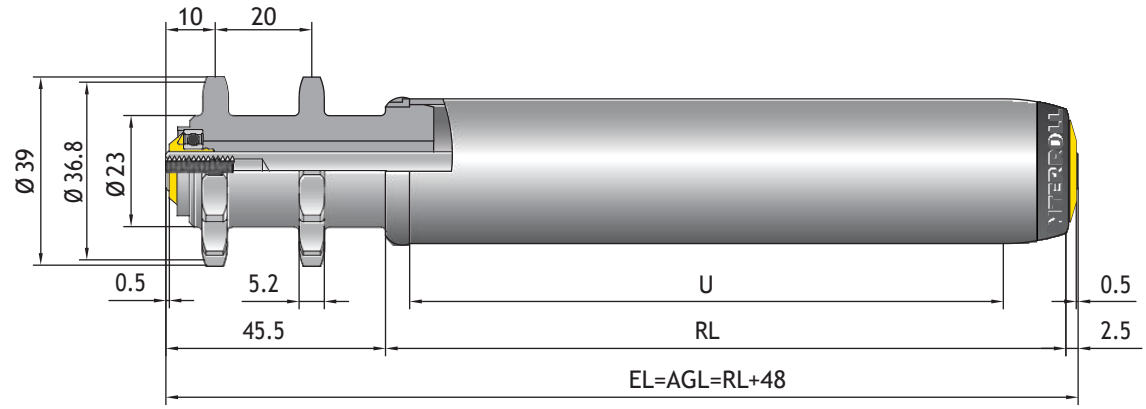
T = Number of teeth

ROLLERS
SERIES 3500 LIGHT
Fixed drive conveyor roller

3/8" steel sprocket head with 12 teeth



3/8" steel double sprocket head with 12 teeth



ROLLERS
SERIES 3800
Friction conveyor roller

Application area
Transporting and accumulating unit handling, such as cardboards or containers. Also suitable for implementing buffer sections.

Modular construction
The friction heads are interchangeable and can also be exchanged with fixed friction heads. A permanently pressed bearing housing allows inserting a variety of drive heads. The friction heads made of polyamide are secured against dropping out.

Low-noise
The use of polyamide or polyoxymethylene drive heads results in very quiet running.

Numerous drive types
Numerous drive types are available. Depending on the requirement profile, the rollers can be driven with flat, PolyVee or toothed belts as well as chains with a pitch of 1/2" or 3/8".

Weight-dependent
Conveyance as well as accumulation pressure depend on the weight of the materials.

Note: Please read the additional important information about the use of the friction roller in the planning section, Friction rollers.

ROLLERS SERIES 3800
Friction conveyor roller

Technical data

General technical data	
Platform	1700
Max. load capacity	500 N
Max. conveyor speed	0.5 m/s
Temperature range	−5 to +40 °C PVC tube: With increased ambient temperature (from +30 °C) and high continuous static load over hours, a permanent deformation of the rollers cannot be ruled out.
Material	
Tube	Zinc-plated steel, stainless steel, aluminum PVC: RAL7030 (stone gray) RAL5015 (sky blue) for Ø 50 mm
Shaft	Uncoated steel, zinc-plated steel, stainless steel
Bearing housing	Polyamide, RAL9005 (jet black)
Drive head	Polyamide, RAL9005 (jet black) Polyoxymethylene, RAL9005 (jet black) Steel (sprocket drive heads only)
Seal	Polypropylene on non-drive side and polyamide on drive side each in RAL1021 (rape yellow)
Bearing version	Precision steel ball bearing 6002 2RZ, precision stainless steel ball bearing 6002 2RZ, bearing play each C3

Design versions

Tube sleeves	PVC sleeve (page 22) PU sleeve (page 24) Lagging (page 25)
Anti-static version	(<10^6 Ω) Standard design for rollers with tube sleeves, cannot be used for PVC tube
Special tube surface treatment	Carbonitriding
Shafts	The following are available in addition to the variants listed in the load capacity tables: • With variable length • Different design of both shaft ends

ROLLERS
SERIES 3800
Friction conveyor roller

Load capacities of series 3800

The load capacity table refers to a temperature range of +5 to +40 °C.
Valid for the following shaft designs: female thread or male thread.

Bearing: 6002 2RZ.

Tube material	Ø Tube/ thickness [mm]	Drive element	Ø Shaft [mm]	Maximum static load [N] for installation length [mm]						
				200	400	600	800	1000	1200	1400
PVC	50 x 2.8	Polymer sprocket head 1/2", T14	12	500	185	75	40	–	–	–
		Polymer double sprocket head 1/2", T14		500	215	85	45	–	–	–
		Polymer flat belt drive head 38 mm	14	500	150	65	35	–	–	–
		Polymer sprocket head 1/2", T9 and T14		300	300	135	70	–	–	–
		Polymer sprocket head 1/2", T14		500	335	135	70	–	–	–
		Polymer double sprocket head 3/8", T20		350	185	75	40	–	–	–
		Polymer toothed belt drive head 8, T18		350	185	75	40	–	–	–
		Polymer double sprocket head 1/2", T14		500	215	80	45	–	–	–
Steel	50 x 1.5	Polymer sprocket head 1/2", T14	12	500	500	500	500	500	500	500
		Steel sprocket head 1/2", T14		500	500	500	500	500	500	500
		Polymer double sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel double sprocket head 1/2", T14		500	500	500	500	500	500	500
		Polymer flat belt drive head 38 mm	14	500	500	500	500	500	500	500
		Polymer sprocket head 1/2", T9 and T14		300	300	300	300	300	300	300
		Polymer sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel sprocket head 1/2", T14		500	500	500	500	500	500	500
		Polymer double sprocket head 3/8", T20		350	350	350	350	350	350	350
		Polymer toothed belt drive head 8, T18		350	350	350	350	350	350	350
		Polymer double sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel double sprocket head 1/2", T14		500	500	500	500	500	500	500
		PolyVee drive head		350	350	350	350	350	350	350
		Steel sprocket head 1/2", T14	15	500	500	500	500	500	500	500
		Steel double sprocket head 1/2", T14		500	500	500	500	500	500	500

ROLLERS
SERIES 3800
Friction conveyor roller

Tube material	Ø Tube/ thickness [mm]	Drive element	Ø Shaft [mm]	Maximum static load [N] for installation length [mm]						
				200	400	600	800	1000	1200	1400
Steel	60 x 1.5	Polymer double sprocket head 1/2", T14	12	500	500	500	500	500	500	500
		Polymer sprocket head 1/2", T9 and T14	14	300	300	300	300	300	300	300
		Polymer sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel sprocket head 1/2", T14		500	500	500	500	500	500	500
		Polymer double sprocket head 3/8", T20		350	350	350	350	350	350	350
		Polymer toothed belt drive head 8, T18		350	350	350	350	350	350	350
		Polymer double sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel double sprocket head 1/2", T14		500	500	500	500	500	500	500
		Steel sprocket head 1/2", T14	15	500	500	500	500	500	500	500
		Steel double sprocket head 1/2", T14		500	500	500	500	500	500	500

T = Number of teeth

ROLLERS
SERIES 3800
Friction conveyor roller

Dimensions

A sufficient axial play is already taken into account, so that the actual lane width between side profiles is required. The dimensions of the conveyor roller depend on the shaft version and the drive element.
Ordering dimensions for tube sleeves, e.g. PVC sleeves, see page 23.

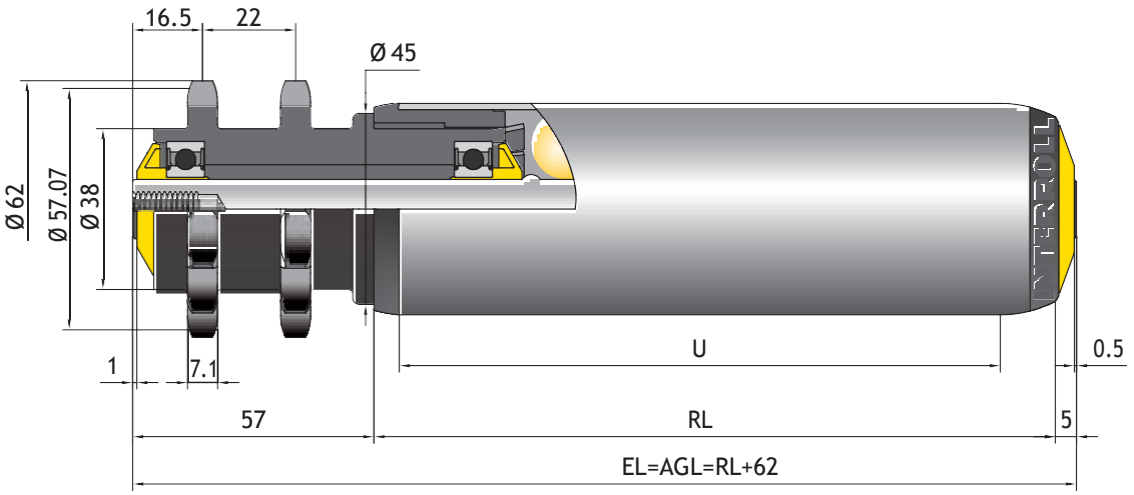
RL = Reference length/ordering length
EL = Installation length, inside diameter between side profiles
AGL = Total length of shaft
U = Usable tube length: Length without bearing housing and for flanged metal tube without length of flanging

Ø Tube [mm]	Tube material	Ø Shaft [mm]	Drive element	EL [mm]	AGL [mm]	U [mm]
50 x 2.8	PVC	12	Polymer sprocket head 1/2", T14	RL + 40	RL + 40	RL – 12
			Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	
		14	Polymer flat belt drive head 38 mm	RL + 40	RL + 40	
			Polymer sprocket head 1/2", T9, T11 and T14			
			Polymer double sprocket head 3/8", T20			
			Polymer toothed belt drive head 8, T18			
			Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	
50 x 1.5	Steel	12	Polymer sprocket head 1/2", T14	RL + 40	RL + 40	RL – 19
			Steel sprocket head 1/2", T14			
			Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	
			Steel double sprocket head 1/2", T14			
		14	Polymer flat belt drive head 38 mm	RL + 40	RL + 40	
			Polymer sprocket head 1/2", T9, T11 and T14			
			Steel sprocket head 1/2", T14			
			Polymer double sprocket head 3/8", T20			
			Polymer toothed belt drive head 8, T18			
			Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	
			Steel double sprocket head 1/2", T14			
			PolyVee drive head	RL + 40	RL + 40	
60 x 1.5	Steel	12	Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	RL – 19
		14	Polymer sprocket head 1/2", T9, T11 and T14	RL + 40	RL + 40	
			Steel sprocket head 1/2", T14			
			Polymer double sprocket head 3/8", T20			
			Polymer toothed belt drive head 8, T18			
			Polymer double sprocket head 1/2", T14	RL + 62	RL + 62	
			Steel double sprocket head 1/2", T14			

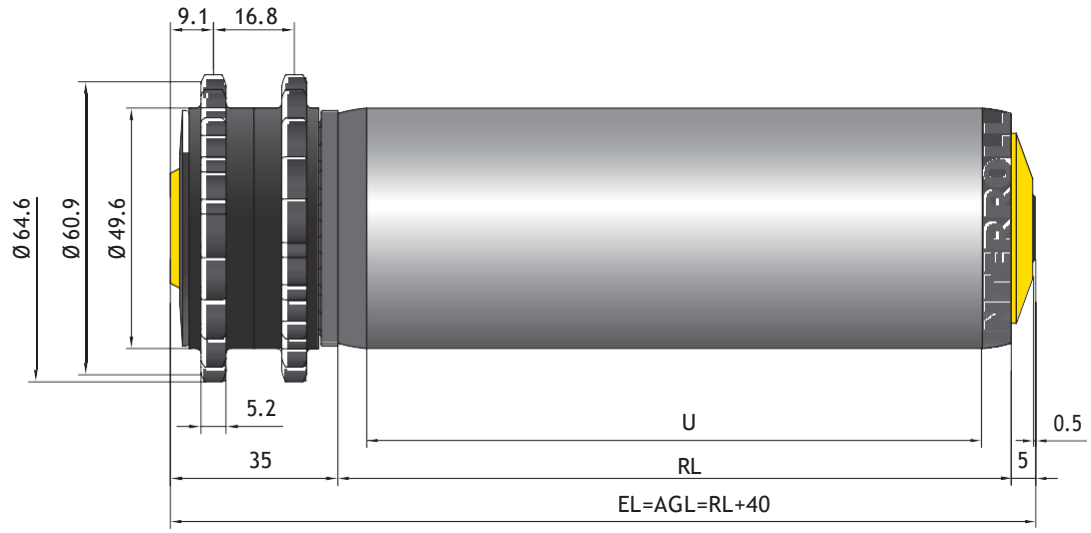
T = Number of teeth

ROLLERS
SERIES 3800
Friction conveyor roller

1/2" polymer double sprocket head with 14 teeth

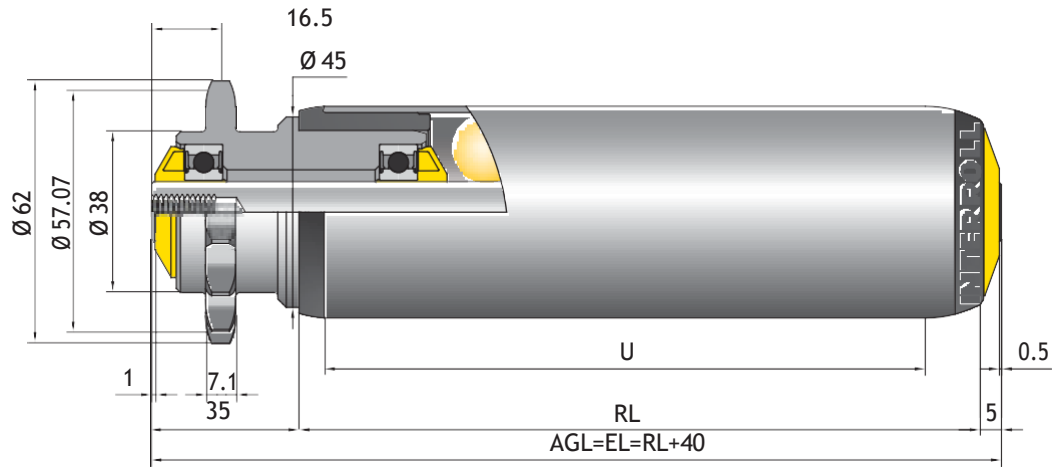


3/8" polymer double sprocket head with 20 teeth

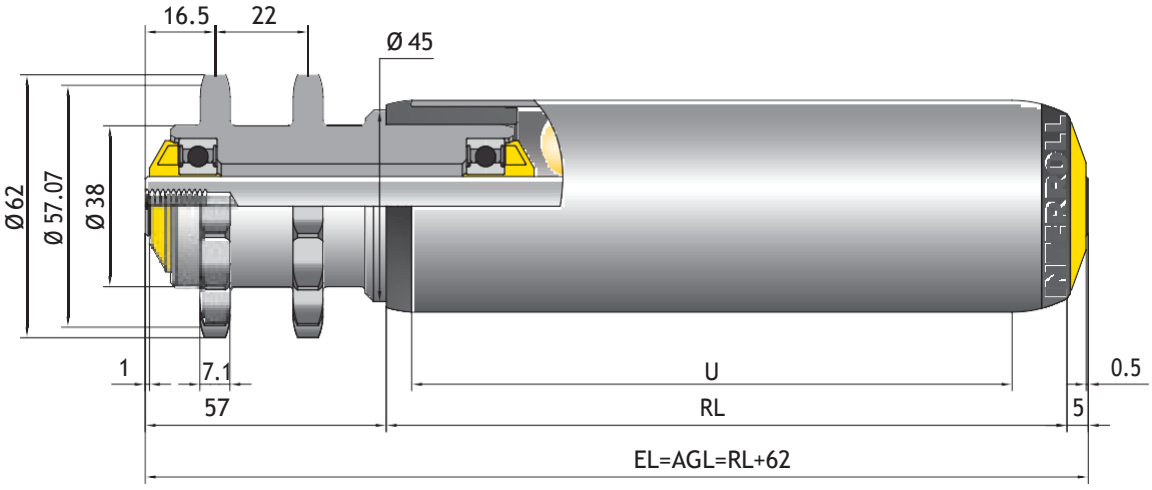


ROLLERS
SERIES 3800
Friction conveyor roller

1/2" zinc-plated steel sprocket head with 14 teeth



1/2" zinc-plated steel double sprocket head with 14 teeth



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SCISSORS LIFT DBNA

v1		2013/01/23

Designed for the mechanization and automation of various transport and loading/unloading operations as well as for work in technological lines. They are characterized by strengthened construction destined for a very harsh work environment. Made for lifting capacities of up to 8t and with a wide range of table dimensions depending on the requirements.

TECHNICAL AND OPERATIONAL DATA:

		DBNA - 1,5t	DBNA - 2,5t	DBNA - 5,0t	DUO - 8,0t
Lifting capacity	t	**1,5**	**2,5**	**5,0**	**8,0**
Table dimensions (standard)	mm	**2000 x 900**	**2500 x 1000**	**2800 x 1200**	**2200 x 5600**
Table lifting time	s	**47**	**32**	**37**	**75**
Maximum lifting height	mm	**1100**	**1600**	**1650/1750**	**1500**
Height when folded	mm	**250**	**300**	**400**	**400**
Drive power	kW	**1,1**	**4,0**	**5,5**	**7,5**
Electric supply	V AC	**3/N/PE, 400V 50Hz**			
Control voltage	dBA	**72-82 (depending on the used pump)**			
Mass	kg	**650**	**900**	**1330**	**2800**

The lift can be equipped with roller conveyors, a rotating table, barriers, flaps, and other mechanisms, offered in a wide range of table dimensions and lifting heights depending on the client's needs.

Lifts are inspected according to appendix C of the PN-EN 1570:2002 standard – "SAFETY REQUIREMENTS REGARDING TABLE LIFTS", and have a CE COMPLIANCE DECLARATION and all necessary documents for UDT registration.

WINTERSTEIGER
Thin-cutting & Repair

EN

DSB Twinhead NG XM
Thin-cutting band saw

Your benefits summed up:

2 modules evolution for modular revolution

- 2-modular basic configuration
- Parallel arranged saw moduls
- Unique price-/performance ratio

High performance and maximum dimensions

- Expandable to a full production system
- Optimum accessibility with minimum footprint
- Cutting width up to 310 mm, block height up to 165 mm, cutting height up to 160 mm

Outstanding precision thanks to leading technology

- Innovative cutting-edge sawing systems for highest precision
- Unique feed system for any material characteristics
- Machine and tool from our own development and production

DSB Twinhead NG XM
Figures. Data. Facts.

Technical data

	Standard	Option
Main drive rating	18.5 kW (25 HP)	32 kW (44 HP)
Max. cutting width	310 mm (12.2")	
Feed speed, infinitely adjustable (depending on wood type and block dimensions)	Standard feed: 4 - 20 m/min (13 - 66 ft/min)	Precision feed: 1 - 15 m/min (3 - 49 ft/min) High-speed feed: 8 - 45 m/min (26 - 148 ft/min)
Saw blade speed, infinitely adjustable	10 - 50 m/sec (33 - 164 ft/sec)	10 - 60 m/sec (33 - 197 ft/sec) (with 32 kW / 44 HP main drive)
Wet cutting – spraying system		For wet cutting as well as for wood types with a high content of resin or silica's
Saw blade tensioning system	Servo-pneumatic	
Saw blade motion control (saw blade motion visible via sight window)	Automatic saw blade regulation	
Voltages*	3 x 400 VAC / 50 Hz 3 x 480 VAC / 60 Hz External switch cabinet at front of main drive for following voltages: 3 x 208 VAC / 60 Hz 3 x 575 VAC / 60 Hz	
Diameter – saw pulleys	Ø 915 mm (36")	
Arrangement of sawing module	Horizontal	
Operating height	Approx. 1,300 mm (51") (approx. 1,100 mm / 43" with sunken fundament)	
Cutting height adjustment of saw blade	Approx. 1.7 to 160 mm (0.067" - 6.29")	
Durable saw blade guide	Carbon guide	
Saw blade lubrication	Via compressed air lubricator	
Compressed air connection	Operating pressure 6 bar (90 psi)	
Required extraction force	Min. 500 liters/min (17.7 cubic feet/min) per machine	
Suction fittings top	1 x Ø 200 mm + 1 x Ø 100 mm per machine	
Extraction capacity	Min. 4,500 m^3/h (158,900 cubic feet/hour) per machine	
Required air speed	30 to 32 m/sec (100 - 105 feet/sec) per machine	
Power and compressed air inlet	Optionally at top or side	

* Other voltages available on request

Block/lamella data

	Standard
Block width	Min. 30 mm / max. 310 mm (1.2" / 12.2")
Saw blade guiding	Adjustable on one side
Cutting precision (depending on original material and tool characteristics)	Approx. +/- 0.15 mm (0.006")
Block height min. / max.	5 mm / 165 mm (0.19" / 2.95")
Block length min. / max.	350 mm (13.78") / unlimited
Lamella thickness (depending on wood type and block dimensions)	> 1.7 mm (0.067")
Individually selectable block guide	Lateral or central block guide

We reserve the right to make technical alterations.

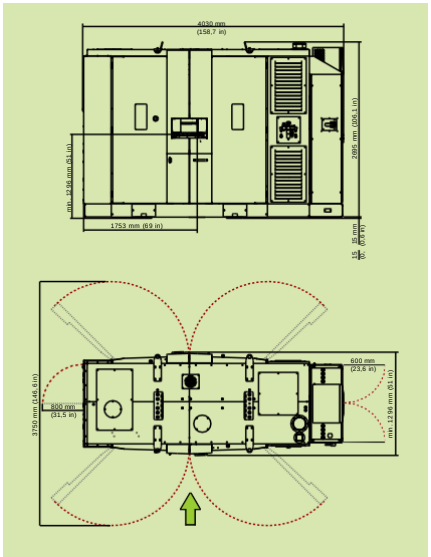
Saw blade data

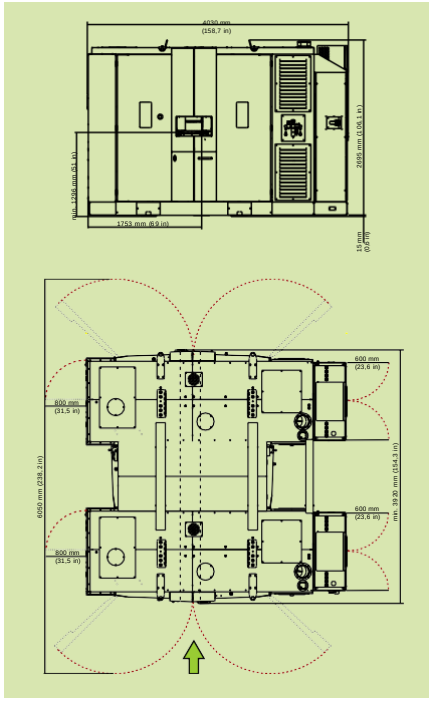
Thickness of cutting kerf	From 1.0 mm (0.039")
Thickness of base material	From 0.7 mm (0.027")
Width of saw band	80 mm (3.15")
Length saw band	5500 mm (216.5")
Easy & ergonomical saw blade change (sash doors swivel through 125°)	Approx. 2 min (2 persons)

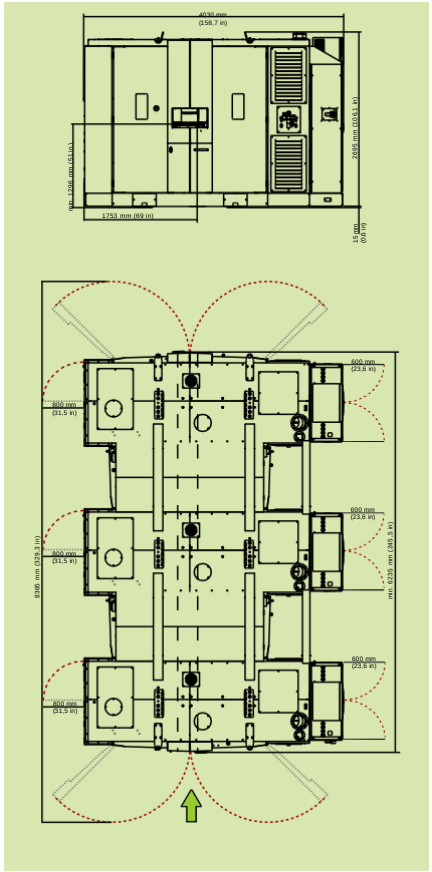
DSB Twinhead NG XM
Figures. Data. Facts.

Dimensions	DSB Twinhead NG 2 XM	DSB Twinhead NG 4 XM	DSB Twinhead NG 6 XM
Height	2695 mm (160.1")		
Width	4030 mm (158.66")		
Depth	1550 mm (61")	3920 mm (154.33")	6235 mm (245.47")
Depth with doors open	3750 mm (147.64")	6050 mm (238.19")	8365 mm (329.33")
Weight	Approx. 8000 kg (17637 lbs)	Approx. 16000 kg (35274 lbs)	Approx. 24000 kg (52911 lbs)
Foundation load	10000 kg (22046 lbs)	20000 kg (44093 lbs)	30000 kg (66139 lbs)
Transport options for machine	2 brackets for fork-lift on underside of machine 2 fittable crane eyes on top of machine		
Transport dimensions machine (W x D x H)	4030 x 1550 x 2695 mm (158.66" x 61" x 106.1")	4030 x 1550 x 2695 mm (158.66" x 61" x 106.1") per machine	
Transport dimensions with pallet (W x D x H)	4200 x 2340 x 2950 mm (165.35" x 92.13" x 116.14")	4200 x 2340 x 2950 mm (165.35" x 92.13" x 116.14") per machine	
Transport dimensions with wooden crate (W x D x H)	4250 x 2400 x 2980 mm (167.32" x 94.49" x 117.32")	4250 x 2400 x 2980 mm (165.35" x 92.13" x 116.14") per machine	
Transport dimensions in seaworthy crate (W x D x H)	4250 x 2400 x 3115 mm (167.32" x 94.49" x 122.64")	4250 x 2400 x 3115 mm (165.35" x 92.13" x 116.14") per machine	

We reserve the right to make technical alterations.







ROBOTICS

IRB 760
Industrial Robot

The 4-axis robot can move and rotate large and heavy products at high speeds, and with the utmost care. Its compact design makes it ideal for fitting into existing lines.

Shorter cycle times
The IRB 760 is the fastest robot of its kind and is capable of significantly shortening cycle times and raising productivity for full-layer palletizing and press tending. This four-axis robot has a reach of 3.2 meters and a 450 kilograms payload capacity, enabling it to lift heavy objects and full pallet layers. With its high torque wrist and long reach it can achieve 880 cycles per hour at full load (400 mm, 2000 mm, 400 mm cycle).

IRB 760PT press tending robot
Aimed at press automation applications in the automotive industry, the IRB 760PT is a flexible press tending robot offering 25 per cent faster cycle times compared to other robot-based press automation solutions. Its 3.18 meter reach, coupled with a linear seventh axis or with the Twin Xbar system avoids the need to reorient parts between consecutive stamping operations, helping users to optimize available space and save costs.

High precision movements
Utilizing ABB's patented motion control software, QuickMove™ and TrueMove™, the IRB 760 family ensures palletizing and press tending is carried out with smooth movements and high path accuracy. This means even the most sensitive products will be handled with great care without losing cycle time.

Low cost of ownership and increased productivity
The robot's robust and rigid design – manufactured to automotive industry standards – ensures high uptime and low maintenance costs. The IRB 760 family also features integrated process cabling which helps extend life and reduces wear.

The IRB 760 family is also covered by Robot Care, a warranty package that includes ABB's Connected Services, where ABB experts can monitor robots and suggest optimized the robot's performance thru advance services to further increase productivity and maintain high OEE.

Offline programming is the best way to maximize return on investment for robot systems. ABB's simulation and offline programming software, RobotStudio, allows robot programming to be done on a PC in the office without shutting down production. RobotStudio provides the tools to increase the profitability of your robot system by letting you perform tasks such as training, programming, and optimization without disturbing production.

Main applications
- Full layer palletizing
- Palletizing
- Depalletizing
- Material handling
- Press tending

ANNEX XI. ROBOT IRB 760, DATASHEET

Specification

Robot version	Reach (m)	Handling capacity (kg)
IRB 760	3.18	450
IRB 760PT	3.18	450
Number of axes	4	
Protection	IP67	
Mounting	Floor mounted	
Controller	IRC5 Single cabinet, IRC5 Dual cabinet	
Integrated power signal supply	Optional	
Integrated air supply	Optional	

Performance (according to ISO 9283)

	Position repeatability RP (mm)	Path repeatability RT (mm)
IRB 760	0.05	0.80

Cycles per hour

	Load (kg)	Cycles per hour
IRB 760	60	450

Technical information

Electrical Connections	
Supply voltage	200-600 V, 50-60 Hz
Power consumption	ISO cube 2.75 kW
Physical	
Dimensions robot base	1140 x 800 mm
Robot weight	2310 kg
Environment	
Ambient temperature for mechanical unit	
During operation	+- 0°C (32°F) to + 50°C (122°F)
During transportation and storage	-25° C (-13° F) to +55° C (131° F)
For short periods (max 24 h)	up to +70° C (158° F)
Relative humidity	Max. 95%
Noise level	< 70 dB (A)
Safety	Double circuits with supervisions, emergency stops and safety functions. 3-position enable device
Emission	EMC/EMI shielded

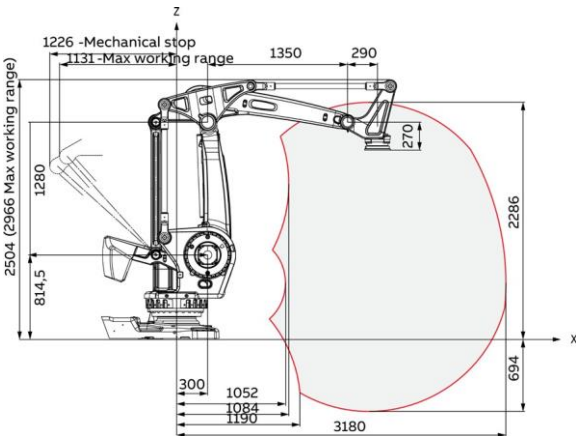
Data and dimensions may be changed without notice.

IRB 760

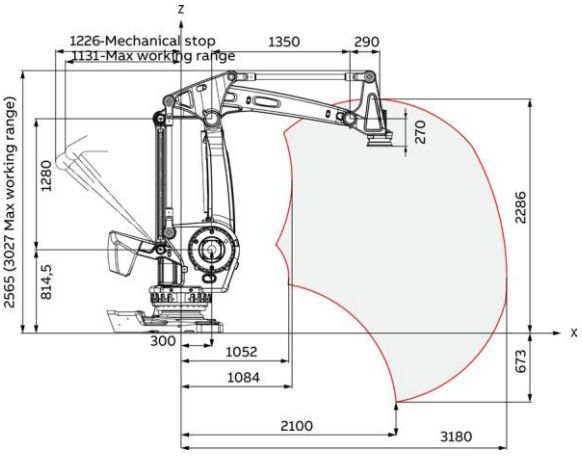
Axis movement	Working range	Axis max speed
Axis 1	+180° to -180°	85°/s
Axis 2	+85° to - 42°	85°/s
Axis 3	+120° to - 20°	85°/s
Axis 4*	+300° to - 300°	160°/s

* +67 rev. to - 67 rev. max

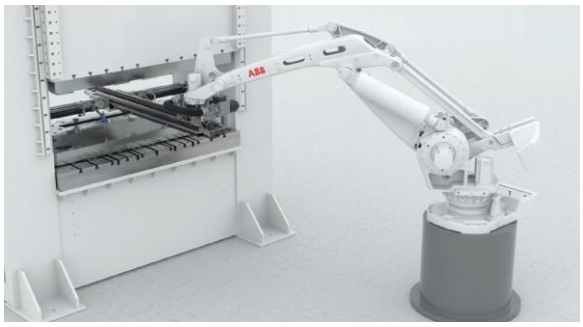
IRB 760, working range



IRB 760PT, working range



IRB 760PT, In press automation applications



The IRB 760FX is a combination of an IRB 760PT and a Linear 7th axis.

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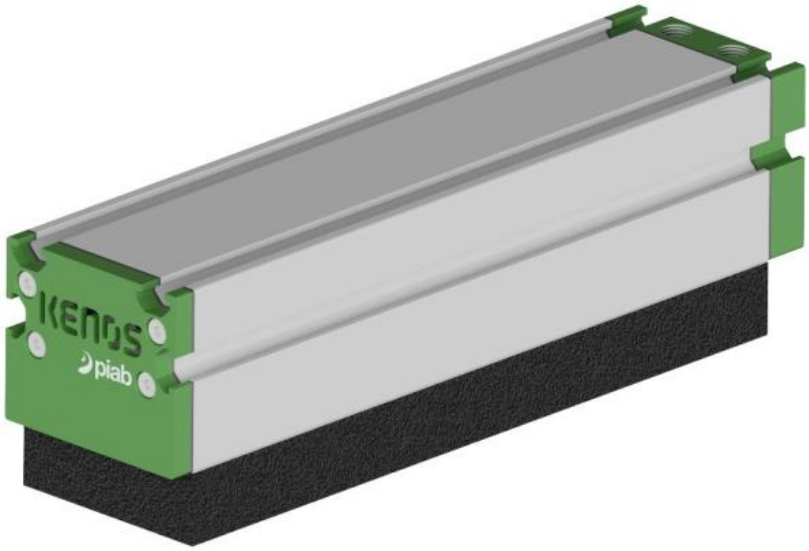
ROB02007EN_A Rev.H October 2020

DATASHEET

KVG60 Series



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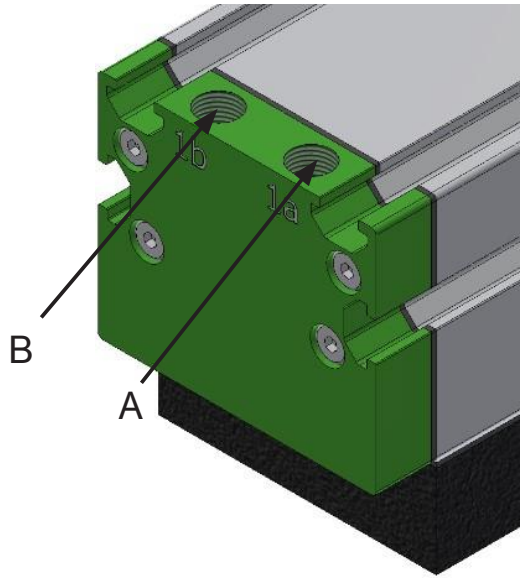
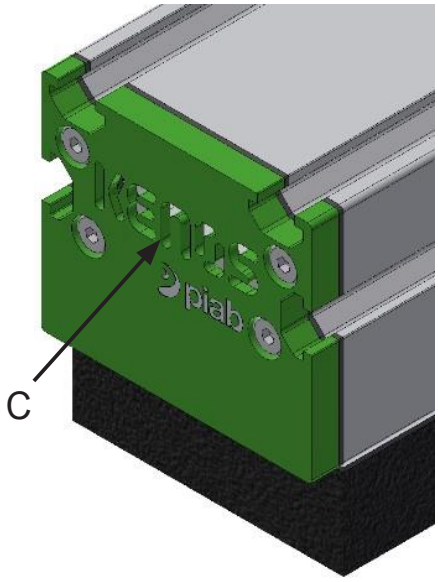
KVG60 Series

Overview

Part list single ejector version



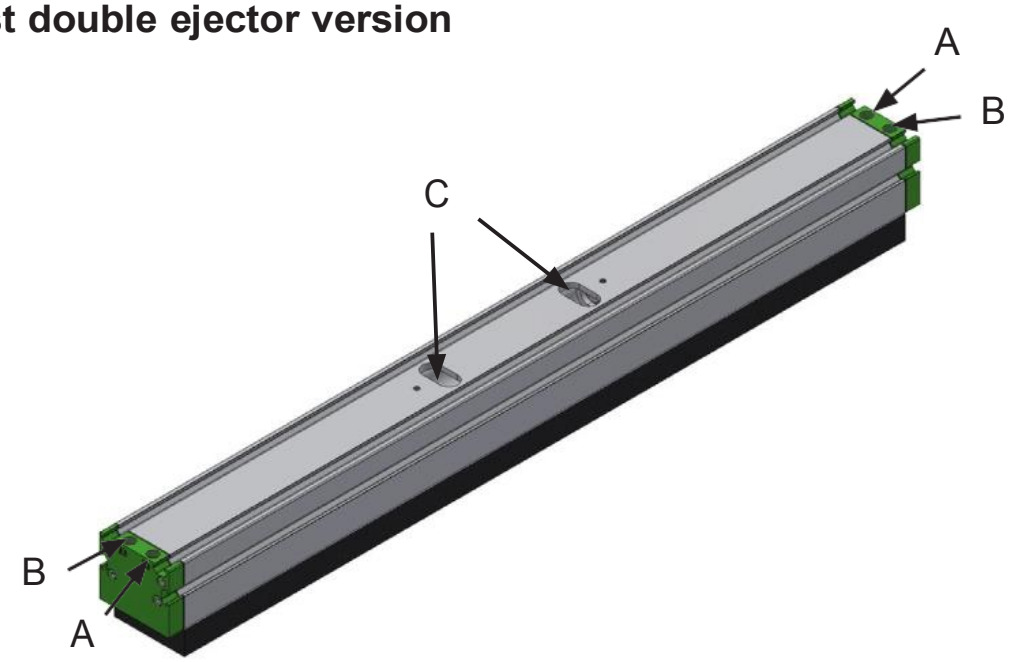


Pos.	Description
A	Connection G 1/8” compressed air (1a)
B	Connection G 1/8” blow-off or vacuum monitoring (1b)
C	Inline ejector exhaust, DO NOT COVER. The aspirated air escapes from the exhaust cover through the written Kenos

KVG60 Series

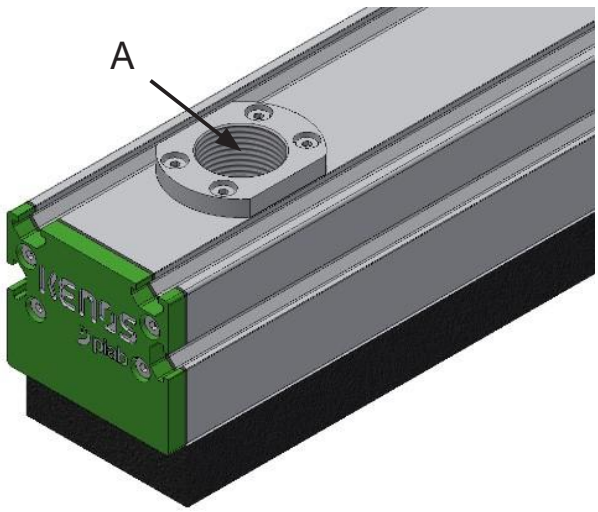
English

Part list double ejector version



Pos.	Description
A	Connection G 1/8” compressed air (1a)
B	Connection G 1/8” blow-off or vacuum monitoring (1b)
C	Ejector exhaust, DO NOT COVER. The aspirated air escapes from the two exhaust slots.

Part list BL version



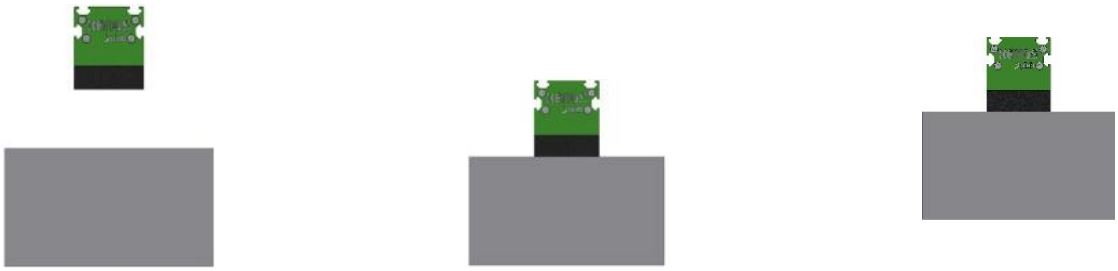
Pos.	Description
A	Vacuum supply G 3/4” connection

KVG60 Series

Work cycle details

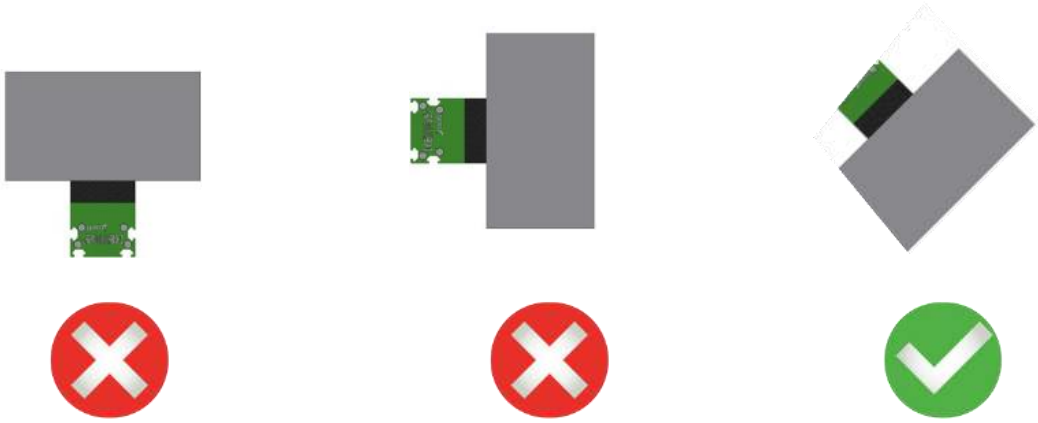
The working cycle for a KVG gripping module follows the different technologies involved:

Check valve balls version(CVL/CVM/CVH):



1. Positioning the module at the object to handle with the grip pad parallel to the grip surface.
2. Lowering of module until contact with the grip surface
3. Sequential activation of vacuum if multiple modules are present
4. Pick-up of object to handle
5. Drop-off of object with removal of vacuum and blow-off if necessary

N.B. If vacuum is activated before KVG is in contact with the workpiece, the workpiece will not be gripped because the check valves will be closed and not allowed the handling.

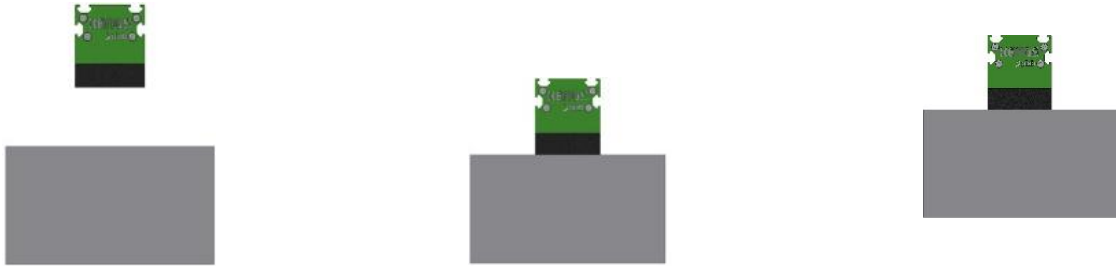


- The KVG CVL/CVM/CVH gripper module was designed for horizontal use; turning the module upside down by 180°, or vertical grips are not possible. Maximum tilt allowed is 45°.
- Stopping or passing through the work area of the gripper module is prohibited, as in case of electrical or pneumatic supply failure, the load handled by the module is released.
- The maximum vertical acceleration allowed is 5 m/s².
- Note that when check valves are present in the KVG module, the vacuum value you can measure through a vacuum switch cannot be used as indication for a safe grip of the object. This because we are detecting the vacuum level inside the gripping module and, thanks to the acting of the CV, it will be high even when the object is not present (CV will close).

KVG60 Series

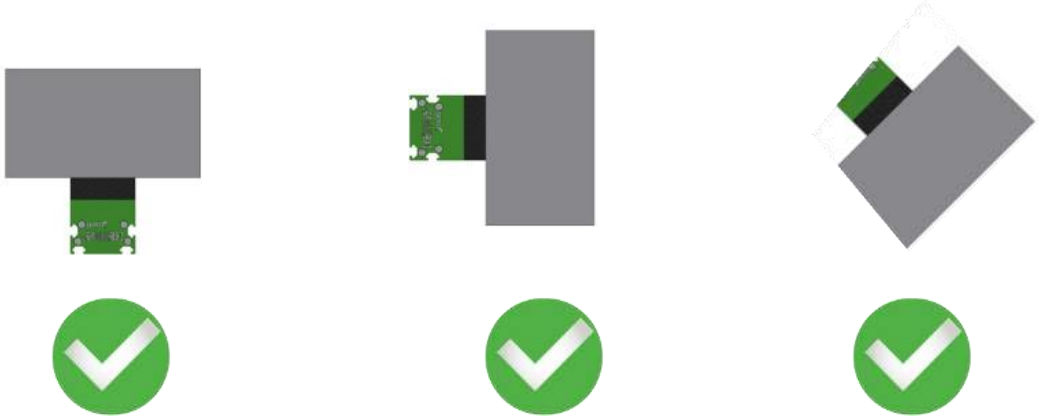
English

Check valve piSAVE sense 02/60 (CV19):



1. Positioning the module at the object to handle with the grip pad parallel to the grip surface.
2. Lowering of module until contact with the grip surface
3. Sequential activation of vacuum if multiple modules are present
4. Pick-up of object to handle
5. Drop-off of object with removal of vacuum and blow-off if necessary

N.B. If vacuum is activated before KVG is in contact with the workpiece, the workpiece will be gripped only if the porosity will not exceed the minimum value (0.001 Nl/s at -45Kpa/0.0002 scfm at 13.3 -inHg) for opening each valve.



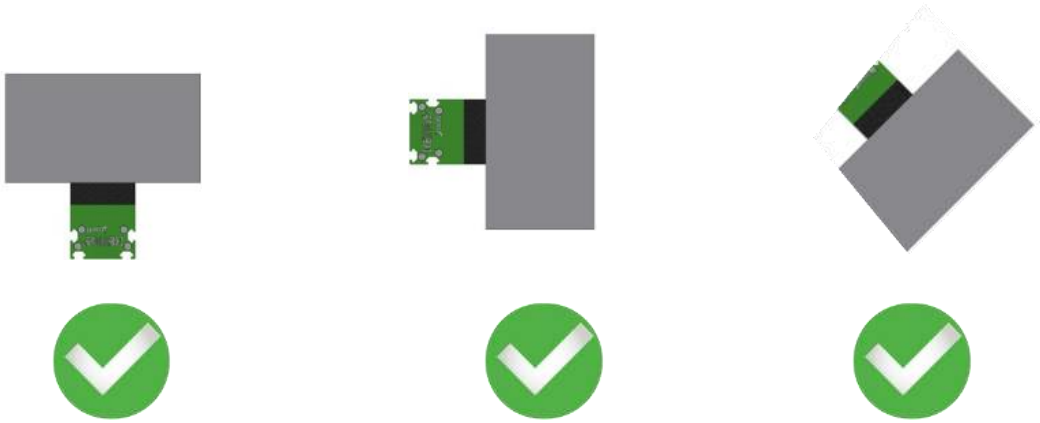
- Stopping or passing through the work area of the gripper module is prohibited, as in case of electrical or pneumatic supply failure, the load handled by the module is released.
- Note that when check valves are present in the KVG module, the vacuum value you can measure through a vacuum switch cannot be used as indication for a safe grip of the object. This because we are detecting the vacuum level inside the gripping module and, thanks to the acting of the CV, it will be high even when the object is not present (CV will close).

KVG60 Series

Flow reduction (FR5/FR6/FR8/FR10):

1. Positioning the module at the object to handle with the grip pad parallel to the grip surface.
2. Lowering of module until contact with the grip surface. **For fast cycle, we suggest to activate vacuum before module is in contact with the object.**
3. Pick-up of object to handle.
4. Drop-off of object with removal of vacuum and blow-off if necessary.

N.B. In this case the activation for vacuum can be done before or after contact with the workpiece.



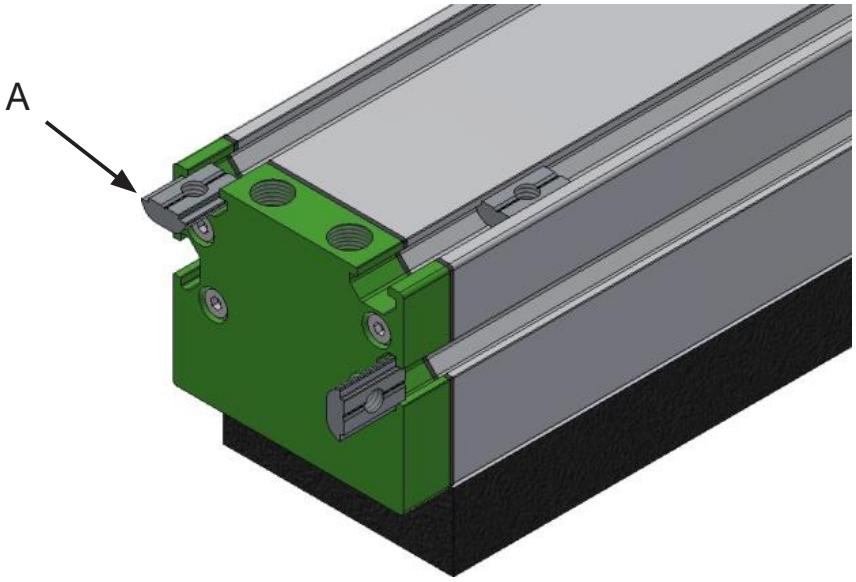
- Stopping or passing through the work area of the gripper module is prohibited, as in case of electrical or pneumatic supply failure, the load handled by the module is released.
- With the flow reduction technology, the vacuum value in the gripper is influenced by the degree of coverage of the gripper. The higher degree of coverage, the higher flow is the vacuum level measured. So in this case the vacuum switch can be used to check the grip.

Note: We recommend always running preliminary tests with original samples. We are able to perform these tests for you.

Installation

Mounting on the handling system

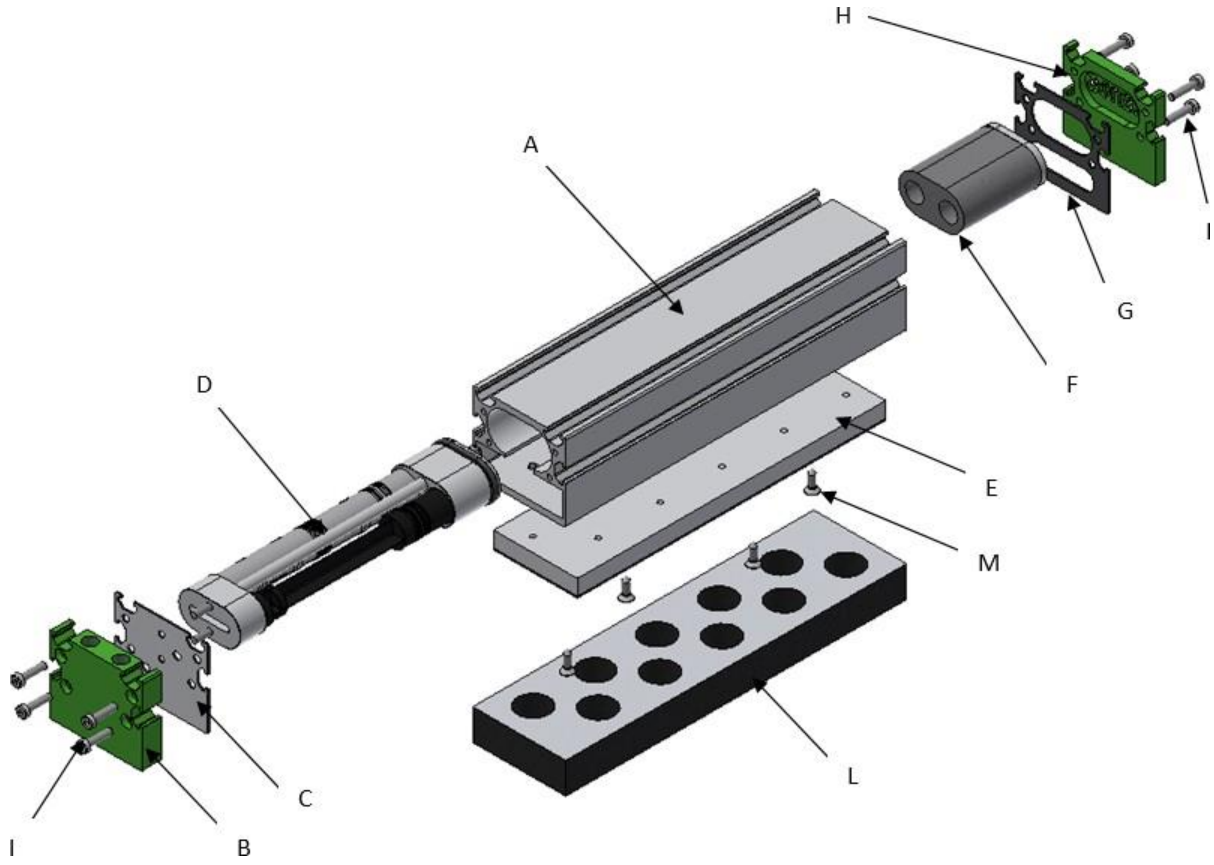
The gripping system is secured with the aid of slot nuts. Special slots for these nuts are available in the basic body. The gripper can be mounted either directly, via robot flange or via spring mountings. Information about the slots are present in the section dedicated to the accessories.



Pos.	Description
A	T-slot nut

KVG60 Series

Parts diagram



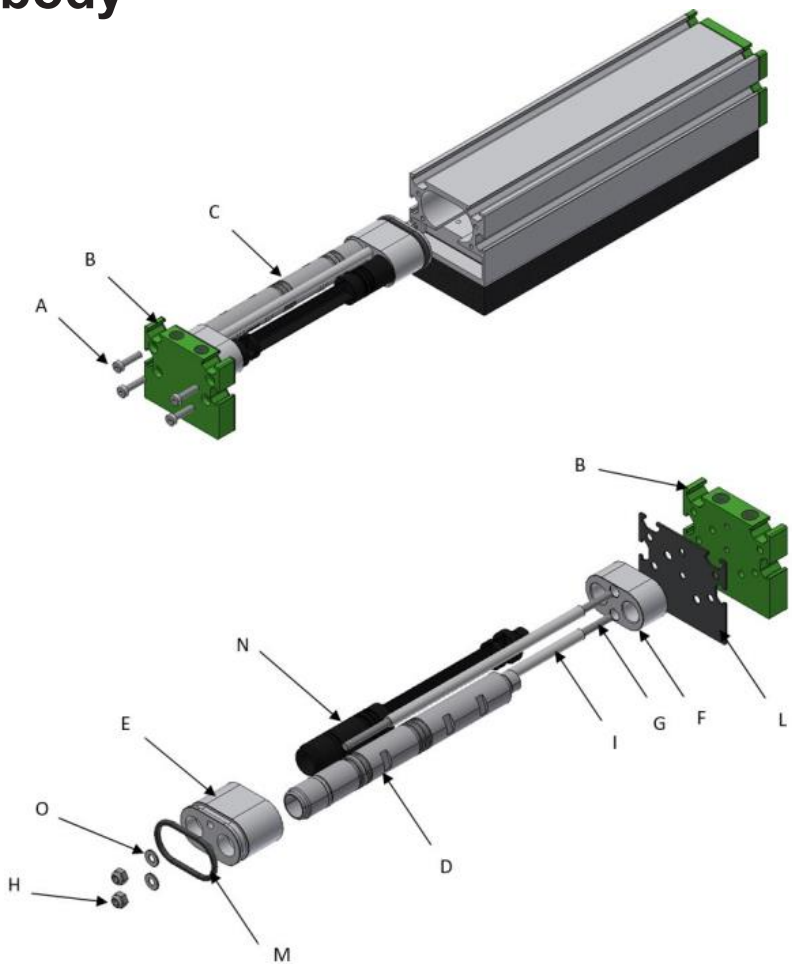
Pos.	Description
A	Basic body
B	Supply cover
C	Supply cover seal
D	COAX® cartridge
E	Check valves module
F	Silencer
G	Exhaust cover seal
H	Exhaust cover
I	Cover screws
L	Technical foam

1. **Basic body** is an extruded aluminum section and is available in different lengths.
2. **Supply/exhaust cover** are made of aluminum properly finished.
3. **Technical foam** is made of EPDM FOAM.
4. **Push in ejector** build of 1 or more multistage COAX® cartridge ejector.

KVG60 Series

English

Ejector body



Pos.	Description
A	Cover screws
B	Supply cover
C	COAX® cartridge
D	COAX® cartridge
E	Posterior housing
F	Anterior housing
G	Tie-beam
H	Tie-beam closing nut
I	Tie-beam cover
L	Supply cover seal
M	O-ring
N	Blind Cartridge for Midi COAX®
O	Flat washer

KVG60 Series

Technical data

Type	Air consumption at 6 bar (Nl/s)/ 87.0 psi (scfm)
KVG.XXX.60.XXXX.CVX.S1.XX.XX	1.75 /3.71
KVG.XXX.60.XXXX.CVX.S2.XX.XX	3.5 / 7.42
KVG.XXX.60.XXXX.CVX.S4.XX.XX	7.0 / 14.84

Pneumatic technical information

Description	Unit	COAX® Si32-3 Si MIDI-cartridge (1-4 nozzles)
Feed pressure, optimal	MPa [psi]	0.6 [87]
Max vacuum at opt. pressure	-kPa [-inHg]	75 [22.1]
Air consumption at opt. pressure/nozzle	Nl/s [scfm]	1.75[3.71]
Max vacuum flow at opt. pressure/nozzle	Nl/s [scfm]	6 [12.71]

Air

Description	
Supply air connection size	8mm internal diameter by up to 2 meters (6.5ft)
Air quality	DIN ISO 8573-1 class 4

Temperature

Description	
Operating temperature environment	0-50°C (32-122F)
Operating temperature workpiece	0-50°C (32-122F)

Compact Guide Cylinder

Ø 12, Ø 16, Ø 20, Ø 25, Ø 32, Ø 40, Ø 50, Ø 63, Ø 80, Ø 100

Up to 24 % Weight reduced!

Weight reduced by up to 24 % with a shorter guide rod and thinner plate

3 types of bearing can be selected.

- **Slide bearing**
  Series MGPM
- **Ball bushing**
  Series MGPL
- **High precision ball bushing**
  Series MGPA

Guide rod shortened
for MGPM40-25 stroke

Max. **22 mm**

Space required between the bottom of the cylinder body and your equipment is **reduced.**

Space saving

New

- Cylinder with stable lubrication function (Lube-retainer) and Guide unit with Lube-retainer added.
- Made to Order: Shock absorber soft type series RJ type (-XB22) and Spatter resistant specification (-XC88, 89, 91) added.

With air cushion

Water resistant cylinder

Series MGP

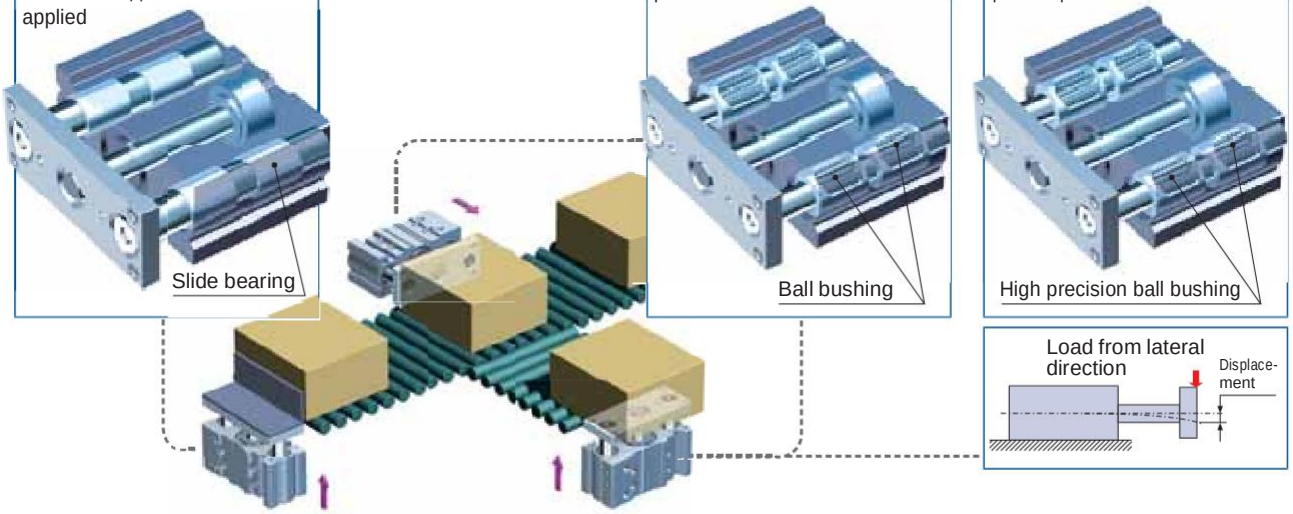
SMC

3 types of bearing can be selected.

Slide bearing
Series MGPM
Suitable for lateral load applications such as a stopper where shock is applied

Ball bushing
Series MGPL
Smooth operation suitable for pusher and lifter

High precision ball bushing
Series MGPA
Suitable for minimiSing plate displacement



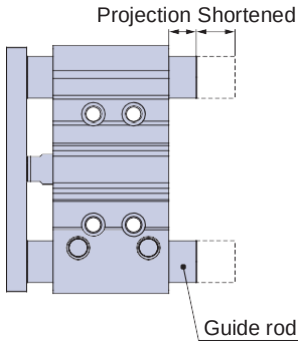
Basic Type

- Weight reduced by up to 17 %

	17	1.41

∗: Compared with the slide bearing type, Ø 12 to Ø 25-20 stroke
∗: Compared with the slide bearing type, Ø 32 to Ø 100-25 stroke

- Guide rod shortened



[mm]

Bore size	Guide rod	
	Shortened by	New dimension
Ø 32	33.5	9
Ø 40	33.5	2.5
Ø 50	22	12.5
Ø 63	22	7.5
Ø 80	35.5	10
Ø 100	35.5	10.5

∗: Compared with the slide bearing type, 25 stroke (Ø 32 to Ø 100)
(No projection for Ø 12 to Ø 25-25 stroke)

- Performance and strength (rigidity) are equivalent to the current MGP series.

- Mounting dimensions are equivalent to the current MGP series.

Series MGP (Basic Type), Stroke Variations

Bearing type	Bore size [mm]	Stroke [mm] 10	20	25	30	40	50	75	100	125	150	175	200	250	300	350	400
MGPM Slide bearing	12	●	●		●	●	●	●	●								
	16	●	●		●	●	●	●	●								
	20	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
	25	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●
MGPL Ball bushing	32			●			●	●	●	●	●	●	●	●	●	●	●
	40			●			●	●	●	●	●	●	●	●	●	●	●
MGPA High precision ball bushing	50			●			●	●	●	●	●	●	●	●	●	●	●
	63			●			●	●	●	●	●	●	●	●	●	●	●
	80			●			●	●	●	●	●	●	●	●	●	●	●
	100			●			●	●	●	●	●	●	●	●	●	●	●

Made to Order

- **-XA□**: Change of guide rod end shape
- **-XB6**: Heat resistant cylinder (-10 to 150 °C)
- **-XB10**: Intermediate stroke (Using exclusive body)
- **-XB13**: Low speed cylinder (5 to 50 mm/s)
- **-XC6**: Made of stainless steel
- **-XC8**: Adjustable stroke cylinder/ Adjustable extension type
- **-XC22**: Fluororubber seal
- **-XC35**: With coil scraper
- **-XC79**: Tapped hole, drilled hole and pinned hole machined additionally
- **-XC82**: Bottom mounting type
- **-X144**: Symmetrical port position
- **-X867**: Side porting type (Plug location changed)

∗: For details, refer to pages 69 to 89.

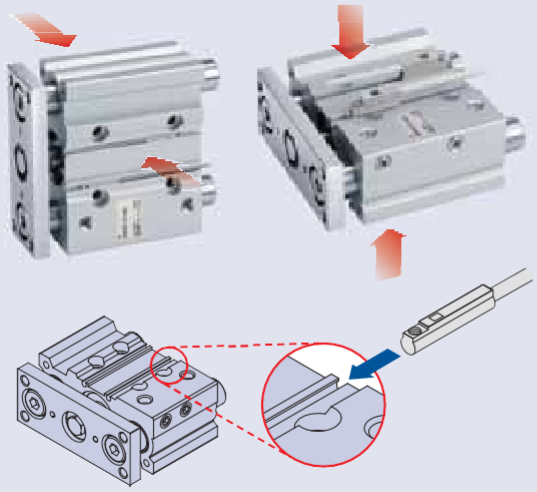
Compact Guide Cylinder *Series MGP*

Small auto switches or magnetic field resistant auto switches can be directly mounted on 2 surfaces.

D-M9□ | D-A9□ | D-P3DWA

∗: The D-Y7 and D-Z7 auto switches are not mountable.

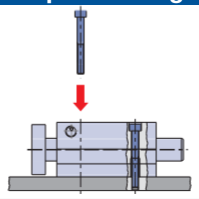
D-M9□ D-P3DWA



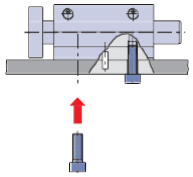
4 types of mounting are possible.

Easy positioning
Knock pin holes provided on each mounting surface

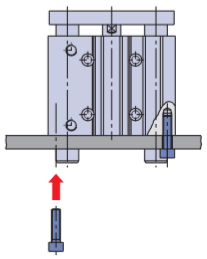
1. Top mounting



2. Bottom mounting

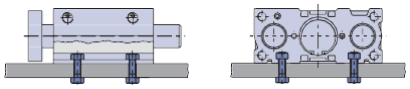


4. Bottom mounting



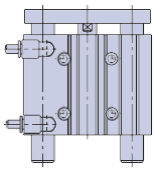
3. T-slot bottom mounting

Easy adjustment of workpiece and cylinder mounting

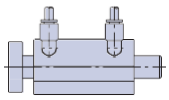


Piping is possible from 2 directions.

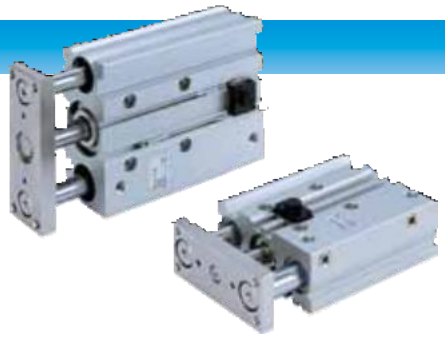
1. Top ported



2. Side ported



With End Lock

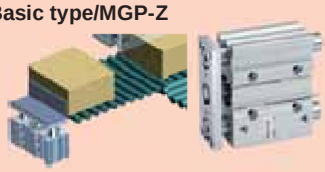
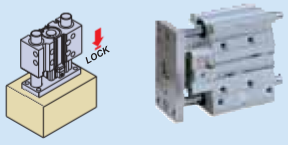


s (OLDS THE CYLINDER'S HOME POSITION EVEN IF THE AIR SUPPLY IS CUT OFF. s COMPACT BODY ▫ 20 TO ▫ 63 qqqqqq 3TANDARD + 25 MM BODY LENGTH
▫ 80, ▫ 100 qqqqqq 3TANDARD + 50 MM BODY LENGTH

■ 3TROKE 6ARIATIONS

Bearing type	Bore size [mm]	Stroke [mm] 25	50	75	100	125	150	175	200	250	300	350	400	Intermediate stroke	Lock direction	Manual release
MGPM 3LIDE BEARING **MGPL** BALL BUSHING BEARING **MGPA** (IGH PRECISION BALL BUSHING	20	●	●	●	●	●	●	●	●	●	●	●	●	3PACER TYPE AVAILABLE IN 5 MM STROKE INCREMENTS.	2OD END LOCK	NON-LOCK TYPE
	25	●	●	●	●	●	●	●	●	●	●	●	●			
	32	●	●	●	●	●	●	●	●	●	●	●	●			
	40	●	●	●	●	●	●	●	●	●	●	●	●		(EAD END LOCK	LOCK TYPE
	50	●	●	●	●	●	●	●	●	●	●	●	●			
	63	●	●	●	●	●	●	●	●	●	●	●	●			
	80	●	●	●	●	●	●	●	●	●	●	●	●			
	100	●	●	●	●	●	●	●	●	●	●	●	●			

Compact Guide Cylinders, Series Variations

Series	Bearing type	Bore size (6 10 12 16 20 25 32 40 50 63 80 100)	Page
Basic type/MGP-Z 	Slide bearing Ball bushing High precision ball bushing	12 16 20 25 32 40 50 63 80 100	**Page 9**
With air cushion/MGP-AZ 		16 20 25 32 40 50 63 80 100	**Page 29**
With end lock/MGP-H/R 	Slide bearing Ball bushing High precision ball bushing	20 25 32 40 50 63 80 100	**Page 46**
Heavy duty guide rod/MGPS 	Slide bearing	50 80	**Page 55**
Clean series/12/13-MGP-Z 	Ball bushing	12 16 20 25 32 40 50 63	**Page 12**
Water resistant cylinder/MGP R/V-Z 	Slide bearing	20 25 32 40 50 63 80 100	**Page 12**
Miniature Guide Rod Cylinder/MGJ 	Slide bearing	6 10 12 16 20 25 32 40 50 63 80 100	Digital Catalogue www.smc.eu
Compact Guide Cylinder with Lock/MLGP 	Slide bearing Ball bushing	20 25 32 40 50 63 80 100	
Hygienic Design Cylinder/HYG 	Slide bearing	20 25 32 40 50 63	

∗: For details about the clean series, refer to the catalogues on **www.smc.eu**.