Tampere University of Technology
Department of Mechanical Engineering and Industrial Systems
MEI-56006 Production Automation Planning

PRODUCT AUTOMATION PLANNING

Project work 2018: Final report

Group ABB OT160

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1. INTRODUCTION

This report answers the group assignment given on the course Production Automation Planning, in Tampere University of Technology. The report consists of planning an automated assembly system for a product known as ABB OT160 (Figure 1). The product is a 3-pole, front operated, base mounted switch-disconnector, and its structure is composed mainly of plastic material with some metallic parts to provide its electrical functions.

The annual production volume desired for this product is circa 500000 units and the production is set to operate five days a week in three shifts. Other ABB products, for example robots, should be used in the automated product assembly system, if possible. Each production phase must be quality-checked automatically.

In phase one of the assignment, a design for assembly (DFA) analysis of the product is made. The analysis consists of an assembly graph and a table identifying the different parts of the product, the problems in their assemblability and suggestions to improve them. Additionally, a calculation of the estimated assembly time is made. As a result, an introduction to the new and re-designed case product is made.

Figure 1. *ABB OT160 assembled*

2. DESIGN FOR ASSEMBLY

As a first step, the product was fully disassembled, and the parts were analyzed in terms of their purpose, and the possibility of automated assembly.

2.1 Part analysis and problem identification

All parts were studied individually. The parts were named, and their purposes were defined. The possible problems with automated assembly were identified and noted along with options to improve the design. A functional (A/B) analysis was made according to the chart shown in figure 2 for the parts. This analysis defined if the parts were deemed necessary (A) or unnecessary (B).

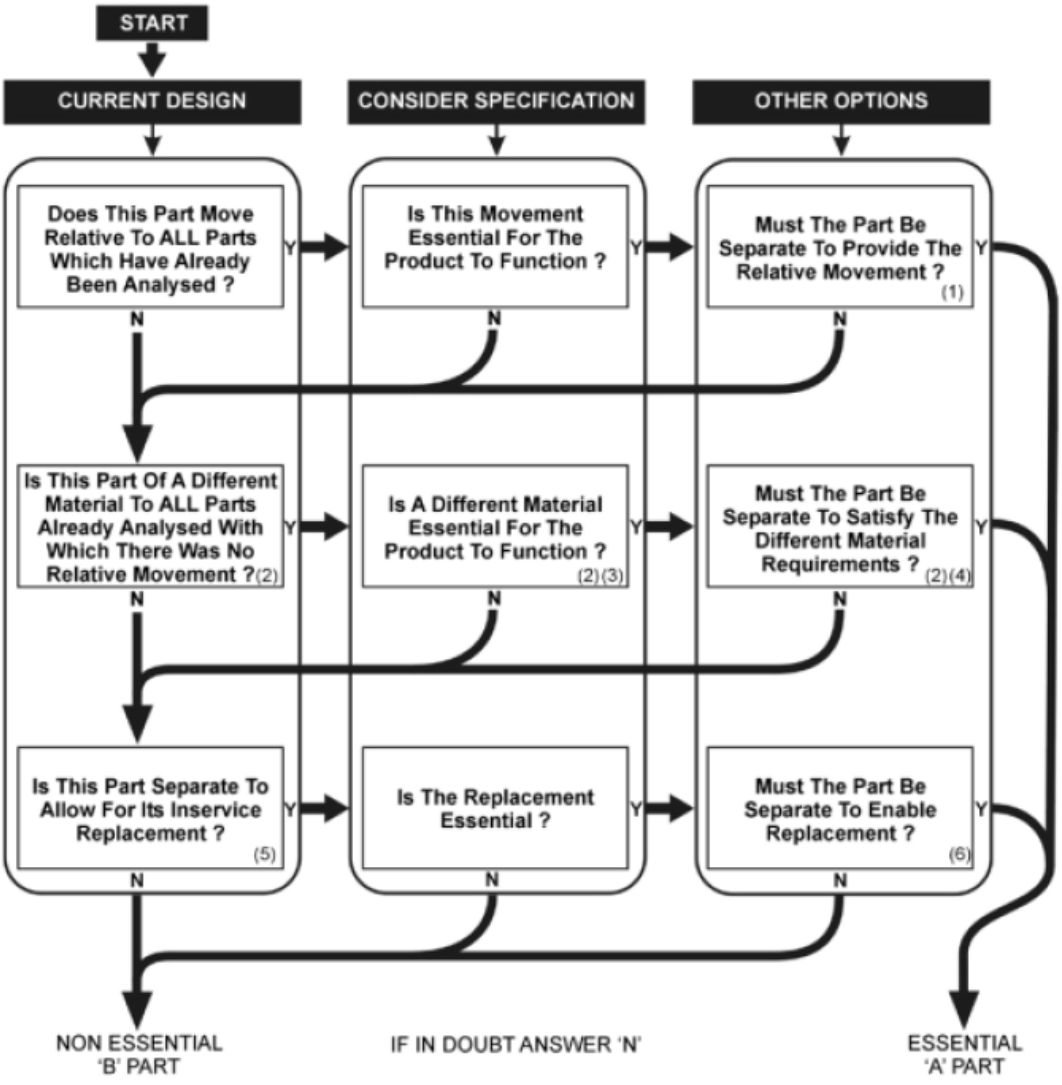
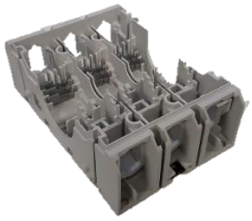
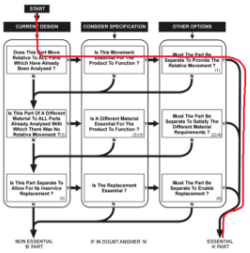
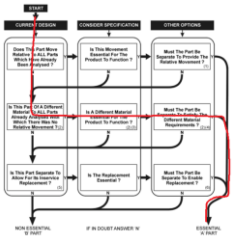
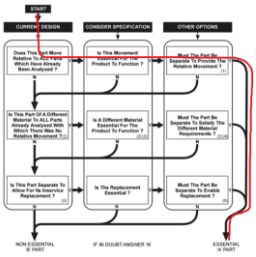
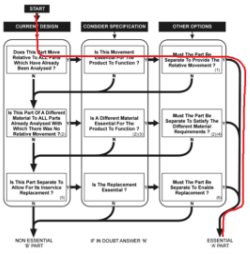
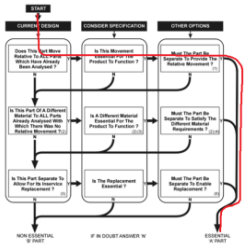
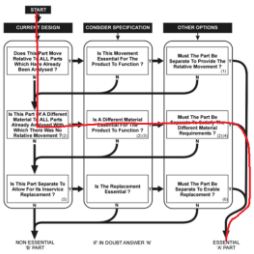
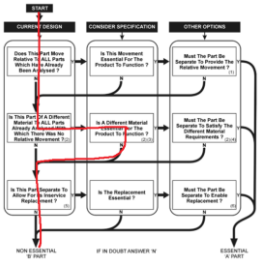
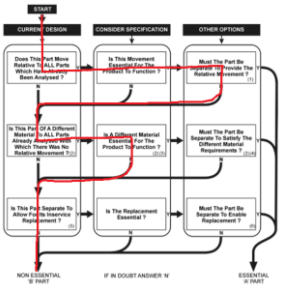


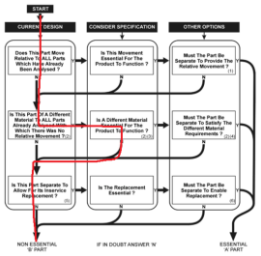
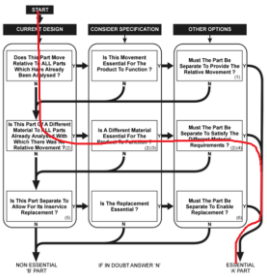
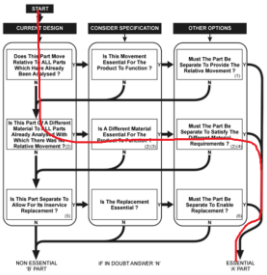
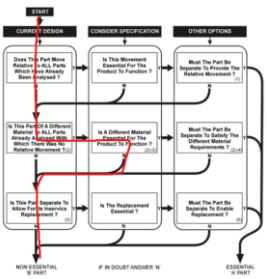
Figure 2. *The functional analysis chart*

All the information derived from the analyses were summarized in table 1.

Table 1. *Characteristics of the parts in the product*

Parts (64x)	Image	Purpose	Problems	Options to improve design	Functional analysis (A/B)
Plastic1 base (1x)		- Provide base to mount all parts.	- Assembly with spark killers is difficult due to the small space available. - The fit of the spark killers and screw terminals is very tight. - Assembly with plastic top requires change of assembly direction.	- Design change to implement a snap-fit connection with plastic top. - Design change for more space to mount spark killers.	**A**
Rail slide (2x)		- To mount the plastic base on a rail.	- Complicated two directional mounting. - Mounting needs high force.	- Design new two-stage snap-fit connection.	**A** 
Spark killer (9x in top + 9x base)		- Kills arcs when the connection is made.	- Very small part, difficult to grip. - Tight fit, needs high force and accuracy to mount.	- Mount first onto a plastic holder, which is easy to install to plastic base - Design change for easier gripping.	**A** 
Screw terminal “up” (3x)		- Holds the wires in place for each pole.	- Tight fit and risk for misaligned mounting. - The parts are loose if screw is not tightened.	- Feed to robot with screw tightened.	**A** 
Screw terminal “down” (3x)		- Holds the wires in place for each pole.	- Tight fit and risk for misaligned mounting. - The parts are loose if screw is not tightened.	- Feed to robot with screw tightened.	**A** 

Parts (64x)	Image	Purpose	Problems	Options to improve design	Functional analysis (A/B)
Axle (1x)		- Holds switch connectors and turns them into place to form connection.	- Difficult to identify position when fed to robot in random orientation. - Needs to be installed in certain angle of rotation. - Difficult to grip.	- Change the circular geometries in the axle ends, so that there is a level face which stops rotation into correct position for gripping. - Add geometry where the axle is easily gripped.	**A** 
Connector (3x) (subassembly)		- Connects the poles together.	- Complicated assembly that “breaks” into separate parts easily. - Needs separate subassembly.	- Design change to help keep the assembly together. - Design change for simpler assembly on a jig. - Replace with one-piece flexible connector	-
Connector plate (2x/connector)		- Conducts electricity in the connector.	Small part. Hard to hold in place during assembly.	- Design change to make easier to hold in place during assembly.	**A** 
Connector plate holder (2x/connector)		- Holds connector plate. - Provides place to mount connector spring and spring holder.	- Small asymmetrical part which is difficult to grip.	- Design change to make easier to hold in place during assembly.	**B** 
Spring holder (2x/connector)		- Provides flexibility for the connector.	- Very small and hard to grip part. - Hard to hold and press into place during assembly.	- Design change to make easier to hold in place during assembly.	**B** 

Parts (64x)	Image	Purpose	Problems	Options to improve design	Functional analysis (A/B)
Connector spring holder (1x/connector)		- Holds the connector assembly together.	- Very small and hard to grip part.	- Integrate function into the connection springs.	**B** 
Axle spring (1x)		- Gives better feeling for disconnecting the switch.	- Hard to insert. - Subassembly. - Function is not critical for operation.	- Integrate spring action in to axle with flexible plastic geometry.	**B** 
Plastic top (1x)		- Covers the internal parts.	- Needs accurate positioning for mounting.	- Chamfered edges that guide insertion. - Replace screw connection with snap fits.	**A** -
O-ring (6x)		- Keeps out dirt from screw terminals.	- Small flexible part, hard to grip. - Difficult to position. - Needs additional assembly direction	- Replace with plastic window which covers screw terminals.	**A** 
Plastic window (1x)		- Gives visibility to the state of connection.	- Complicated 2-directional mounting.	- Replace with one-directional snap-fit connection.	**A** 
Screws (4x)		- Holds the plastic base and top together.	- Assembly needs change of direction for mounting.	- Replace with snap-fit connection between plastic top and base.	**B** 

Parts (64x)	Image	Purpose	Problems	Options to improve design	Functional analysis (A/B)
Sticker large (1x)		- Provides information regarding the product	- Flexible and difficult to grip. - How to feed part to robot?	- Insert information with a laser. - Apply sticker in packing phase with an automated labelling machine	**A** 
Sticker small (1x)		- Provides information regarding the product	Flexible and difficult to grip. How to feed part to robot?	- Insert information with a laser. - Apply sticker in packing phase with an automated labelling machine	**A** 

The part count for the product is 64 pieces. A design efficiency index E was calculated on the basis of the functional (A/B) analysis.

$$E = \left(\frac{A}{(A+B)}\right) \times 100\% = \left(\frac{44}{44+20}\right) \times 100\% \approx 68{,}75\% \qquad (1)$$

Where,
$A = Necessary\ parts$
$B = Unnecessary\ parts$

As can be seen from the calculation the design efficiency of the original product is quite high already. It is commonly suggested that 60% design efficiency is threshold of a ‘good’ design.

2.2 Assembly process of the original product

In order to do the assembly graph of the actual product, the Assembly Stage Decomposition Model (ASDM) was used. The ASDM model visualizes the order of the assembly and divides it into phases. The ASDM model of the main assembly of the product is shown in figure 3.

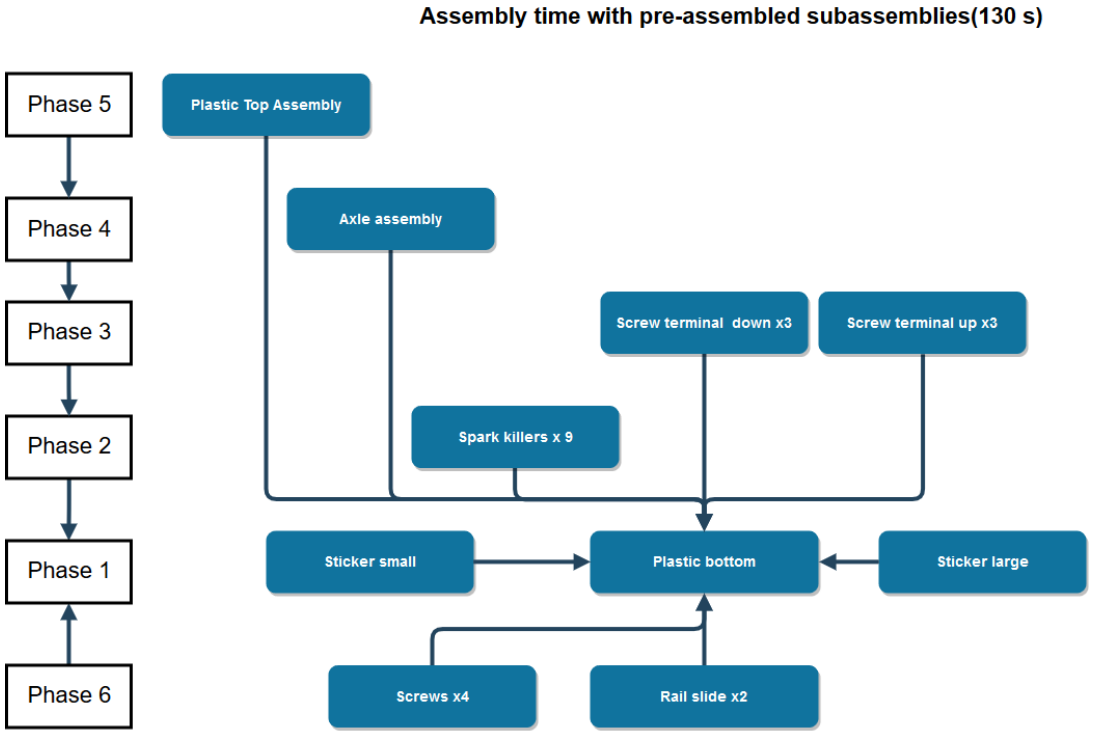


Figure 3. *Assembly graph of the product main assembly*

Similarly, an ASDM model which is shown in figure 4, was also made for the different subassemblies of the product.

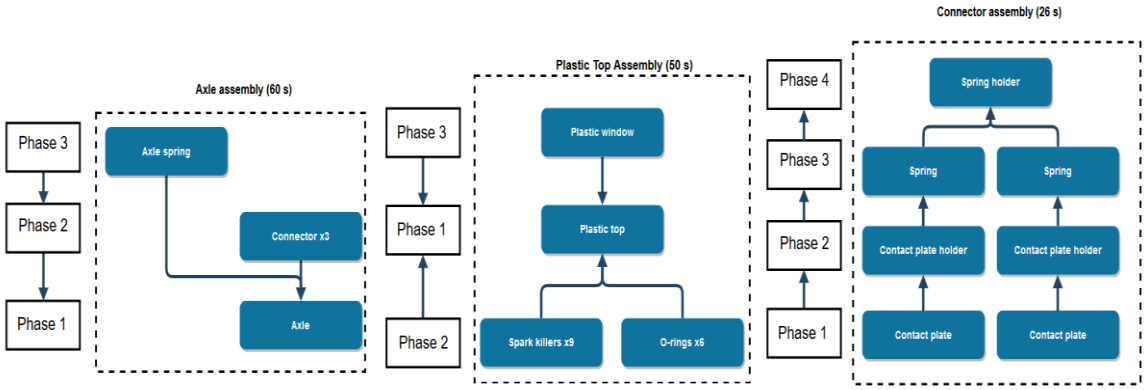


Figure 4. *Assembly graph of the product subassemblies*

Additionally to the ASDM models, it is useful to visualize the actual assembly process with the physical parts. This is shown in figures 5-10. The first step of the process is to assemble the connector subassemblies which is shown in figure 5. The two connector plates, two connector plate holders and the two connector springs are hold together with the connector spring holder. This provides flexibility to the connector in the current design.

Figure 5. *Connector subassembly*

After the connector subassemblies are ready, it is possible to assemble the axle with the 3 connectors and the axle spring (which requires a change of assembly direction). The subassembly of the axle, shown in figure 6, is then ready.

Figure 6. *Axle subassembly*

The final subassembly necessary is the plastic top, which is shown in figure 7. First the plastic window is mounted to the plastic top. After that, the 9 spark killers and 6 o-rings are mounted (from the opposite assembly direction) and the subassembly is ready.

Figure 7. *Plastic top subassembly*

In the plastic base assembly, shown in figure 8 the assembly is carried out by first mounting all the 9 spark killers 9 and then the 3 downward facing screw terminals and 3 upward facing screw terminals onto the plastic base. All of the assembly is done in the same direction.

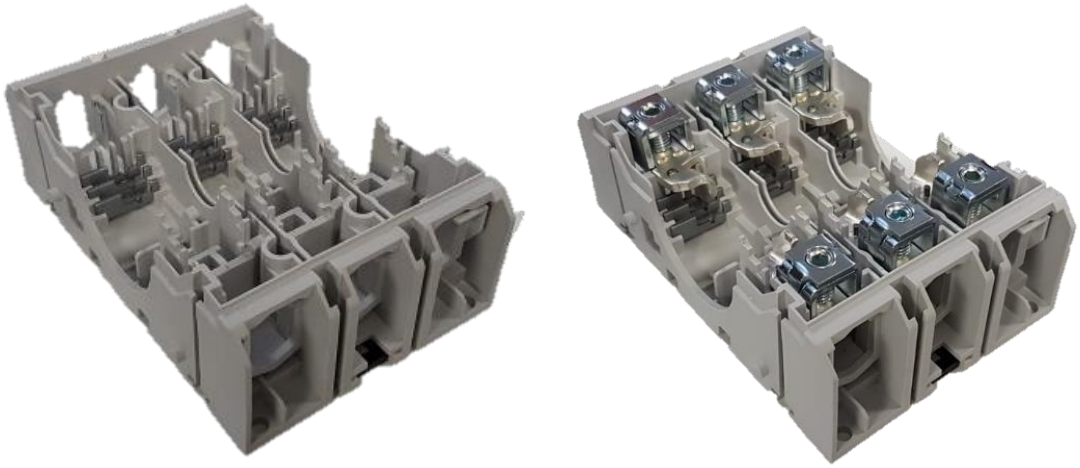


Figure 8. *Plastic base with spark killers and screw terminals*

Now it is possible to first mount the axle subassembly on the plastic base and then the plastic top subassembly as shown in figure 9. Assembly is again from the same direction.

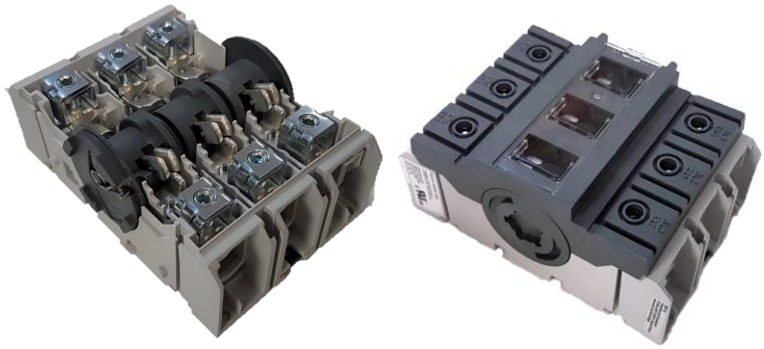


Figure 9. *Main assembly with subassemblies*

After this, the main assembly is tightened with the 4 screws and the 2 rail slides are mounted to the plastic base as shown in figure 10. The assembly direction is now opposite to previous main assembly phases.

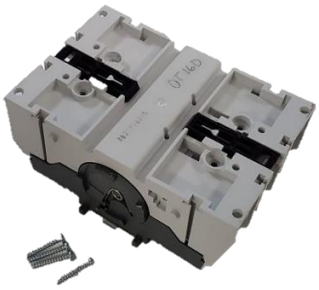


Figure 10. *Final product from the bottom and the screws*

After this, it is necessary to assembly 2 rail slides which can be seen in figure 10 and 11. To do this, the product needs to be upside down. The assembly process is done from up to down and then a slide movement for each rail slides.

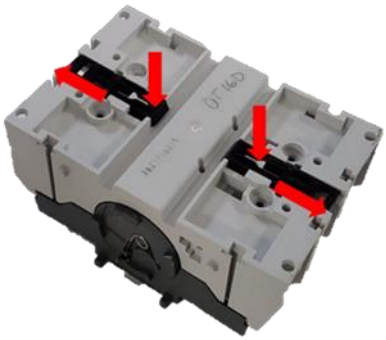


Figure 11. *Old rail slide assembly*

3. DESIGN FOR ASSEMBLY (REDESIGNED PRODUCT)

3.1. PRODUCT CHANGES

3.1.1. The connector

The assembly of the connectors is a very complicated process to do, for both humans and robots. It contains many small parts that are difficult to assemble. For that reason, two solutions were suggested:

First the subassembly could be substituted by a single flexible part that ensures the same functions. However, this change would most likely bring problems regarding optimization for a sufficient fatigue life and wear, and changes would be needed in the design of the mounting holes in the axle also, but it could potentially make the assembly process much simpler and decrease the assembly times. This suggestion is shown in figure 12 on the left.

The second solution that was suggested, was to lengthen the connector spring and make small holes in the end of all the connector parts. This way the parts could be positioned easily for automated assembly on a jig with two pins as shown in figure 12 on the right.

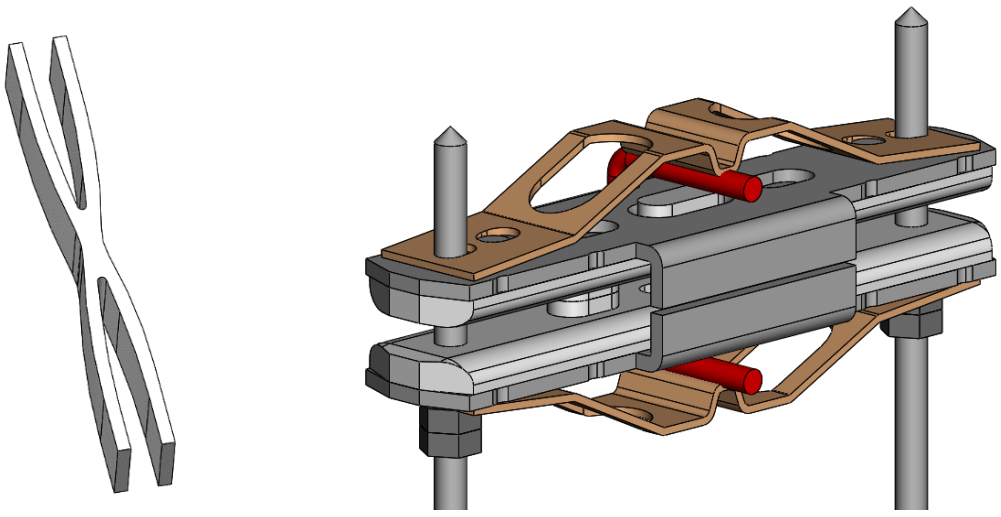


Figure 12. *Two new connector design suggestions*

3.1.2. Modifications to axle

If the one-piece connector design solution was chosen, the axle would have required modifications to the three mounting holes. However, the slightly modified old connector design solution was chosen to be used instead.

Due to this, the only modifications needed for the axle were, to add geometry where the axle can be reliably gripped (1.), and to add geometry which will position the axle correctly (2.) and (3.) in the feeding process for the robot. These geometries are visualized in figure 13.

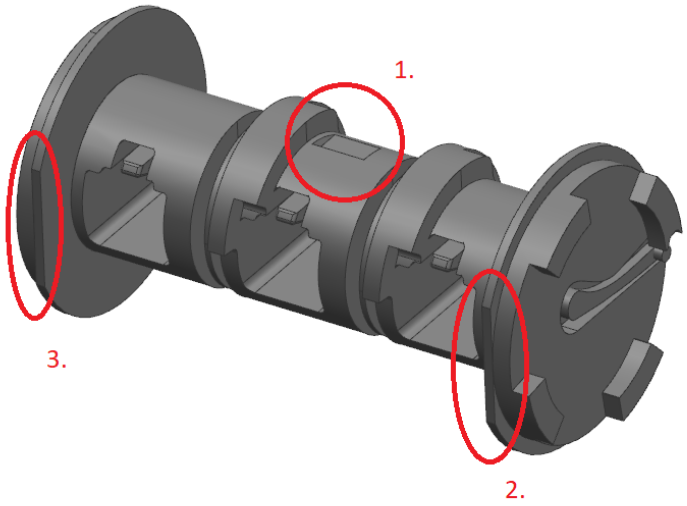


Figure 13. *Modifications made to the axle geometry*

3.1.3. Guiding chamfers for screw terminals

The mounting of the screw terminals was noted to be very tight and the mounting has a high risk of getting misaligned. As can be seen in figure 14. The plastic base had some chamfers designed already, but we decided to make them bigger to guide the mounting of the screw terminals more.

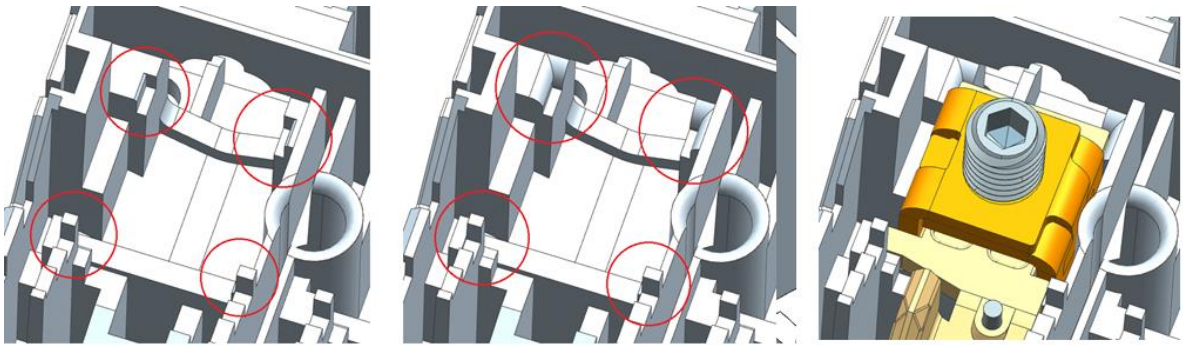


Figure 14. *Bigger guiding chamfers*

3.1.4. Snap-fit connection and guiding fillets between plastic top and base

The plastic top and the plastic base connection needed a redesign too. Our suggestion consists of a change to substitute the four screw mounts with four snap-fits connections as shown in figure 15. The connection location would be moved to the sides between the top and base as shown. In this case, a press to open snap-fit could be used. In this specific design a tool such as a flat head screw driver might be needed to press the prong and release each snap-fit one-by-one. However in the automated manufacturing process of the product, the robot would only need to press the plastic top into place, which is a much easier task than mounting the 4 screws from the opposite assembly direction.

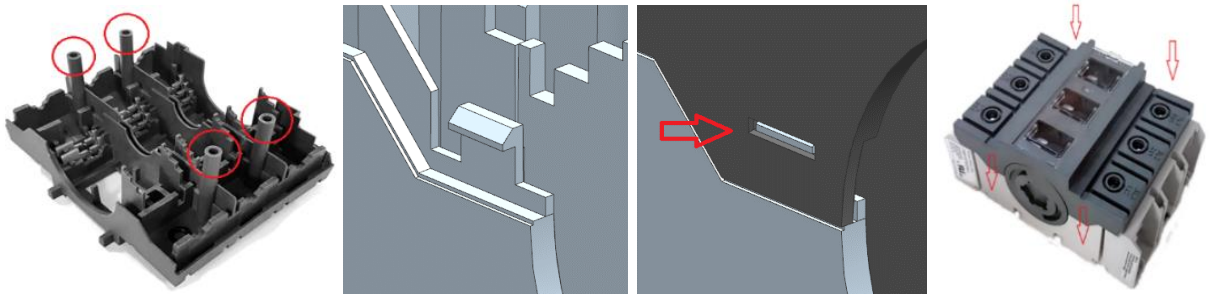


Figure 15. *New connection between the plastic top and the plastic base*

Additionally, the old screw mounting holes in the plastic base would be filled in the new design and the 4 “cylinders” for the screw threads in the plastic top would be used only to guide the mounting of the plastic top on to the plastic base. This guiding action could be improved also by adding fillets to the plastic base as shown in figure 16.

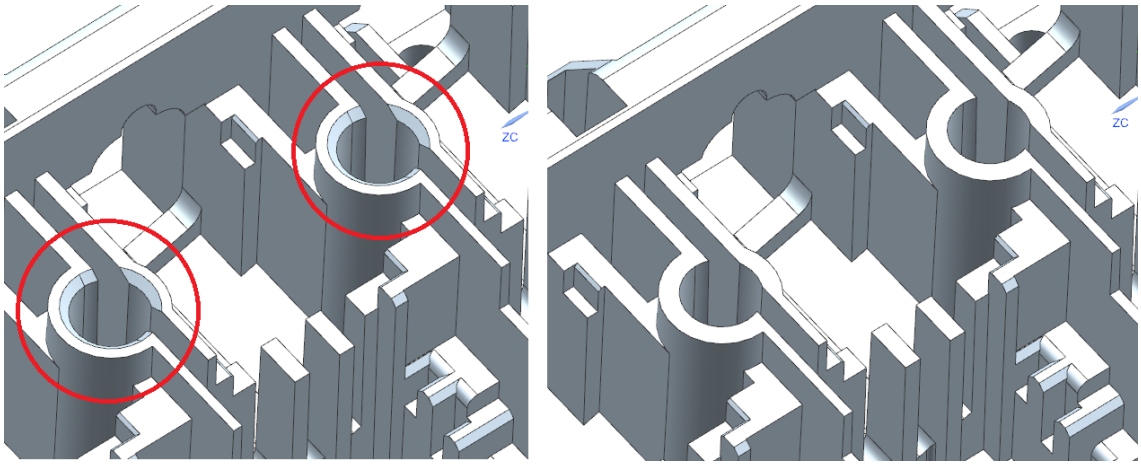


Figure 16. *Guiding chamfers in plastic base*

3.1.5. Improved rail slide

To improve the rail slide assembly with the plastic base, a solution was made:

Rail slide has been redesigned so that it could be pushed down in front of the plastic base instead a top-down and then a horizontal movement at back of the plastic base. This will simplify assembly when the base doesn't need to move in the assembly process.

Figure 17. *Original rail slide on left and improved rail slide on right*

Rail slide has a little cab at one end so that it will fit the little triangle shaped tightener through the rail slide.

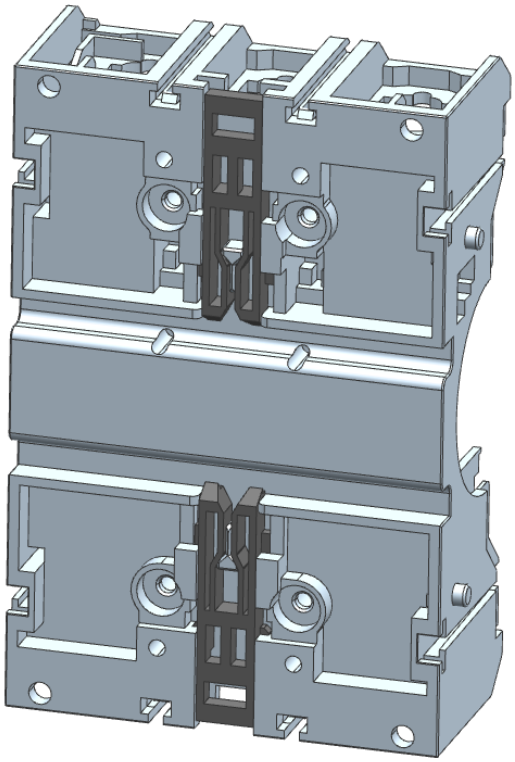


Figure 18. *Improved rail slide with plastic base*

3.1.6. One-piece spark killer

Spark killers are re-designed so that they are made of one plastic piece like in figure 19 with electroplating. Electroplating process is called selective electroless plating. Electroplating ensures that there are three electrically isolated areas. With this redesign, assembly becomes easier with larger and fewer parts. In the original design, there are 18 spark killers and this will reduce this number to 6.

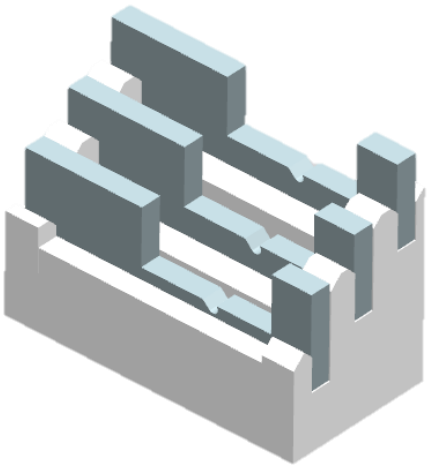


Figure 19. *Spark killer redesigned with electroplating*

Redesigned part will be fitted on the plastic base with a snap fit connection.

3.1.7. Redesign of axle spring

The redesign of the axle spring was suggested due to the difficulty of the current mounting process. Instead of a separate metal spring, it was suggested that the spring could be integrated in to the plastic axle geometry as shown in figure 20. This however would need optimization to provide sufficient flexibility without fracturing the plastic. The axle material might need to be changed to a softer plastic, but it should not be a problem.

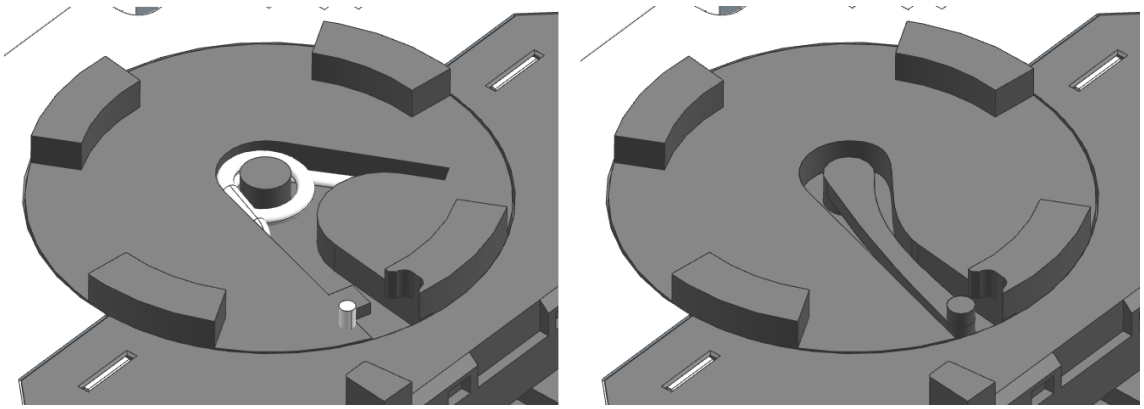


Figure 20. *Integrated axle spring.*

3.1.8. Snap-fit plastic window

The snap-fit plastic window has 2-directional mounting. This makes very difficult to assembly. For that reason, it was replaced with one-directional snap-fit connection.

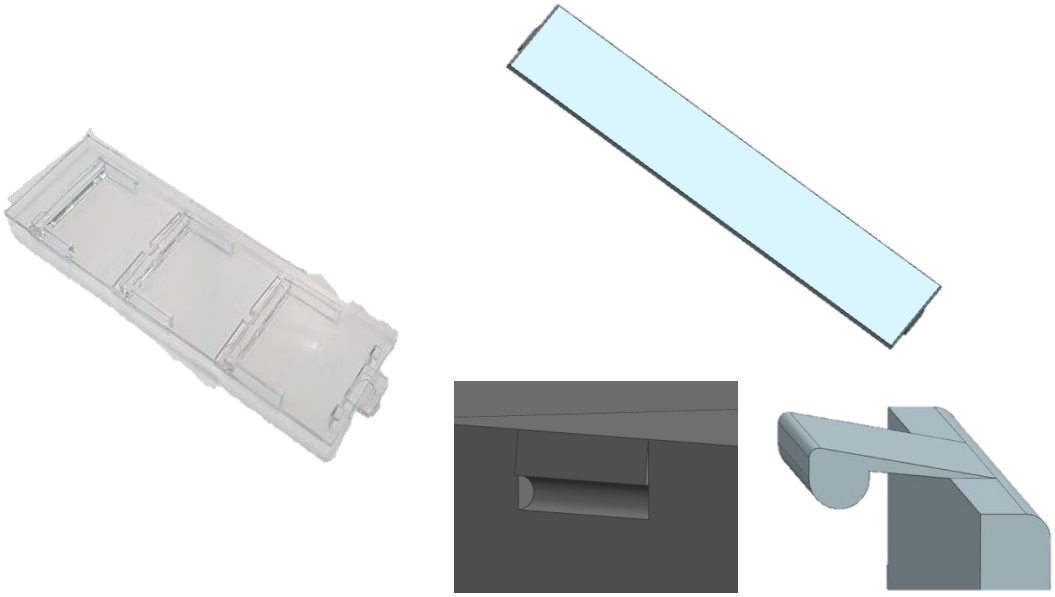


Figure 21. *Old plastic window (left) and new plastic window and snap fit (right)*

The new plastic window has 2 snap fits (one at each end) that allows to fix it to plastic top part and be assembled in just one direction (top to down).

3.1.9. Snap-fit plastic window to replace O-rings

To keeps out the dirt and remove the 6 o-rings (small flexible part, hard to grip, difficult to position) of the assembly, the top plastic part was redesign, where a plastic window (same as the center one) is added in both sides, covering the screw terminals.

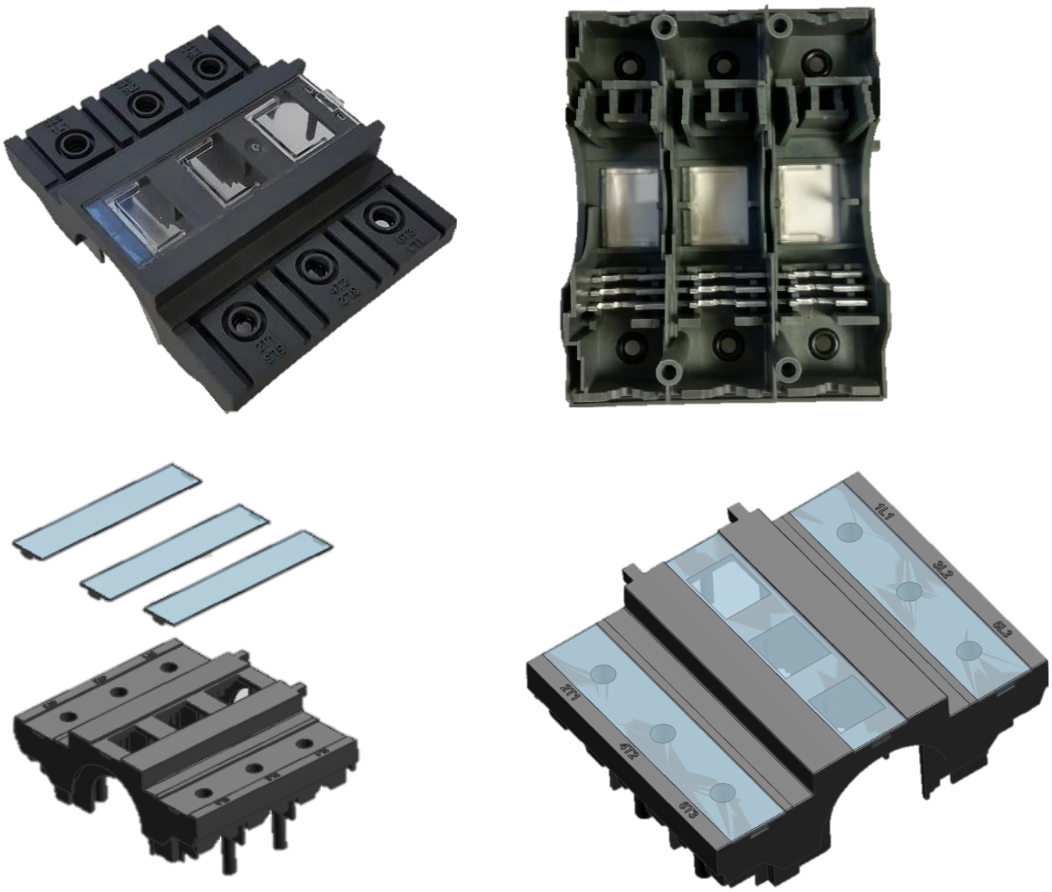


Figure 22. *Old top plastic part (top) and new plastic top with 3 windows (down)*

Changes (figure 22) on the top plastic part were made to use the same plastic window. Thus, it is necessary just one type of plastic window that can serve all the three cases (left, center and right).

4. ASSEMBLY PROCESS FOR IMPROVED PRODUCT

To plan the assembly of the product, a drawing was made to understand all processes and sequences of the line, position of subassemblies, feeding of the system and movements of components and this can be seen on the figure 23.

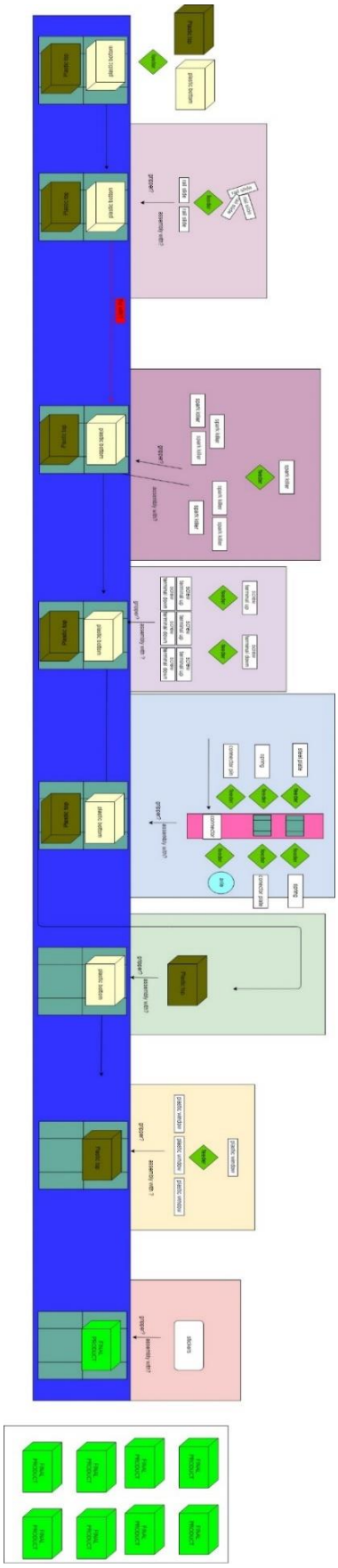


Figure 23. *Preliminary system design*

5. COMPARISON OLD VS NEW DESIGN

The estimated yearly production volume for the product is 500 000 units. The factory operates five days a week in three shifts. The estimated assembly time is 6 minutes and 24 seconds for full manual assembly. Labor cost were estimated by using 37 €/h as hourly cost of industrial labor. Yearly work time for one worker was estimated to be 1 920 hours. Number of assembled products per works was calculated

$$Assembled\ products\ per\ year = \frac{Yearly\ work\ hours}{Assembly\ time/product}.$$

When using these estimates 28 workers could assemble 500 000 units in a year. We estimated that 6 additional workers will be needed for as a reserve personnel and as support personnel (for logistics and for supervisors). Total labor cost for year was calculate by using this formula

$$Total\ labor\ cost = Number\ of\ workers * \frac{Yearly\ work\ hours}{worker} * \frac{labor\ cost}{hour}.$$

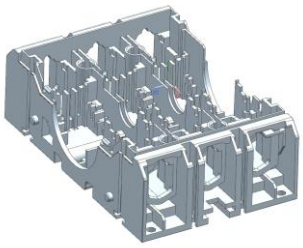
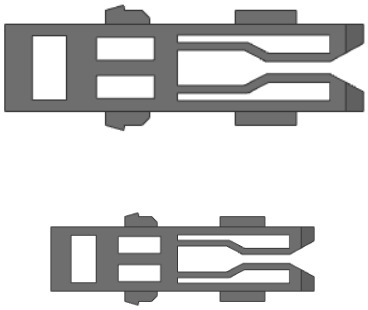
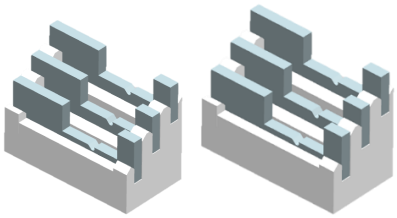
Results of these calculations are shown in Table 2.

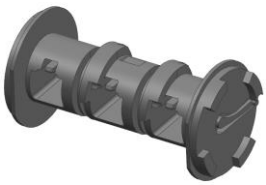
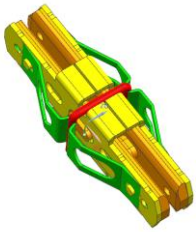
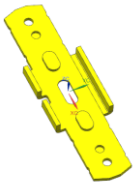
Table 2. *Old and new design comparison*

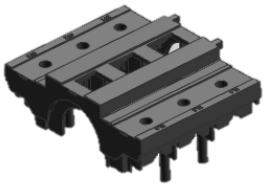
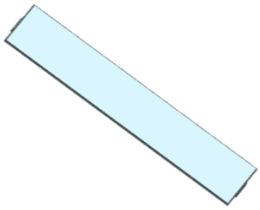
	Old Design	New Design
Work hours/worker (h)	1624	1624
Assembly time (min)	6,4	4
Assembled units in a year	18000	28800
Yearly production (pieces)	500 000	500 000
Needed assembly workers	28	18
Needed workers +support and reserve personel	34	24
Hourly wage	37	37
Labor cost in a year for one worker (€)	60088	60088
Total labor cost for year (€)	1682464	1081584
Machine operation costs		
Investment cost (€)	0	0
Total costs / year (€)	1682464	1081584
Total costs / unit (€)	3,364928	2,163168

The part count for the product is 58 pieces. It was made a classification on the redesigned parts of the new product, as is possible to see in table 3.

Table 3. *Characteristics of redesigned parts in the new product*

Parts (43x)	**Image**		**Achieved improvements**	**Functional analysis (A/B)**
Plastic base (1x)			-Easier assembly with plastic top was made possible with snap-fits	A
”Rail slide” (2x)			High accuracy is needed to assemble. -Only one assembly direction needed	B
Spark killer (3x in top + 3x base)			-Made possible to assemble with automation -Reduced assembly time -Difficult to produce.	A
Screw terminal “up” (3x)			-	A
Screw terminal “down” (3x)			-	A

Parts (43x)	Image		Achieved improvements	Func-tional analysis (A/B)
Axle (1x)			Some difficulties to identify position if fed to robot in random orienta-tion. -Removed the need for a separate spring. -Feeding and grip-ping the part was made easier	A
Connector (3x) and connector parts (subassem-bly)			-Easy assembly on a jig was made possible by small modifications	-
Connector plate (2x/connector)			-Holding the part in place during as-sembly was made easy by small holes that locate the part on a jig	A
Connector plate holder (2x/connector)			-Holding the part in place during as-sembly was made easy by small holes that locate the part on a jig	B
Spring holder (2x/connector)			-Holding the part in place during as-sembly was made easy by extending the part and adding small holes that lo-cate the part on a jig	B
Connector spring holder (1x/connector)			-	B

Parts (43x)	Image		Achieved improvements	Functional analysis (A/B)
Plastic top (1x)		Covers the internal parts and allows to see the connection.	-Easier assembly with plastic base was made possible with snap-fits -Modifications allow for one directionally mounted plastic windows	A
Plastic window (3x)			-Removed the need for 6 x O-rings -Assembly is now from only one direction.Some accuracy is necessary to assemble	B
Sticker large (1x)			-Requires rotation of the product	A
Sticker small (1x)			Requires rotation of the product -	A

Efficiency index E for the new design:

$E = \left(\frac{A}{(A+B)}\right) \times 100\% = \left(\frac{9}{9+2}\right) \times 100\% \approx 81\%$ (2)$\left(\frac{28}{28+15}\right) \times 100\% \approx 65{,}12\%$

As we can see the efficiency index is actually lower than in the original product, but it does not mean that the design has gotten worse. The result comes from the fact that we have highly reduced the overall part count, and now the connectors "non-essential" parts are in a bigger role for the calculation.

Where,
$A = Necessary\ parts$
$B = Unnecessary\ parts$

The redesigned product has an efficiency index of 81% reveling a good using of the redesigned components.

6. SYSTEM DESIGN

Production system for improved product is designed for almost fully automated assembly. Manual phases are refilling parts for robots and removing pallet with finished parts.

6.1. SYSTEM LAYOUT

Assembly was divided to 8 workcells and this layout can be seen on figure 24. The process goes from left to right and starts with unloading bottom and top plastic parts on the main conveyor and then ends with finished products placed on pallet and leaving manually with pallet jack. It was assumed that finished product would leave to another facility and it will be a part of bigger assembly, so the finished parts are only placed on pallets with cardboard on it and a cardboard between layers.

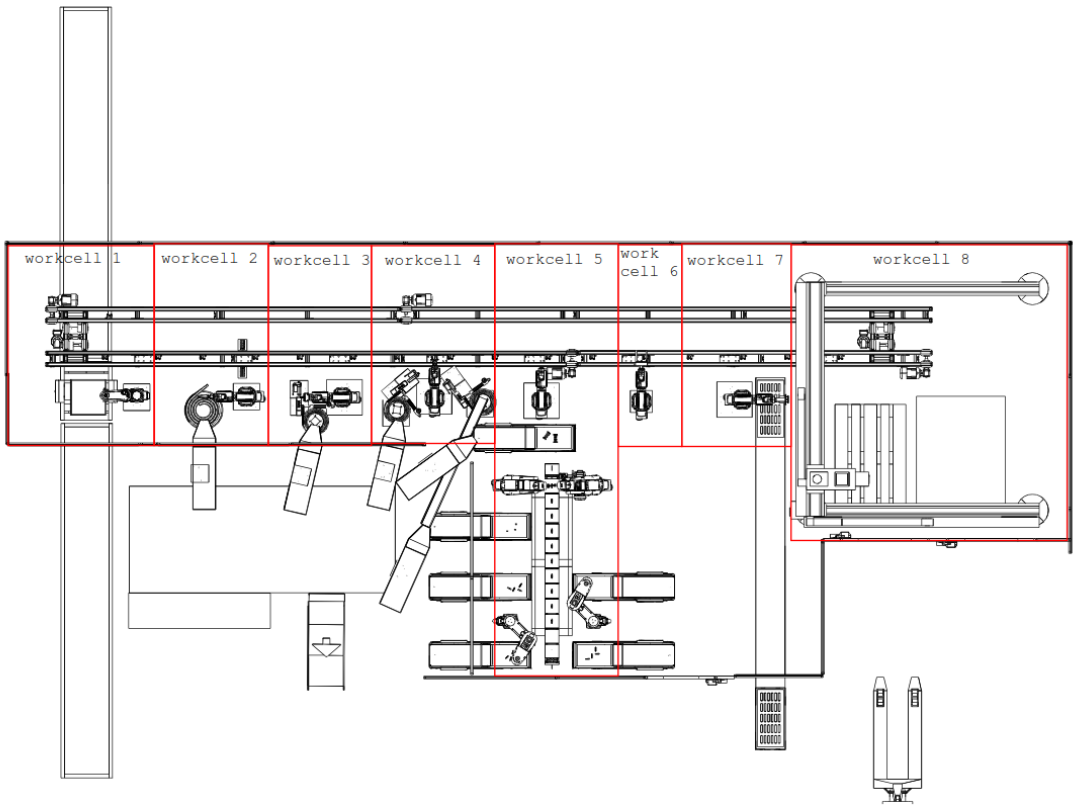


Figure 24. *Final layout*

Main conveyor is looping pallets with stops for individual workstations. Technical details are explained chapter 5.3. Figure 25 shows whole system with every part in place.

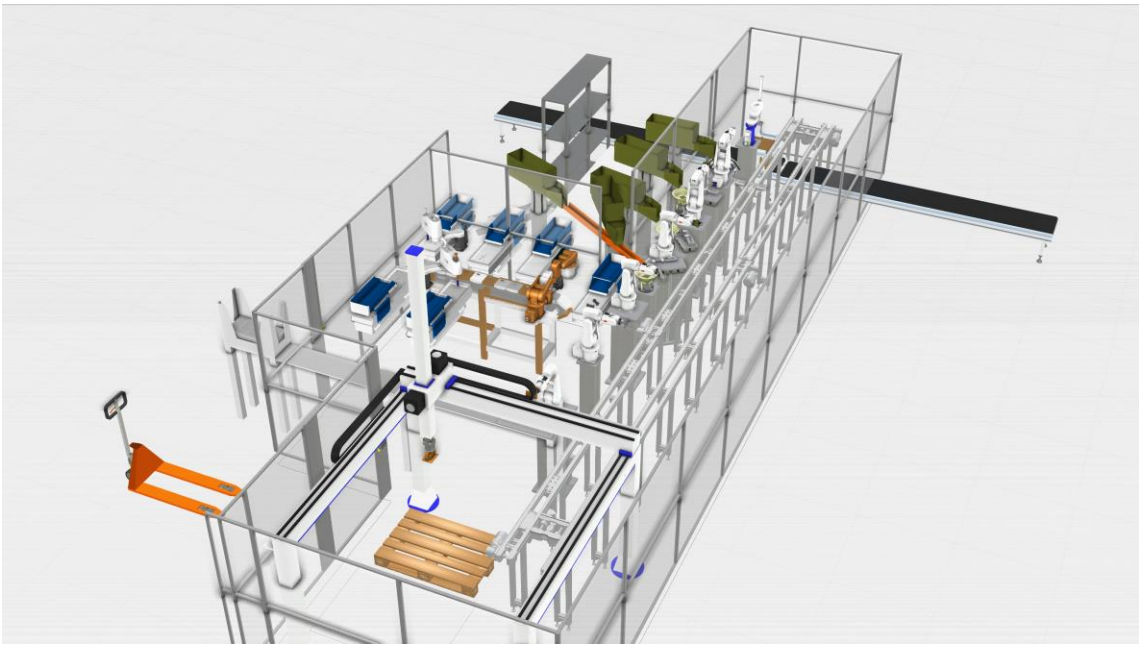


Figure 25. *3D model of the layout*

Whole assembly system is covered with fences and feeding the parts to robots can mostly be done outside the fences with the help of hoppers. It was considered that this is almost fully automated assembly system and the system should be able to work several hours without human intervention.

Capacity calculations

Capacity calculations are done on the assumption that yearly production is stable and this is warehouse product, which can be made to stock (MTS). Calculations, which are considered in our system design, are shown in table 4.

Table 4. *Capacity calculations*

Required annual volume	500000	products / year
Line efficiency	0,9	
1-shift working seconds / year	4536000	seconds /year
3-shifts working seconds / year	13608000	seconds /year
Required cycle-time 1-shift all-year	9,072	seconds
Required cycle-time 3-shift all-year	27,216	seconds

These calculations defined, that every workcell should have 27 seconds cycle-time at most. Cycle-time for 1-shift work cycle was not feasible and not considered further. Workcell assembly times are estimates based on our simulation and modified as seemed fit. For comparison manual assembly times estimates are shown next to estimated automated assembly times in table 5.

Table 5. *Cycle-times comparison*

	Automated assembly	Manual assembly	Difference in seconds
Workcell 1 Transfer system loader	17	0	17
Workcell 2 Railslide placement	26	10	16
Workcell 3 Spark killer	21	84	-63
Workcell 4 Screw terminal	24	22	2
Workcell 5 Axle assembly	27	65	-38
Workcell 6 Flipper	5	7	-2
Workcell 7 Plastic windows	24	24	0
Workcell 8 Palletizer	10	0	10
Throughput time =	143	235	-92

Improvements for the throughput time are mainly caused by better performance of axle, and spark killer assemblies.

6.2. Line Balancing

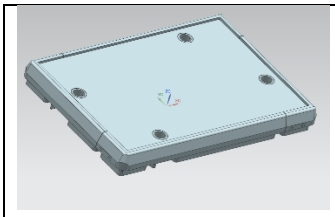
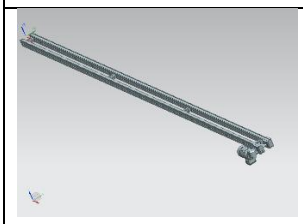
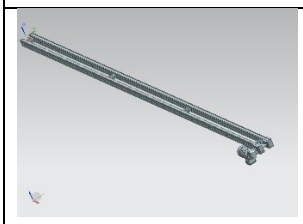
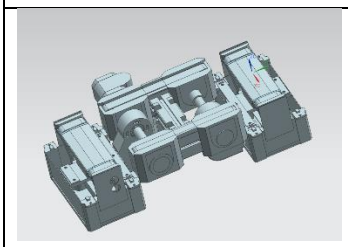
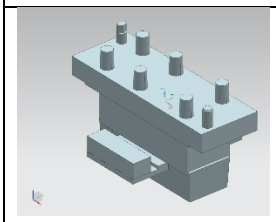
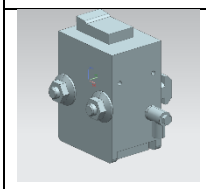
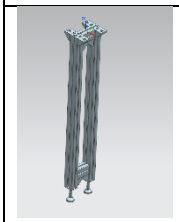
Line balancing was done by meeting the required cycle time as calculated in previous section. This was confirmed with simulation that all the workcells were able to meet this requirement. Simulation also confirmed that there was no excess idle on any of the workcells, because combining workcells would have violated the cycle time requirement.

6.3. Transfer system

Transfer system used for production system is called TS2plus and it is produced by Bosch Rexroth. TS2 plus transfer system is modular system which offers longitudinal and transverse conveyors, curves, workpiece pallets, leg sets, workpiece positioning units and transportation controls. TS2plus is designed for workpiece pallets from 160 mm x 160 mm up to 640 mm x 640 mm and for maximum load of 240 kg per pallet. For workpiece pallets WT 2 with dimensions 160 mm x 240 mm was chosen for this system because that pallet was smallest one that could have both plastic bottom and plastic top simultaneous. Selection of workpiece pallet determined selection of longitudinal and transverse conveyors and width of the track (160 mm). System was designed with two parallel conveyors in closed loop. The distance between parallel conveyors is 320 mm. One of the conveyors was fitted 8 positioning units for workstations. Positioning accuracy for positioning units is ±0,1 mm in x/y plane.

Table 6. *Components of the transfer system*

Picture	System component	Quantity

	Workpiece Pallet WT 2 (160 mm x 240)	16
	Belt Section BS 2 (track width 160 m, section length 6 m)	2
	Belt Section BS 2 (track width 160 m, section length 4 m)	2
	Electric Transverse Conveyor EQ 2/T	2
	Positioning Unit PE 2	8
	Stop gate VE 2	19
	Leg set SZ 2 (height 1100 mm)	22

6.4. Jig for plastic base and top

A jig was designed to stand the plastic bottom part and plastic top part through all work-cells. In this jig cylindrical tubes were added to fix both parts (these features coincide with holes in both parts, fitting and fixing in a specific place).

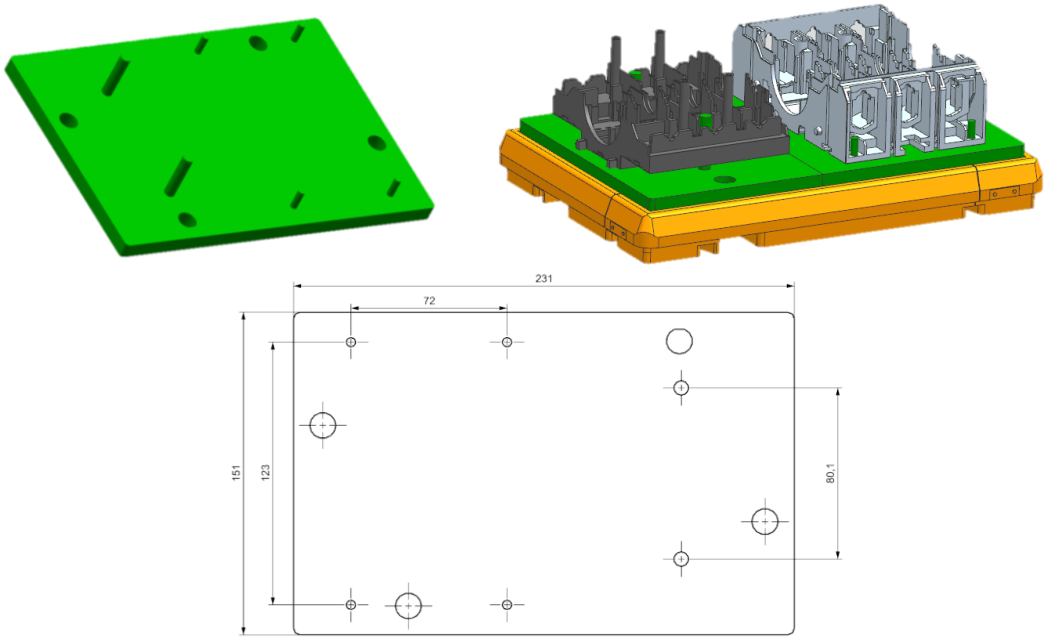


Figure 26. *Configuration of jig and dimensions*

6.5. Assembly processes

Every workcell has some kind of feeder and depending on the size of the bowl and part, these may not suffice for longer periods of operation. That is why we chose to feed bowl feeders with RNA BU-W Hoppers. It is an off the self-range of standard equipment. These function as reserve for parts and feed bowl feeders as needed. These hoppers have fill volume from 5-200 liters and driven by 3-phase motor and the adjustable raised face can be adjusted for different part sizes.

Figure 27. *RNA BU-W Hopper*

Hoppers are driven automatically with sensor reading from the feeder. These sensor could measure as an example surface level of the bowl. .

6.5.1. Transfer system loader

Robot type:	SCARA
Robot model:	ABB IRB 910SC
Gripper:	Festo BUB HGPL 14 A
Fingers:	Festo BUB HGPL 63 (modiefied)
Feeders:	Conveyer
Conveyor:	MK-Group SPU-2040
Parts:	Plastic top + bottom

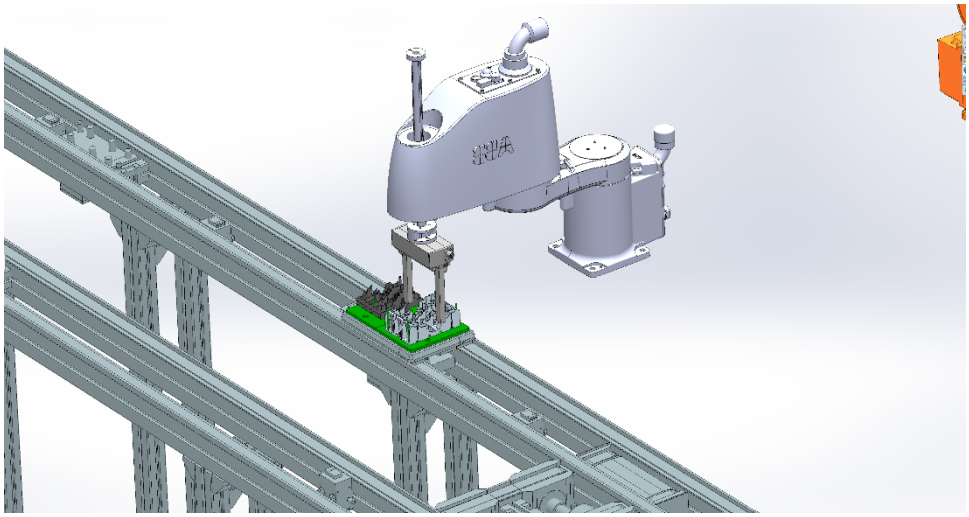


Figure 28. *Transfer system loader*

Transfer system loader feeds the main conveyor with plastic top and bottom from a card-board box that is in another conveyor. This conveyor is not shown on the figure 28 but is

shown at the layout. It is assumed that the box comes filled with plastic tops and bottoms with an accurately defined layout. As the box moves in smaller conveyor to the loader, it is then raised to the robot with a lift. As the box is empty, box is lowered and then moved under the main conveyor to be disposed of by operator. This second conveyor was designed because it was assumed that the one box could not hold enough plastic bottoms and tops for longer periods of operation.

6.5.2. Railslide placement

Robot type:	Six-axis
Robot model:	ABB IRB120
Gripper:	Festo HGPC 12 A
Fingers:	Custom fingers
Feeders:	Bowl Feeder AFAG 50279264
Parts:	railslide x2

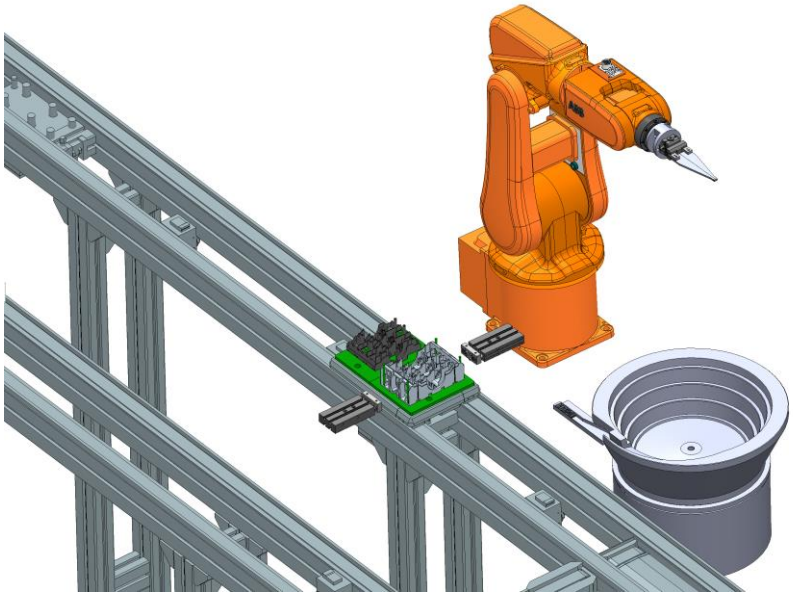


Figure 29. *Railslide placement*

Railslides are fed with a bowl feeder at certain orientation. Robot has custom fingers that able to go through the end of the small cavity in railslide. It then expands fingers and grips the part.

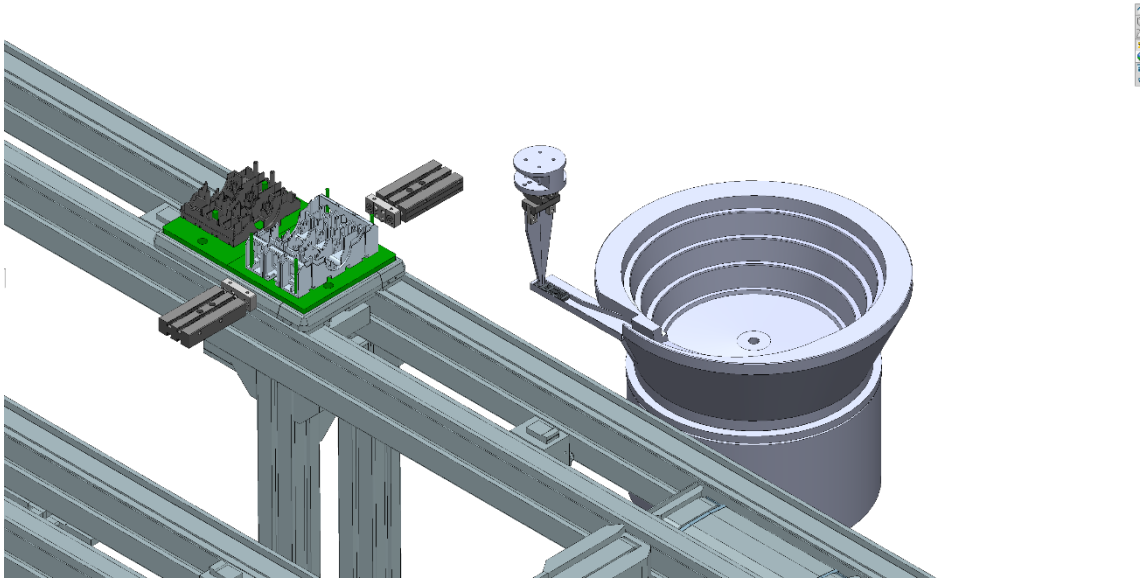


Figure 30. *Gripping railslide from feeder*

Railslide is the then positioned in the plastic bottom with gripper.

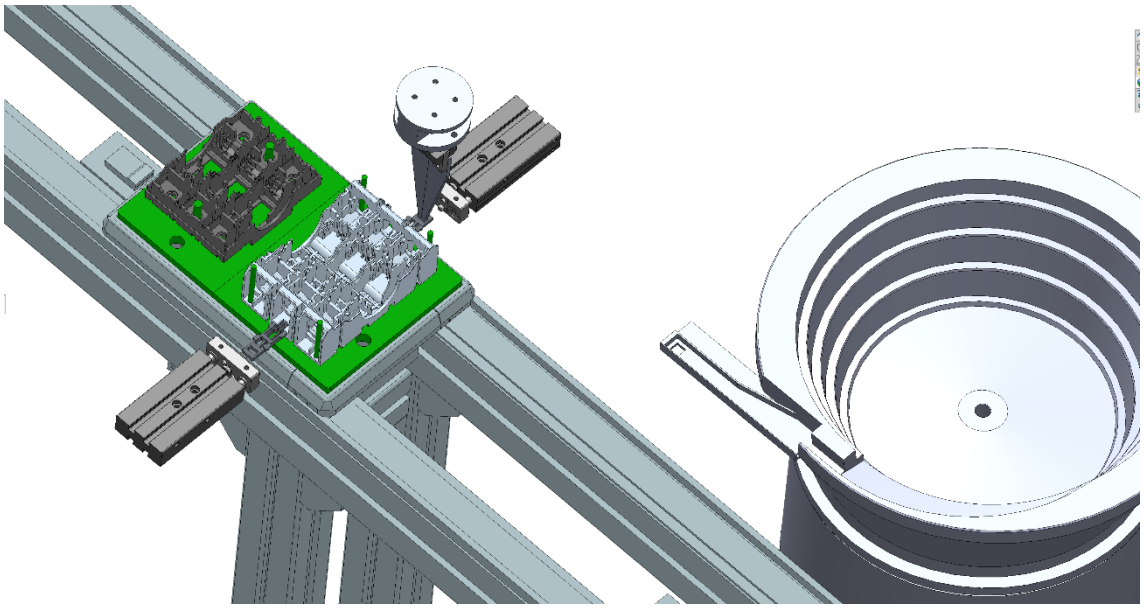


Figure 31. *Placing railslide on the pallet*

As both of the railslides are in place, two pneumatic actuators simultaneously push railslides in to the plastic bottom.

Individual tasks for the robot are estimated in the table 7. These estimates are rough and are overestimated, because precise placement is needed from the robot at the bowl and tray.

Table 7. *Tasks for railslide placement*

TASK	TIME (s)
Move to bowl feeder x2	6
Pick up railslide x2	4
Move to plastic bottom x2	6
Position railslide x2	4
Push railslides in with actuators	1
Move part to station	5
Cycle time workcell	**26**

Railslide gripper can be seen on figure 32, which shows detailed look on the custom fingers. Fingers are designed so that the railslide would slide on the hole at the end of the fingers to effectively place in on to the tray.

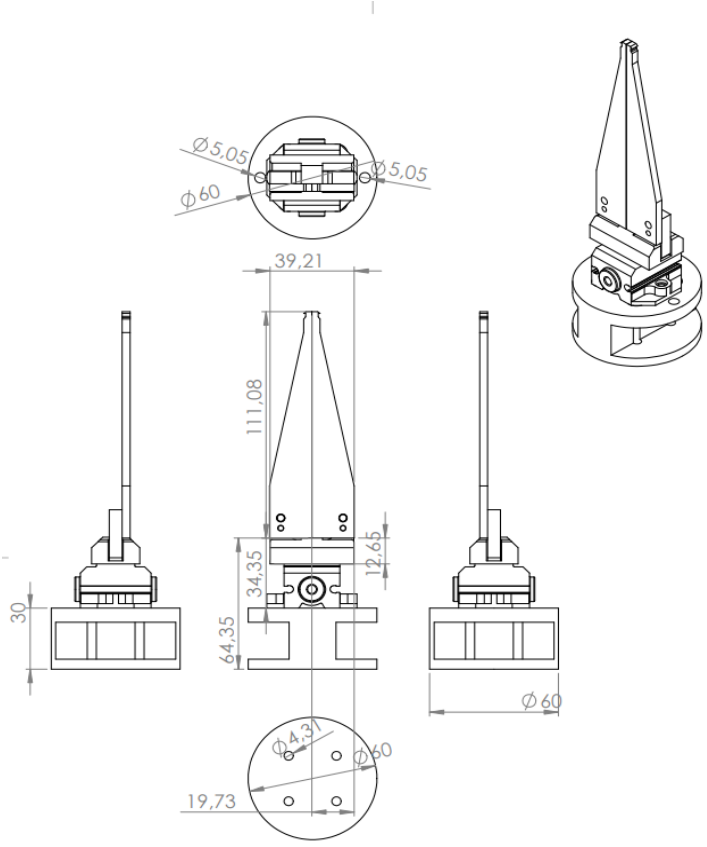


Figure 32. *Railslide gripper*

6.5.3. Spark killer workcell

Robot type:	6-axis
Robot model:	ABB IRB 120
Gripper:	SCHUNK PGB 80
Fingers:	Custom fingers
Feeders:	Bowl feeder RNA TAG-ZA 250 (541)-32-180
Actuators:	SKF CAT33, SKF CAHB-10
Parts:	Spark killers

Fingers were design to be able to pick up three spark killers and once. A feature was added at each finger to assemble the spark killers in the direction top to down. In the end, the fingers are prepared to assemble 3 spark killers at once in each part (plastic bottom and plastic top).

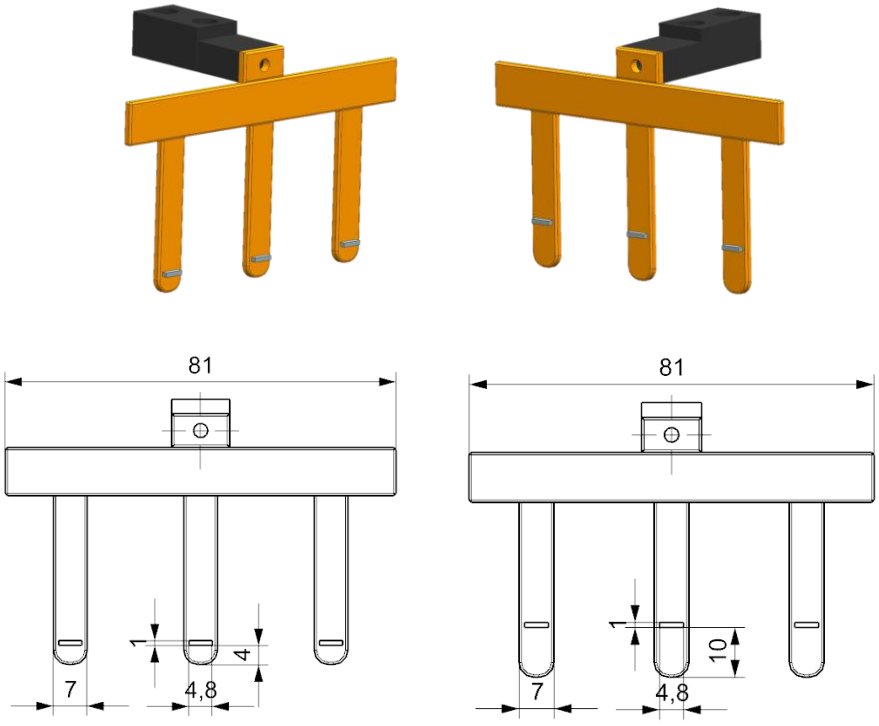


Figure 33. *View (top) and dimensions (down) of spark kill fingers*

In the next figure, is possible to see the designed fingers and gripper together attached to the robot.

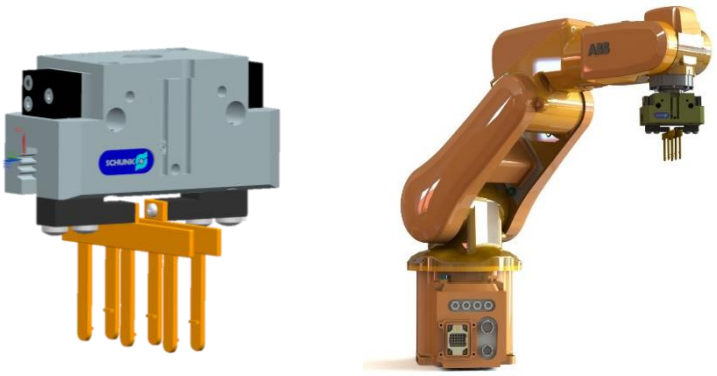


Figure 34. *Gripper and fingers (left) attached to the robot (right)*

Workcell process:

In this workcell the redesigned spark killers will be assembled on the plastic bottom and in the plastic top. For that, it is needed a bowl feeder with a guide, a carrier, 2 linear actuators (1 connected to the carrier and other with a tool), the designed fingers, a gripper and a robot. The system was designed to position the 3 spark killers at correct distance to be assembled.

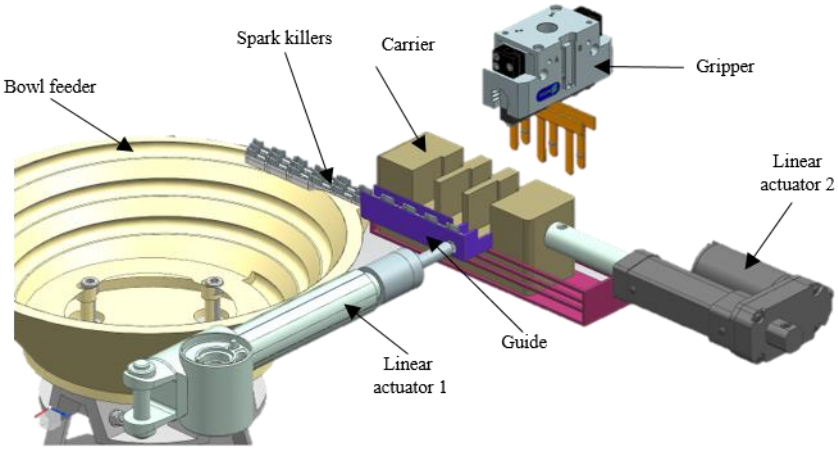


Figure 35. *Disposing of all components of workcell*

All the spark killers are dropped inside of the bowl feeder and will be ordered and enter on the designed guide. This guide has a hole that allows to start starts the first process where the linear actuator goes forward and push the first spark killer to the first space of the carrier. After this the second actuator will pull the carrier and align the second space of the carrier with the guide, allowing the first actuator push the second spark killer. A third spark killer will be pushed in the same way to the third space of carrier and then 3 spark killers are in the carrier.

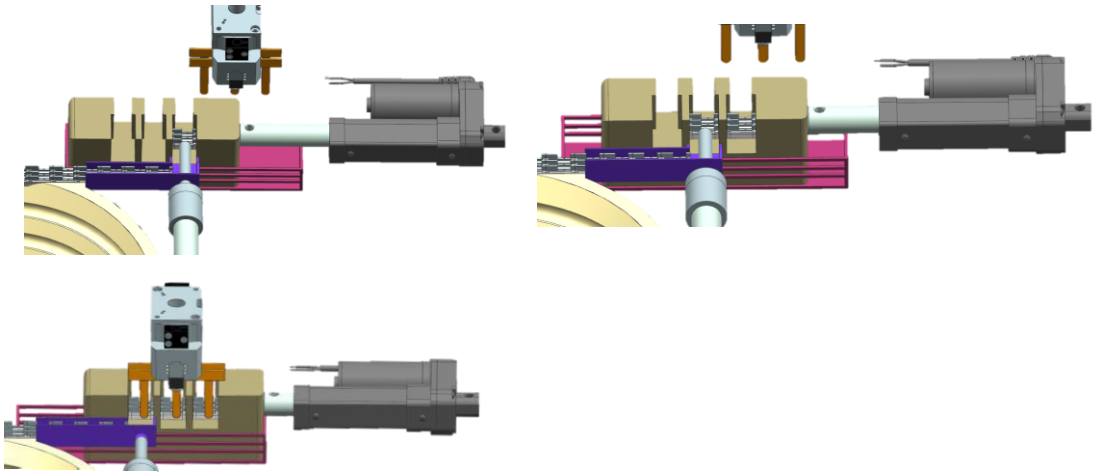


Figure 36. *Process of position the spark killers on carrier*

Thus the 3 spark killers are aligned and in the correct position to be assembled in the main parts. To do that, the robot moves to the carrier, picks up the spark killers (the 3 at the same time) and assemble first on the plastic bottom (at the same time the it is happening the first process) and then picks other 3 spark killers and assemble on the plastic top.

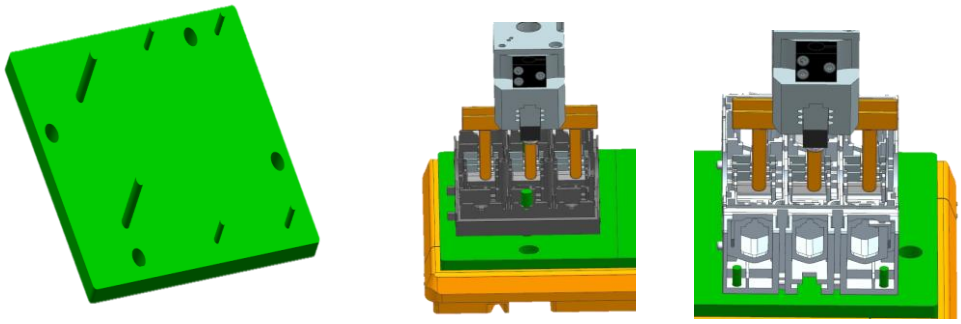


Figure 37. *Assemble of spark killers on plastic bottom and plastic top*

Estimated times of the movements were made to realize how long is the cycle time of this workcell. It was considered the task of actuator 1 than actuator 2 because it has a bigger space to travel and 7 seconds to robot pick up 3 spark killers, move them, assemble on the part and return to the initial position.

Table 8. *Times of the movements to assemble spark killers*

TASK	TIME (s)
Push 1 spark killer	1
Move carrier	0.5
Push 2 spark killer	1

Move carrier	0.5
Push 3 spark killer	1
Move carrier	0.5
Robot pick up parts and assemble	7
Move carrier initial position	1
Push 1 spark killer	1
Move carrier	0.5
Push 2 spark killer	1
Move carrier	0.5
Push 3 spark killer	1
Move carrier	0.5
Pick up parts and assemble	7
Cycle time workcell	**21**

6.5.4. Screw terminals

Robot type:	6-axis
Robot model:	ABB IRB 120
Gripper:	SCHUNK PGB 80
Fingers:	Custom fingers
Feeders:	Bowl feeder RNA TAG-ZA 250 (541)-32-180
Actuators:	SKF CAT33, SKF CAHB-10
Parts:	Screw terminals

Fingers were design to be able to pick up three screw terminals at once. Finger shown below are designed using the same design as the fingers for spark killers. Only few modification were made for original design. Fingers for spark killers have two configurations but fingers for screw terminals were designed with only one configuration.

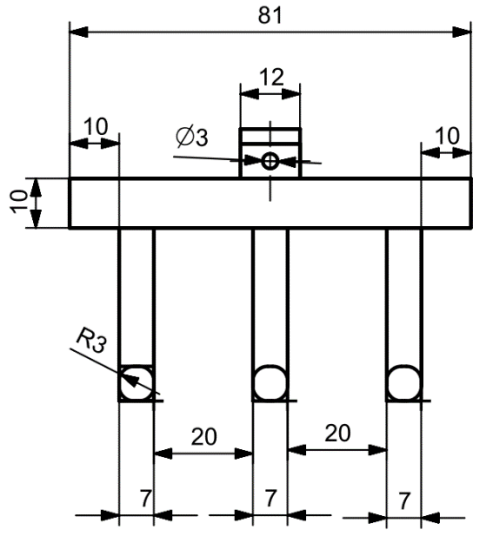


Figure 38. *Dimensions of fingers for screw terminals*

Screw terminal assembly stattion operates with same principles as spark killer assembly but gripper and postioning jig are slightly modified. Because screw terminals have two different modifications screw terminals positioning jig has two configurations. Screw terminals are fed to positioning jig by using bowl feeder and they are assembled three at a time. Even thought assembly process for screw terminals works with same principle as for spark killers there are few differences between theese two proceses especially in time required for movements. Modified feeder for screw terminals is shown in the figure below. More detailed drawings are available in apendix.

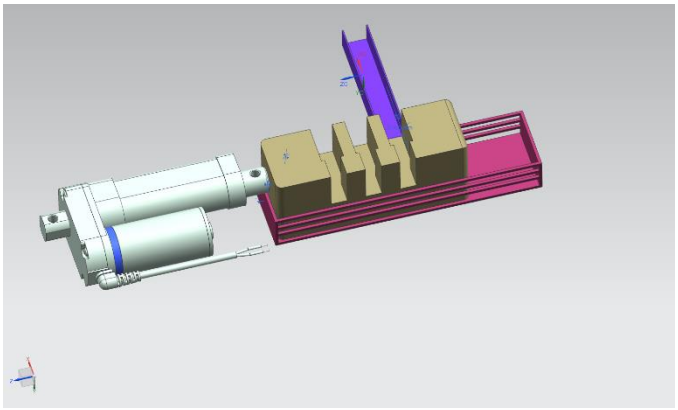


Figure 39. *Carrier and actuator position for screw terminal "up" feeder*

Table 9. *Times of the movements to assemble screw terminals*

TASK	**TIME (s)**
Robot pick up parts and assemble	12
Pick up parts and assemble	12
Cycle time workcell	**24**

Because screw terminals are fed from two different feeders time needed for positioning of three screw terminals are not included in Table 9. This is because while robot picks up screw terminals and assembles them other feeder can position next three screw terminals during that operation

6.5.5. Connectors and axle

Robot types:	6-axis, SCARA
Robot models:	2 x IRB 120, 3x IRB 910SC -3/0.55m
Gripper:	5 x SCHUNK EGP 25-N S/N-B
Fingers:	10x Custom finger
Feeders:	Adept AnyFeeder SX-240
Conveyor:	MK-Group SPU-2040
Jigs:	27 x Custom connector pallet jig
Machine Vision:	ABB integrated vision camers
Parts:	Connector + axle

A separate subassembly line (shown in figure 40) had to be designed for the assembly of the connectors and axle. The subassembly line has three stations which are all designed to run on a circa. 25 second cycle time.

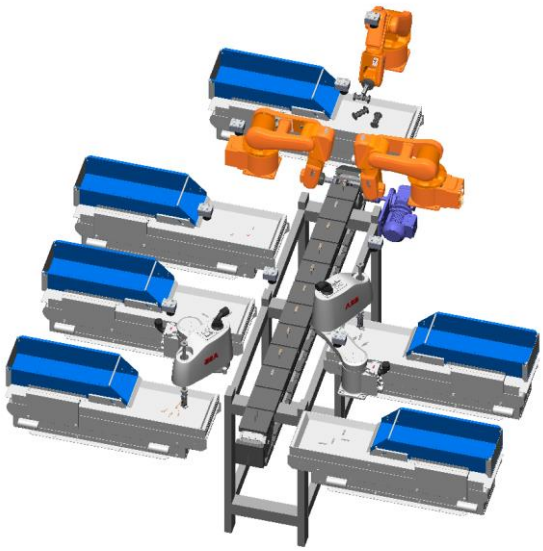


Figure 40. *Connector and axle subassembly line*

In the first subassembly station two IRB 910SC SCARA robots assemble the connector on top of a pallet jig which move on a circulating conveyor. The connector parts are fed for the robots from 4 Adept AnyFeeders. Each feeder vibrates the parts to a random orientation, from which a machine vision system detects suitably oriented parts to be gripped

with the robots. The needed orientation is determined by the current assembly phase. The robots are designed to assemble the connector on one pallet at a time, by assembling the parts on top of each other on the jig turn by turn. Both robots have specific grippers. The *left-side* robot can pick the **springs** in both orientations *normal* and *upside-down* and the **connector plate** in the *normal* orientation. Additionally, the *right-side* robot can pick up the **steel plate** in both orientations *normal* and *upside-down*, and the **connector plate** in the *upside-down* orientation. The machine vision system is also used to check that the gripped connector parts are in correct orientation before mounting the parts on the jig. After the two SCARA robots have assembled the connector parts on top of the jig, the pallet moves one place forwards toward the second subassembly station.

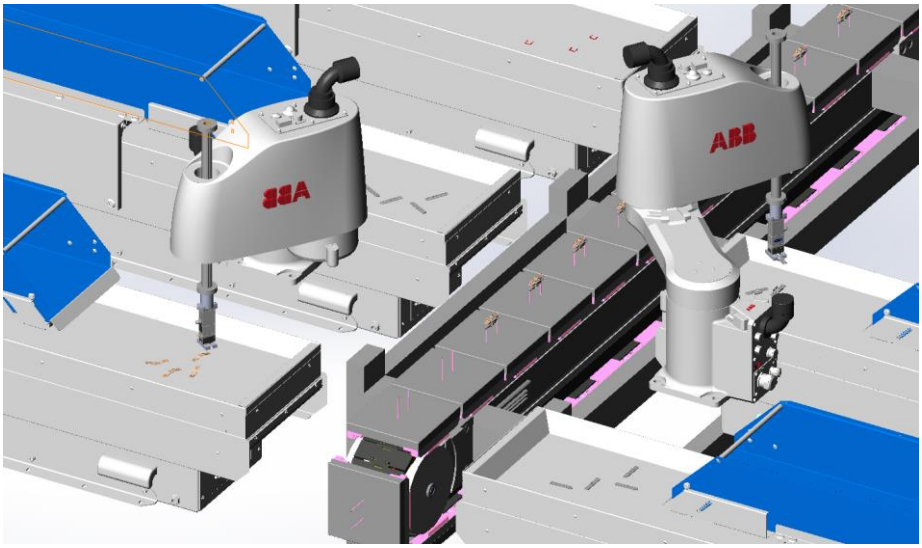


Figure 41. *First station of the subassembly line*

The assembly times of the first subassembly station are shown below in table 10. The parts are assembled mostly in turns. This way, time is saved in simultaneous robot movements.

Table 10. *Assembly times of the first subassembly line station*

Robot	**TASK**	**TIME (s)**
Left SCARA	Pick upside-down **spring** and assemble	1,5
Right SCARA	Pick upside-down **connector plate holder** and assemble	1
Right SCARA	Pick upside-down **connector plate** and assemble	1,5
Left SCARA	Pick normal **connector plate** and assemble	1
Right SCARA	Pick normal **connector plate holder** and assemble	1
Left SCARA	Pick normal **spring** and assemble	1
Conveyor	Move pallets one step forward	1,0

	Cycle time workcell	**8,0**
	Cycle time workcell (3x nearly finished connectors)	**24**

In the second subassembly station a pallet arrives with the almost fully assembled connector, and two ABB IRB 120 robots perform the next two assembly phases. One Adept AnyFeeder is used to feed the **connector spring holder** for the *left-side* robot. The *left-side* robot picks the **connector pin** and corrects the parts orientation on a jig next to the feeder. The same machine vision system design is used here also. Simultaneously the *right-side* robot uses its gripper to compress the springs on the connector. Next the *left-side* robot continues to move the pin towards the connector and finally into its mounting position. The right side robot then grabs the connector and lifts it off the jig and offers it towards the third subassembly station. At this point the empty pallet jig moves one step forward towards the beginning of the subassembly line.

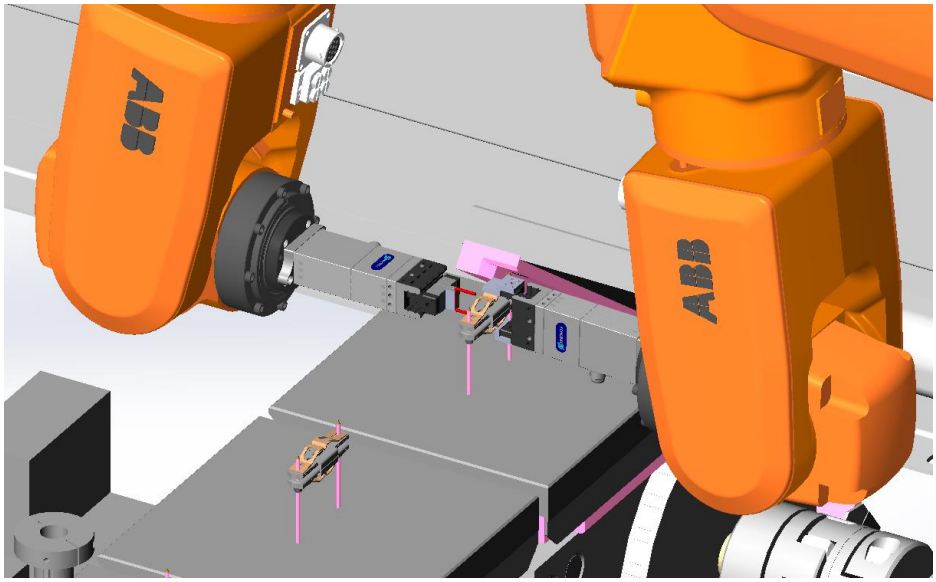


Figure 42. *Second station of the subassembly line*

The assembly times of the second subassembly station are shown below in table 11.

Table 11. *Assembly times of the second subassembly line station*

Robot	**TASK**	**TIME (s)**
Left IRB 120	Pick **connector spring holder** and mount to con-	4,5
Right IRB 120	Press down the **springs** on the connector assembly	0 (simultaneous)
Right IRB 120	Pick assembled **connector** and offer towards next	3
Conveyor	Move pallets one step forward	0,5
	Cycle time workcell	**8**
	Cycle time workcell (3x connectors)	**24**

In the third subassembly station a single ABB IRB 120 robot and a single Adept AnyFeeder is used. The feeder presents the axles for the robot as in the previous stations. The same machine vision system design is used here also. The single robot grabs the **axle** and moves it to face the *right-side* robot of the previous assembly station which is offering the assembled **connectors**. The robot from the previous station mounts the connectors one-by-one into the axle as they get assembled. Once the three connectors have been mounted on the axle, the machine vision system checks the **axle-connector assembly**, and the robot is instructed to turn and face the main assembly line and mount the **axle-connector subassembly** on to the **plastic base**.

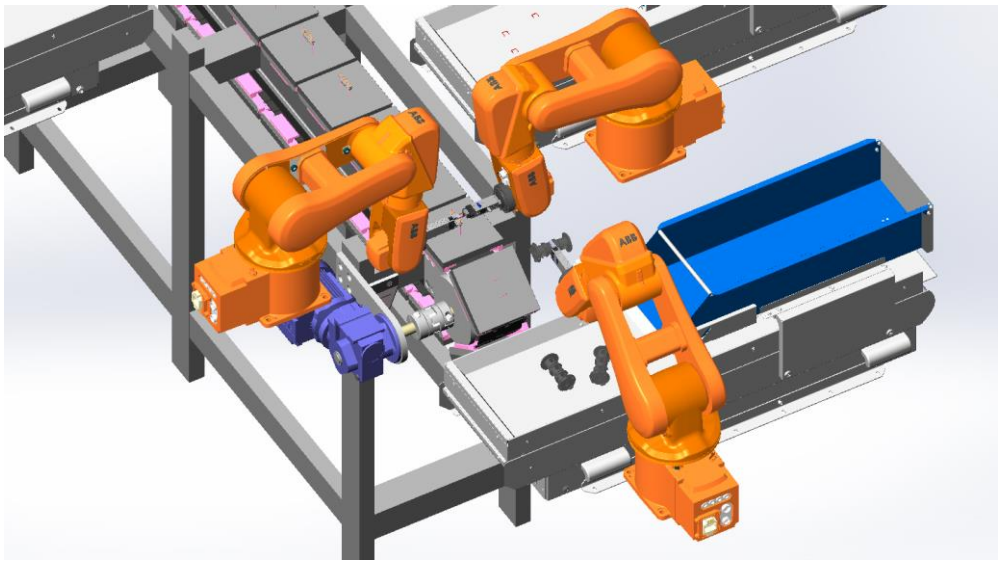


Figure 43. *Second and third station of the assembly line*

The assembly times of the third subassembly station are shown below in table 12.

Table 12. *Assembly times of the third subassembly line station*

Robot	**TASK**	**TIME (s)**
Center IRB 120	Pick **axle** and move towards previous station left robot	0 (waiting for prev. station)
Left IRB 120	Mount **connector** to axle	8
Left IRB 120	Mount **connector** to axle	8
Left IRB 120	Mount **connector** to axle	8
Center IRB 120	Turn and mount **axle** to **plastic base**	3
	Cycle time workcell (1x axle)	**27**

All the needed components for the assembly station are listed in table 13.

Table 13. *Needed components of the subassembly line*

Robots:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
IRB 910SC – 3/0.55m	2	20 000	40 000
IRB 120	3	20 000	60 000

Grippers:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
SCHUNK EGP 25-N-N-B	5	1000	3000

Fingers:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
Custom finger	10	50	500

Conveyor:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
MK-Group SPU-2040	1	10 000	10 000

Machine Vision:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
ABB Integrated vision cameras	8	300	2400
Machine vision control system	1	27 600	27 600

Jigs:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
Custom connector pallet jig	27	150	4000

Feeders:	**Amount (pcs.)**	**Price (€)**	**Total (€)**
Adept AnyFeeder SX-240	6	30 000	180 000

Pictures of how the grippers are used are shown in figures 44 – 48.

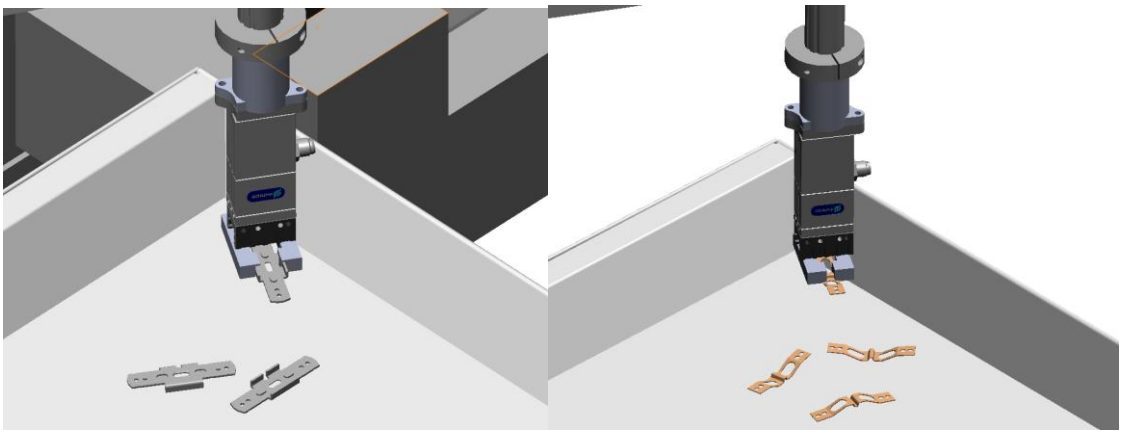


Figure 44. *How the connector parts are gripped*

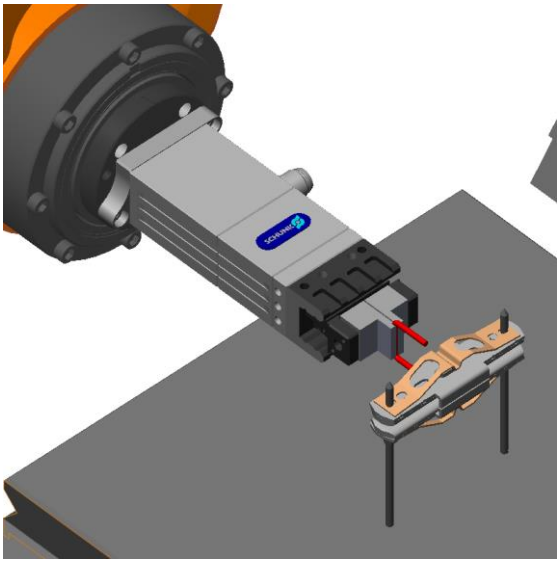


Figure 45. *How the spring holder pin is gripped*

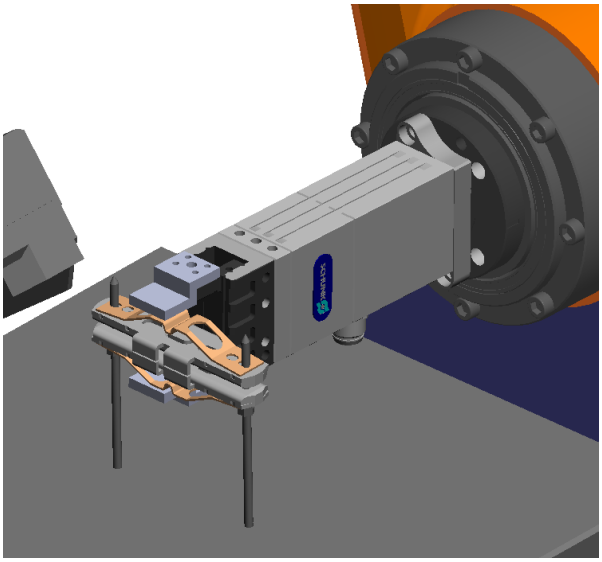


Figure 46. *How the connector springs are compressed*

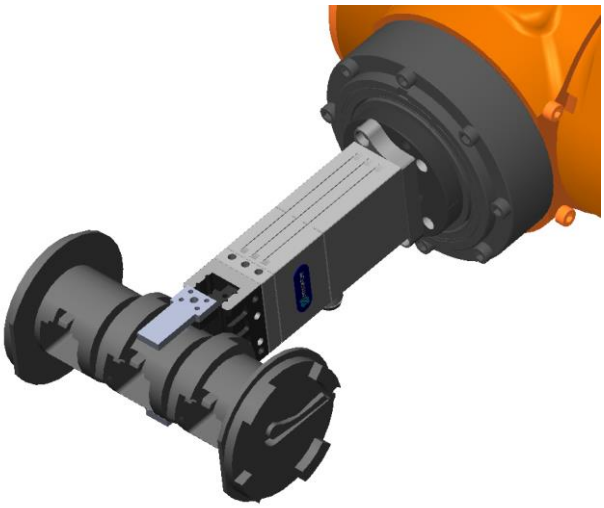


Figure 47. *How the axle is gripped*

The gripper fingers for the spring holder pin, connector spring compression and the axle are very simple. However, for picking up the connector parts, much more complex gripper fingers have to be used. These are shown in figures 48 and 49. The geometry on the fingers are meant to directly follow the geometries of the parts.

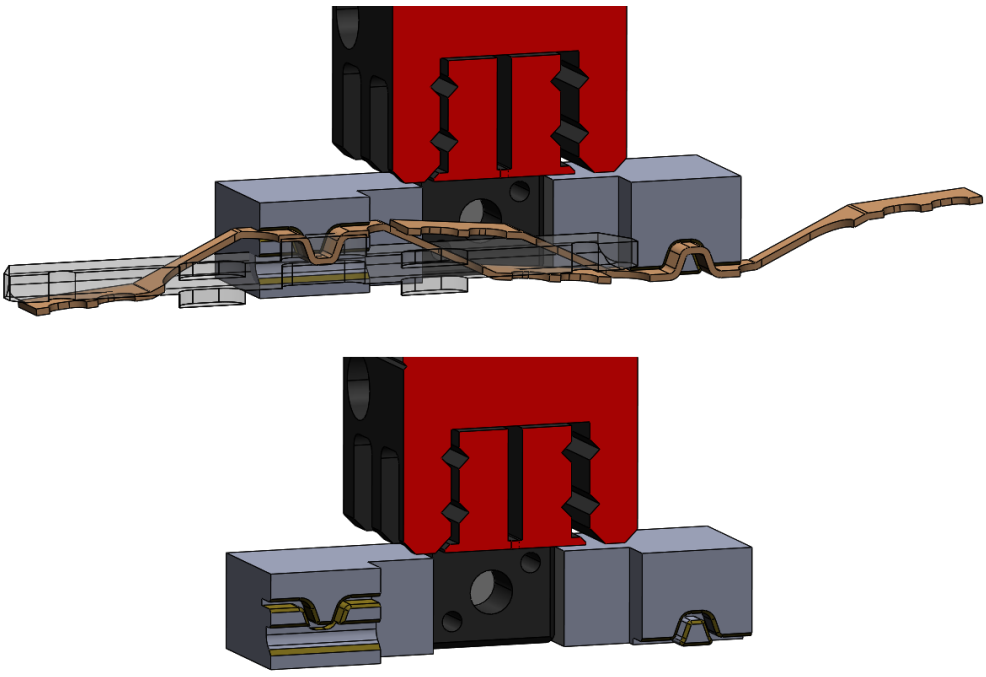


Figure 48. *Gripper fingers for the left side SCARA robot*

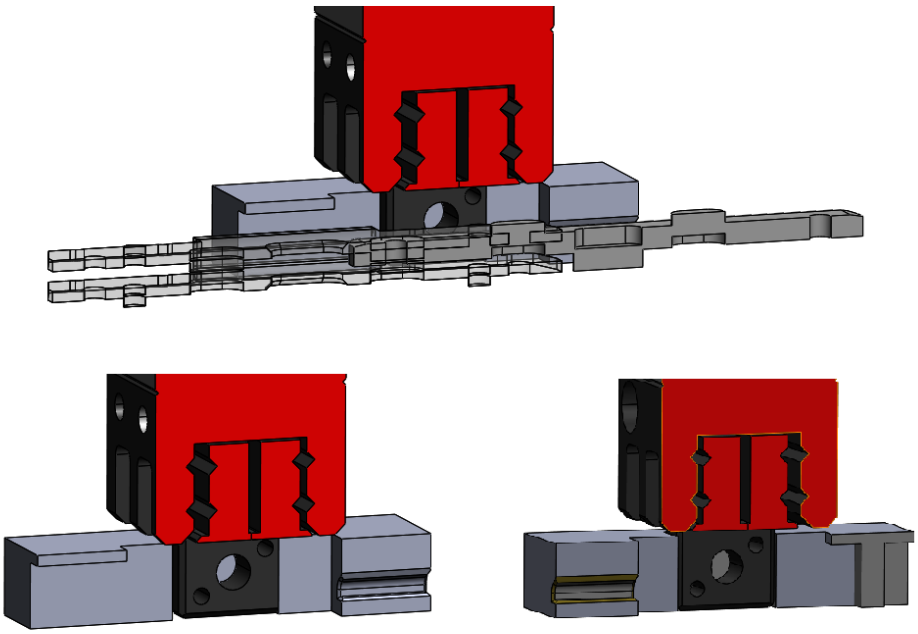


Figure 49. *Gripper fingers for the right side SCARA robot*

6.5.6. Flipper

Robot type:	Six-axis
Robot model:	ABB IRB120
Gripper:	Festo BUB HGPL 14 A
Fingers:	Festo BUB HGPL 63 (modified)
Feeders:	-
Parts:	-

Flipper robot only job is to flip the plastic top and place it on plastic bottom. Figures 49, 50 and 51 are not showing correct phase of the product because every part should be visible at that point except plastic windows. This flipping has to be done by individual robot although it will not be so occupied with tasks, because it needs precise placement and other robots don’t have available capacity to do this.

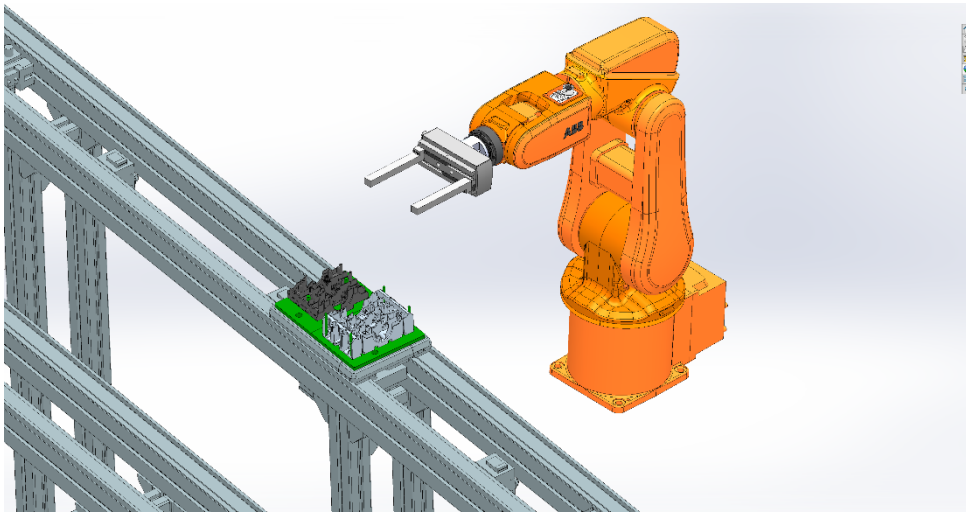


Figure 50. *Flipper*

Figure 20 shows how the gripper takes the plastic top out of the tray. It is the most secure gripping position and it can be done with many different types of ordinary grippers. Gripper that is used here, is the same one on the first SCARA robot which picks up the plastic bottoms and tops to place them on the track.

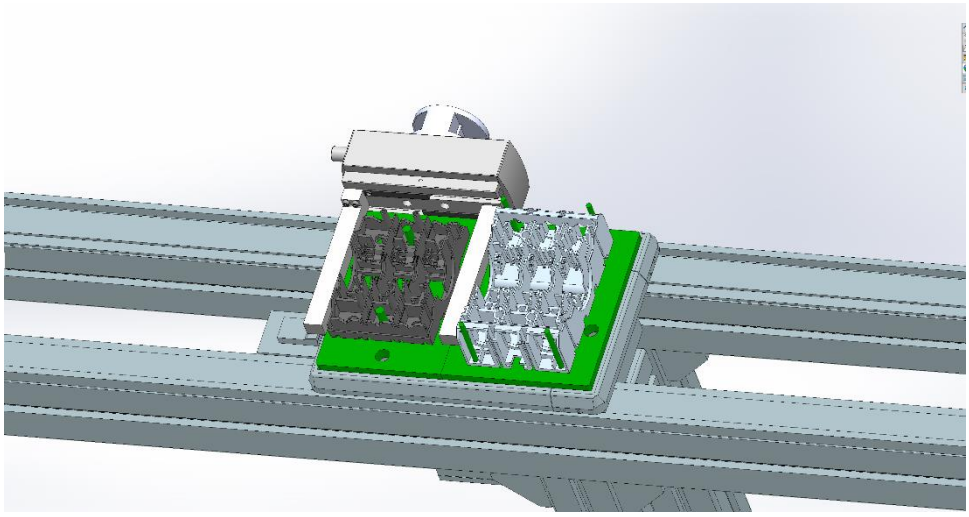


Figure 51. *Gripper grapping plastic top*

Placing the bottom is straight forward thing but it would need to tested can the robot push down part gripping from the sides or does it need to just place it and the push it in from the top of the plastic part.

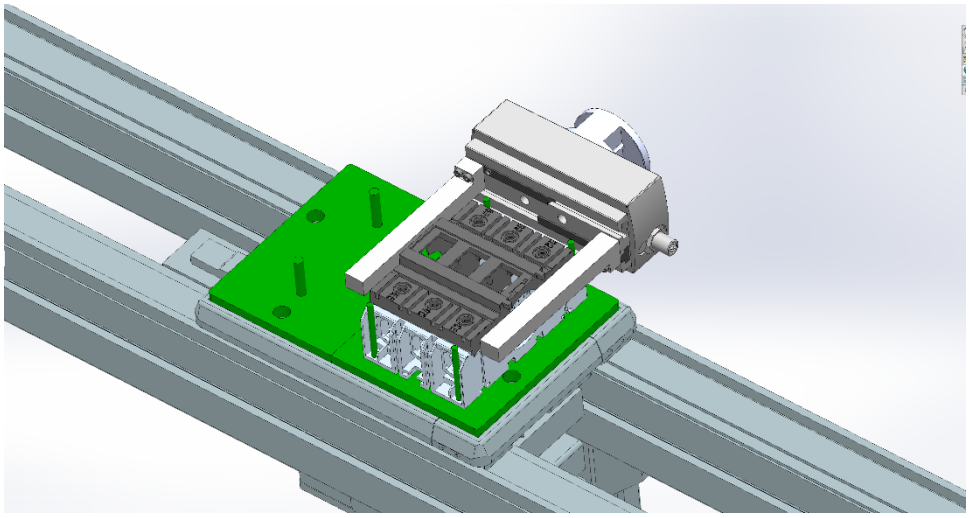


Figure 52. *Placing the top on plastic bottom*

Robot gripper is a standard gripper and is shown at figure 52. Festo fingers were modified to be narrower that the original, because the plastic top and bottom didn’t have enough space between them.

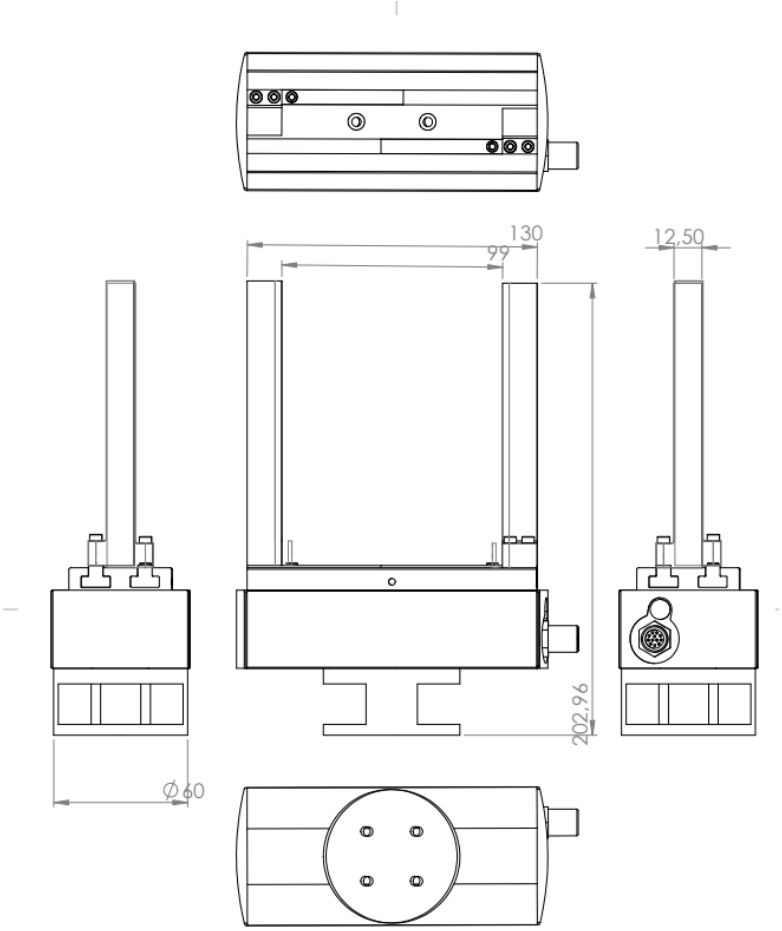


Figure 53. *Plastic top gripper*

6.5.7. Plastic window

Robot type:	6-axis
Robot model:	IRB 120
Gripper:	3x Schmalz SGON 24 x 8 mm suction cups, 6x FESTO pneumatic cylinders
Feeder:	Devprotek FTF-21P with custom trays
Parts:	Plastic windows

Plastic windows are assembled with one robot seen in figure 53 The robot is ABB IRB 120 and it can assemble all three windows at the same time with a custom gripper. Gripper works with suction cups and pneumatic cylinders.

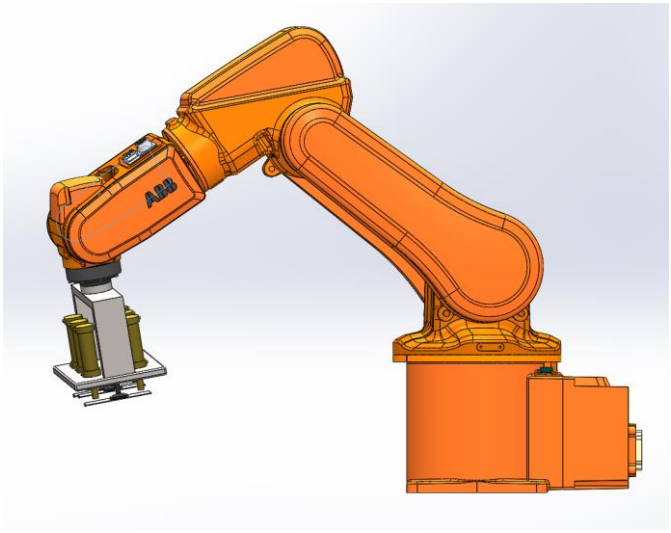


Figure 54. *Robot and the custom gripper*

Table 14. *Cycle time of plastic window assembly*

TASK	TIME (s)
Move to tray feeder	5
Pick up three windows	4
Move windows to their place	5
Push windows with pneumatic cylinders	4
Change tray	6
Cycle time workcell	24

Plastic windows come in a tray from a tray feeder. Tray feeder must be loaded manually. Tray feeder can carry 30 trays at the time. Feeder slides one tray in the end of the line so that robot can operate with it. Feeder changes the tray automatically when it gets empty. Robot takes 3 windows from the tray with suction cups and takes them to the right place. The cycle time of this workcell can be seen in table 14. Suction cups are made of rubber, so they don’t harm the surface of the window.

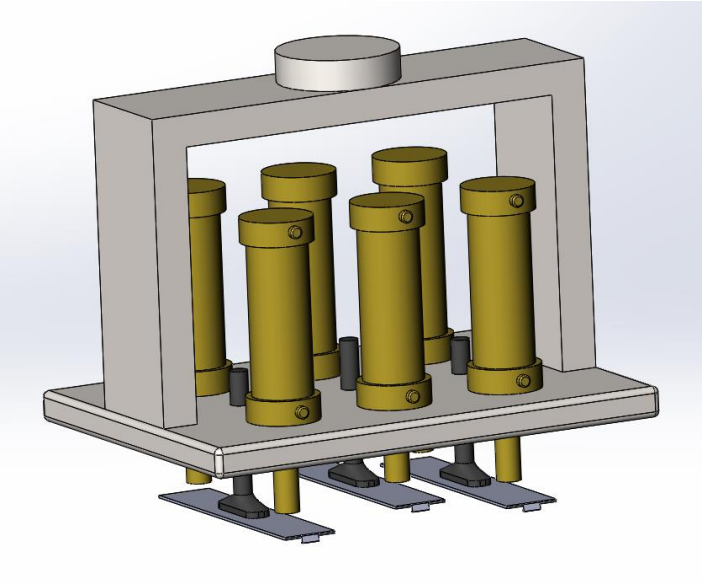


Figure 55. *Custom gripper*

Pneumatic cylinders in the gripper are used to push the window to its place because suction cups can't be used for pushing parts. There are two pneumatic cylinders for each window as in figure 54 shows. Cylinders push the window near the snap-fits so that window doesn't bend when pushing it.

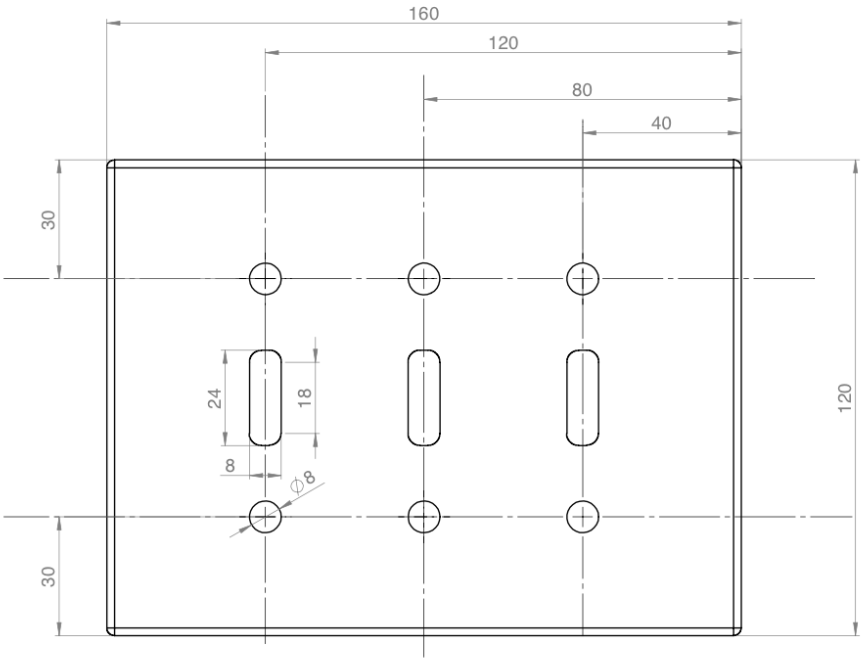


Figure 56. *Drawing of the gripper*

In the drawing in figure 55, you can see the dimensions of the gripper that is used. Suction cups are the oval shaped in the middle and the circles describes the piston of the pneumatic cylinder.

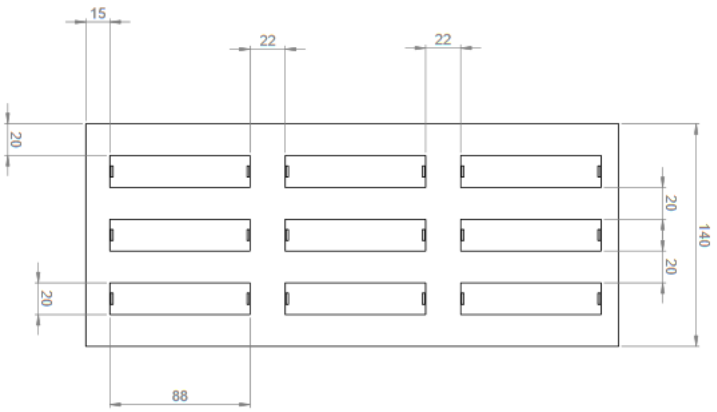


Figure 57. *Drawing of the tray*

The tray can carry 9 windows at the same time. The dimensions can be seen in figure 56. Size is limited because of the tray feeder we use.

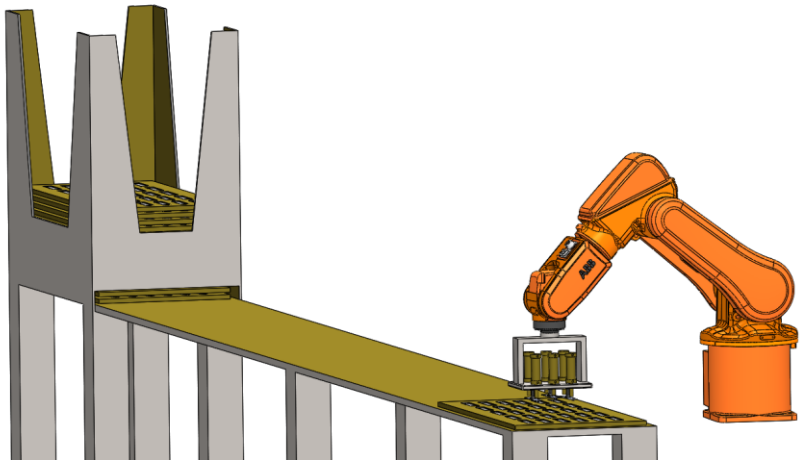


Figure 58. *Tray feeder and the robot*

6.5.8. Place workcell

Robot type:	Cartesian
Robot model:	Omron palletizer
Gripper:	3x Schmalz SGON 24 x 8 mm suction cups, 6x FESTO pneumatic cylinders
Parts:	Finished product

Last workcell on the line takes the finished product and swipes stickers on it and place it on pallet. No 3d-model was available for this product but figure 58 represent a concept of how it would be implemented in this conveyor. In the layout picture, cartesian robot is

modelled with generic model. Works is done with same gripper as the windows placement, because it can also pick up the cardboard to put between layers.

Figure 58. *Omron palletizer*

Unlike the figure 58, no conveyor is present at the of this assembly system because the products are considered so small that pallet could have hundreds of pieces, so pallet is removed only once per shift by pallet lifter.

Table 15. *Cycle time of palletizing*

TASK	TIME (s)
Move to conveyor	4
Pick up finish product	4
Move to labeler	3
Place stickers	4
Move to pallet	6
Place the finish product on pallet	2

Cycle time workcell	23

Figure 59. *HERMA 400 labeler*

Two pieces of Herma 400 is put sideways for the cartesian robot and robot swipes the finished product as it moves to pallet.

6.6. Simulation

Completed production system was simulated for 60 minutes with Visual Components Premium 4.1. In simulation new work piece pallet is entered to the production system every 27 seconds. During the 60 minutes 124 pieces were produced (Figure 60). With this information production volume for 8 hours would be 992 pieces and for 24 hours 2 976 pieces and 732 096 pieces for yearly production volume. If 90 % availability is assumed yearly production would be 658 886 pieces.

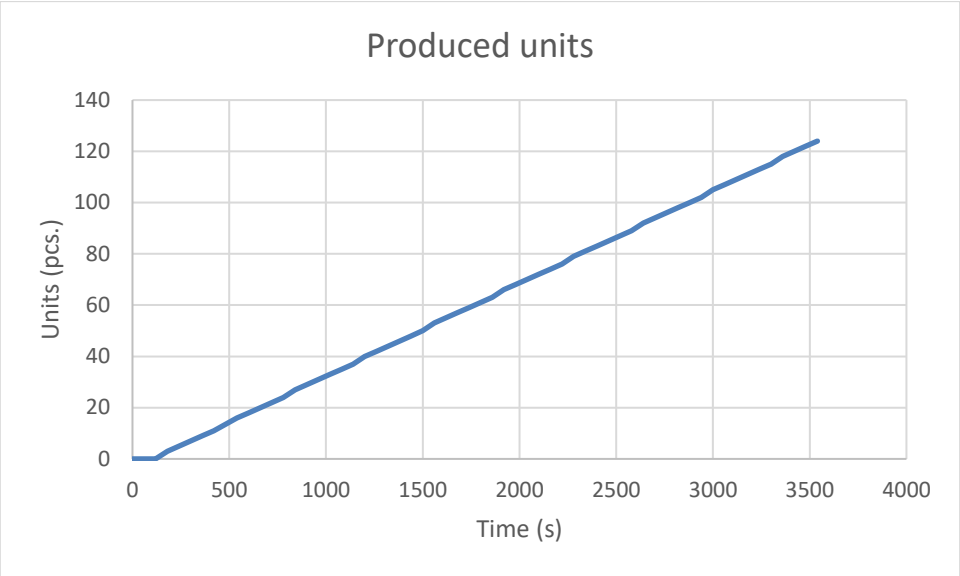


Figure 60. *Number of produced units during 60 minutes*

Simulation estimated only time for robot movements from feeder to pallet. These movements were not optimized. Time for positioning and other movements were not simulated. This means that there some sources of error in cycle times shown in the table below. But because optimization would make cycle times shorter and inclusion of time needed for positioning would make cycle time longer when these points are considered cycle times, shown in the table below, can be trusted as an approximation of real cycle times.

The target for cycle times was 9 seconds for connector subassembly (Connector phase 1, Connector phase 2 and U-pin). The target for actual work cells was 27 seconds. As shown in the table 27 second target was accomplished by all process. Unfortunately these cycle times to long for each process that combining of two separate process to one would be very difficult. Target for connector subassembly was not met but this subassembly process could be faster after the optimization of robot movements.

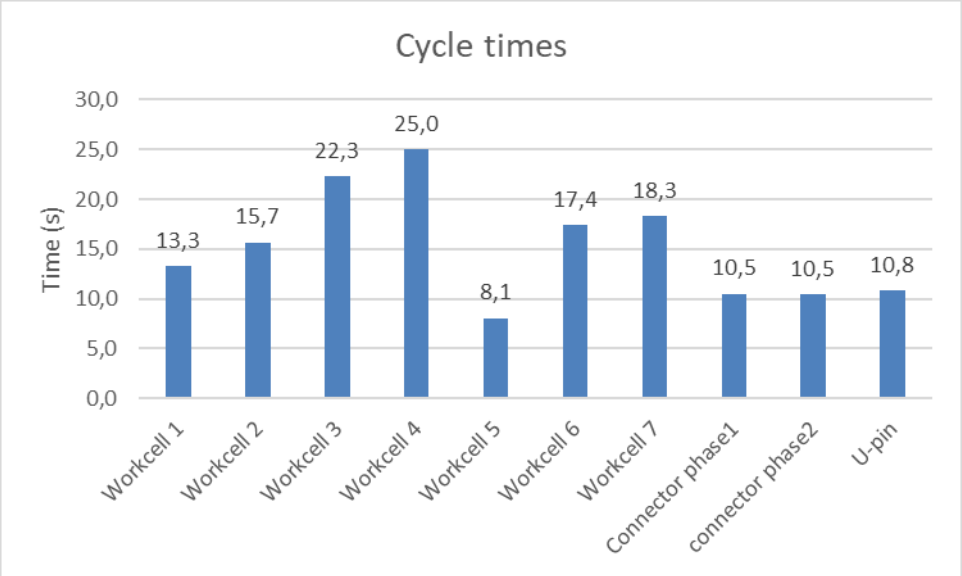


Figure 61. *Cycle times during the simulation*

Utilization of robots is also imported from simulation are shown in figure below. As shown in figure below utilization of robots in connector subassembly (SCARA 1, SCARA 2, U-pin robot and Spring holder robot) is very high (almost 90 %) for all of them except Spring holder robot. Utilization of Spring holder robot is much lower than U-pin robot because in simulation Spring holder robot made only one movement after 3 connectors were ready. In real system Spring holder robot would hold the axle on place during the assembly of 3 connectors.

Utilization of robots in the main assembly line (Wokcells 1 to 8) are much lower than utilization of robots in connector subassembly. Utilization of main assembly line changes from 18 % up to 42 %. This means that efficiency of could be improved for main assembly line robots.

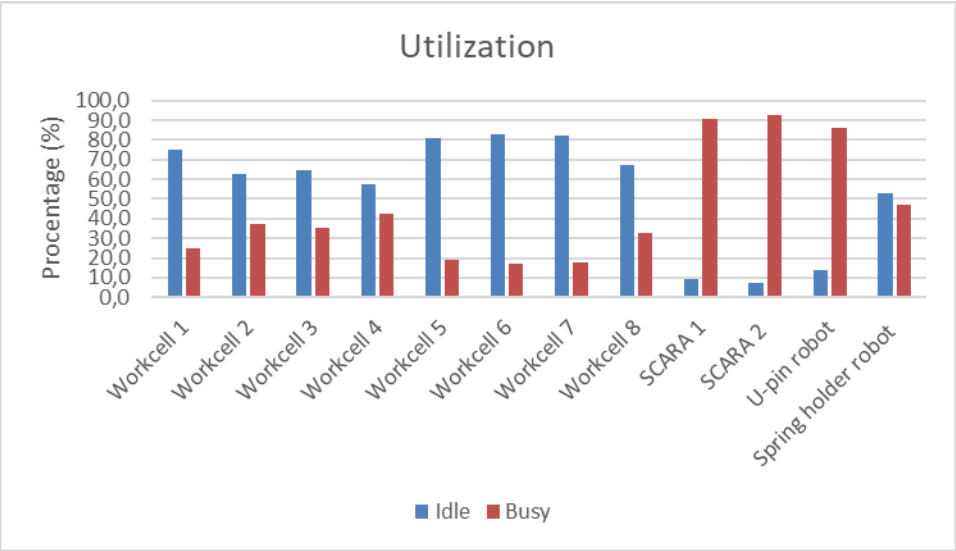


Figure 62. *Utilization of work cell*

Simulation results show that this assembly system has a bottle neck in connector subassembly. With this simulation no bottle neck was formed but if new work piece pallets would be entered to the production system faster than every 27 second bottleneck would form to axle assembly station. If faster cycle time would be needed connector sub assembly should be improved. This improvement would not make possible to lower cycle time more than 2 seconds because bottleneck would form first to screw terminal assembly station and then to spark killer assembly station. Overall designed system performed well in the simulation no bottle neck was formed and production goal was reached.

7. ECONOMIC JUSTIFICATION

To achieve and build this automation line, the costs of machines and components needs to take in consideration. For that, a list of all components and quantities used were collected and an estimated price was defined per unit. In the end, the line components cost 556 550 €. In the table 16 is possible to see all the data considered and final cost.

Table 16. *Approximated cost for different components*

Quantity	Device	Cost unity	Cost aprox €
20.6 m	Transfer system		40000
10 m	Conveyor	1000+400/m	4200
8	ABB IRB 120	20 000	160 000
3	ABB IRB 910	20 000	60 000
1	Omron Cartesian robot	20000	20 000
5	Hopper	1500	7500
4	Bowl feeder	2500	10 000
10	simple Gripper	600	6000
6	pneumatic cylinder	1500	9000
4	Suction cups	150	600
13	Customized finger	150	1950
2	customized Jig	150	300
6	Actuator	1250	7500
2	Machined parts	250	500
6	Adept anyfeeder	30000	180 000
1	tray feeder	1000	1000
1	Conveyor lift	3000	3000
1	Conveyor spu-2040		12000
1	Vision system		30000
1	Fences		3000
		Total	**556 550 €**

To go full automation assembled line (without considering the operators to place parts and feed the hoppers) and achieve the 500 000 units in a year, an investment of 556 550€ needs to be done for the components. In the calculations, we used multiplier 3x to estimate needed investment for programming, safety and control components, which counts as 1 669 650 € as total investments.

Table 17. *Cost comparison of automated and manual assembly*

	New Design	New Design (automated)
Work hours/worker (h)	1624	1624
Assembly time (min)	4	4
Assembled units in a year	28800	28800
Yearly production (pieces)	500 000	500 000
Needed assembly workers	18	6
Needed workers +support and reserve personel	24	24
Hourly wage	37	37
Labor cost in a year for one worker (€)	60 088	60 088
Total labor cost for year (€)	1081584	360528
Machine operation costs		62 400
Investment cost (€)	0	1669650
Total costs / year (€)	1 081 584	422 928
Total costs / unit (€)	2,163168	0,845856

Machine operation costs are calculated as follows:

Working days per year * 24h * Number Of Robots * 5€/h

In the beginning of this project, it was estimated that 28 workers were necessaire to have the same number of products in the end of the year. The line developed can replace the 10 workers and the payback time can be calculated.

$$\text{Payback period} = \frac{\text{Money paid for the solution}}{\frac{\text{units}}{\text{year}} * \text{difference(assemblycost)}}$$

Substituting in this equation the money paid for the solution per the cost of the assembled automation line and the annual cost reduction per the cost of 10 workers, the payback period will be:

$$\text{Payback period} = \frac{1\,669\,650\,€}{659050\,€/\text{year}} \approx 2{,}53\ years$$

After 3 years the automation assembly line will be already paid the investment made and starts to be profitable comparing to the manual assembled line.

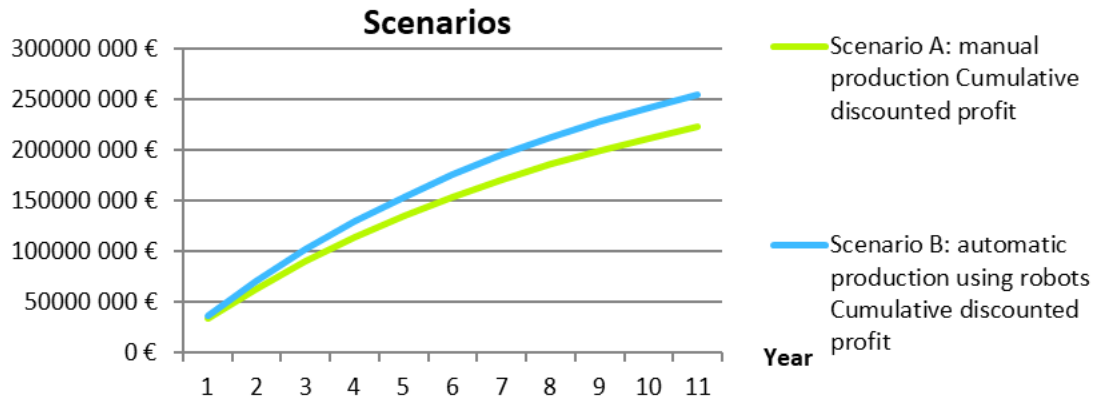


Figure 63. *Cumulated profit over time*

Cumulative profits are calculated based on the knowledge on volume and costs. Manufacturing/shipment costs are estimated to be 10x assembly costs and sales price for the finished product around 100€. Figure 63 shows how assembly system cumulates profits over time. This comparison is done between old-design and manual assembly versus new design and automated assembly.

8. CONCLUSIONS

Our work began with analyzing the product ABB OT160 and focusing on the functions of the product parts. With DFA analysis we found that some of the parts were unnecessary to be separated so we were able to reduce number of parts for the product. This was the first step in making a more straightforward assembly tasks. Some of the improvements didn't reduce parts but nevertheless improved assemblability. Comparing the old and new design made an impact on needed workforce to assembly the product by reducing almost 10 operators from the line.

With the new design, we started developing a system that would be able to automatically assemble the product. This design process started with analysis of the assembly process and how the new design was put together. Afterwards we made a preliminary layout of the system and analyzed what was the needed cycle-time to meet required capacity. After each cell was created, we simulated the results to verify our system met the requirements.

New automated line had a payback time of three years and we conclude that the new design and automated process is justified in economic point.

ANNEX A: DATASHEETS

ROBOTICS

IRB 120

ABB's 6 axis robot – for flexible and compact production

The IRB 120 robot is the latest addition to ABB's new fourth-generation of robotic technology. It is ideal for material handling and assembly applications and provides an agile, compact and lightweight solution with superior control and path accuracy.

Compact and lightweight
IRB 120's compact design enables it to be mounted virtually anywhere at any angle without any restriction - for example inside a cell, on top of a machine or close to other robots.

IRB 120 is also the most portable and easy to integrate on the market with its 25 kg weight. The smooth surfaces are easy to clean and the cables for air and customer signals are internally routed, all the way from the foot to the wrist, ensuring that integration is effortless.

Multipurpose
IRB 120 is ideal for a wide range of industries including the electronic, food and beverage, machinery, solar, pharmaceutical, medical and research sectors.

The Food Grade Lubrication (NSF H1) option includes Clean Room ISO Class 5, which ensures uncompromising safety and hygiene for food and beverage applications.

Optimized working range
IRB 120 has a horizontal reach of 580 mm, the best in class stroke, the ability to reach 112 mm below its base and a very compact turning radius.

Fast, accurate and agile
Designed with a light, aluminum structure, the motors ensure the robot is enabled with a fast acceleration, and can deliver accuracy and agility in any application. Using the IRB 120T variant, cycle-times can be reduced up to 25% where the work piece needs extensive reorientation and axis 4, 5 and 6 are predominantly used. This faster versions is well suited for pick and packing applications and guided operations together with PickMaster 3™.

IRC5 Compact controller – optimized for small robots
ABB's new IRC5 Compact controller presents the capabilities of the IRC5 controller in a compact format. It brings accuracy and motion control to applications which have been exclusive to large installations and enables easy commissioning through one phase power input, external connectors for all signals and a built-in expandable 16 in, 16 out, I/O system.

RobotStudio for offline programming enables manufacturers to simulate a production cell to find the optimal position for the robot, and provide offline programming to prevent costly downtime and delays to production.

Reduced footprint
The combination of the new lightweight architecture of the IRB 120 with the new IRC5 Compact controller introduces a significantly reduced footprint.

Specification

Robot version	Reach (m)	Payload (kg)	Armload (kg)
IRB 120-3/0.6	0.58	3*	0.30
Number of axes	6		
Protection	IP30		
Mounting	Any angle		
Controller	IRC5 Compact/IRC5 Single Cabinet		
Integrated signal supply	10 signals on wrist		
Integrated air supply	4 air on wrist (5 bar)		

* 4 with vertical wrist

Performance (according to ISO 9283)

	IRB 120	IRB 120T
1 kg picking cycle		
25 x 300 x 25 mm	0.58 s	0.52 s
25 x 300 x 25 with 180° axis 6 reorientation	0.92 s	0.69 s
Acceleration time 0-1 m/s	0.07 s	0.07 s
Position repeatability	0.01 mm	

Technical information

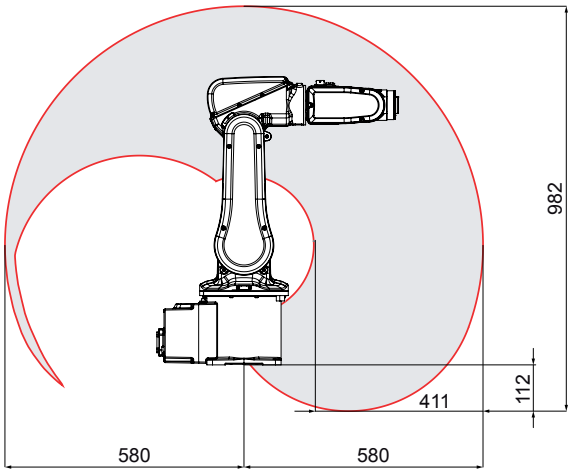
Electrical Connections	
Supply voltage	200-600 V, 50/60 Hz
Rated power transformer rating	3.0 kVA
Power consumption	0.25 kW
Physical	
Dimensions robot base	180 x 180 mm
Dimension robot height	700 mm
Weight	25 kg
Environment	
Ambient temperature for robot manipulator:	
During operation	+5°C (41°F) to +45°C (122°F)
During transportation and storage	-25°C (-13°F) to +55°C (131°F)
During short periods (max. 24 h)	up to +70°C (158°F)
Relative humidity	Max. 95%
Noise level	Max. 70 dB (A)
Safety	Safety and emergency stops 2-channel safety circuits supervision, 3-position enabling device
Emission	EMC/EMI-shielded
Options	Clean Room ISO class 5 (certified by IPA)**

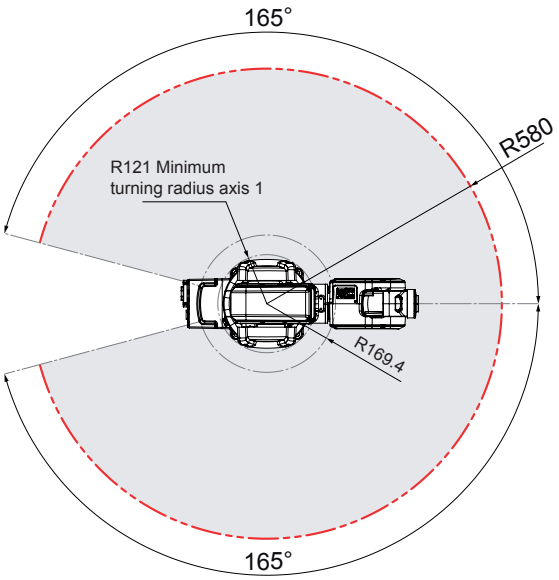
** ISO class 4 can be reached under certain conditions.
Data and dimensions may be changed without notice.

Movement

Axis movement	Working range	Axis max speed IRB 120	Axis max speed IRB 120T
Axis 1 rotation	+165° to -165°	250 °/s	250 °/s
Axis 2 arm	+110° to -110°	250 °/s	250 °/s
Axis 3 arm	+70° to -110°	250 °/s	250 °/s
Axis 4 wrist	+160° to -160°	320 °/s	420 °/s
Axis 5 bend	+120° to -120°	320 °/s	590 °/s
Axis 6 turn	+400° to -400°	420 °/s	600 °/s

Working range





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ROBO149EN_D Rev.H Ocotber 2018

ROBOTICS

IRB 910SC
SCARA

The IRB 910SC (SCARA) is fast, cost-effective and, because it's from ABB, accurate. In designing its Selective Compliance Articulated Robot Arm (SCARA), or IRB 910SC, ABB has delivered a single arm robot capable of operating in a confined footprint. ABB's SCARA is ideal for the Small Parts Assembly, Material Handling and parts inspection.

Variants
With a maximum payload of 6 kg, the IRB 910SC is available in three configurations (IRB 910SC –3/0.45, IRB 910SC – 3/0.55m, and IRB 910SC – 3/0.65.).

All are modular by design, with different linking arm lengths and have individual reaches of 450 mm, 550 mm and 650 mm, respectively.

All members of the SCARA family are tabletop mountable. IP20 and clean room options are under development.

Applications
ABB's SCARA family is designed for a variety of general-purpose applications such as tray kitting, component placement, machine loading/unloading and assembly.

These applications require fast, repeatable and articulate point-to-point movements such as palletizing, depalletizing, machine loading/unloading and assembly.

ABB's SCARA family is ideal for customers requiring rapid cycle times, high precision and high reliability for their Small Part Assembly applications and for laboratory automation and prescription drug dispensing.

Features
- A Clean Room ISO-5 option is under development
- IP20 protection is under development
- Table top mountable
- Ease of integration
- Custom interfaces
- Modular design

Customer benefits
- Short cycle times which achieved by high speed
- High precision which is achieved by superior motion control
- Superb reliability due to reuse and standard proven components.

Specification

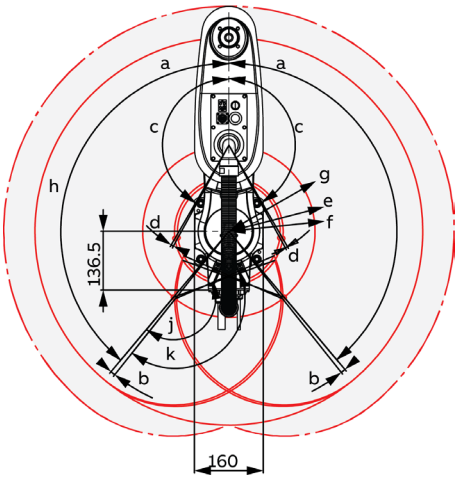
Robot version IRB	Reach (m)	Payload (kg)	Armload
IRB 910SC-3/0.45	0.45	Rated: 3 Max: 6	Included in the max payload
IRB 910SC-3/0.55	0.55	Rated: 3 Max: 6	Included in the max payload
IRB 910SC-3/0.65	0.65	Rated: 3 Max: 6	Included in the max payload
Protection	IP20		
Mounting	Table		
Controller	IRC5 Compact		

Technical information

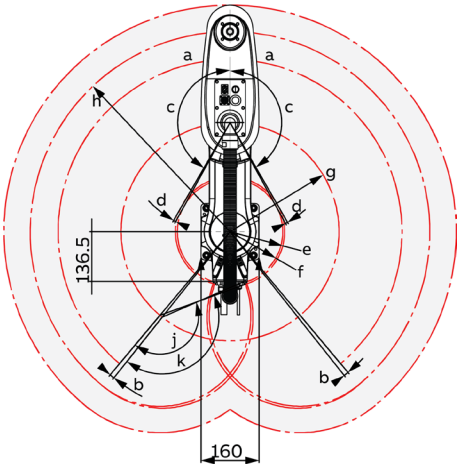
Electrical Connections	
Supply voltage	200-600 V, 50/60Hz
Transformer rating	3.0 kVA
Power consumption	220 W
Physical	
Footprint	160mm x160mm
Weight	
IRB 910SC -3/0.45	24.5 kg
IRB 910SC -3/0.55	25 kg
IRB 910SC -3/0.65	25.5 kg
Features	
Integrated signal supply	10 signals on wrist
Integrated air supply	4 air on wrist (5 bar)

Performance (according to ISO 9283)	**IRB 910SC -3/0.45**	**IRB 910SC -3/0.55**	**IRB 910SC -3/0.65**
1 kg picking cycle	0.380 s	0.370 s	0.385 s
Max TCP Velocity	6.2 m/s	6.9 m/s	7.6 m/s
Max TCP Acceleration	65 m/s^2	60 m/s^2	55 m/s^2
Acceleration time 0-1m/s	0.04 s	0.05 s	0.06 s
Axis 3 (Z stroke) down force	250 N	250 N	250 N
Maximum Speed			
Axis 1+ Axis 2	6.13 m/s	6.86 m/s	7.58 m/s
Axis 3	1.02 m/s	1.02 m/s	1.02 m/s
Axis 4	2400 °/s	2400 °/s	2400 °/s
Position Repeatability			
Axis 1 + Axis 2	±0.015 mm	±0.015 mm	±0.015 mm
Axis 3	±0.01 mm	±0.01 mm	±0.01 mm
Axis 4	±0.005°	±0.005°	±0.005°

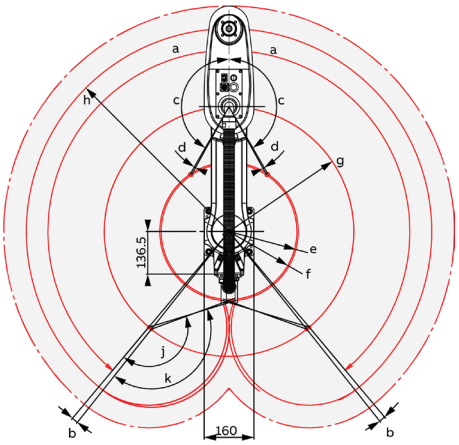
IRB 910SC-3/0.45, working range



IRB 910SC-3/0.55, working range



IRB 910SC-3/0.65, working range



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ROBOTICS

Integrated Vision

Vision-guided robotics for use by any industry

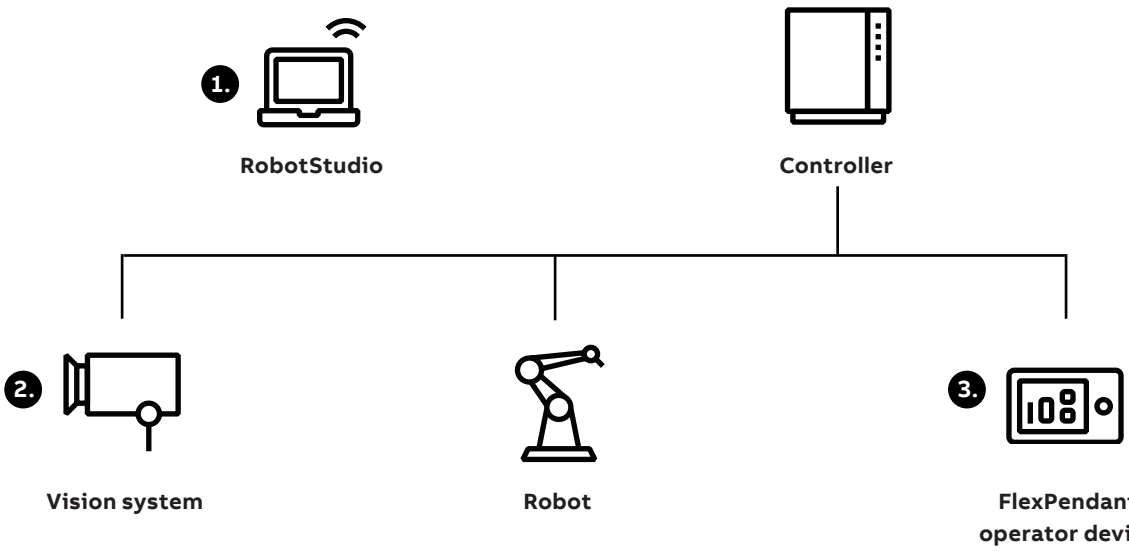
A powerful vision-guided robotics system is one that can face the numerous challenges posed by the factory floor head on by saving time and improving the flexibility of the robot. Integrated Vision offers a fast and easy way to ensure that end-user products meet the highest quality and standards.

Smart vision cameras
The ABB vision system represents a true revolution in machine vision featuring powerful vision tools; optics, faster image capture, capability to power and control a range of external lighting and enough input/output capacity for virtually any inspection scenario - all in a compact, industrial IP67 package that makes the system ideal for more applications than ever before.

Powerful vision tools
Regardless if you want to localize, inspect or trace products, ABB integrated Vision consist of +50 smart vision tools that reduce engineering times and can be deployed quickly. Both the advanced and first-time vision user will find Integrated Vision‘s extensive library of vision commands easy-to-use.

Vision fully integrated with the robot
There are a wide range of robotic vision-guided systems available on the market. None, however, offers the programming power of RobotStudio®‘s comprehensive set of robot commands which seamlessly communicates with both robot and smart camera. Predefined and complete camera to robot tasks are by a single click installed in your program which saves the programmer substantial time and minimizes the risk of errors.

RobotStudio
ABB’s widely used offline 3D programming tool. RobotStudio offers as standard ready-made components for easy programming of the robot and the vision system.



Integrated Vision process

1. RobotStudio is a graphical programming environment that allows robots and vision system to be programmed offline.

2. The Vision system to locate, inspect and guide parts. It perform tasks that are practically impossible for people to do reliably and consistently.

3. ABB's FlexPendant operator device with an intuitive graphical user interface that is fully customizable to the user's requirements.

—

Camera specification

Variants	Speed	Resolution
Medium Resolution	6x	800x600
High Resolution	12x	1280x1024

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ROBOTICS

Product specification

Integrated Vision

Trace back information:
Workspace R18-2 version a11
Checked in 2018-10-11
Skribenta version 5.3.008

Product specification
Integrated Vision

Document ID: 3HAC046868-001
Revision: E

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Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

ABB AB, Robotics
Robotics and Motion
Se-721 68 Västerås
Sweden

Table of contents

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Overview of this specification

About this product specification

This product specification describes the functionality, performance, and options available for Integrated Vision in terms of:

- Application environment setting
- Basic concepts
- Ease of use of the software application configuration
- Interactions with robots, cameras, sensors, conveyors, and other peripheral equipment
- Operation and controls
- Software and hardware options and licenses

Usage

Product specifications are used to find data and performance about the product, for example to decide which product to buy. How to handle the product is described in the product manual.

Users

It is intended for:

- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel

References

Reference	Document ID
Product specification - Controller software IRC5	*3HAC022349-001*
Product specification - Controller IRC5 with FlexPendant	*3HAC041344-001*
Application manual - Integrated Vision	*3HAC044251-001*
Product specification - Robot user documentation, IRC5 with RobotWare 5	*3HAC024534-001*

Revisions

Revision	Description
-	New specification
A	Minor corrections/update
B	Minor corrections/update
C	Added the IRB 14000-specific stationary camera, In-Sight Micro 1402.
D	Note deleted in *Licensing on page 29*.
E	Minor corrections/update

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1 Integrated Vision

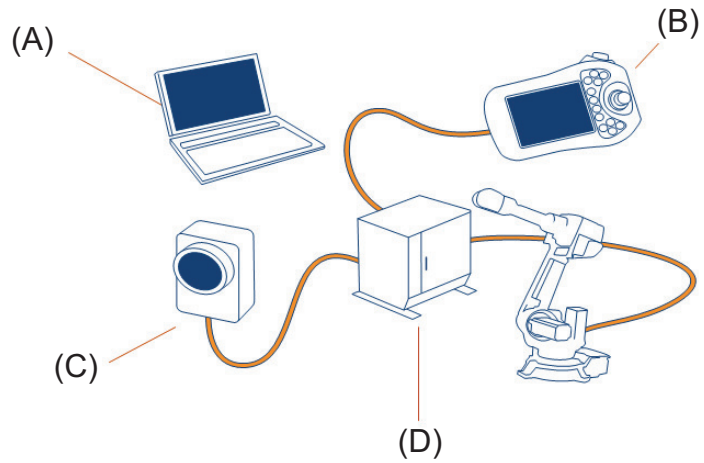
1.1 What is Integrated Vision

General

The purpose of ABB's Integrated Vision system is to provide a robust and easy-to-use vision system for general purpose Vision Guided Robotics (VGR) applications.

The system includes a complete software and hardware solution that is fully integrated with the IRC5 robot controller and the RobotStudio programming environment. The vision capability is based on the Cognex In-Sight® smart camera family, with embedded image processing and an Ethernet communication interface.

RobotStudio is equipped with a vision programming environment that exposes the full palette of Cognex EasyBuilder® functionality with robust tools for 2D part location, part inspection, and identification. The RAPID programming language is extended with dedicated instructions and error tracing for camera operation and vision guidance.



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Position	Description
A	PC (Configuration from RobotStudio)
B	FlexPendant (Monitoring and simple maintenance)
C	ABB Smart camera
D	IRC5 (Connect up to 3 cameras)

1.2 Typical applications

Typical usage

The Integrated Vision system can reduce the need for hard automation and in some cases solve tasks that can only be implemented using vision technology. Typical applications include part positioning, visual part inspection, sorting, identification, and more. The time from acquiring an image until the image processing has completed typically ranges from 50ms up to 2s or more, depending on the complexity of the task. For more information, see *Does Integrated Vision solve your application? on page 25*.

Locating the part

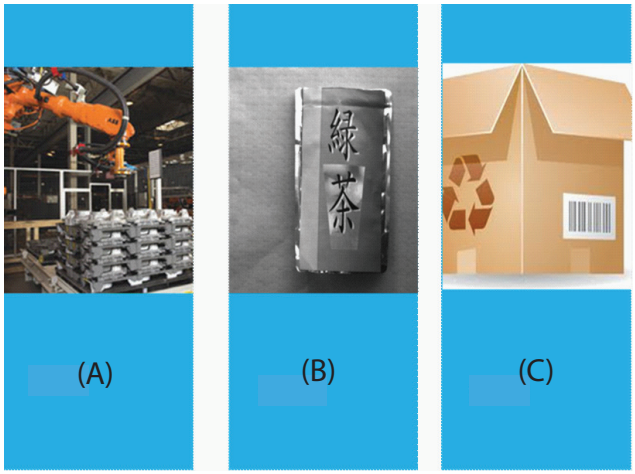
The vision system may be used as an alternative to mechanical fixtures to find the location and angle of the part in 2D. The vision system can be configured to find multiple types of parts – even simultaneously in the same scene if needed. Various vision tools are available ranging from simple and fast segmentation models that execute in a few milliseconds and up to complex feature based object recognition models with superior robustness.

Inspecting the part

The system comes with a large set of easy-to-use inspection tools tuned to a multitude of applications. Choose from simple operations such as brightness or sharpness measurements to complex pattern recognition operations. Multiple inspection tools and logic can be added as needed.

Identifying the part

With the Integrated Vision system the robot now also has the means to read text, bar codes, matrix codes etc. Thanks to the wide range of capabilities provided by the vision system it replaces an array of traditional sensors used in robotic applications.



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Position	Description
A	Find it

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Position	Description
B	Verify it
C	Trace it

1.3 Required equipment

The following software and hardware is required to run Integrated Vision:

- RobotWare version: 5.60 or later
- RobotWare option: 1341-1 Integrated Vision
- A PC with RobotStudio installed (for configuration, not required for production)
- RobotStudio Free version: 5.60 or later. Launch 32-bit version. DPI and text size shall be set to 100%.
- Main computer: DSQC1000
- Camera firmware: Required 4.08(22), Recommended 4.10.2 (DSQC1020, DSQC1021 and In-Sight Micro 1402) or 4.9.4 (AE3 YuMi Smart Gripper)
- FlexPendant: SxTPU3 (optional - FlexPendant may be used for viewing images)

Note

RobotStudio may be downloaded from "www.robotstudio.com". Integrated Vision can be used with the free version of RobotStudio. Cameras and RobotStudio connect through the service port of the main computer.

2 Overview of the product

Hardware

The camera system is based on the Cognex In-Sight® 7000 series, but any Cognex In-Sight® camera can be used. The camera is supplied with 24 VDC and Ethernet from the controller.

The kit cameras feature IP67 protection and C-mount lensing. Up to three cameras can be connected to the supplied Ethernet switch.

Software

- Integrated Vision provides easy-to-use vision guidance for the IRC5 robot controller.
- Simple installation and configuration of both cameras and robots from RobotStudio.
- Rich toolset of industry proven vision algorithms for various situations.
- Find, inspect and categorize parts using dedicated vision tools such as pattern matching, caliper measurements and barcode reading.
- Save time with dedicated RAPID instructions for camera communication.
- Monitor and record images from the FlexPendant during production.

Integrated Vision is installed as part of the RobotStudio and RobotWare software. The functionality is enabled with a RobotWare option (*1341-1 Vision Interface*).

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3 Technical specification

3.1 Hardware

Cameras

The following table provides the basic characteristics of the kit cameras provided by ABB. For additional details, see the technical specification of the camera, available on the Cognex website. The ABB kit cameras DSQC1020 and DSQC1021 are electrically and mechanically equivalent to In-Sight 7200 and 7402 respectively.

Specification	DSQC1020	DSQC1021
Resolution	800x600	1280x1024
Sensor properties	5.3 mm diagonal, 5.3 x 5.3 µm sq. pixels, monochrome	8.7 mm diagonal, 5.3 x 5.3 µm sq. pixels, monochrome
Job/program memory	512 MB	
Image processing memory	256 MB SDRAM	
Sensor type	1/1.8-inch CMOS	
Shutter speed	16µs to 950 ms	
Acquisition	Rapid reset, progressive scan, full frame integration	
Lens type	C-mount	
Protection	IP67 with lens cover properly installed	
Power consumption	24DC 24±10%, 2 A External light - Continuously on; output 24V, 500mA max. External light - Strobe; output 24V, 1A max. at 50% duty cycle (max. on time of 100ms)	
M12 Lens, configuration, dimensions	75 mm (2.95 in) x 84.8 (3.34 in) x 55 mm (2.17 in)	
Operating temperature	0°C to 45°C (32°F to 113°F)	

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Lenses

It is important to select the correct lens before ordering a vision system. The tables below can be used as a guide when determining which lens provides the appropriate field of view. Note that the same lens results in different fields of view when used on DSQC1020 and DSQC1021 respectively. The reason is that the two cameras have image sensors of different sizes.

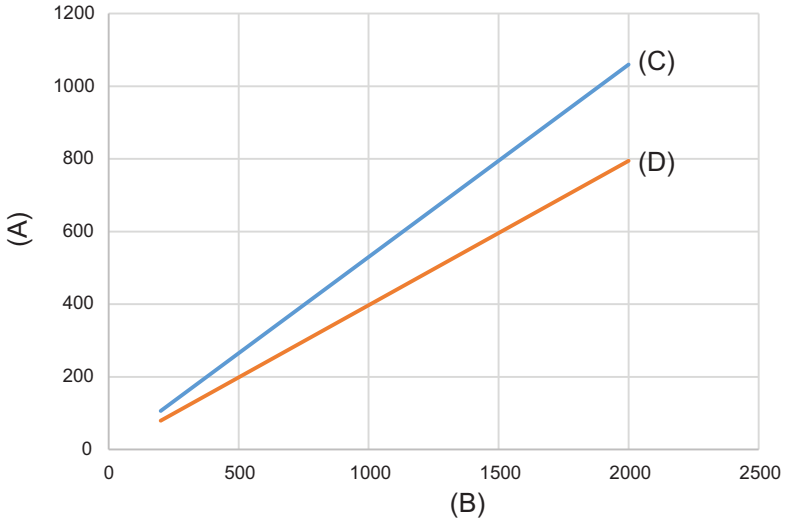

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Figure 3.1: DSQC1020 - 8 mm lens

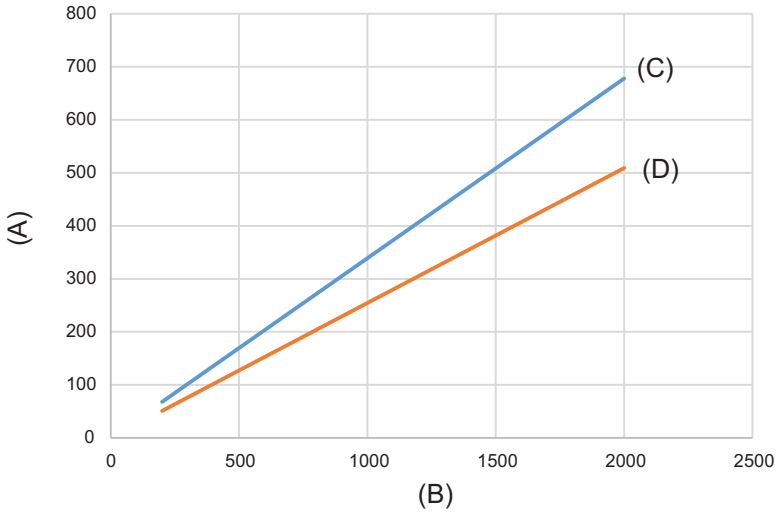

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Figure 3.2: DSQC1020 - 12.5 mm lens

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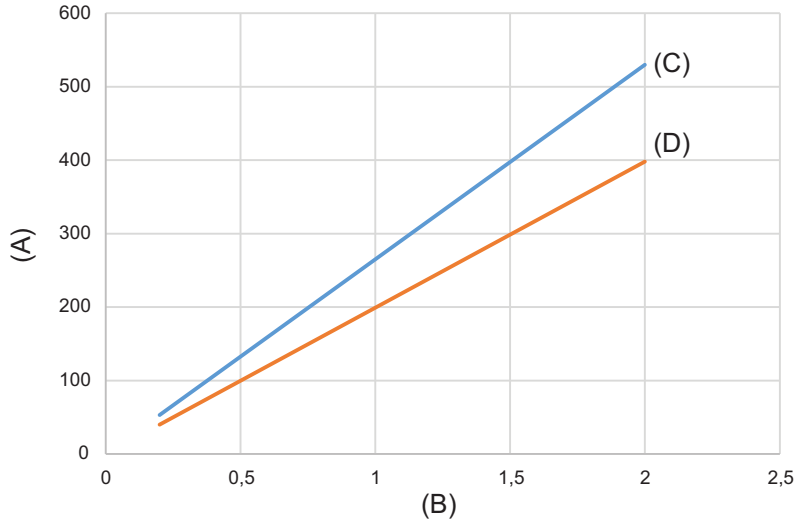

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Figure 3.3: DSQC1020 - 16 mm lens

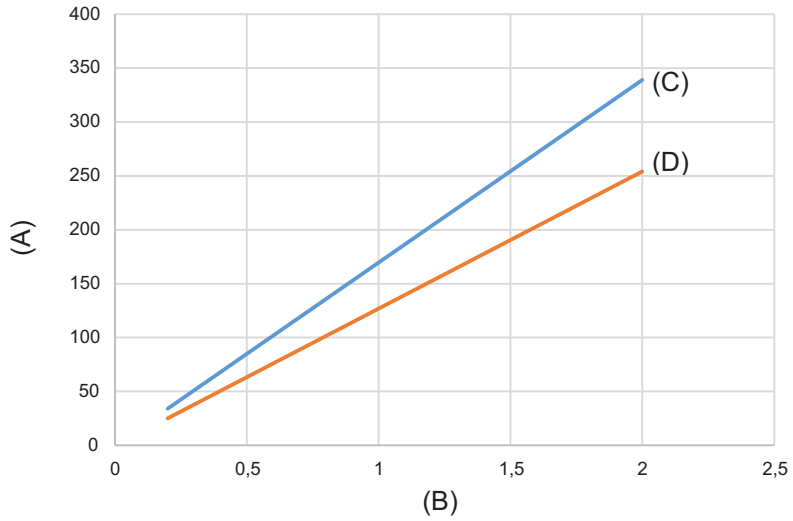

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Figure 3.4: DSQC1020 - 25 mm lens

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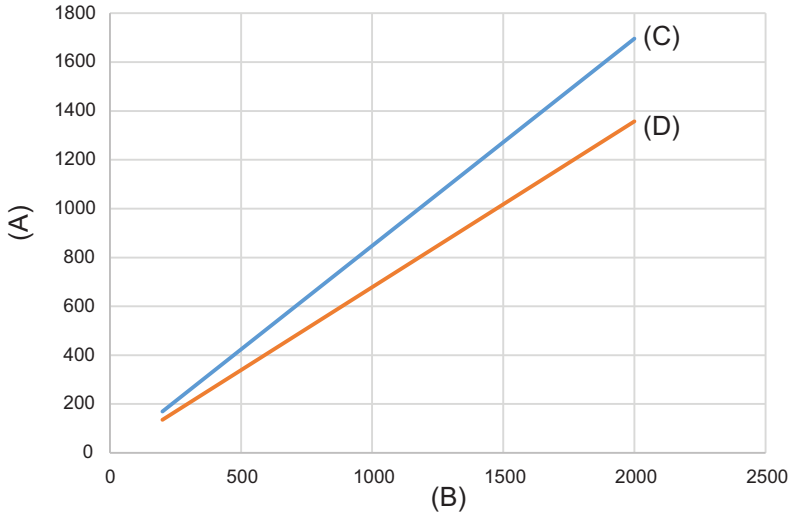

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Figure 3.5: DSQC2021 - 8 mm lens

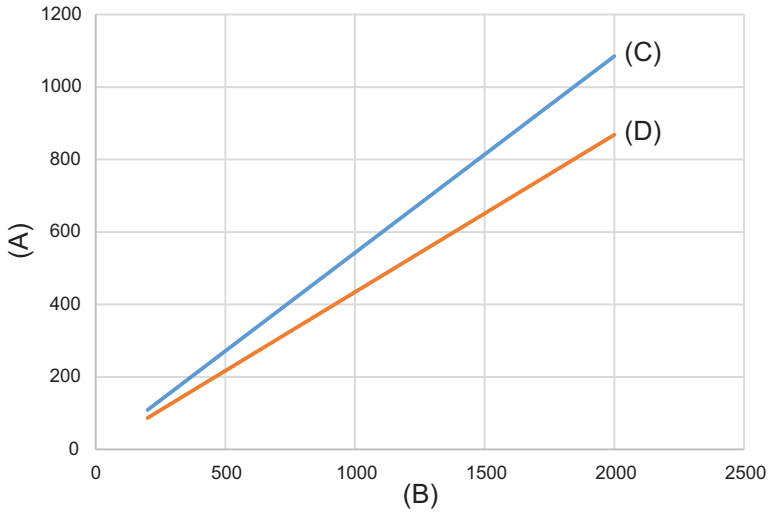

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Figure 3.6: DSQC2021 - 12.5 mm lens

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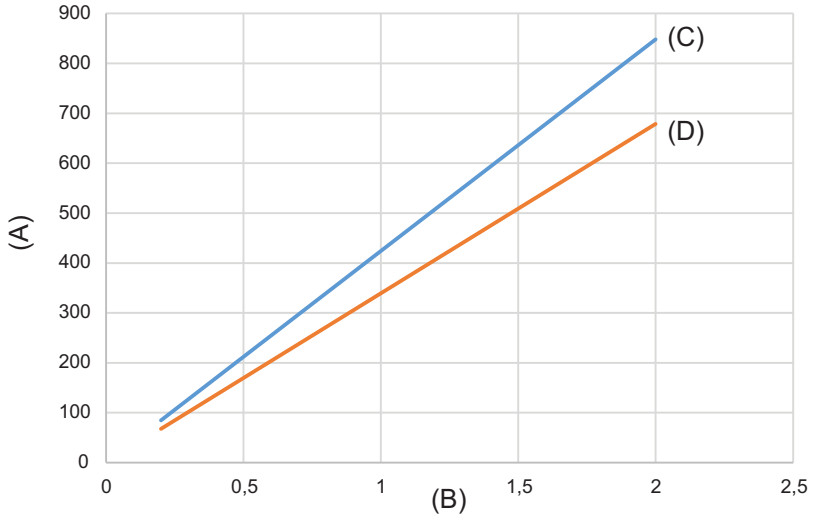

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Figure 3.7: DSQC2021 - 16 mm lens

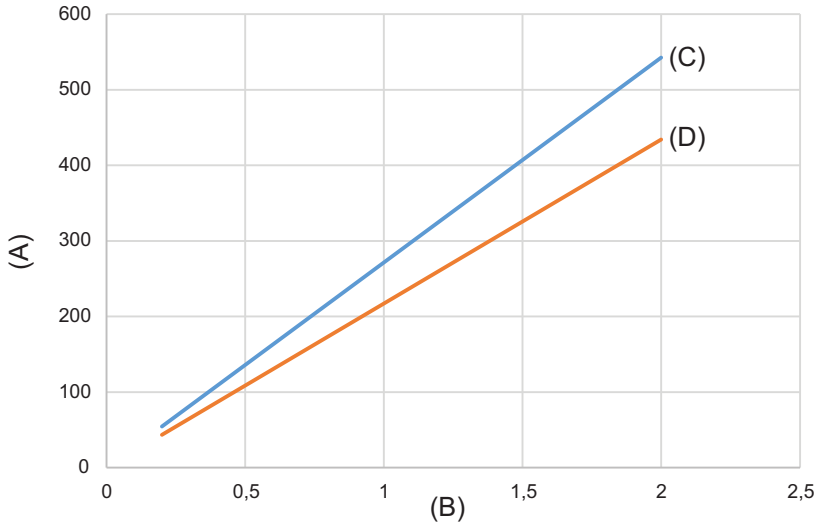

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Figure 3.8: DSQC2021 - 25 mm lens

Position (valid for all above diagrams)	Description
A	Field of view (mm)
B	Distance (mm)
C	Width (mm)
D	Hight (mm)

Continues on next page

Note

Appropriate lenses can also be calculated here:
http://www.cognex.com/ExploreLearn/UsefulTools/LensAdvisor/?id=8341

Input product and model: DSQC1020 = In-Sight 7200 and DSQC1021 = In-Sight 7402.

Selecting lens

Below is an example showing how to calculate the proper lens to be used, knowing the working distance between camera and work piece, and the required field of view. The example assumes that the user has selected DSQC1021.

Camera	DSQC1021
Maximum distance between camera and product	500 mm
Minimum field of view	200 x 200 mm

The example specifies that the FOV shall be at least 200 mm in both vertical and horizontal directions. Since the image is rectangular rather than square, it means that the shortest dimension, the height, has to be greater than 200mm. Figure "DSQC1021 - 12.5 mm lens" shows that at 500 mm both the width and height are greater than 200 mm. In this case an 8 mm lens would also work, but the resolution of the camera would not be fully utilized since the field of view would be larger than needed.

IRB 14000-specific stationary vision

Camera

The following table provides the basic characteristics of the IRB 14000-specific stationary camera, In-Sight Micro 1402.

Specification	In-Sight Micro 1402
Resolution	1280x1024
Sensor properties	8.7 mm diagonal, 5.3 x 5.3 µm sq. pixels
Job/program memory	128 MB non-volatile flash memory; unlimited storage via remote network device
Image processing memory	256 MB
Sensor type	1/1.8-inch CMOS
Shutter speed	16µs to 1000 ms
Acquisition	Rapid reset, progressive scan, full frame integration
Lens type	CS-mount and C-mount (with 5mm extension, included)
Protection	IP51 with cables and lens attached
Power consumption	6.49 W maximum per Class 2 PoE
Dimensions	30 mm (1.18 in) x 30 (1.18 in) x 60 mm (2.36 in) without mounting block 30 mm (1.18 in) x 38.2 (1.50 in) x 60 mm (2.36 in) with mounting block
Operating temperature	0°C to 45°C (32°F to 113°F)

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Lens

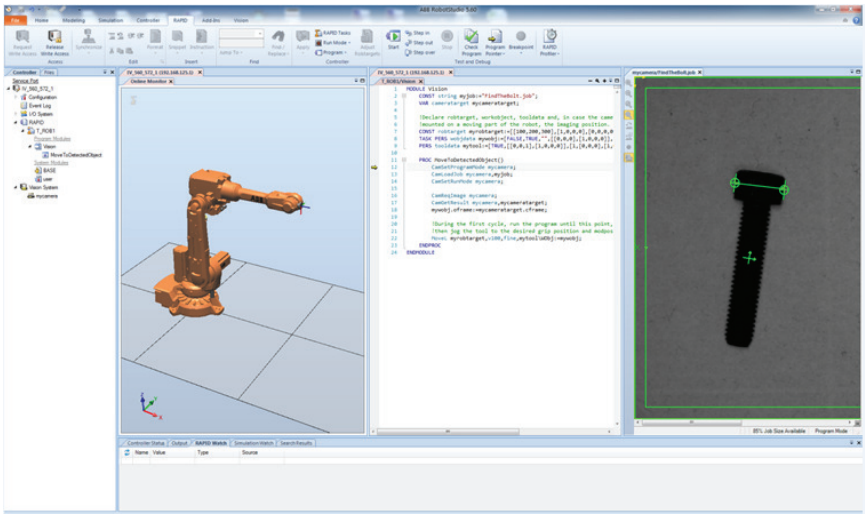
HF 12.5HA-1B is the lens used together with the IRB 14000-specific stationary camera In-Sight Micro 1402. The following table details the basic specifications of the lens.

Specification	HF 12.5HA-1B
Focus length (mm)	12.5
Iris range	F1.4-F16
Operation	Focus: manual Iris: manual
Angle of view (H x V)	2/3": 38"47' x 29"35' 1/2": 28"43' x 21"44' 1/3": 21"44' x 16"23'
Focusing range (from front of the lens) (m)	∞ - 0.1
Object dimensions at M.O.D. (H x V) (mm)	2/3": 78 x 58 1/2": 57 x 42 1/3": 42 x 32
Back focal distance (in air) (mm)	15.09
Exit pupil position (from image plane) (mm)	-31.3
Filter thread (mm)	M25.2 x 0.5
Mount	C
Mass (g)	45

3.2 Software

RobotStudio

RobotStudio is equipped with an additional tab that can be launched when connected to a robot controller with the option Integrated Vision. A graphical interface provides point-and-click instructions to assemble a vision task or "job". The vision tab offers a rich set of "vision tools" that can be used to solve a wide variety of applications. Rapid snippets are available to get off to a quick start.



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Note

The ABB kit cameras cannot be programmed with Cognex In-Sight Explorer.

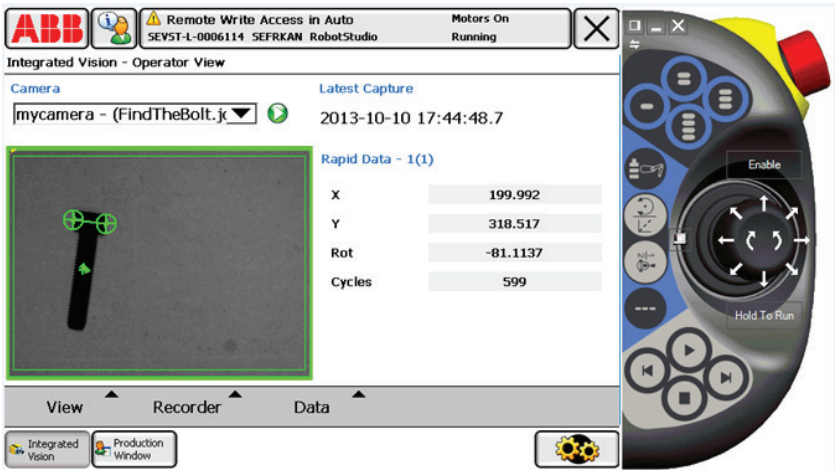
Robot controller

The RobotWare option Integrated Vision enables a set of dedicated instructions for communicating with the camera in an efficient manner. The instructions include commands for acquiring images, queue handling for the output as well as generic instructions for changing various parameters during runtime.

Continues on next page

FlexPendant

To eliminate the need for an additional operator panel the FlexPendant includes a vision application for monitoring images, observing result output, and saving images during run-time. The application can be configured so that the user may add favorite data to be displayed alongside the image.



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4 Does Integrated Vision solve your application?

When deciding to deploy a vision solution it is of critical importance to evaluate if the expected result can be achieved. The best way to make sure that required results can be achieved is to perform a test, and the closer the test setup is to the intended installation the better the result.

As good practice the following requirements shall be identified/quantified and verified:

Samples	Collect good and bad samples of the actual customer product to be used for evaluation.	OK
Accuracy	What accuracy is required? The overall number combines robot accuracy, influence by part variation, lighting etc.	OK
Tolerance	Can the part vary in size? Uniformly or irregularly?	OK
Cycle time	The vision system requires processing time. Depending on the application this may or may not affect the cycle time.	OK
Part positioning	Make sure you know the perspective from which the camera will observe the object. A simple thing like looking at the object from the side may affect the result.	OK
Variations in the process	Apart from the verified variables, can something else change?	OK
Lighting needs	Lighting is extremely important. Shield out ambient light and applying light that brings out the desired features of the part. Experimentation is the only reliable method.	OK
Physical space constraints	Taking all factors into consideration such as field of view, lighting solution, point of view – does everything fit together?	OK

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5 Stationary camera or mounted on the robot

General

Depending on the application requirements and physical constraints the camera may be mounted in different ways. Generally it can be said that mounting the camera on a fixed structure is more efficient unless requirements are such that the camera must be carried by the robot. When mounted on a robot the camera may be subjected to substantial force. For special considerations, see *Hardware on page 15*.

Stationary

A stationary camera generally provides faster cycle times since the robot does not have to stop on its path to acquire an image. Setup and calibration is generally easier with fixed cameras since the point from which the image is acquired is fixed. When mounting the camera on a fixed structure it is important that the camera is not subject to vibrations which can cause motion blur.

Mounted on the robot

When placing a camera on a moving position it is the responsibility of the user to make sure that the camera is not subjected to mechanical forces greater than what is specified in the camera specification. The cables are of a flexible type, but wear depends greatly on both the cable routing and the programmed robot path.

CAUTION

When using a robot held camera, or by other means moving camera, it is important to have a good cable routing.

When routing the cables caution has to be taken to avoid mechanical stress on the connectors, allowing sufficient bend radius for the cables, and minimizing the wear on the cables. It is also recommended to fit the cables with extra wear protection at the attachment points and at especially exposed areas.

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6 Sales options

Licensing

Integrated Vision is licensed as RobotWare option 1341-1. The software option enables the RAPID programming interface and FlexPendant operator panel. The vision programming tool in RobotStudio is free to use.

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7 Specification of variants and options

Options

Option	Description	Remark	Description
1341-1	Integrated Vision interface	Requires 24V [727-1 or 727-3]	The option provides the software option that enables use of the RAPID vision instructions and the FlexPendant operator panel. The controller is also fitted with the necessary hardware to enable connection of up to three cameras.
Integrated Vision cameras			
1342-1	(1-3) Medium resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1020 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
1343-1	(1-3) High resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1021 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
Camera lenses			
1348-1	(1-3) 8 mm camera lens	Requires Integrated vision interface [1341-1]	Camera lens with focal length 8 mm as specified in section *Lenses on page 16*.
1352-1	(1-3) 12.5 mm camera lens	Requires Integrated vision interface [1341-1]	Camera lens with focal length 12.5 mm as specified in section *Lenses on page 16*.
1349-1	(1-3) 16 mm camera lens	Requires Integrated vision interface [1341-1]	Camera lens with focal length 16 mm as specified in section *Lenses on page 16*.
1350-1	(1-3) 25 mm camera lens	Requires Integrated vision interface [1341-1]	Camera lens with focal length 25 mm as specified in section *Lenses on page 16*.

IRB 14000-specific option

Option	Description	Remark	Description
IRB 14000-specific stationary vision			
1521-1	(1-2) High res. PoE camera	Requires IRB 14000-0.5/0.5 [435-131]	This option provides a package specific to IRB 14000, including camera, lens, adapter, cables and so on. Camera ISM1402 and related lens as specified in sections *IRB 14000-specific stationary vision on page 20*.

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8 Spare Parts list

Spare parts for Integrated Vision

Below is available spare parts for Integrated Vision listed.

Article number	Description
3HAC053944-001	8 mm C-mount lens
3HAC053944-002	12.5 mm C-mount lens
3HAC053944-003	16 mm C-mount lens
3HAC053944-004	25 mm C-mount lens
3HAC053953-001	DSQC1020 Camera Std Resolution for C-mount lens
3HAC053954-001	DSQC1021 Camera High Resolution for C-mount lens
3HAC051736-003	Ethernet cable 10 m
3HAC051736-004	Ethernet cable 15 m
3HAC051753-003	Power cable 10 m
3HAC051753-004	Power cable 15 m

Spare parts for IRB 14000-specific stationary vision

Below is available spare parts for IRB 14000-specific stationary vision listed.

Article number	Description
3HAC053166-001	Congex camera, ISM1402-11
3HAC053167-001	Congex LFC-12.5F lens
3HAC053168-001	Standard Ethernet cable 5m
3HAC053227-001	PoE adapter
3HAC024254-009	Ethernet cable, straight con. 3m

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Telephone +46 (0) 21 344 400

ABB AS, Robotics
Robotics and Motion
Nordlysvegen 7, N-4340 BRYNE, Norway
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Telephone: +47 22 87 2000

ABB Engineering (Shanghai) Ltd.
Robotics and Motion
No. 4528 Kangxin Highway
PuDong District
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Telephone: +86 21 6105 6666

ABB Inc.
Robotics and Motion
1250 Brown Road
Auburn Hills, MI 48326
USA
Telephone: +1 248 391 9000

abb.com/robotics

3HAC046868-001, Rev E, en

TECHNOLOGY GROUP

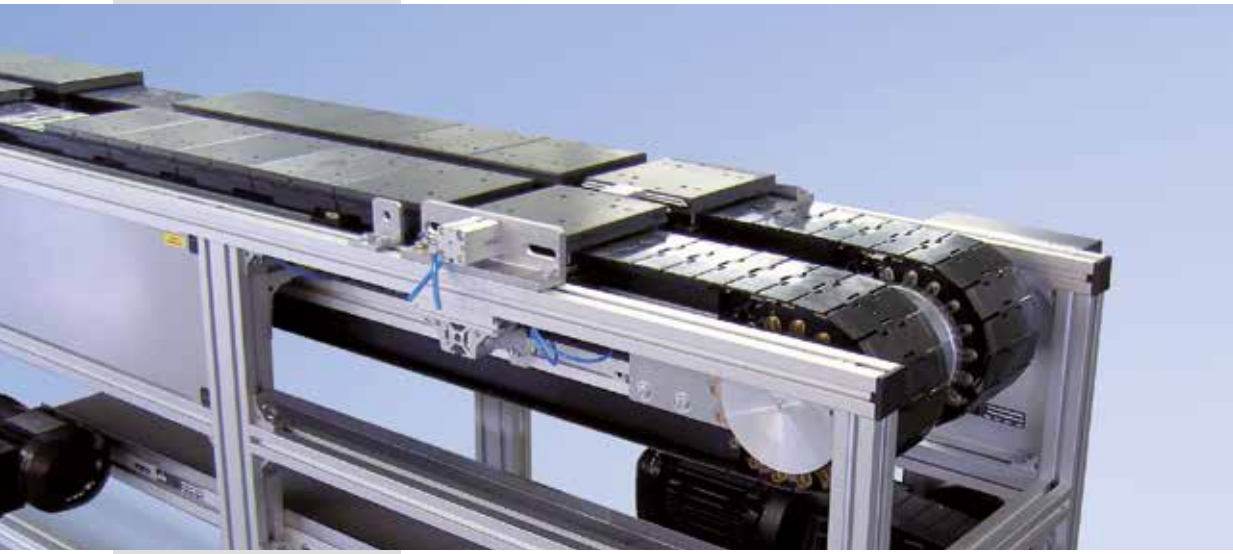
SPU 2040

Accumulating Pallet Recirculation Systems




with automatic return of pallets

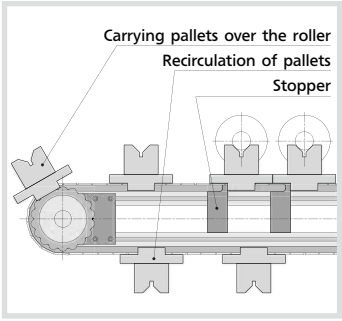
SPU 2040
Accumulating Pallet Recirculation Systems



Linking. Feeding. Buffering.

mk – we're one of the leading suppliers of mechanical components, modules and turnkey solutions for factory automation. Our SPU 2040 is an accumulating pallet recirculation system with which we offer you cost-effective linking, feeding, buffering, positioning and separating of workpieces in the smallest possible space. The robustness and the variety of configurations of the system allows it to be used in practically all areas of automation and material flow.

Automatic recirculation of pallets
Using a flat top chain conveyor the workpieces on the pallets are loaded on the upper transport level. After removal of the workpieces the empty pallets are safely carried over the return roller and then conveyed back on the underside of the conveyor. They are then once again available at the starting point of the conveyor waiting to be loaded with new workpieces. A second conveying level and devices for lifting and lowering are no longer required. Neither is any additional manual or automated loading of pallets necessary.

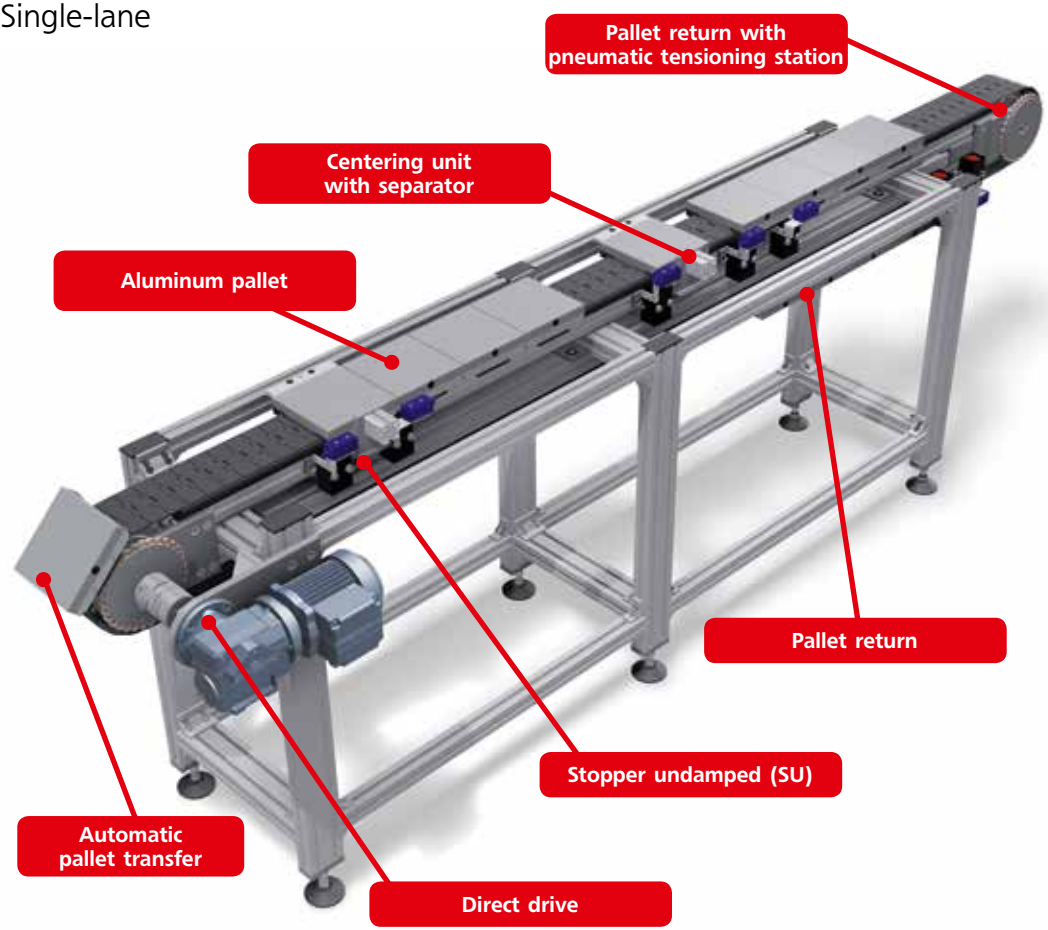


Advantages of SPU 2040

- Cost-effective interlinking of two processing stations
- Process-safe feeding, buffering, positioning and separation
- Compact design with space-saving recirculation of pallets beneath the transport level
- Buffer capacity compensates for varying cycle times within the production line.
- Flexibility as a result of the modular design and variable pallets
- Loading depends on the speed, the maximum value being 300 kg (Single-lane) and 450 kg (Dual- and Double-lane)
- Conveyor lengths ranging from 2 to 10 m
- Speeds ranging from 4 to 15 m/min
- Low friction and low maintenance

SPU Layout planning

Single-lane



Dual-lane

Double-lane

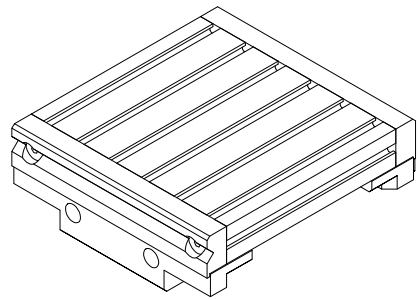
In the case of single or dual-lane systems the lengths of pallets used range from 150 to 350 mm, while the widths of pallets range from 160 to 250 mm.

The largest possible pallet weighs max. 3 kg
In the double-lane systems the pallet width is determined by the conveyor width.

The pallet loads must be confirmed in advance to determine the center of gravity.

Workpiece carriers/pallets

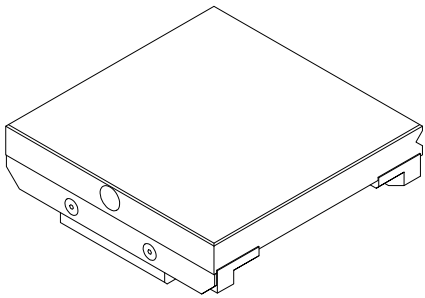
WT 20 pallet



- Total load* 20 kg
- The carrier plate is made of profile series 40 aluminum
- Lateral locating groove and locating bushing
- POM Slide rails
- The max. weight of workpiece holder is 7.5 kg

System 114	**7-20.020-110-000**
System 190	**7-20.020-111-000**

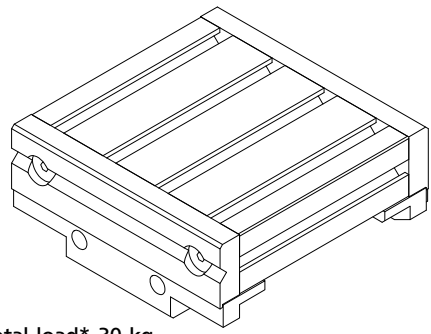
WT Aluminum pallet



- Total load* 25 kg
- Aluminum carrier plate (Hard-Coating is recommended)
- Lateral locating groove and locating bushing ensure extremely precise positioning
- POM Slide rails
- The max. weight of workpiece holder is 7.5 kg

System 114	**7-20.020-130-000**
System 190	**7-20.020-131-000**

WT 40 pallet



- Total load* 30 kg
- The carrier plate is made of profile series 40 aluminum
- Preferred for Double-lane systems
- Lateral locating groove and locating bushing
- POM Slide rails
- The max. weight of workpiece holder is 7.5 kg

System 114	**7-20.020-120-000**
System 190	**7-20.020-121-000**

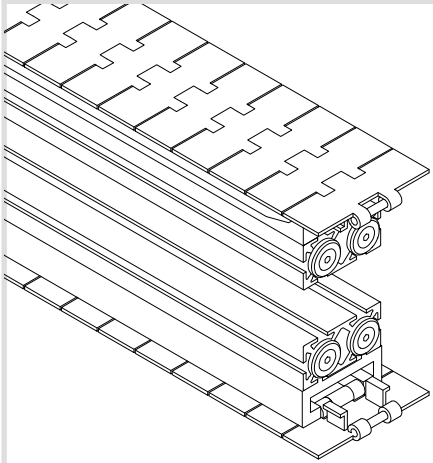
*Total load: Workpiece carrier/pallet + Workpiece holder + Workpiece

Modules

Transfer line

Flat top chain conveyors are available in two different widths. The 114 system is designed using 2 profiles having a cross-section of 40 x 80 mm and can be used as single-lane or a multi-lane option. The 190 system, which is larger, is designed using 4 profiles of cross-section 40 x 40 mm and is used as a single-lane system, if the weight of the workpiece is not concentrated at the center and consequently additional supporting surface is needed. The flat top chain is made of wear-resistant carbon steel.

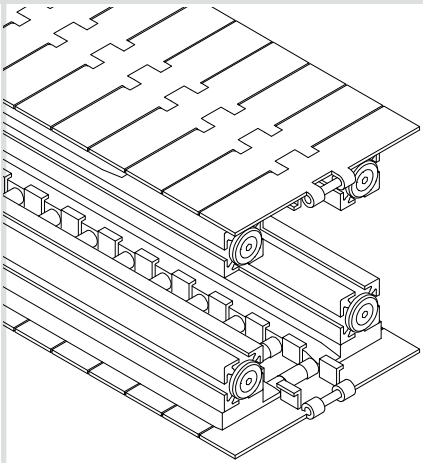
Narrow SPU transfer line



Flat top chain width = 114.3 mm

Single-lane 114 system	**7-20.020-210-000**
Double-lane 114 system	**7-20.020-211-000**

Wide SPU transfer line



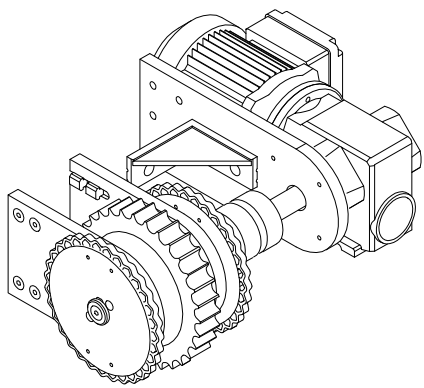
Flat top chain width = 190.5 mm

Single-lane 190 system	**7-20.020-220-000**
Double-lane 190 system	**7-20.020-221-000**

Drive

Vulkolan pressure pads ensure secure transfer of pallets over the return rollers. The pallets/ workpiece carriers are thus moved automatically beneath the conveyor level with minimum space requirements. Individual pressure pads allow easy replacement.

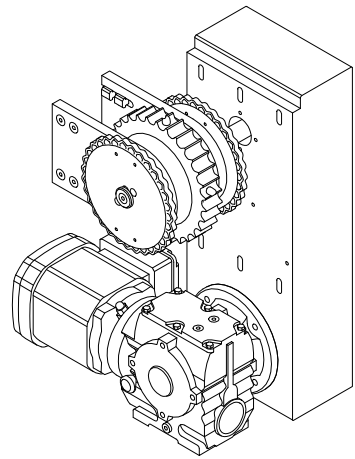
Direct drive



- Flange-mounted hollow-shaft motor
- Line speed can be adjusted via the motor
- Arrangement is to the right or to the left of the conveyor line
- The driving chain wheel is linked to the motor using a combination of shaft and coupling
- Alternatively, you can use a safety coupling instead of a clamping coupling

System 114	**7-20.020-510-000**
System 190	**7-20.020-512-000**

Indirect drive



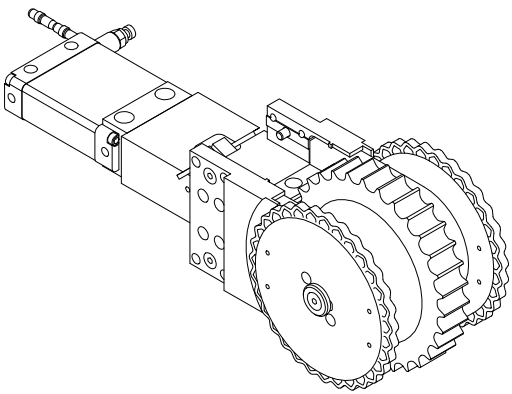
- Gear motor with output shaft
- Line speed can be controlled using the motor and the drive sprocket combination.
- Location of the motor: Below the conveyor belt
- Drive assembly to the right or to the left
- Optionally, a safety coupling may be used

System 114	**7-20.020-520-000**
System 190	**7-20.020-522-000**

Return

Vulkolan pressure pads ensure secure transfer of pallets over the return rollers. In order to set the required chain tension, the system provides an automatic or manual tensioning station that is integrated in the return assembly. Tensioning stations are based on the length and the load on the system.

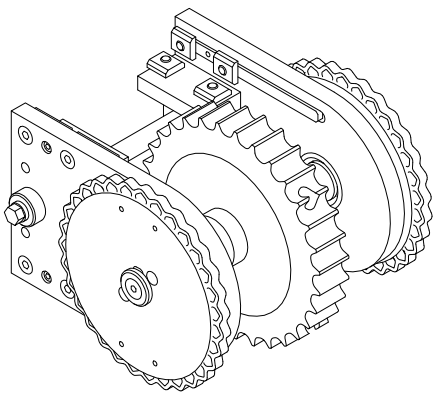
Return with automatic tensioning station



- Pneumatic operation
- Space-saving flat cylinders
- Stroke 30 mm
- Guidance of the tensioning station using linear anti-friction bearings and guide rods

System 114	**7-20.020-310-000**
System 190	**7-20.020-325-000**

Return with/without manual tensioning station

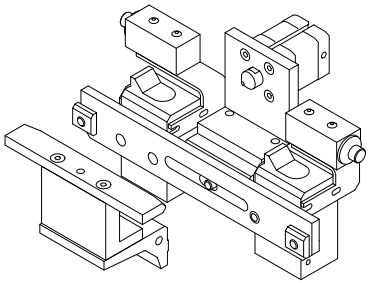


- Stroke 35 mm
- Adjustment via an eccentric

System 114 without tensioning station	**7-20.020-314-000**
System 190 with tensioning station	**7-20.020-321-000**

Centering unit

- Lateral connection to the body of the belt conveyor
- Positioning accuracy of +-0.2 mm
- Stopper sensing (SU 400) possible electrically or inductively
- The stopper is installed for both stopping and centering
- Lift using a pneumatic cylinder with a centering pin

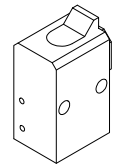


with separation	
System 114	**7-20.020-412-000**
without separation	
System 114	**7-20.020-414-000**
System 190	**7-20.020-420-000**

Stopper/Separator

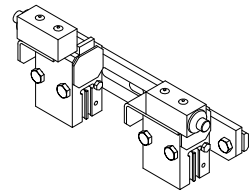
- Undamped stopping
- Depending on the travel velocity for load up to 400 kg
- Stopper sensing possible electrically or inductively

Stopper SU 400



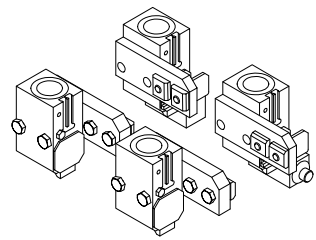
SU-400 EW electrical sensing	**K503011401**
SU-400 EW inductive sensing	**K503011405**

Separator at the top



System 114	**7-20.020-440-000**
System 190	**7-20.020-442-000**

Separator at the bottom

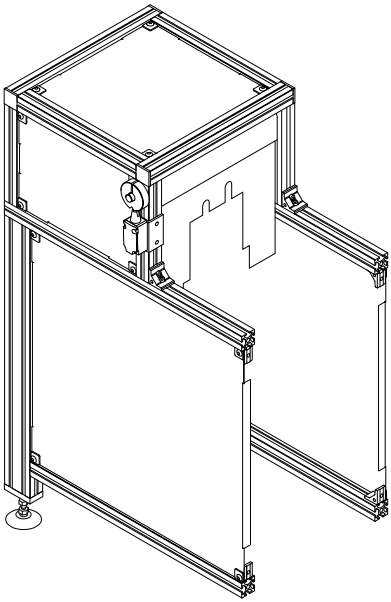


System 114	**7-20.020-441-000**
System 190	**7-20.020-443-000**

Protective housing

The protective housing at the returns prevents unauthorized access during operation and minimizes the risk of injury to the operator. In the event of an accidental contact an optional pendulum flap gets triggered and stops the entire system. A cover between the flat top chain and the frame can be provided on request.

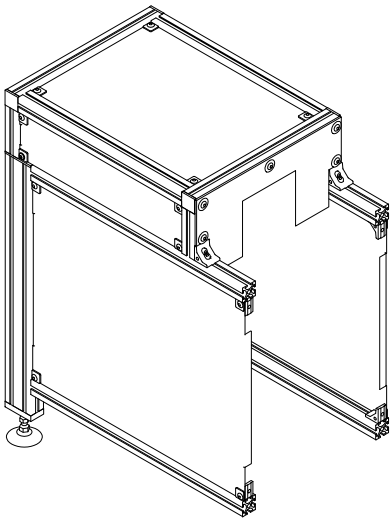
Protective housing with a pendulum flap



- The protective hood prevents any access at the return
- As soon as it is moved the pendulum flap is triggered and stops the entire system

System 114 and 190	**7-20.020-611-000**

Protective housing, simple

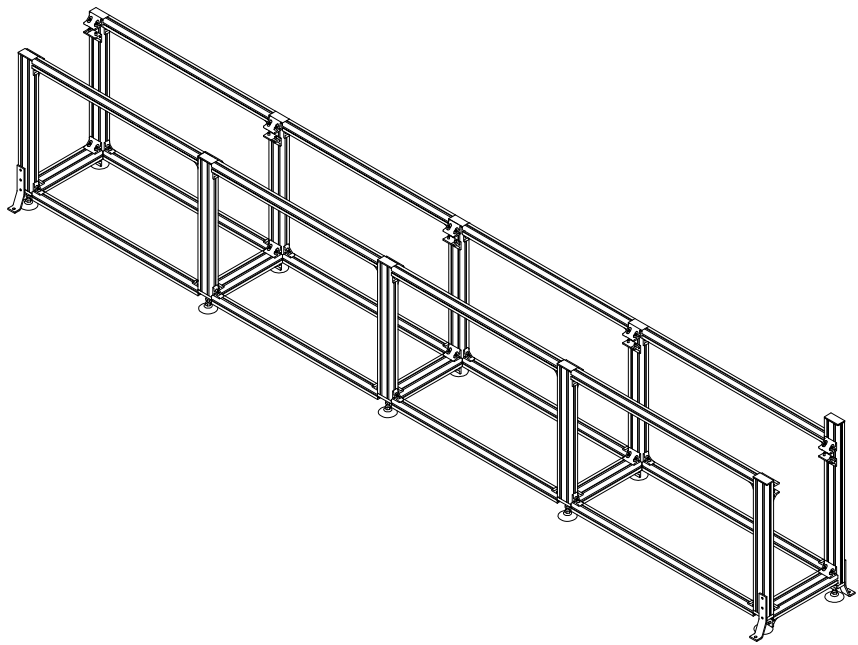


- Available in aluminum profile framing design (shown here) or as a simple sheet metal hood
- The protective hood prevents any access at the return

Aluminum profile design	
System 114 and 190	**7-20.020-613-000**
Sheet metal hood	
System 114 and 190	**7-20.020-614-000**

Frame

The base frame is used for the system to stand securely and firmly, and various working heights can be selected. As an option, the frame is also available with paneling elements (sheet metal or polycarbonate) and with casters as a mobile option. Alternatively, the system can also be configured with individual stands.



Frame with leveling feet	**7-20.020-711-000**
Stand with leveling feet	**7-20.020-711-100**
Frame with casters	**7-20.020-712-000**
Floor mounting	**7-20.020-712-100**
Stand with casters	**7-20.020-712-200**

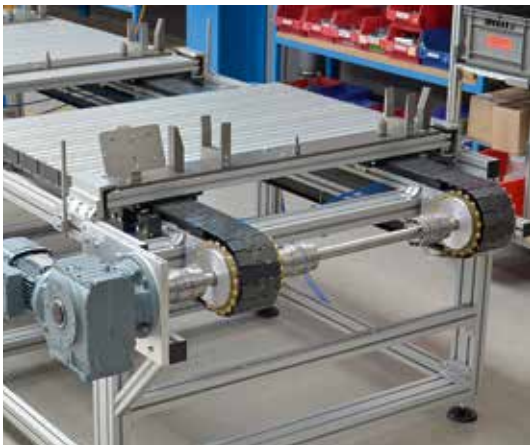
Application examples

Accumulating pallet recirculation system with automatic pallet separation function designed for supplying components to a production process

SPU System 190 with pallet for two workpieces

SPU with separation function for manual removal during continuous operation

SPU with separation function for manual loading and robotic removal



SPU double-lane system 114 with customized pallets

SPU with special chain and lateral positioning via roller strips

Application examples

SPU double-lane system with separation function for supplying components to an assembly and welding machine

Centering unit for precise positioning of the workpiece carriers

Centering unit for separation and stopping

SPU double-lane system 114 with separation function designed for supplying components to a production process

SPU double-lane system as a conveyor belt of a dishwasher housing

SPU double-lane system with belt conveyor GUF-P 2000 as a discharge conveyor for rejected parts

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info@mk-group.com

Flexible Feeding System

AnyFeeder

Feeding bulk parts for alignment and assembly

- Quickly flip forward and backward for easy pickup by robot in combination with vision
- Pickup after flipping parts to identify front or rear
- Easy configuration of AnyFeeder, vision, and robots using wizards in ACE software
- Flexible feeding of various parts registered in Recipe Manager in ACE software
- Available with all models of SCARA, articulated, and parallel robots

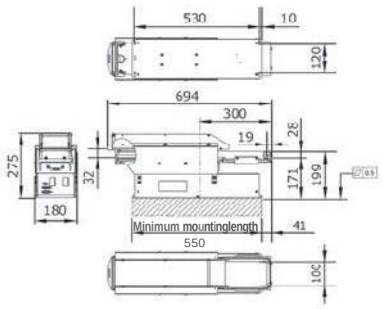
Ordering Information

Product Name		SXM-100	SXM-140	SX-240	SX-340
Model		09725-500	18819-500	12480-500	14269-500
Field of Vision		100 x 134 mm	140 x 193 mm	240 x 320 mm	340 x 453 mm
Suitable for Parts	Materials	Metal, Plastic, Glass (Stable)			
	Main Dimensions	< 30 mm	< 45 mm	< 75 mm	< 110 mm
	Thickness	> 0.15 mm		> 0.5 mm	
	Weight	< 15 mm	< 25 mm	< 60 mm	< 80 mm
Maximum Weight in Field of Vision		500 g		1500 g	
Connections	Electrical	1	1	1	1
	Pneumatic	-	-	1	1
	Serial	1	1	1	1
Weight		18 kg / 40 lb	22 kg / 49 lb	50 kg / 110 lb	55 kg / 121 lb
Power Requirements		24 VDC 10 A			
Typical Power Usage		100W (usage dependent)			
Air Requirements		-	-	6 bar / 87 psi, compressed air, filtered, unlubricated	
Drivers		RS232 (D-SUB 9 connector)			
Environmental Requirements	Temperature	5 - 45 °C			
	Humidity	5 - 90% (non-condensing)			
Materials of Construction	Main Unit	Stainless Steel 1.4301 (304)			
	Feeder Platform	Stainless Steel 1.4301 (304)			
	Feed Surface Border	Stainless Steel 1.4301 (304)			
	Bulk Construction	Stainless Steel 1.4301 (304)			

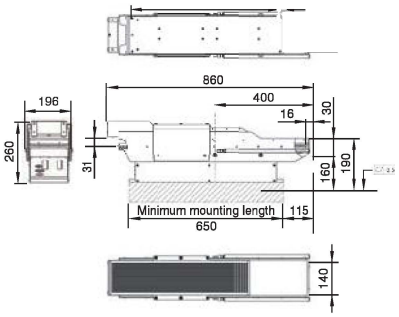
Dimensions

(Unit: mm)

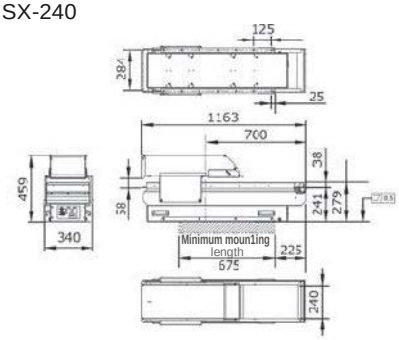
SXM-100



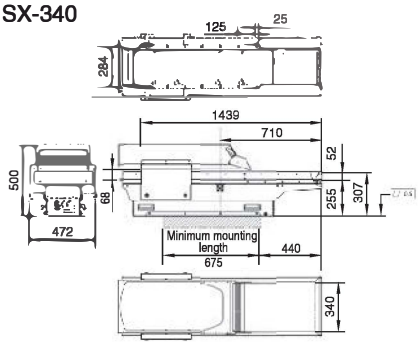
SXM-140



SX-240



SX-340



Options

Type	Name/Specifications	Model
Backlight	Backlight - IR 875nm, SXM100	09725-202
	Backlight - Red 630nm, SXM100	09725-201
	Backlight - IR 875nm, SXM140	14630-000
	Backlight - Red 630nm, SXM140	14630-001
	Backlight - IR 875nm, SX240	05284-208
	Backlight - Red 630nm, SX240	05284-206
	Backlight - IR 875nm, SX340	14269-001
	Backlight - Red 630nm, SX340	14269-002
Surface	Surface , POM-C , Flat, Light Brown, ESD, SXM100	09725-104
	Surface, POM-C, Flat, Black, SXM100 (Not available with backlight}	09725-102
	Surface, POM-C, Flat, Black, ESD, SXM100 (Not available with backlight}	09725-103
	Surface, POM-C, Flat, White, SXM100	09725-101
	Surface , POM-C , Flat, Light Brown, ESD, SXM140	09725-303
	Surface, POM-C, Flat, Black, SXM140 (Not available with backlight}	09725-302
	Surface , POM-C , Flat, White, SXM140	09725-301
	Surface, PVC, Flat, Light Gray, SXM140 (Not available with backlight}	09725-304
	Surface , POM-C Flat, Light Brown, ESD, SX240	05284-103
	Surface, POM-C, Flat, Black, SX240 (Not available with backlight)	05284-102
	Surface, POM-C, Flat, Black, ESD, SX240 (Not available with backlight}	05284-104
	Surface, POM-C, Flat, White, SX240	05284-101
	Surface , PVC, Flat, Gray, SX240 (Not available with backlight)	05284-105
	Surface, POM-C Flat, Light Brown, ESD, SX340	14269-005
	Surface , POM-C, Flat, Black, SX340 (Not available with backlight)	14269-004
	Surface, PVC, Flat, Black, SX340 (Not available with backlight)	14269-006
	Surface, POM-C, Flat, White, SX340	14269-003
Others	Power Cable, AnyFeeder , 5m	05284-301
	RS232 Cable, AnyFeeder , 4.5m	05284-303
	ESD Option, SX240	05284-204
	Filter, Daylight, M27x5	09324-000

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• Solid State Relays

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• Programming & Configuration • Runtime

Note: Specifications are subject to change.

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Superior Clamping and Gripping

SCHUNK®

Product Information

Gripper for small components EGP 25

High Performance Density. Fast. Compact.

EGP gripper for small components

Electric 2-finger parallel gripper with smooth-running base jaws guided on roller bearings

Field of application

Gripping and moving of small to medium-sized workpieces with flexible force and high speed in clean environments, such as assembly, testing, laboratory and pharmaceutical industry

Advantages – Your benefits

Highest performance density for the use of smaller grippers sizes

Control via digital I/O for easy commissioning and rapid integration into existing systems

Two to four stage adjustable gripping force for simple adaption to sensitive workpieces

Backlash-free, pre-loaded cross roller guide for precise gripping with nearly constant force for all permissible finger lengths

Very high maximum cycles per minute for highest productivity

Compact dimensions for minimal interfering contours in the application

Proven a thousand times MPG-plus basis for equal gripping forces and strokes with identically high efficiency

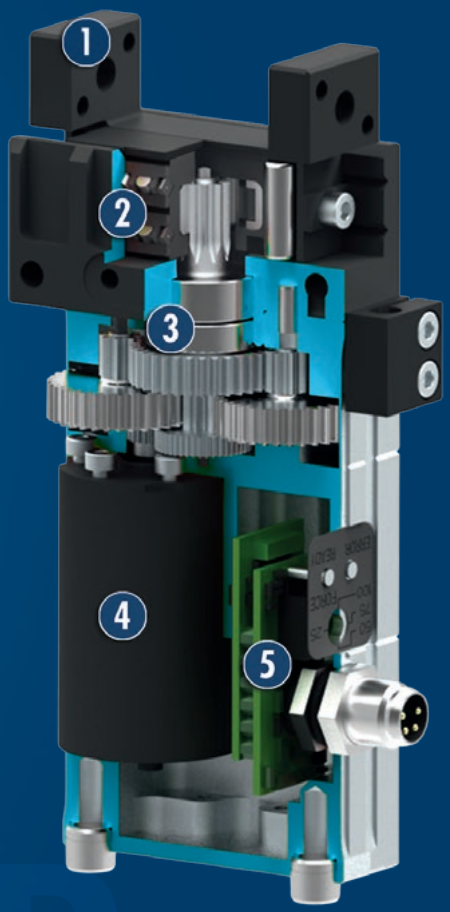
Brushless DC servomotor for almost wear-free use and a long service life

Sizes	Weight	Gripping force	Stroke per jaw	Workpiece weight
Quantity: 4	0.11 .. 0.8 kg	12 .. 300 N	3 .. 10 mm	0.07 .. 1.25 kg

Functional description

The brushless servomotor drives the base jaw via the gear mechanism.

The jaw stroke is synchronized by means of rack and pinion kinematics.



① **Base Jaw**
for the connection of workpiece-specific gripper fingers

② **Cross roller guidance**
precise gripping due to backlash-free base jaw guidance

③ **Gear**
Rack and pinion principle for centric gripping

④ **Drive**
Brushless DC servomotor

⑤ **Control electronics**
Integrated control and power electronics for decentralized control of the servomotor

CAD data, operating manuals and other current product documents can be found online.

EGP

Gripper for small components

General notes about the series

Operating principle: Rack and pinion principle

Housing material: Aluminum alloy, coated

Base jaw material: Steel

Actuation: servo-electric, via brushless DC servomotor

Warranty: 24 months

Scope of delivery: Enclosed pack with centering sleeves, mount for proximity switch, assembly and operating manual with Declaration of Incorporation.

Gripping force: is the arithmetic total of the gripping force applied to each gripper jaw at distance P (see illustration).

Finger length: is measured from the reference surface as the distance P in direction to the main axis.

Repeat accuracy: is defined as the spread of the end position during 100 consecutive strokes.

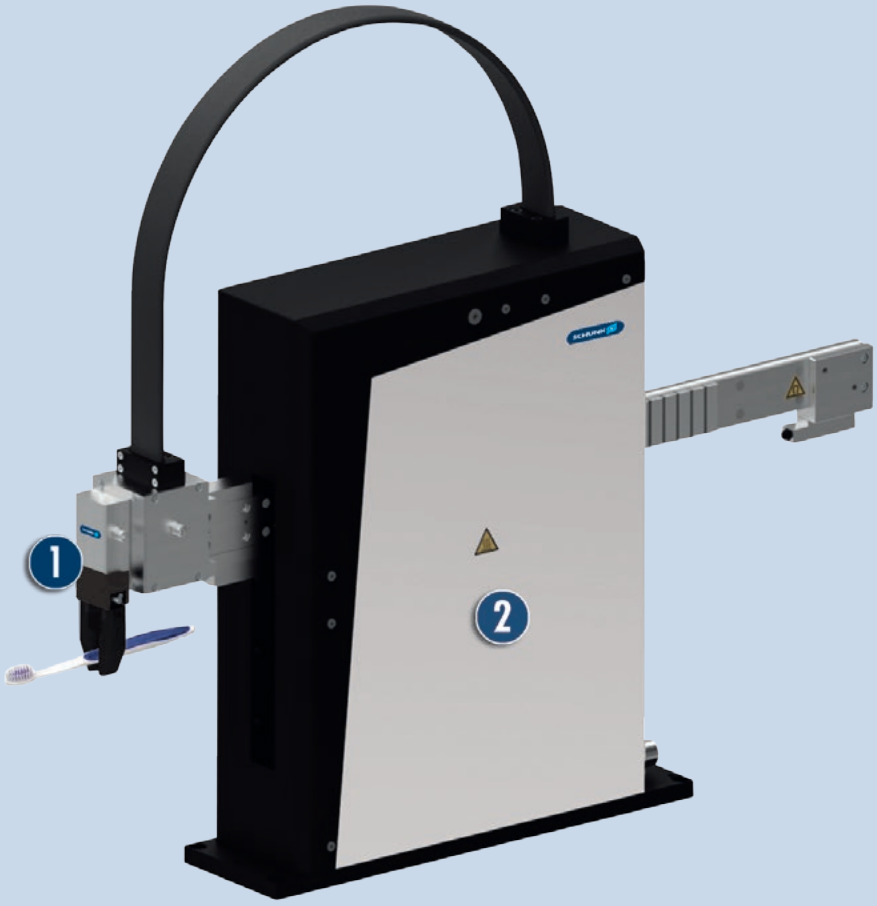
Workpiece weight: is calculated for force-fit gripping with a coefficient of static friction of 0.1 and a safety factor of 2 against workpiece slippage at acceleration due to gravity g. For form-fit or capture gripping, there are significantly higher permissible workpiece weights.

Closing and opening times: are purely the times that the base jaws or fingers are in motion. PLC reaction times are not a part of this and are to be considered when cycle times are calculated.

Application example

Electrically driven, dual-axis pick-and-place machine for small components

1. EGP electric 2-finger parallel gripper
2. PPU-E pick & place unit

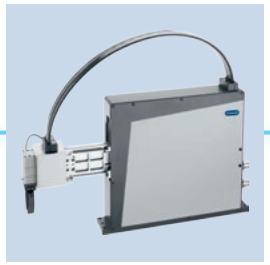


SCHUNK offers more ...

The following components make the product EGP even more productive – the suitable addition for the highest functionality, flexibility, reliability, and controlled production.


Linear modules


Rotary modules

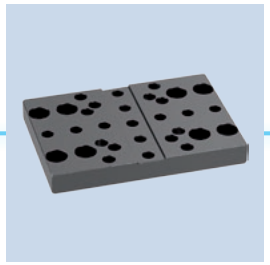

Pick & Place modules


Pillar assembly system


Flexible position sensor


Inductive Proximity Switches


Finger blanks


Adapter plates


Optical distance sensor


Connection cables

ⓘ Additional information regarding the products can be found on the following product pages or at www.schunk.com. Please contact us for further information: SCHUNK technical hotline +49-7133-103-2696

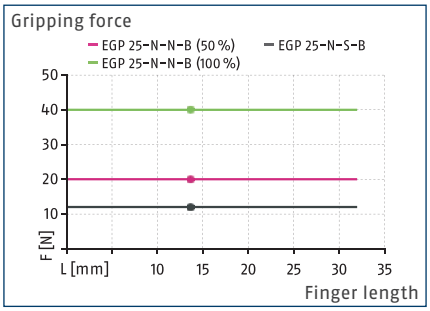
Options and special information

Manually adjustable gripping force: With an integrated rotary switch, the gripping force can be adjusted in two stages for the EGP 25 – 100% and 50%, and in four stages for EGP 40, 50 and 64 – 100%, 75%, 50%, and 25%.
Optional status monitoring via external sensor system: The status of the gripper can be monitored by external senors.
Optional adapter plates: Space-saving frontal mounting of the gripper is enabled by optional adapter plates.
KA connection cable: Connection cables with an angled or a straight female connector can be ordered in various lengths to connect the gripper with the power supply and higher-level control system.
Speed Version S: for faster closing and opening times due to the use of a different gear ratio. The option of a gripping force adjustment is no longer available.

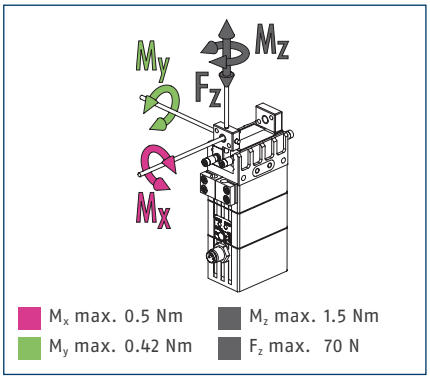
EGP 25

Gripper for small components

Gripping force



Finger load

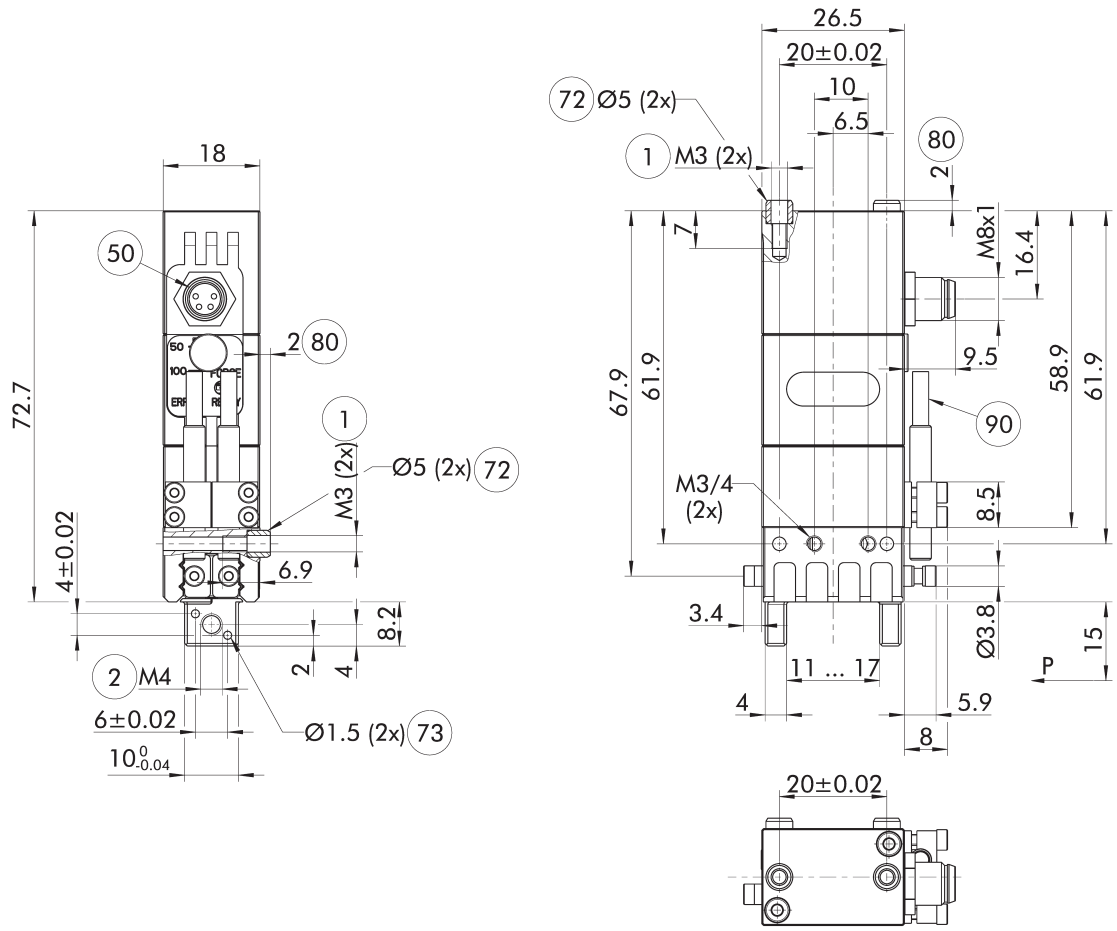


ⓘ The specified torques and forces are static values, apply for each base jaw, and may occur simultaneously. M_y may arise in addition to the moment generated by the gripping force itself.

Technical data

Description		EGP 25-N-N-B	EGP 25-N-S-B
ID		0310900	0310902
General operating data			
Stroke per jaw	[mm]	3	3
Min./max. gripping force	[N]	20/40	12/12
Recommended workpiece weight	[kg]	0.2	0.07
Max. permissible finger length	[mm]	32	32
Max. permissible mass per finger	[kg]	0.02	0.02
Repeat accuracy	[mm]	0.02	0.02
Closing/opening time	[s]	0.09/0.09	0.03/0.03
Weight	[kg]	0.11	0.12
Min./max. ambient temperature	[°C]	5/55	5/55
Protection class IP		30	30
Noise emission	[dB(A)]	< 70	< 70
Electrical operating data			
Nominal voltage	[V DC]	24	24
Nominal current	[A]	0.14	0.14
Max. current	[A]	1	1
Controller electronics		integrated	integrated
Communication interface		Digital Inputs	Digital Inputs
Number of digital inputs/outputs		2/-	2/-

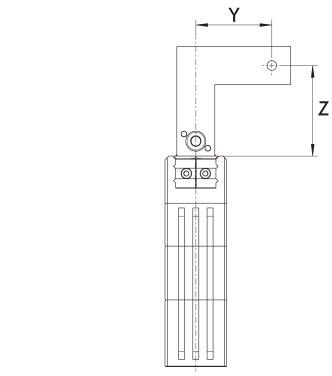
Main view

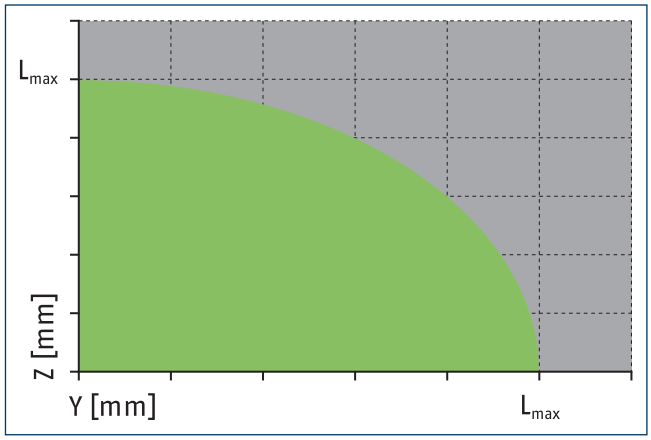


The drawing shows the basic version of the gripper with open jaws, without dimensional consideration of the options described below.

1 Gripper connection
2 Finger connection
50 Electrical connection
72 Fit for centering sleeves
73 Fit for centering pins
80 Depth of the centering sleeve hole in the counter part
90 Sensor IN ...

Maximum permitted finger projection





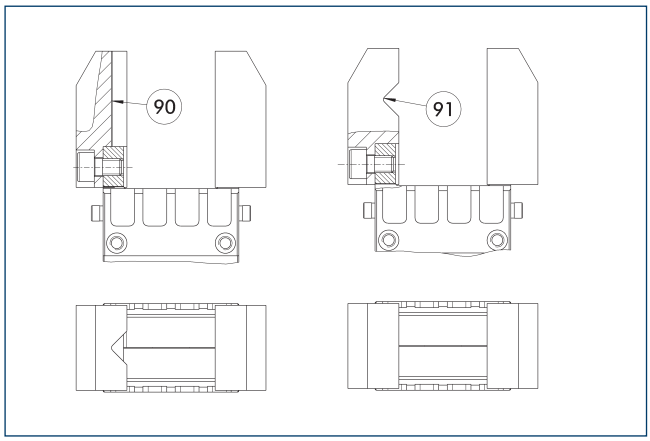
Permitted range
Inadmissible range

L^{max} is equivalent to the maximum permitted finger length, see the technical data table

EGP 25

Gripper for small components

Jaw design

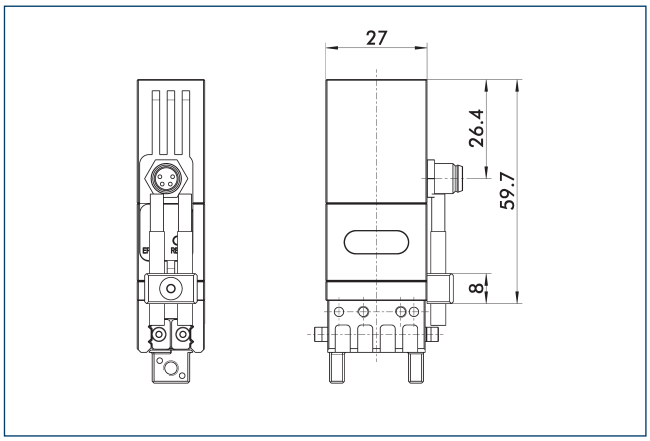


(90) Vertically positioned prism

(91) Horizontally positioned prism

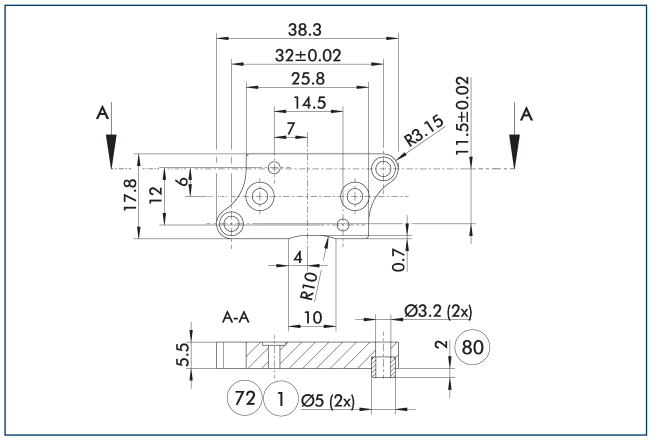
A workpiece, which is gripped using three points of contact, can be reliably gripped with high repeatability. A system with more than three points of contact is overdetermined. The drawing shows two alternative gripper finger designs for coaxial and radial gripping of a cylindrical part.

Speed version S



The speed version S offers reduced closing and opening times by using a different internal gear ratio. The drawing shows the changes in dimension of the speed version in comparison to the basic version illustrated in the main view.

Adapter plate



(1) Gripper connection

(72) Fit for centering sleeves

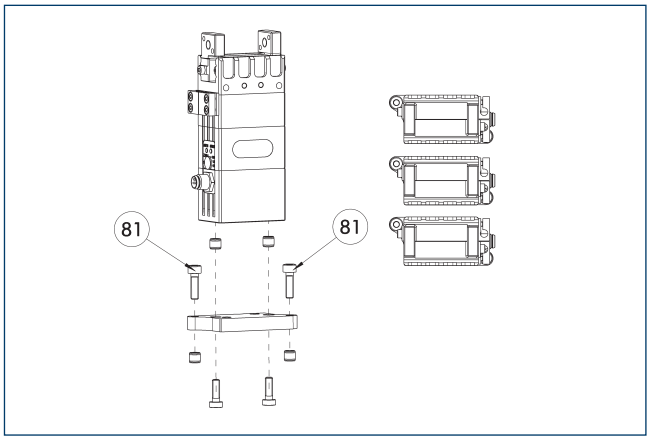
(80) Depth of the centering sleeve hole in the counter part

The adapter plate includes an O-ring* for a direct air connection, additional centering sleeves, and screws for mounting the gripper.
*Optional only with pneumatic actuators

Description	ID	
Adapter plate		
APL-MPG-plus 25	0305507	

ⓘ The adapter plate is a separately ordered, optional accessory.

Adapter plate



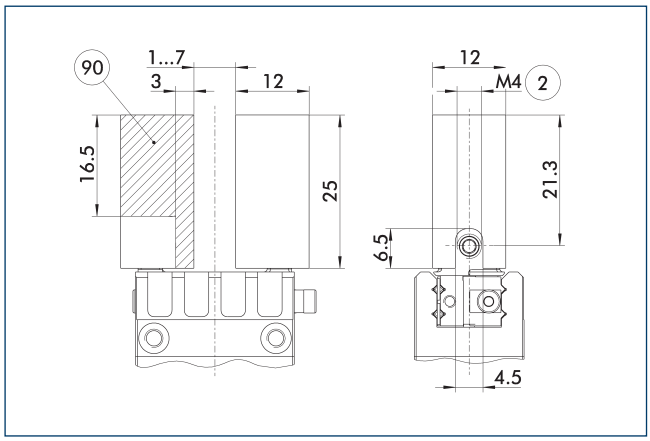
(81) Not included in the scope of delivery

The adapter plate includes an O-ring* for a direct air connection, additional centering sleeves, and screws for mounting the gripper.
*Optional only with pneumatic actuators

Description	ID	
Adapter plate		
APL-MPG-plus 25	0305507	

ⓘ The adapter plate is a separately ordered, optional accessory.

Finger blanks with BSWS ABR-BSWS-MPG-plus 25



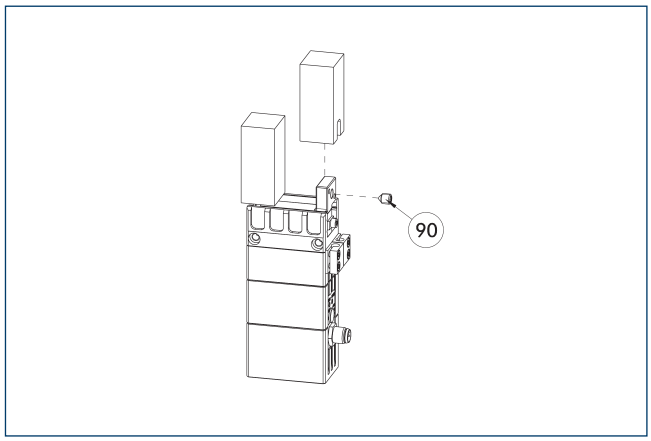
(2) Finger connection

(90) Machining volume

Finger blanks for customized subsequent machining with integrated jaw quick-change system for precise and fast finger changes.

Description	ID	Scope of delivery
Finger blanks with quick-change jaw system		
ABR-BSWS-MPG-plus 25	0302894	2

Finger blanks with BSWS

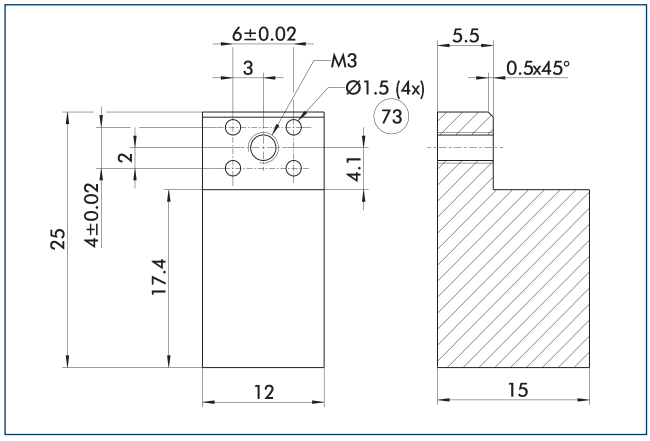


(90) Included in the scope of delivery

The finger blanks with jaw quick-change system allow fast and manual gripper finger changes. The mechanical interface to the gripper is already integrated. Only the specific workpiece geometry needs to be machined into the finger blank.

Description	ID	Scope of delivery
Finger blanks with quick-change jaw system		
ABR-BSWS-MPG-plus 25	0302894	2

Finger blanks ABR-MPG-plus 25

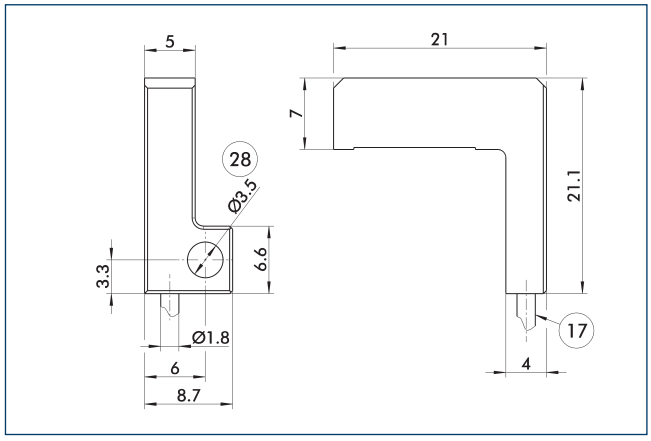


(73) Fit for centering pins

The drawing shows the finger blank which can be reworked by the customer.

Description	ID	Material	Scope of delivery
Finger blanks			
ABR-MPG-plus 25	0340211	Aluminum	2

Object distance sensor OAS-MPG-plus 25



(17) Cable outlet

(28) Through-hole

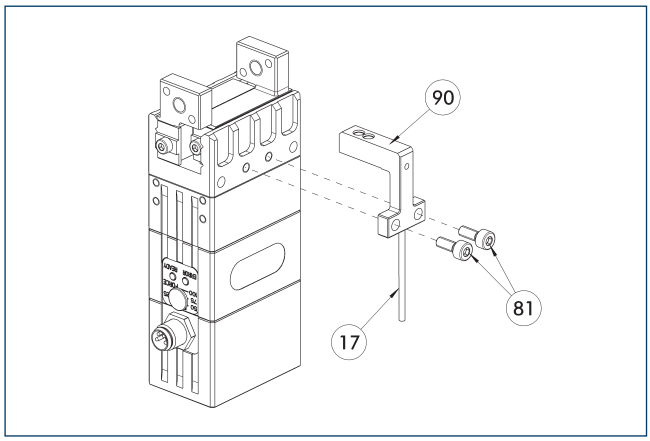
Object distance sensor for detecting a workpiece and for measuring its distance to the gripper.

Description	ID	
Object distance sensor		
OAS-MPG-plus 25	0308891	

EGP 25

Gripper for small components

Object distance sensor

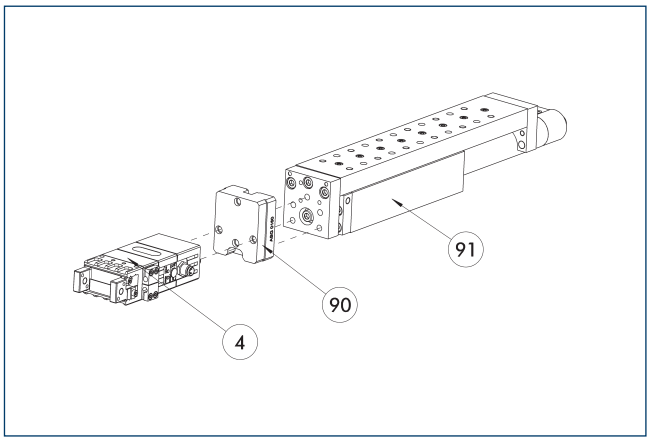


(17) Cable outlet
(81) Not included in the scope of delivery
(90) OAS

Optical distance and presence sensor for direct mounting to to the gripper. One OAS sensor can be attached per gripper.

Description	ID	
Object distance sensor		
OAS-MPG-plus 25	0308891	
Evaluation electronics		
OAS-V09-D	0308865	
OAS-V10-A	0308867	
OAS-V10-D	0308866	

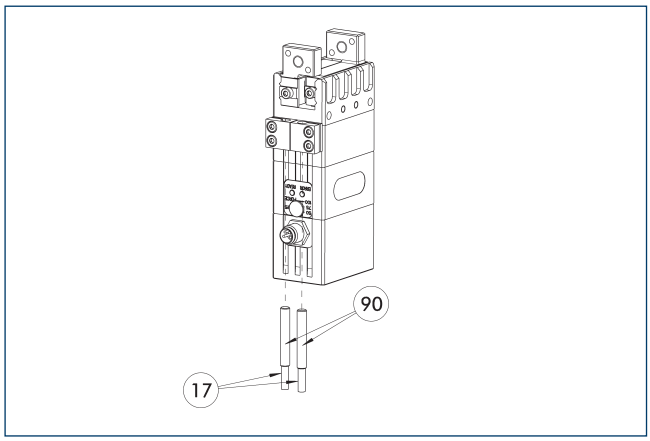
Modular Assembly Automation



(4) Grippers
(90) ASG adapter plate
(91) CLM/KLM/LM/ELP/ELM/ELS/HLM linear modules

Grippers and linear modules can be combined with standard adapter plates from the modular assembly system. For more information see our main catalog "Modular Assembly Automation".

IN 40 inductive proximity switches



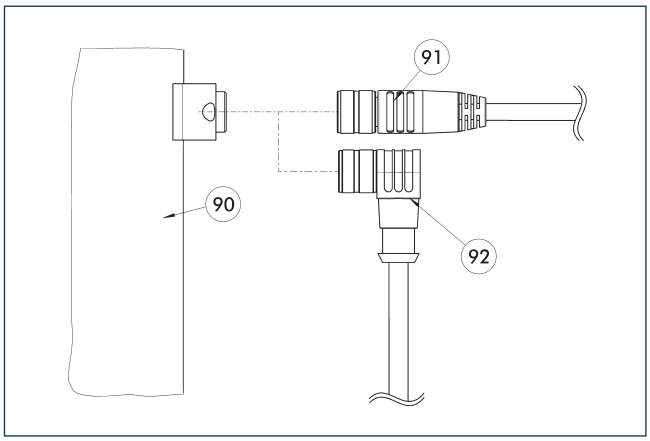
(17) Cable outlet
(90) Inductive Proximity Switches

Directly mounted end position monitoring.

Description	ID	Often combined
Inductive Proximity Switches		
IN 40-S-M12	0301574	
IN 40-S-M8	0301474	●
INK 40-S	0301555	
Cable extension		
KV BG12-SG12 3P-0030-PNP	0301999	
KV BG12-SG12 3P-0060-PNP	0301998	
KV BW08-SG08 3P-0030-PNP	0301495	
KV BW08-SG08 3P-0100-PNP	0301496	
KV BW08-SG08 3P-0200-PNP	0301497	●
KV BW12-SG12 3P-0030-PNP	0301595	
KV BW12-SG12 3P-0100-PNP	0301596	
KV BW12-SG12 3P-0200-PNP	0301597	
clip for plug/socket		
CLI-M12	0301464	
CLI-M8	0301463	
Connection cables		
KA BG08-L 3P-0300-PNP	0301622	●
KA BG08-L 3P-0500-PNP	0301623	
KA BG12-L 3P-0500-PNP	30016369	
KA BW08-L 3P-0300-PNP	0301594	
KA BW08-L 3P-0500-PNP	0301502	
KA BW12-L 3P-0300-PNP	0301503	
KA BW12-L 3P-0500-PNP	0301507	
Sensor distributor		
V2-M12	0301776	●
V2-M8	0301775	●
V4-M12	0301747	
V4-M8	0301746	
V8-M12	0301752	
V8-M8	0301751	

ⓘ Two sensors (closer/S) are required for each unit and extension cables are available as an option. For sensor cables, note the minimum permissible bending radii. These are generally 35 mm.

Connection cables



(90) Electrical connection component
(91) Cable with straight connector
(92) Cable with angled connector

Description	ID	Length	Often combined
		[m]	
Connection cables			
KA BG08-L 4P-0500	0307767	5	●
KA BG08-L 4P-1000	0307768	10	
KA BW08-L 4P-0500	0307765	5	
KA BW08-L 4P-1000	0307766	10	

ⓘ BG stands for a connection cable with a straight female connector and BW for an angled female connector. SG stands for a connection cable with a straight male connector and SW for an angled male connector.

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Jens Lehmann, German goalkeeper legend, SCHUNK brand ambassador since 2012 for safe, precise gripping and holding.
schunk.com/Lehmann

Parallel grippers HGPC

FESTO

Type discontinued
Available up until 2018

Parallel grippers HGPC

Key features

At a glance

General

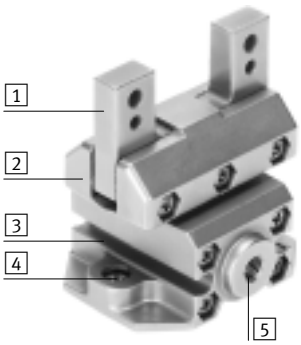
The compact and low-cost parallel gripper consists of a two-part symmetrical housing. The piston moves traverse to the half-shell casing in an optimum housing design that guarantees reliable operation, long service life and convenient sensing. The gripper jaws move along the half shells in backlash-free, preloaded ball bearing guides.

- Double-acting gripper
- Compression spring for supplementary or retaining gripping forces
- Internal fixed flow control, does away with the need for external flow control in 80% of applications
- High force with minimal volume
- Suitable for external and internal gripping
- Wide range of options for attaching drive units
- Repetition accuracy of 0.05 mm
- Slot for proximity sensor SME/SMT-10

Note

Sizing software
Gripper selection
➔www.festo.com

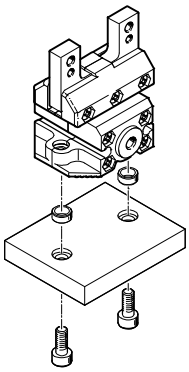
Details



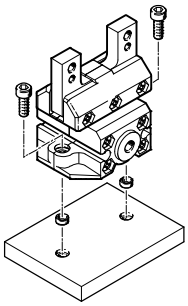
1 Gripper jaw with ball bearing guide
2 Housing based on half-shell principle
3 Slot for proximity sensor, for sensing the piston position
4 Mounting option
5 Supply port

Mounting option

from underneath

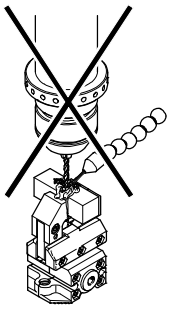


from above

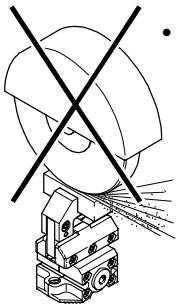


Note

Parallel grippers are not designed for the following applications:

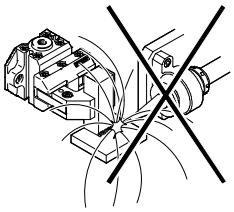


- Machining
- Aggressive media



- Grinding dust

- Welding spatter

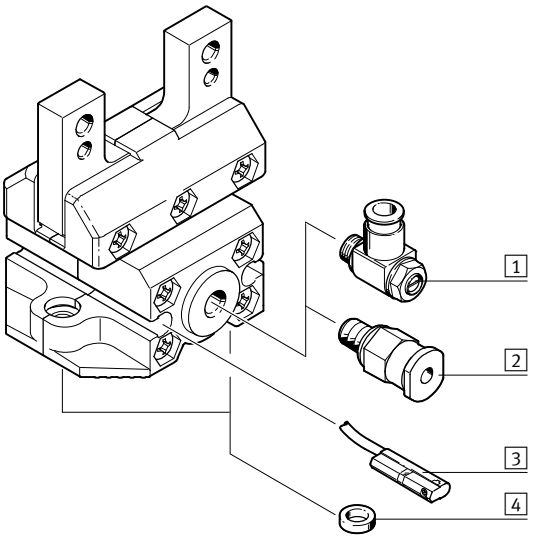


Parallel grippers HGPC

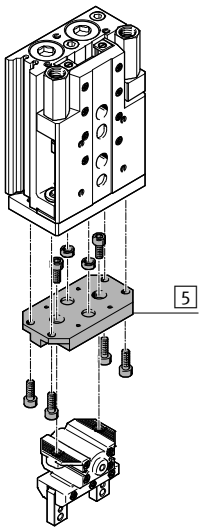
Peripherals overview and type codes

FESTO

Peripherals overview



System product for handling and assembly technology



Accessories

	Type	Description	➔ Page/Internet
1	One-way flow control valve GRLA	For regulating speed	grla
2	Push-in fitting QS	For connecting compressed air tubing with standard O.D.	qs
3	Proximity sensor SME/SMT-10	For sensing the piston position	13
4	Centring sleeve ZBH	For centring when attaching to a drive (2 included in the scope of delivery)	13
5	Adapter kit HMSV, HAPG	Drive/gripper connections	12

Type codes

HGPC – 12 – A – G2

Type

HGPC	Parallel gripper

Size

Position sensing

A	Via proximity sensor

Gripping force backup

G2	Closing

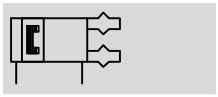
Type discontinued
Available up until 2018

Parallel grippers HGPC

Technical data

FESTO

Function
Double-acting
HGPC-...-A



Single-acting or
with gripping force retention
closing HGPC-...-G2

Size
12, 16, 20 mm

Stroke
6 ... 14 mm

General technical data				
Size		12	16	20
Constructional design		Wedge-shaped drive		
		Guided motion sequence		
Mode of operation		Double-acting		
Gripper function		Parallel		
Number of gripper jaws		2		
Max. load per external gripper finger[1]	[g]	20	50	80
Stroke per gripper jaw	[mm]	3	5	7
Pneumatic connection		M5		
Repetition accuracy[2]	[mm]	≤ 0.05		
Max. interchangeability	[mm]	≤ 0.2		
Max. gripper jaw backlash[3]	[mm]	0		
Max. gripper jaw angular backlash[4]	[°]	0		
Max. operating frequency	[Hz]	4		
Rotational symmetry	[mm]	< ∅ 0.2		
Position sensing		For proximity sensing		
Type of mounting		With female thread and centring sleeve		
Mounting position		Any		

1) Valid for unthrottled operation
2) End-position drift under constant conditions of use with 100 consecutive strokes in the direction of movement of the gripper jaws
3) Perpendicular to the direction of motion of the gripper jaws
4) Pretensioned, backlash-free ball bearing guide

Operating and environmental conditions			
Min. operating pressure	HGPC-...-A [bar]		2
	HGPC-...-G2 [bar]		4
Max. operating pressure		[bar]	8
Operating medium			Compressed air in accordance with ISO 8573-1:2010 [7:4:4]
Note on operating/pilot medium			Operation with lubricated medium possible (in which case lubricated operation will always be required)
Ambient temperature[1]		[°C]	+5 ... +60
Corrosion resistance class CRC[2]			2

1) Note operating range of proximity sensors
2) Corrosion resistance class 2 according to Festo standard 940 070
Components requiring moderate corrosion resistance. Externally visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment or media such as coolants or lubricating agents

Weights [g]			
Size	12	16	20
HGPC-...-A	152	241	473
HGPC-...-G2	154	244	477

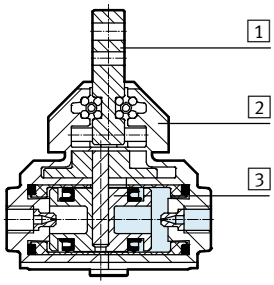
Parallel grippers HGPC

Technical data

FESTO

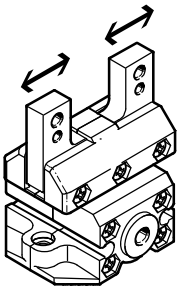
Materials

Sectional view



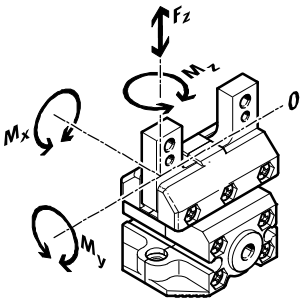
Parallel gripper		
1	Gripper jaw	High-alloy steel
2	Housing	Die-cast zinc
3	Piston	Polyamide
–	Seals	Polyurethane, nitrile rubber
–	Note on materials	Copper and PTFE-free
		Conforms to RoHS

Gripping force [N] at 6 bar



Size	12	16	20
Gripping force per gripper jaw			
Opening	22	41.5	63
Closing	22	41.5	63
Total gripping force			
Opening	44	83	126
Closing	44	83	126

Static characteristic load values at the gripper jaws



Indicated permissible forces and torques apply to a single gripper jaw. The indicated values include the lever arm, additional applied loads caused by the workpiece or external gripper fingers, as well as forces which occur during movement.
The zero coordinate line (gripper finger guide) must be taken into consideration for the calculation of torques.

Size		12	16	20
Max. permissible force F_z	[N]	40	80	120
Max. permissible torque M_x	[Nm]	1	2,5	5
Max. permissible torque M_y	[Nm]	1	2,5	5
Max. permissible torque M_z	[Nm]	1	2,5	5

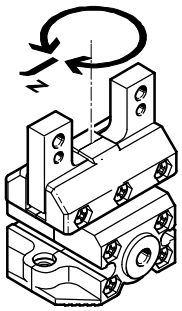
- 1 - **Type discontinued**
Available up until 2018

Parallel grippers HGPC

Technical data

FESTO

Mass moment of inertia [kgm²x10⁻⁴]

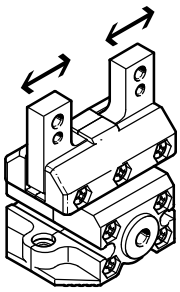


Mass moment of inertia [kgm²x10⁻⁴] of the parallel gripper in relation to the central axis with no load.

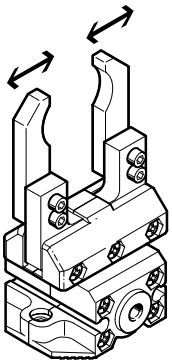
Size	12	16	20
HGPC-...-A	0.272	0.679	2.095
HGPC-...-G2	0.274	0.683	2.105

Opening and closing times [ms] at 6 bar

without external gripper fingers



with external gripper fingers



The indicated opening and closing times [ms] have been measured at room temperature and at 6 bar operating pressure with horizontally mounted gripper without additional gripper fingers. The grippers must be throttled for greater loads [g]. Opening and closing times must then be adjusted correspondingly.

Size		12	16	20
without external gripper fingers				
HGPC-...-A	Opening	30	60	90
	Closing	30	60	90
HGPC-...-G2	Opening	30	70	105
	Closing	30	50	75
with external gripper fingers (as a function of the load per gripper finger)				
HGPC-...	40 g	40	–	–
	50 g	60	–	–
	60 g	80	–	–
	70 g	–	80	–
	100 g	–	100	–
	120 g	–	–	100

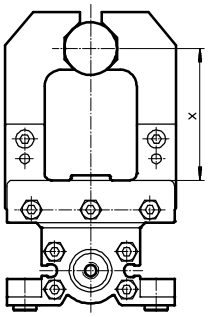
Parallel grippers HGPC

Technical data

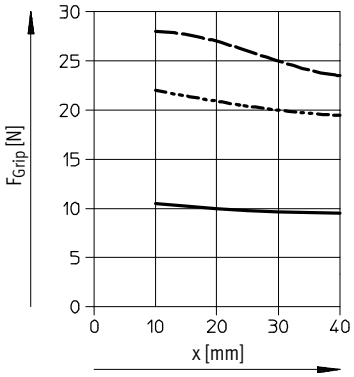
FESTO

Gripping force F_{Grip} per gripper jaw as a function of operating pressure and lever arm x

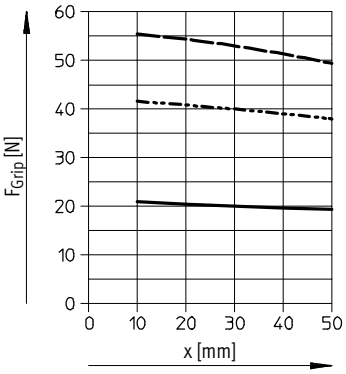
Gripping forces as a function of the operating pressure and the lever arm can be determined for the size using the following graph.



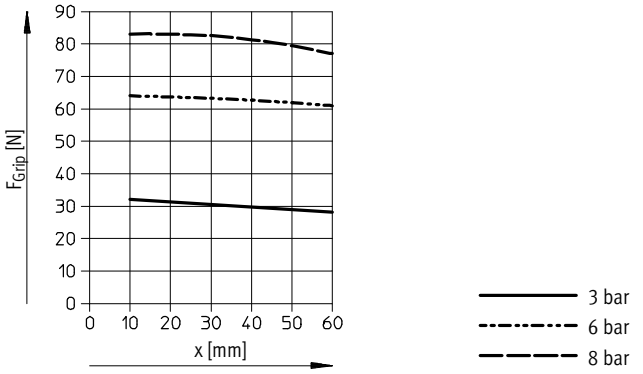
HGPC-12-A



HGPC-16-A



HGPC-20-A



Parallel grippers HGPC

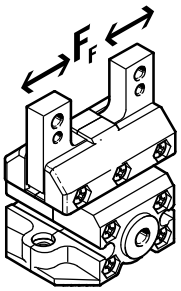
Technical data

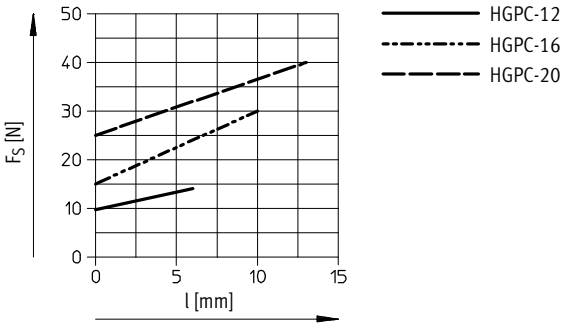
FESTO

Spring force F_S as a function of the gripper size and the overall stroke l

Gripping force retention for HGPC-...-G2

Spring forces F_S as a function of the gripper size and the overall stroke l for various gripper types (HGPC-...-G2) can be determined using the following graphs.





The lever arm x must be taken into consideration when determining the actual spring force F_{Stotal}.
The formulae for calculating the spring force are provided in the table opposite.

Size	F_{Stotal} =
12	$-0.02 * x + 0.5 * F_S$
16	$-0.05 * x + 0.5 * F_S$
20	$-0.05 * x + 0.5 * F_S$

Determination of the actual gripping forces F_{Gr} for HGPC-...-G2 depending on the application

Parallel grippers with integrated spring type HGPC-...-G2 (closing gripping force retention) can be used as:
- single-acting grippers
- grippers with supplementary gripping force
- grippers with gripping force retention

In order to calculate available gripping forces F_{Gr} (per gripper jaw), the gripping force (F_{Grip}) and spring force (F_{Stotal}) must be combined accordingly.

Application

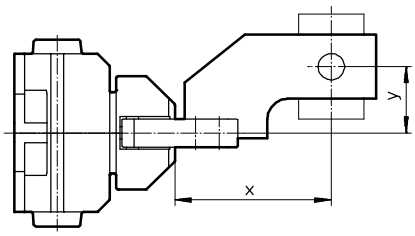
Single-acting	Supplementary gripping force	Gripping force retention
• Gripping with spring force: $F_{Gr} = F_{Stotal}$	• Gripping with pressure and spring force: $F_{Gr} = F_{Grip} + F_{Stotal}$	• Gripping with spring force: $F_{Gr} = F_{Stotal}$
• Gripping with pressure force: $F_{Gr} = F_{Grip} - F_{Stotal}$		

Parallel grippers HGPC

Technical data

FESTO

Gripping force F_{Grip} per gripper jaw at 6 bar as a function of lever arm x and eccentricity y



Gripping forces at 6 bar dependent upon eccentric application of force and the maximum permissible off-centre point of force application can be determined for the size using the following graph.

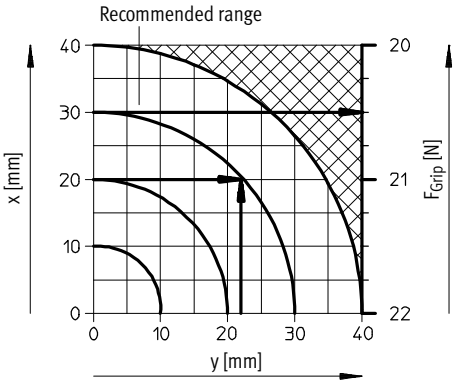
Calculation example

Given:
Lever arm x = 20 mm
Eccentricity y = 22 mm
To be found:
Gripping force at 6 bar

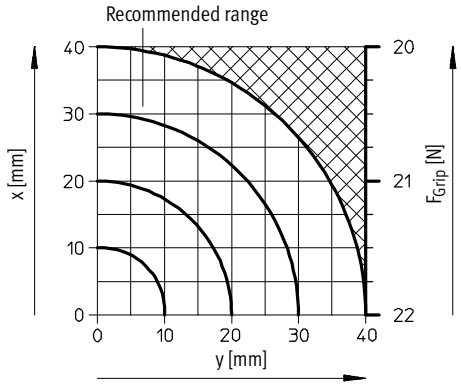
Procedure:

- Determine the intersection xy between lever arm x and eccentricity y in the graph for HGPC-12-A-...
- Draw an arc (with centre at origin) through intersection xy.
- Determine the intersection between the arc and the X axis.
- Read the gripping force.

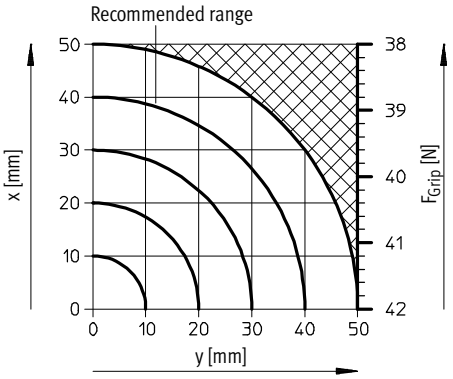
Result:
Gripping force F = approx. 20.5 N



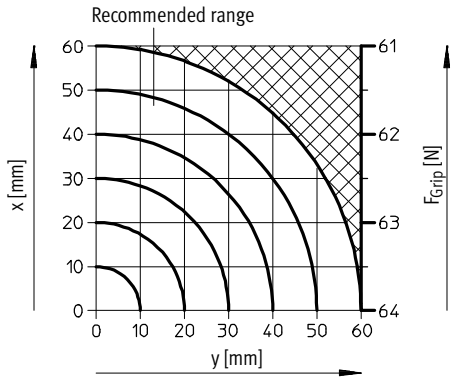
HGPC-12-A



HGPC-16-A



HGPC-20-A



Type discontinued
Available up until 2018

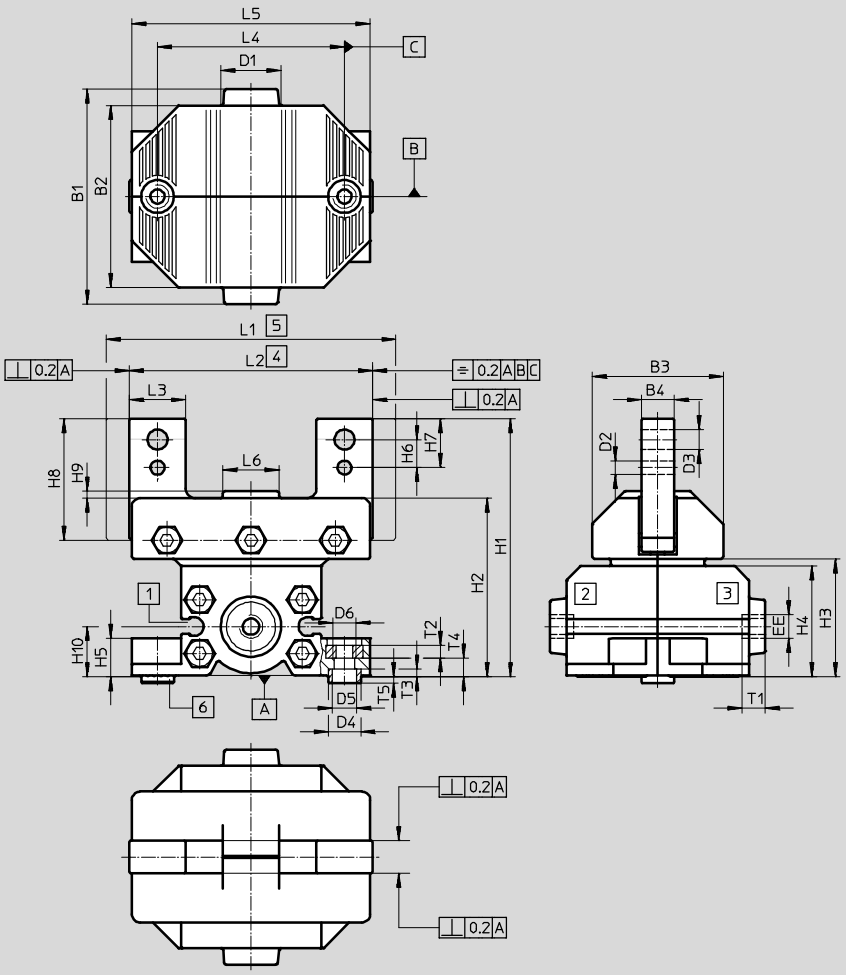
Parallel grippers HGPC

Technical data

FESTO

Dimensions

Download CAD data ➔ **www.festo.com**



1 Sensor slot for proximity sensor
2 Supply port, opening
3 Supply port, closing
4 Gripper jaw closed
5 Gripper jaw open
6 Centring sleeves ZBH
(2 included in scope of delivery)

Size	B1	B2	B3	B4	D1	D2	D3	D4	D5	D6
[mm]				±0.1			±0.1	∅ F10/h7	∅	
12	38	33	22.4	6	12	$2.5^{+0.04/+0.01}$	3.3	7	5.3	M4
16	46	39	28	7	12	3^{H8}	4.3	7	5.3	M5
20	57	50	35	8	12	4^{H8}	5.3	9	6.4	M6

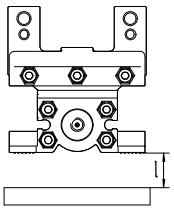
Size	EE	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
[mm]		±0.5							−0.2		
12	M5	48.2	33.6	21.7	20.2	6.9	$5_{+0.05/-0.1}$	$9_{+0.05/-0.1}$	25	1.2	9.2
16	M5	55.2	38.2	25.2	23.7	8.2	$6_{\pm 0.1}$	$10.5_{\pm 0.4}$	28.5	1.5	10.7
20	M5	68.7	48.2	32.5	30.5	10.2	$7.5_{\pm 0.1}$	$13_{\pm 0.4}$	34.5	1.5	13.7

Size	L1	L2	L3	L4[1)]	L5	L6	T1	T2	T3	T4	T5
[mm]	±0.5	±0.5					min.		±0.1	+0.4 −0.3	+0.1 −0.3
12	45	39	$10_{-0.02/-0.06}$	33	42	10	4.5	2.2	1.7	3.1	1.3
16	62	52	$12_{-0.05}$	40	51	12	4.5	2.7	1.8	3.8	1.2
20	77	63	$14_{-0.05}$	50	65	16	4.5	3.2	2.3	5.2	1.7

1) Tolerance for centring hole ±0.03
Tolerance for thread ±0.1

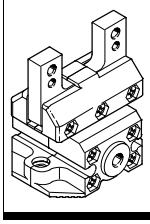
Parallel grippers HGPC

Technical data



Minimum distance l between gripper and ferritic object				
		12	16	20
Distance	[mm]	10		

Ordering data

	Size	Double-acting Without compression spring		Single-acting or with gripping force retention Closing	
	[mm]	Part No.	Type	Part No.	Type
	12	**539 267**	**HGPC-12-A**	**539 268**	**HGPC-12-A-G2**
	16	**539 269**	**HGPC-16-A**	**539 270**	**HGPC-16-A-G2**
	20	**539 271**	**HGPC-20-A**	**539 272**	**HGPC-20-A-G2**

Type discontinued
Available up until 2018

Parallel grippers HGPC

Accessories

Adapter kit
HAPG

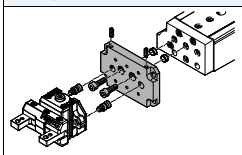
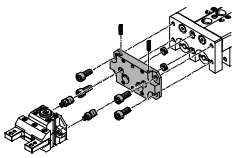
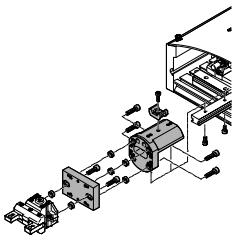
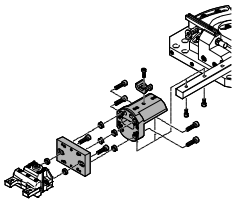
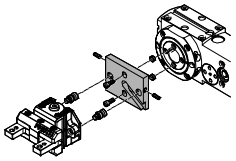
Material:
Wrought aluminium alloy
Free of copper and PTFE
RoHS-compliant

Note

The kit includes the individual mounting interface as well as the necessary mounting material.

Permissible drive/gripper combinations with adapter kit

Download CAD data ➔ **www.festo.com**

Combination	Drive	Gripper	Mounting option		Adapter kit		
	Size	Size			CRC[1]	Part No.	Type
DGSL/HGPC	DGSL	HGPC			HAPG		
	12, 16	12	■	■	2	**529018**	**HAPG-58**
	20, 25	16	■	■		**191267**	**HAPG-49**
	20, 25	20	■	■		**191269**	**HAPG-51**
SLT/HGPC	SLT	HGPC			HAPG		
	10	12	■	–	2	**542670**	**HAPG-100**
	16	12	■	–		**529018**	**HAPG-58**
	16	16	■	–		**542666**	**HAPG-101**
	20	16	■	–		**191267**	**HAPG-49**
	20	20	■	–		**542667**	**HAPG-102**
	25	20	■	–		**191269**	**HAPG-51**
HSP/HGPC	HSP	HGPC			HAPG		
	16	16	■	–	2	**191901**	**HAPG-55**
						540882	**HAPG-71-B**
	25	20	■	–		**191901**	**HAPG-55**
						540883	**HAPG-72-B**
HSW/HGPC	HSW	HGPC			HAPG		
	12, 16	16	■	–	2	**191901**	**HAPG-55**
						540882	**HAPG-71-B**
ERMB/HGPC	ERMB	HGPC			HAPG		
	20	16	■	■	2	**542668**	**HAPG-SD2-42**
	20	20	■	■		**542669**	**HAPG-SD2-43**
	25	20	■	■		**542758**	**HAPG-SD2-44**

1) Corrosion resistance class 2 according to Festo standard 940 070
Components subject to moderate corrosion stress. Externally visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment or media such as coolants or lubricating agents.

Parallel grippers HGPC

Accessories

FESTO

Ordering data – Centring sleeves					Technical data ➔ Internet: zbh
	For size [mm]	Weight [g]	Part No.	Type	PU[1]
	12, 16	1	**186717**	**ZBH-7**	10
	20	1	**150927**	**ZBH-9**	10

1) Packaging unit

Ordering data – Proximity sensors for C-slot						
	Type of mounting	Electrical connection, connection direction	Switching output	Cable length [m]	Part No.	Type
	N/O contact, magneto-resistive					Technical data ➔ Internet: smt
	Insertable in the slot from above	Cable, 3-wire, in-line	PNP	2.5	**551373**	**SMT-10M-PS-24V-E-2,5-L-OE**
		Plug M8x1, 3-pin, in-line		0.3	**551375**	**SMT-10M-PS-24V-E-0,3-L-M8D**
	N/O contact, magnetic reed					Technical data ➔ Internet: sme
	Insertable in the slot lengthwise	Cable, 3-wire, in-line	Contacting	2.5	**173210**	**SME-10-KL-LED-24**
		Plug M8x1, 3-pin, in-line		0.3	**173212**	**SME-10-SL-LED-24**

Ordering data – Proximity sensors for C-slot						
	Type of mounting	Electrical connection, connection direction	Switching output	Cable length [m]	Part No.	Type
	N/O contact, magneto-resistive					Technical data ➔ Internet: smt
	Insertable in the slot from above	Cable, 3-wire, lateral	PNP	2.5	**551374**	**SMT-10M-PS-24V-E-2,5-Q-OE**
		Plug M8x1, 3-pin, lateral		0.3	**551376**	**SMT-10M-PS-24V-E-0,3-Q-M8D**
	N/O contact, magnetic reed					Technical data ➔ Internet: sme
	Insertable in the slot lengthwise	Cable, 3-wire, lateral	Contacting	2.5	**173211**	**SME-10-KQ-LED-24**
		Plug M8x1, 3-pin, lateral		0.3	**173213**	**SME-10-SQ-LED-24**

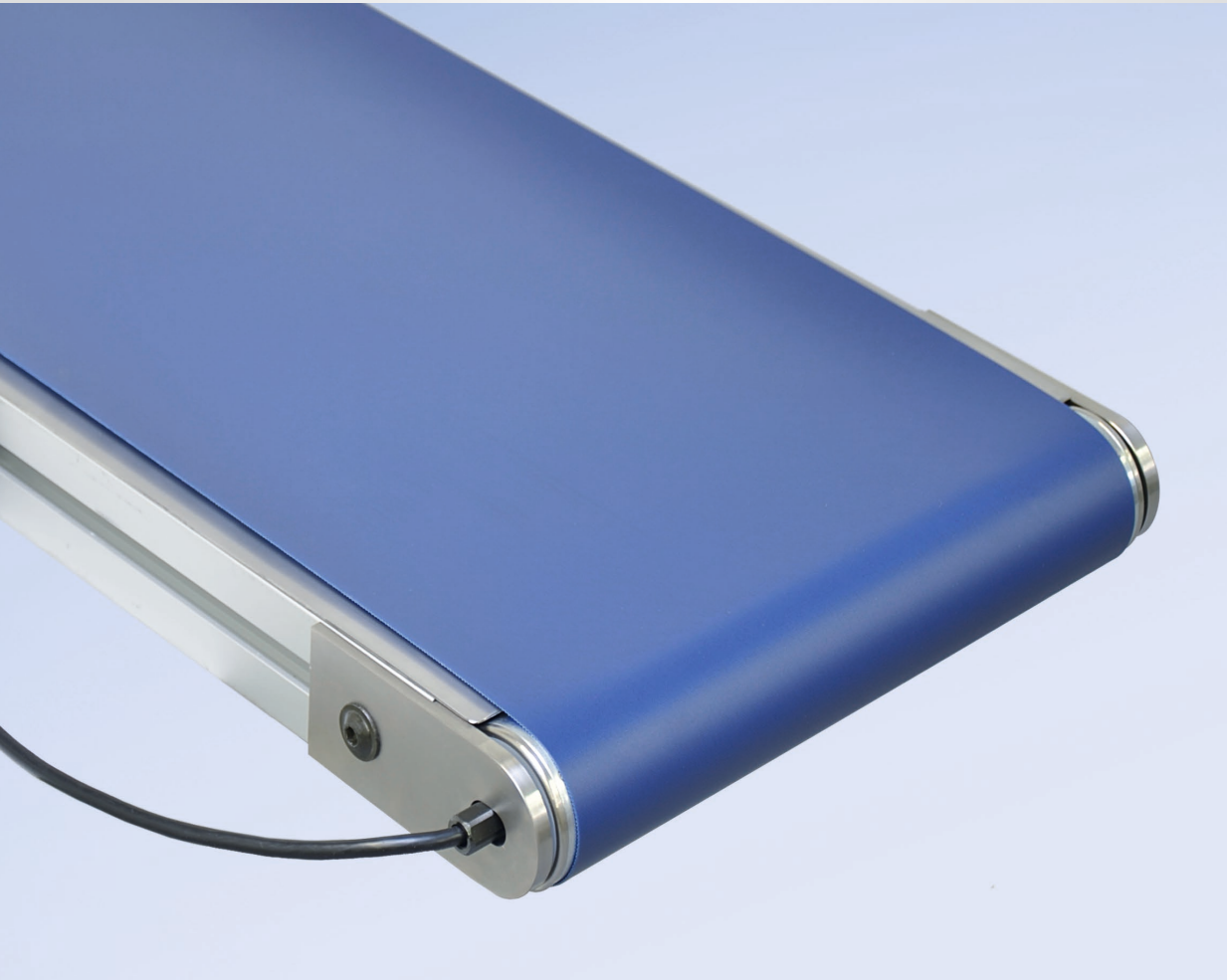
Ordering data – Connecting cables						Technical data ➔ Internet: nebu
	Electrical connection, left	Electrical connection, right		Cable length [m]	Part No.	Type
	Straight socket, M8x1, 3-pin	Cable, open end, 3-wire		2.5	**541333**	**NEBU-M8G3-K-2.5-LE3**
				5	**541334**	**NEBU-M8G3-K-5-LE3**
	Angled socket, M8x1, 3-pin	Cable, open end, 3-wire		2.5	**541338**	**NEBU-M8W3-K-2.5-LE3**
				5	**541341**	**NEBU-M8W3-K-5-LE3**

TECHNOLOGY GROUP

Belt Conveyor GUF-P 2045




Compact. Light. Inexpensive.

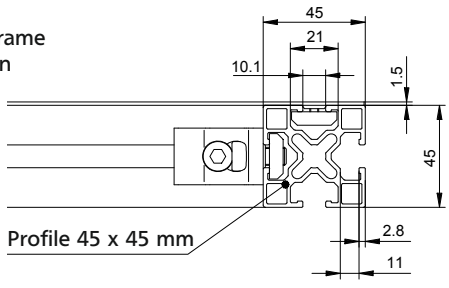


Belt Conveyor
GUF-P 2045

Compact structure for optimal integration

The new, extremely compact GUF-P 2045 belt conveyor is outstandingly suited for integration in units with minimal installation space. The ø 50 mm motorized rollers combined with the weight-optimized 45 mm high conveyor frame profiles, results in an extremely flat conveyor without interference contours. The permissible total load of 15 kg is suited for the majority of products that are typical in the packaging and plastics industry. The speed is configured via the associated control box that is prepared for connection to a customer-provided power supply (24 V DC). Four different belts are available, which either enable accumulated operation or ensure good traction. Reversing operation is also possible with the GUF-P 2045. Stands, side rails, Reglomats, as well as lateral cleats, are available as accessories! See the mk Conveyor Technology catalog. The motorized roller, the sub belt metal, and the idler drum are optionally available in stainless steel.

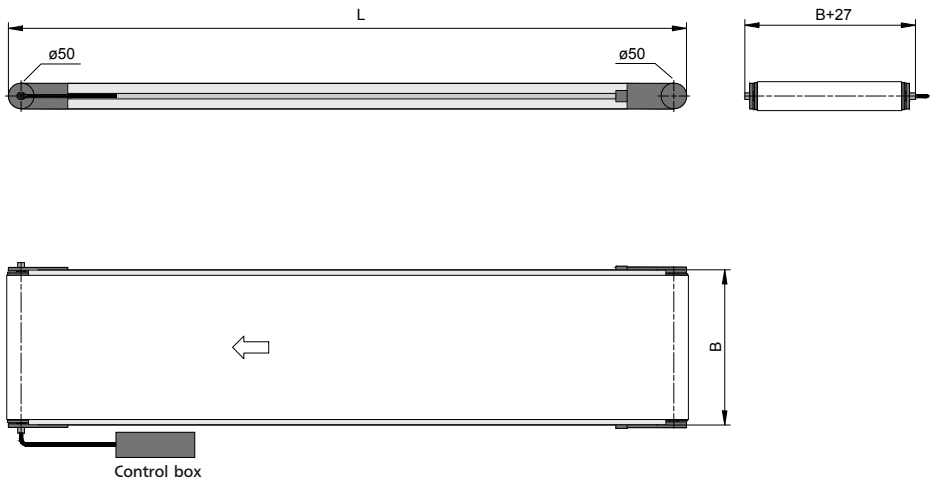
Conveyor frame
cross-section



GUF-P 2045 CA

Belt conveyor with driven roller

B20.45.001



Features

	Technical information	Comments
Conveyor length L	between 600-2500 mm	any increment possible
Conveyor widths B	275, 300, 350, 400 and 500 mm	length-width ratio at least 2:1
Belt width	B-20 mm	
Belt types (not all types suitable for all widths, please inquire)	GU-U0302-001WE	good traction, white, FDA
	GU-V0203-006DG	accumulation limited, green
	GU-U0202-053LB	accumulation limited, blue, FDA
	GU-U0303-054LB	good traction, blue, FDA
Speed [m/min]	3,7 | 4,9 | 6,1 | 7,3 | 8,6 | 9,8 | 11 | 12,2 | 13,4 | 14,6 | 15,9 | 17 | 18,3 | 19,5 | 22 | 23,1 | 24,4 | 25,4	configurable via provided control box (IP20, higher on request) cable length 1 m (optional 1.5 m)
Load capacity	total load to 15 kg	accumulated operation: max. 5 kg indexing: max. 10 kg
Indexing	max. 900 cycles/hour	minimum times: 2s ON/2s OFF

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mk Technology Group

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H400 WinderSystem

Strong performance, high intelligence, low installation depth

> **Flat:** 58 mm (2.3“) installation depth only.

> **Intelligent:** The components of the winder system automatically adapt to the current task!

> **Fast:** With a mean winding speed of 120 m/min (4,700“/min) there is no problem in dispensing 120,000 labels and more per hour.

In conjunction with the new, ultra-light carbon fibre winding discs and the newly developed loop-forming device, the HERMA 400 high-speed labeller has now stepped up a gear - notably in conjunction with extra-large label rolls up to 600 mm in diameter. The complete winding system, including the motorised unwind and rewind units, easily allows more than 120,000 labels to be dispensed per hour. It is an ideal configuration in view of the high speeds achieved by rotary machines, especially since the installation depth of the HERMA 400, even with the motorised winding system, is just 58 mm.

H400 WinderSystem

HERMA 400 WinderSystem SlimLine

An ultra-flat basic unit comprising the same hardware and software for all components of the winder system.

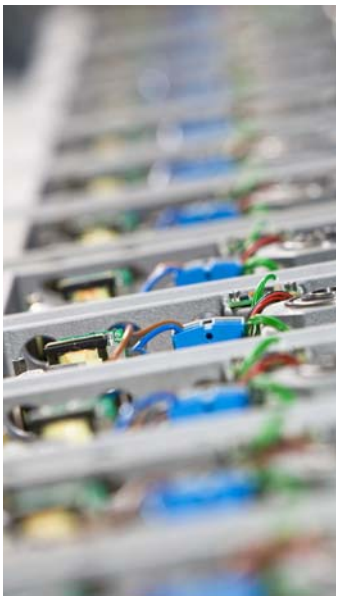
Comparing the new and old basic unit

The loop-forming device is positioned between the unwind unit and the applicator. In conjunction with the intelligently controlled unwind and rewind units, it ensures that the label roll is unwound entirely inertia-free. The outcome is maximum label positioning accuracy, even at high production speeds. The unwinding and rewinding of the label web no longer exert an undesirable influence on the start-stop operation of the central drive unit at the dispensing beak.

As does the successful applicator HERMA 400 the winder system units feature a wide-range power input that can be used worldwide.
By networking via a bus system an intelligent communication between the applicator HERMA 400 and the components of the winder system is made possible – for an even better performance.

The new carbon fibre discs are approximately one-third lighter than conventional discs made from aluminium. Their lower weight plays a decisive role in accelerating the unwind and rewind units to the high speeds required in a very short time.

We are constantly endeavouring to improve our products.
All technical data is therefore subject to change without prior notice.



HERMA GmbH
Labelling Systems Division
73779 Deizisau / Germany
www.herma.com
www.herma-labeler.com

Palletiser

Machine Case Study

GANTRY ROBOT

- Graphical wizard based operator interface
- Open parameter servo drive
- Motion function blocks

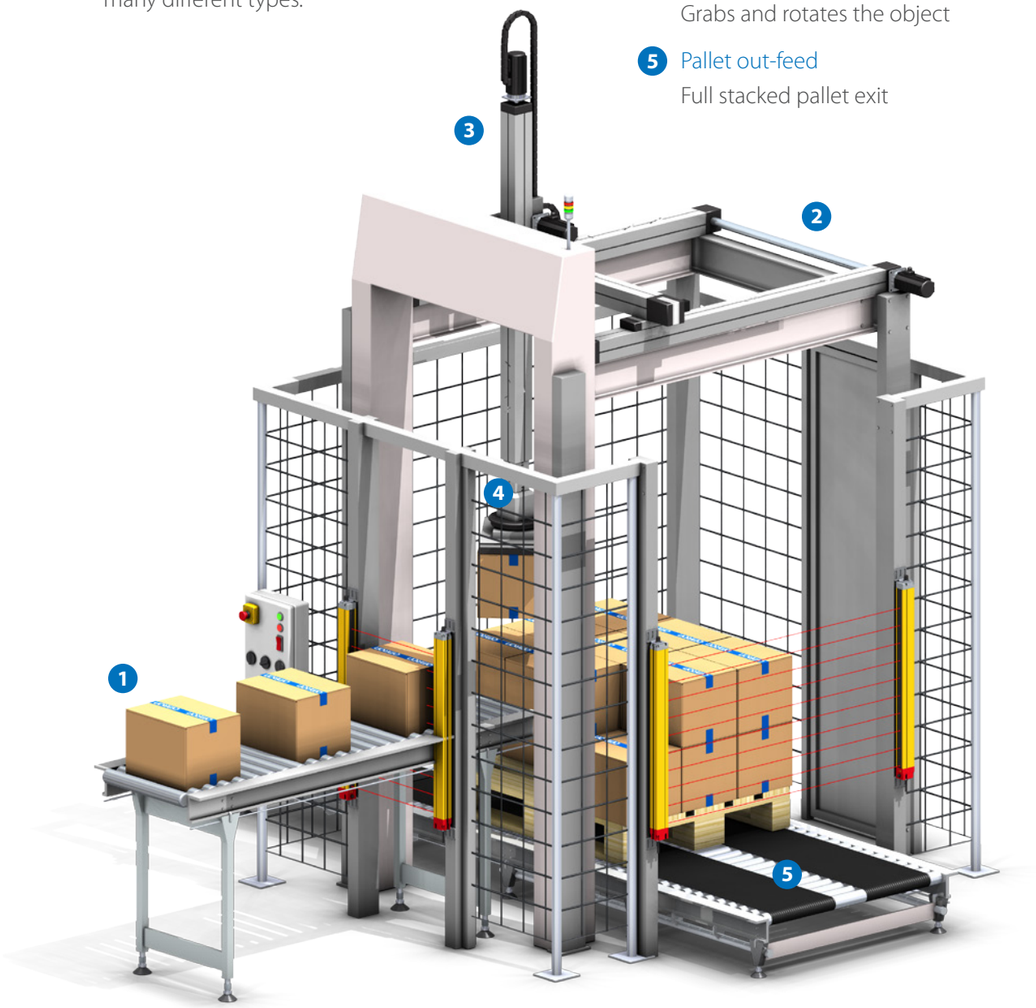
Palletiser gantry robot

Machine description

Gantry robot palletisers are linear, cartesian (XYZ) coordinated robots for pick and place applications. The axes slide linearly in relation to each other, rather than rotate as with a robotic arm. Large work spaces can be covered with high positioning accuracy. The portal construction ensures rigidity while using less floor space than a robotic arm. Replaceable grippers make this type of robot capable of handling loads of many different types.

Machine function

1. **Product in-feed**
   Stackable object like carton box
2. **X-Y movement system**
   Transports the object to the pallet position
3. **Z movement system**
   Moves the object up and down
4. **Rotation pick-up**
   Grabs and rotates the object
5. **Pallet out-feed**
   Full stacked pallet exit

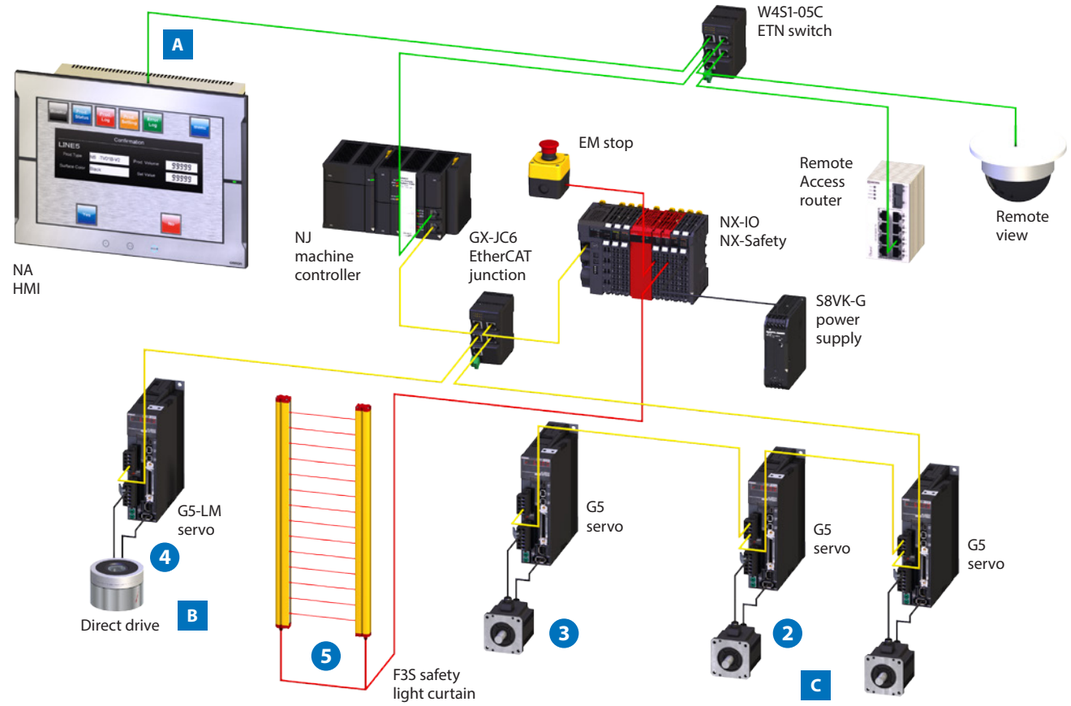


Your automation partner in packaging

We automate machines! We supply all the automation products for palletisers, including the logic and motion or hybrid controller. In addition we provide all motors, drives, position sensors, safety devices and other panel components.

A Graphical wizard based operator interface

Flexible, rotating operator teams lead to machine training investments. A graphical wizard and instruction video makes the need for training virtually obsolete while giving greater flexibility in layer stacking patterns. Made possible due to the power of Omron's NA HMI.



B Open parameter servo drive

Servo drive and motor are sold as a matching set. Omron's G5-LM servo drive has an open parameter structure to drive any servo motor. Not only linear, but also dedicated application motors, such as direct-drive servos.

C Motion function blocks

XYZ robots are available in a variety of mechanical configurations. H-bot gantry robots have the XY motors fixed on the static frame, making the moving arm lighter. Omron saves you engineering time as the H-bot motion function has already been programmed.

Would you like to know more?

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CD_EU-01_machine_case_study_Palletiser_2014

Self-adjusting, Automated
Matrix Tray Feeder - Model FTF-21P

FTF-21P

Tray Feeder Specifications

Magazine Capacity

- 21 Trays Single Pitch
- 10 Trays Double Pitch

Number of Magazines:

1

Tray Exchange Time

- 6 – 10 seconds (based on device and conveyor length)

Pick Location Repeatability

- ± 0.125mm

Magazine Weight

- 6.3 kg

Maximum Tray Weight

- .36 Kg

Maximum Tray Warpage

- <.5%

Tray Aspect Ratio

- Trays feed along their longest length (portrait)

Temperature Range

- 10-35 C°

Tray Size Alignment

- Automated, Self-Adjusting
- Some trays need programmable setup

adjustments

Pitch

- 12 mm (Single Pitch) or 24 (Double Pitch)

Maximum Tray Size

- 334 x 180mm

Minimum Tray Size

- 312 x 122mm

Maximum Tray Height

- 8mm (half pitch) or 18mm (full pitch)

Minimum Tray Height

- 5.5mm

Statutory Compliance

- CE conformance, Semi-S2 and Semi-S8

Electrical Requirements

- 24 VDC or 42 VDC @ 3 A Peak, 1.5 A Rest

Communication Signals

- Input driven by I/O or RS-232 communication (optional RS-485)
- 0 V is logic low
- 24 VDC is logic high
- Outputs are open collectors or are configurable to source 24 VDC

Ports

- One Program, One Serial

Mass (without magazine)

- 40 Kg.

Physical Dimensions:

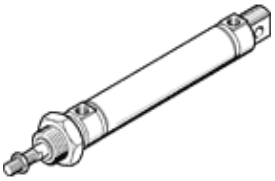
Length: 1166 mm
Height:: 781 mm
Width: 205.6 mm

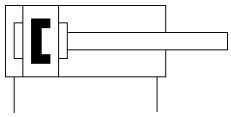
Download PDF

Standard cylinder
DSNU-20-40-P-A

Part number: 19209
★ Core product range

FESTO





Data sheet

Feature	Value
Stroke	40 mm
Piston diameter	20 mm
Piston rod thread	M8
Cushioning	P: Flexible cushioning rings/plates at both ends
Assembly position	Any
Conforms to standard	CETOP RP 52 P ISO 6432
Piston-rod end	Male thread
Design structure	Piston Piston rod Cylinder barrel
Position detection	For proximity sensor
Variants	Single-ended piston rod
Working pressure	1 ... 10 bar
Mode of operation	double-acting
Operating medium	Compressed air in accordance with ISO8573-1:2010 [7:4:4]
Note on operating and pilot medium	Lubricated operation possible (subsequently required for further operation)
Corrosion resistance classification CRC	2 - Moderate corrosion stress
Ambient temperature	-20 ... 80 °C
Maritime classification	see certificate
Impact energy in end positions	0.2 J
Theoretical force at 6 bar, return stroke	158.3 N
Theoretical force at 6 bar, advance stroke	188.5 N
Moving mass with 0 mm stroke	44 g
Additional weight per 10 mm stroke	7.2 g
Basic weight for 0 mm stroke	186.8 g
Additional mass factor per 10 mm of stroke	4 g
Mounting type	with accessories
Pneumatic connection	G1/8
Materials note	Conforms to RoHS
Material cover	Wrought Aluminum alloy neutral anodization
Material seals	NBR TPE-U(PU)
Material piston rod	High alloy steel, non-corrosive
Material cylinder barrel	High alloy steel, non-corrosive

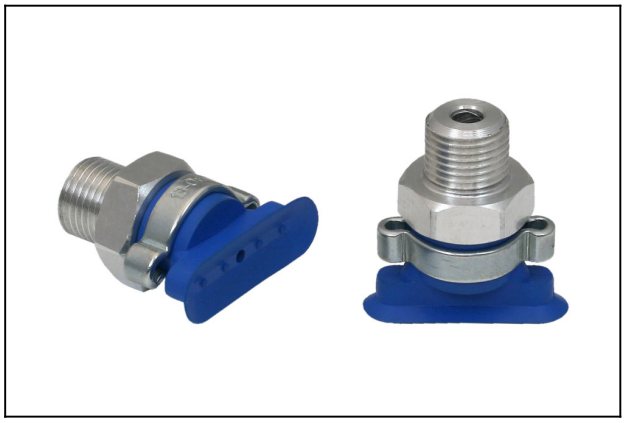
Flat suction cup (oval)

SGON 24x8 HT1-60 G1/8-AG

Part no.:10.01.05.00409

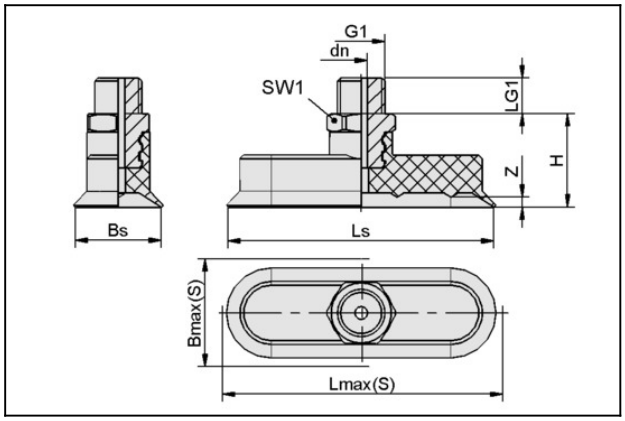
https://www.schmalz.com/10.01.05.00409

Flat suction cup (oval) for long and also curved workpieces



Dimensions (LxB): 24 x 8 mm
Suction cup material:
High temp material HT1
Material hardness: 60 °Sh
Material property: non-marking
Nipple material: Aluminium
Vacuum connection: G1/8"-M

Design Data



Attribute	Value
Bmax(S)	9 mm
Bs	8 mm
dn	1.5 mm
G1	G1/8"-M
H	17 mm
LG1	8 mm
Lmax(S)	24.5 mm
Ls	24 mm
SW1	14 mm
Z (Stroke)	1 mm

Flat suction cup (oval)

SGON 24x8 HT1-60 G1/8-AG

Part no.:10.01.05.00409

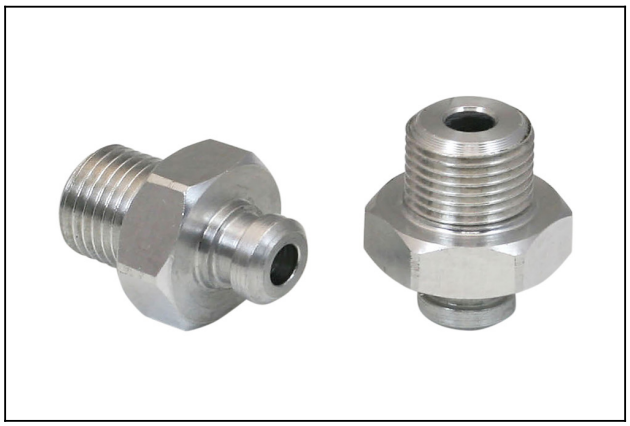
https://www.schmalz.com/10.01.05.00409

Technical Data

Attribute	Value
Suction force	8 N
Volume	0.327 cm³
Curve radius (min) (convex)	7.5 mm
Hose diameter (empf.) d	4 mm
Dimensions (LxB)	24 x 8
Number of folds	0
Suction cup material	High temp material HT1
Material hardness [Shore A]	60
Weight	6.7 g
Product family	SGON

Note: Suction force: The specified suction forces are theoretical values at a vacuum of -0.6 bar and with a smooth, dry workpiece surface - they do not include a safety factor Hose diameter: The recommended hose diameter refers to a hose length of approx. 2 m

Spare Parts



SA-NIP N022 G1/8-AG DN350

Part no.10.01.05.00124

Suction cup connection nipple

Nipple: N 022

Thread G1: G1/8"-M

Overall length: 18.5 mm

Fitting length: 5 mm

Nominal size: 3,50 mm

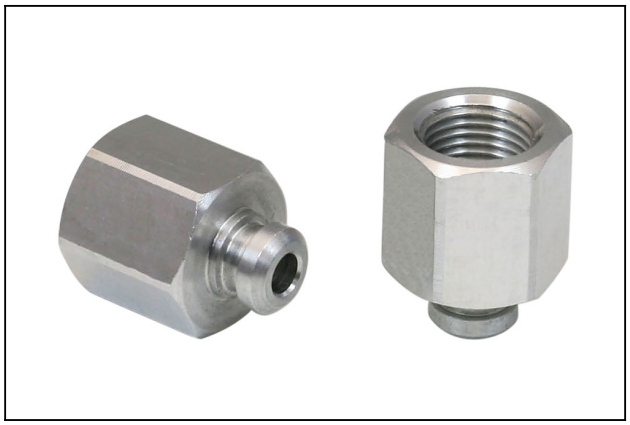
Material: Aluminium

Flat suction cup (oval)

SGON 24x8 HT1-60 G1/8-AG

Part no.:10.01.05.00409

https://www.schmalz.com/10.01.05.00409



SA-NIP N022 G1/8-IG DN350

Part no.10.01.05.00123

Suction cup connection nipple

Nipple: N 022

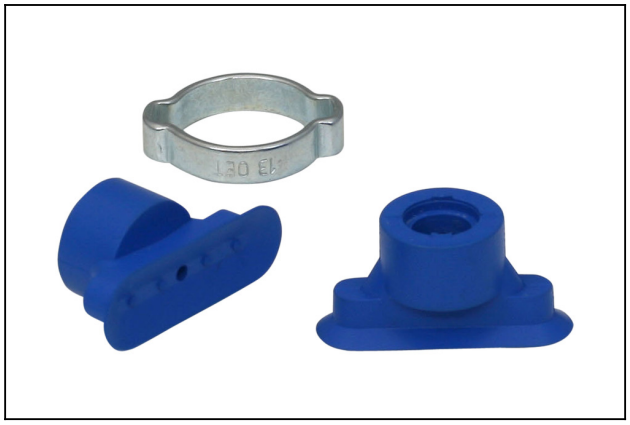
Thread G1: G1/8"-F

Overall length: 18.5 mm

Fitting length: 13 mm

Nominal size: 3,50 mm

Material: Aluminium



SGO 24x8 HT1-60 N022

Part no.10.01.05.00437

Flat suction cup (oval) for narrow or curved workpieces

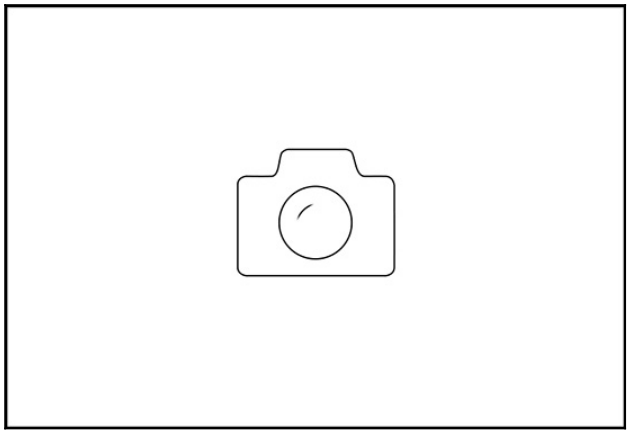
Dimensions (LxB): 24 x 8 mm

Suction cup material:

High temp material HT1

Material hardness: 60 °Sh

Material property: imprint-free



ZOKL 11-13

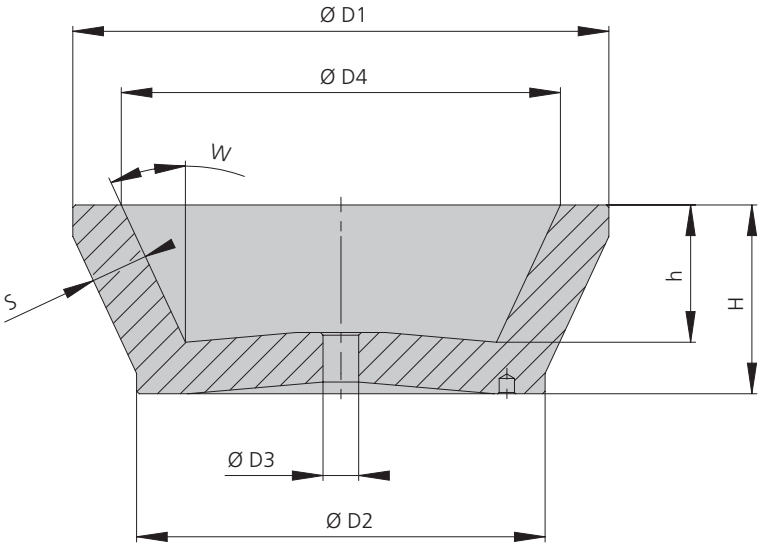
Part no.10.07.10.00032

Two-ear clamp

Clamping range: 11.0 ... 13.0 mm

Material: Steel galvanised

Blank bowl



Technical data

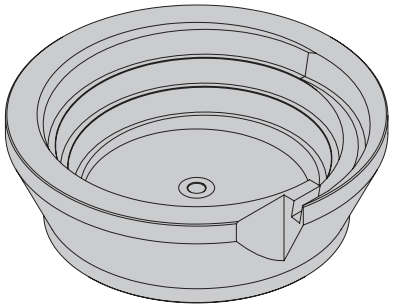
Blank bowl		BB10	BB15	BB20	BB25	BB30
Order no.						
Polyamide		**50201071**	**50201075**	**50201076**	**50201077**	**50201081**
FDA-Polyamide (white)		**50238273**	**50238298**	**50238299**	**50238302**	**50238303**
Dimensions	**Units**					
D1	[mm]	105	155	210	260	310
D2	[mm]	80	117	170	208	250
D3	[mm]	7	7	9	12	12
D4	[mm]	86	130	179	217	260
H	[mm]	37	52	65	84	98
h	[mm]	26.9	41.0	50.0	66.7	78.1
S	[mm]	11.2	14.2	19.4	26.1	30.5
W	[°]	25	25	25	25	25
Technical data						
Load volume* [l]		0.07	0.25	0.6	1.1	1.8
Weight [kg]		0.17	0.45	1.12	2.2	3.7
Moment of inertia [kg*dm²]		0.025	0.15	0.7	2.15	5.1
Recommended drive		BF10	BF15 WV151-1	BF20 WV151-1	BF25 WV201-1	BF30 WV201-1

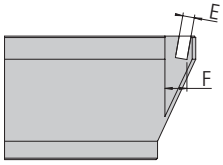
Blank bowl		BB35	BB40	BB50	BB63
Order no.					
Polyamide		**50201085**	**50201086**	**50201091**	**50196141**
FDA-Polyamide (white)		**50238304**	**50238306**	**50238308**	**50238309**
Dimensions	**Units**				
D1	[mm]	365	415	510	630
D2	[mm]	275	300	380	450
D3	[mm]	12	14	20	22
D4	[mm]	305	350	436	500
H	[mm]	127	157	224	255
h	[mm]	103.9	129.7	185.3	193.0
S	[mm]	33.7	37.4	56	70
W	[°]	25	25	25	25
Technical data					
Load volume* [l]		3.2	5.1	9.2	15.3
Weight [kg]		5.9	8,95	21,2	35.7
Moment of inertia [kg*dm²]		11.0	21.3	79.6	192.2
Blind plug polyamide including		---	---	---	•
Blind plug FDA-polyamide including		---	---	---	•
Recommended drive		BF35 WV310-1	BF40	BF50	WV401-1 WV402-1

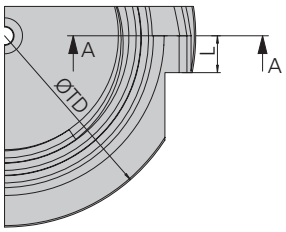
*theoretical value, current load volume largely dependent on the component to be fed and the specific project conditions

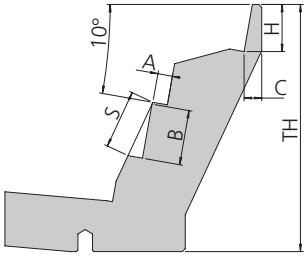
Feeding bowls

BB-S





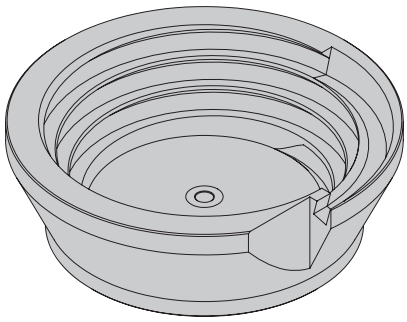


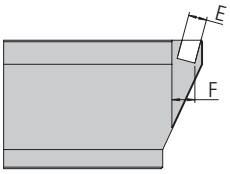


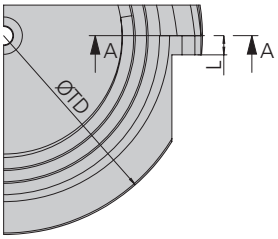
Step helix	BB10-S	BB15-S	BB20-S	BB25-S	BB30-S	BB35-S	BB40-S	BB50-S
Order no.								
Right*	**50279239**	**50279241**	**50279243**	**50279245**	**50279247**	**50279249**	**50279251**	**50279253**
Left*	**50279240**	**50279242**	**50279244**	**50279246**	**50279248**	**50279250**	**50279252**	**50279254**
Right - FDA	**50409457**	**50343381**	**50409460**	**50409463**	**50409466**	**50409469**	**50409474**	**50409479**
Left - FDA	**50409555**	**50409459**	**50409461**	**50409464**	**50409468**	**50409470**	**50409477**	**50409480**

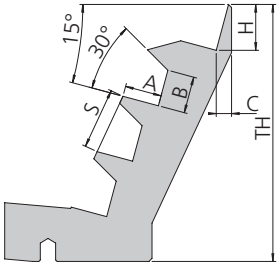
Dimen.	Units							
S	[mm]	8	10	18	20	25	30	35	45
A	[mm]	2	2.5	4.5	5	6	7.5	9	10
B	[mm]	7.5	9	16.5	18.5	22	28	33	37
H	[mm]	5	8	12	16	18	20	25	40
C	[mm]	2.5	3.5	5	6	7	8.5	11.5	15
E	[mm]	4	5	6	8	10	12	14	20
F	[mm]	6	9	12	15	18	21	24	27
L	[mm]	10	15	20	25	30	35	40	50
TH	[mm]	37	52	65	84	98	127	157	219.5
TD	[mm]	105	155	210	260	310	365	415	510

*delivery direction (right = clockwise / left = anticlockwise)
Note: Bowl with FDA-certification on demand.









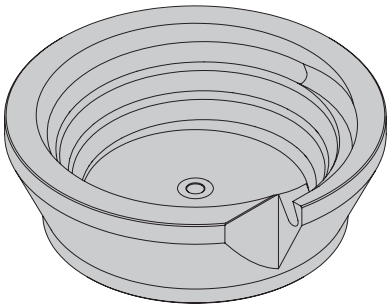
Groove helix	BB10-N	BB15-N	BB20-N	BB25-N	BB30-N	BB35-N	BB40-N	BB50-N
Order no.								
Right*	**50279255**	**50279257**	**50279259**	**50279261**	**50279263**	**50279265**	**50279267**	**50279269**
Left*	**50279256**	**50279258**	**50279260**	**50279262**	**50279264**	**50279266**	**50279268**	**50279270**
Right - FDA	**50409481**	**50409483**	**50409485**	**50409489**	**50409496**	**50409500**	**50409503**	**50409508**
Left - FDA	**50409482**	**50409484**	**50409487**	**50409493**	**50409499**	**50409501**	**50409505**	**50409509**

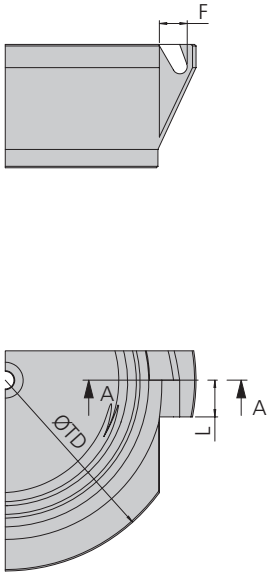
Dimen.	Units							
S	[mm]	8	10	18	20	25	30	35	45
A	[mm]	4	5	8	12	15	17	19	24
B	[mm]	4	5	8	12	12	17	19	24
H	[mm]	5	8	12	15	18	20	24	40
C	[mm]	2.5	3.5	5	5	7	8.5	10	13
E	[mm]	4	5	8	12	15	17	19	24
F	[mm]	6.5	8	11	15	17	20	22	27
L	[mm]	5	7.5	10	12.5	15	17.5	20	25
TH	[mm]	37	52	65	84	98	127	157	219.5
TD	[mm]	105	155	210	260	310	365	415	510

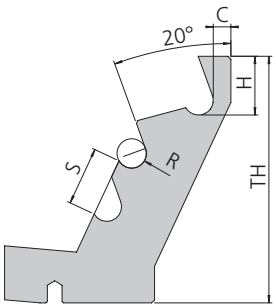
*delivery direction (right = clockwise / left = anticlockwise)
Note: Bowl with FDA-certification on demand.

Feeding bowls

BB-R







Radius helix	BB10-R	BB15-R	BB20-SR	BB25-R	BB30-R	BB35-R	BB40-R	BB50-R
Order no.								
Right*	**50279271**	**50279273**	**50279275**	**50279277**	**50279279**	**50279281**	**50279283**	**50279285**
Left*	**50279272**	**50279274**	**50279276**	**50279278**	**50279280**	**50279282**	**50279284**	**50279286**
Right - FDA	**50409510**	**50403835**	**50409517**	**50409520**	**50403839**	**50409524**	**50409526**	**50409529**
Left - FDA	**50409511**	**50403837**	**50409518**	**50409521**	**50403840**	**50409525**	**50409528**	**50409530**

Dimen.	Units							
S	[mm]	8	10	18	20	25	30	35	45
R	[mm]	2	2.5	4	5	6.5	8	9	12.5
B	[mm]	8	10	15	20	25	30	35	45
H	[mm]	1.5	2.6	4	6	6.5	9	10	7.5
C	[mm]	9	10.5	14	19	22	23.8	27.5	39.5
E	[mm]	10	15	20	25	30	35	40	50
F	[mm]	37	52	65	84	98	127	157	219.5
L	[mm]	105	155	210	260	310	365	415	510
TH	[mm]	37	52	65	84	98	127	157	219.5
TD	[mm]	105	155	210	260	310	365	415	510

*delivery direction (right = clockwise / left = anticlockwise)
Note: Bowl with FDA-certification on demand.

Twin cylinders DPZ/DPZJ

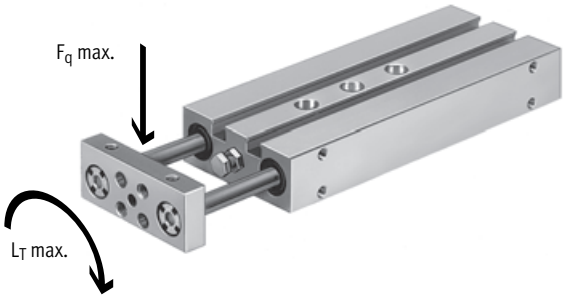
FESTO

Twin cylinders DPZ/DPZJ

Key features

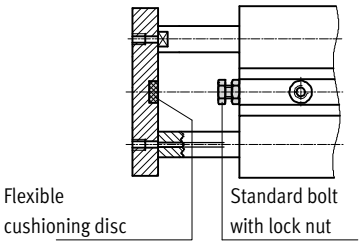
High force with excellent protection against torsion

- 100 to 1,000 N thrust at 6 bar operating pressure
- Load capacity (F_q) from 8 to 105 N
- Permissible torque load (T_L) centrally acting from 0.1 to 3 Nm
- Widely-spaced piston rods for high load capacity



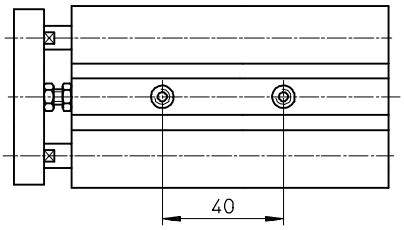
Precision stroke adjustment

- A standard bolt and lock nut allows variation of the standard strokes within a range of 10 mm
- If necessary, a longer bolt can be used



Grid dimension

- 20 and 40 mm to suit profile systems

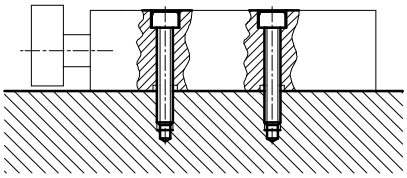


Twin cylinders DPZ/DPZJ

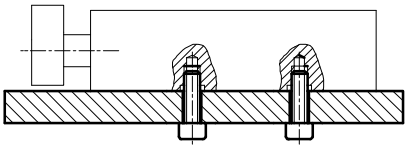
Key features

Mounting options

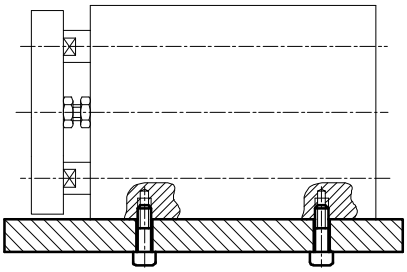
Horizontal mounting from above



Horizontal mounting from below



Side mounting from below



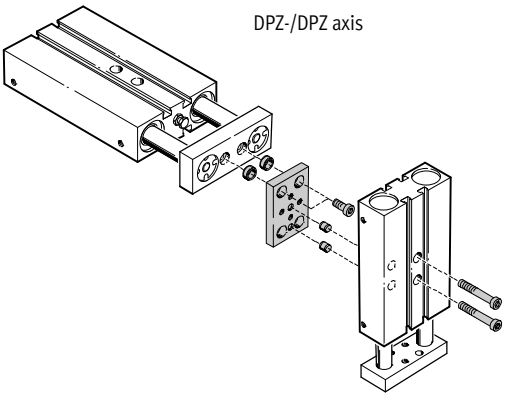
Multi-axis and drive combinations

The twin cylinder DPZ/DPZJ can be combined with different drives. An adapter kit is required for mounting between the two drives.

Adapter kits

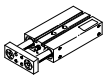
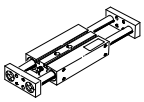
➔www.festo.com

DPZ-/DPZ axis



Twin cylinders DPZ/DPZJ

Product range overview

Function	Version	Type	Piston ∅ [mm]	Stroke [mm]	Precision end position adjustment	
					Retracted end position	Advanced end position
Double-acting	**Basic version**					
		**DPZ**	10	10, 25, 40, 50	■	–
			16, 20, 25, 32	10, 25, 40, 50, 80, 100		
	Through piston rods with additional yoke plate					
		**DPZJ** for higher lateral forces and precision	10	10, 25, 40, 50	■	■
			16, 20, 25, 32	10, 25, 40, 50, 80, 100		

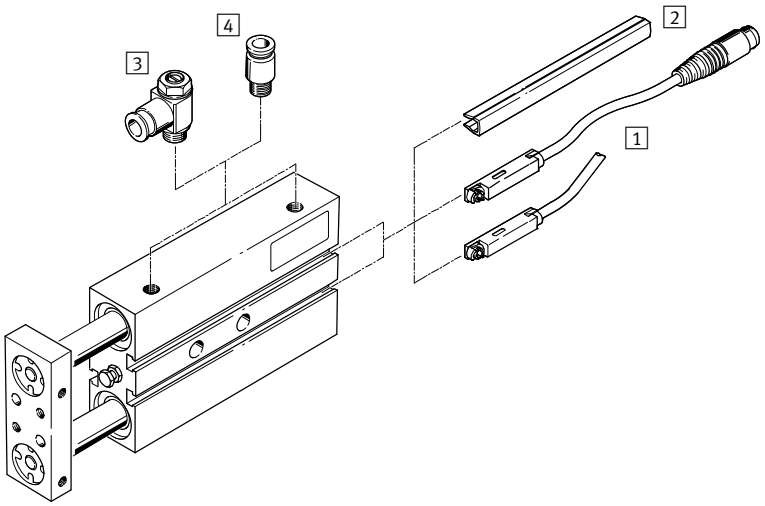
Twin cylinders DPZ/DPZJ

Product range overview

Type	Position sensing A	Plain bearing guide GF	Recirculating ball bearing guide KF	Through piston rod S2	➔ Page/Internet
Basic version					
DPZ	■	■	■	■	8
Through piston rods with additional yoke plate					
DPZJ for higher lateral forces and precision	■	■	■	■	8

Twin cylinders DPZ/DPZJ

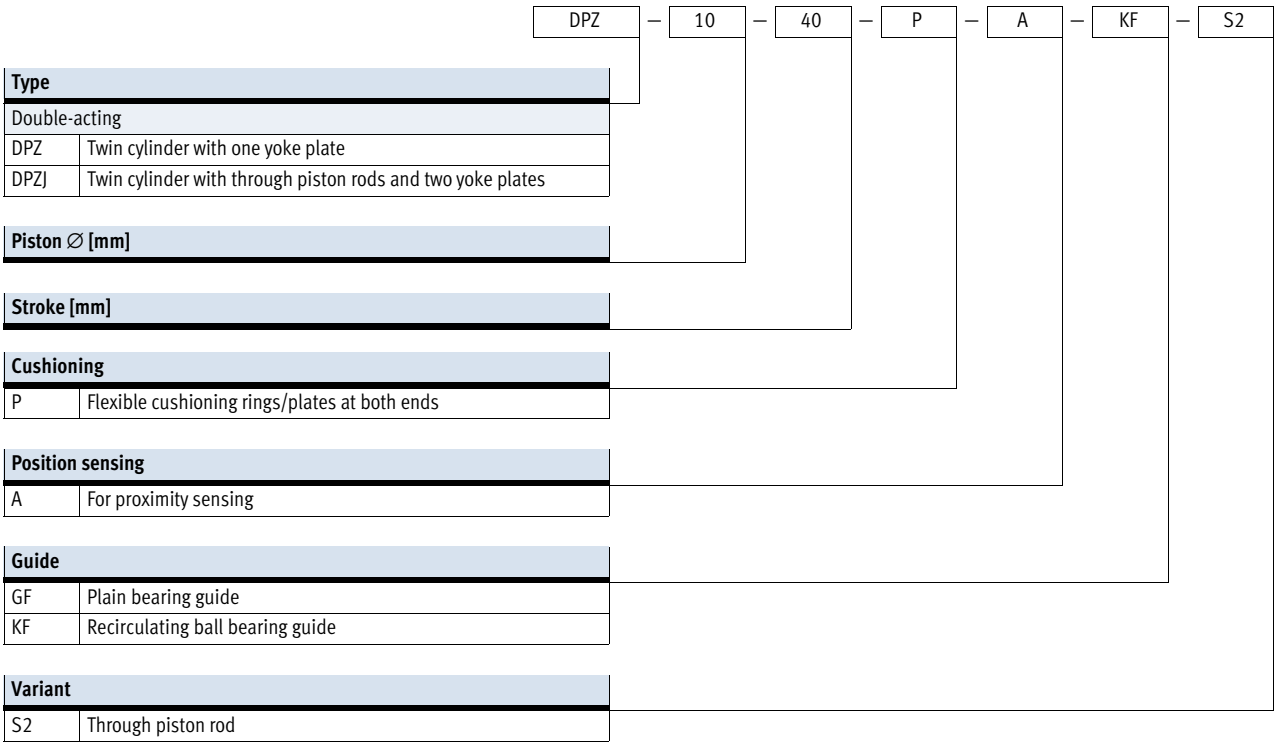
Peripherals overview



Accessories				
	Description	Piston ∅		➔ Page/Internet
		10, 16 mm	20, 25, 32 mm	
1 Proximity sensor SME/SMT-8	Can be integrated in the cylinder profile barrel	■	■	19
2 Slot cover ABP-5-S	To protect the sensor cable and keep dirt out of the sensor slots	■	■	19
3 One-way flow control valve GRLA	To regulate speed	■	■	20
4 Push-in fitting QS	For connecting compressed air tubing with standard O.D.	■	■	qs
– Centring pin ZBS	4 pieces included in scope of delivery	■	–	20
– Centring sleeve ZBH	4 pieces included in scope of delivery	–	■	20
– Adapters	For drive/drive combinations	■	■	21
	For drive/gripper combinations			gripper

Twin cylinders DPZ/DPZJ

Type codes



Type	
Double-acting	
DPZ	Twin cylinder with one yoke plate
DPZJ	Twin cylinder with through piston rods and two yoke plates

Piston ∅ [mm]

Stroke [mm]

Cushioning	
P	Flexible cushioning rings/plates at both ends

Position sensing	
A	For proximity sensing

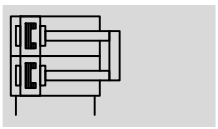
Guide	
GF	Plain bearing guide
KF	Recirculating ball bearing guide

Variant	
S2	Through piston rod

Twin cylinders DPZ/DPZJ

Technical data

Function DPZ



Diameter
10 ... 32 mm

Stroke length
10 ... 100 mm

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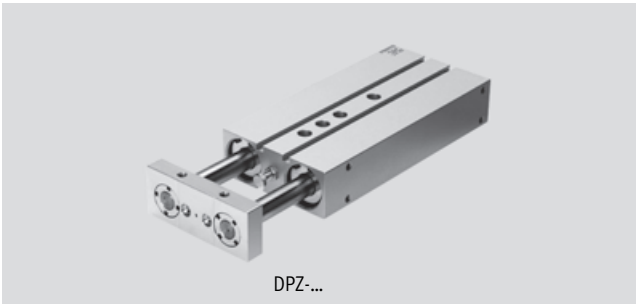
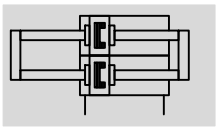
Variants

S2



DPZ-...

Function DPZJ



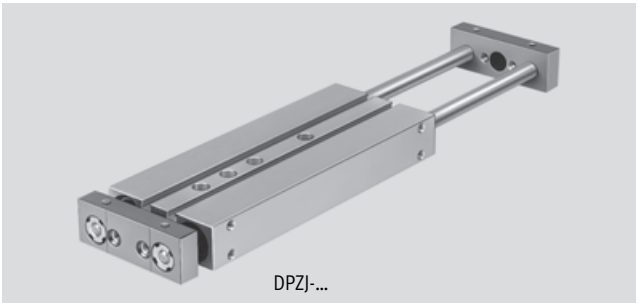
Diameter
10 ... 32 mm

Stroke length
10 ... 100 mm

www.festo.com

Variants

S2



DPZJ-...

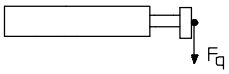
General technical data					
Piston ∅	10	16	20	25	32
Pneumatic connection	M5	M5	M5	M5	G1/8
Operating medium	Compressed air in accordance with ISO 8573-1:2010 [7:4:4]				
Note on operating/pilot medium	Operation with lubricated medium possible (in which case lubricated operation will always be required)				
Operating pressure [bar]	2.5 ... 10	1 ... 10			
Constructional design	Parallel piston rods with yoke				
	Through parallel piston rods with yoke				
Cushioning	Flexible cushioning rings/plates at both ends				
Position sensing	For proximity sensing				
Type of mounting	Via through-holes				
	With female thread				
	With mounting plate				
Mounting position	Any				
Protection against torsion/guide	Parallel piston rods/with plain-bearing guide or ball bearing guide				

Ambient conditions		
Variant	Plain-bearing guide GF	Recirculating ball bearing guide KF
Ambient temperature[1] [°C]	–20 ... +80	
Corrosion resistance class CRC[2]	2	–

1) Note operating range of proximity sensors.
2) Corrosion resistance class CRC 2 to Festo standard FN 940070
Moderate corrosion stress. Indoor applications in which condensation may occur. External visible parts with primarily decorative requirements for the surface and which are in direct contact with the ambient atmosphere typical for industrial applications.

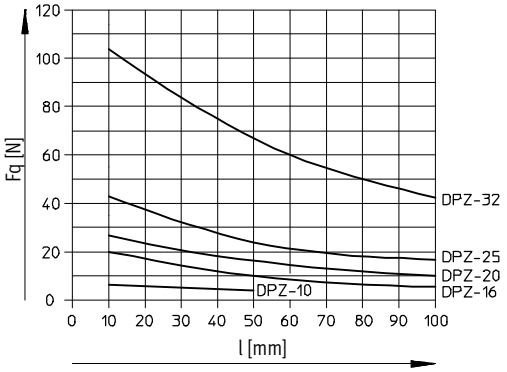
Forces [N] and impact energy [J]						
Piston ∅		10	16	20	25	32
Theoretical force at 6 bar, advancing		94	242	376	590	966
	S2, DPZJ	60	180	282	452	724
Theoretical force at 6 bar, retracting		60	180	282	452	724
	S2, DPZJ	60	180	282	452	724
Max. impact energy at end positions		0.08	0.15	0.2	0.3	0.5

Permissible lateral force F_q as a function of stroke l

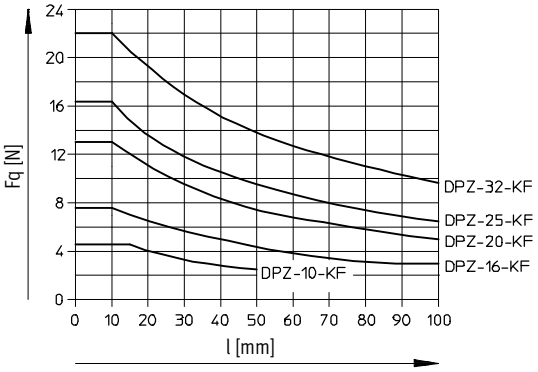


Piston rods at one end

Plain-bearing guide GF

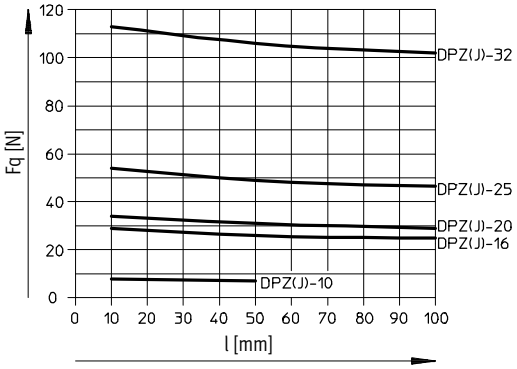


Recirculating ball bearing guide KF

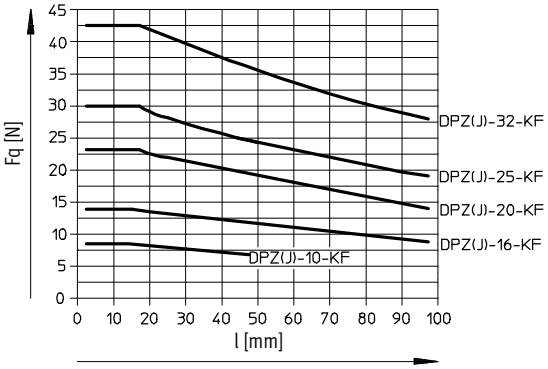


Through piston rods

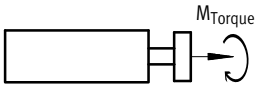
Plain-bearing guide GF



Recirculating ball bearing guide KF

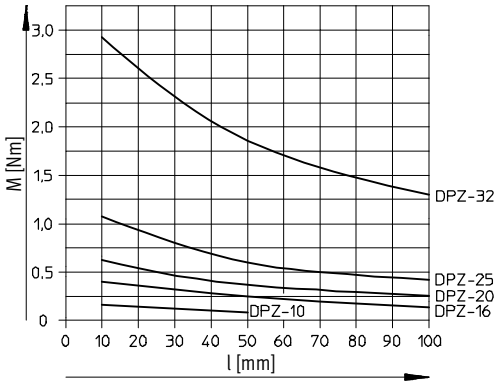


Permissible torque M as a function of stroke l

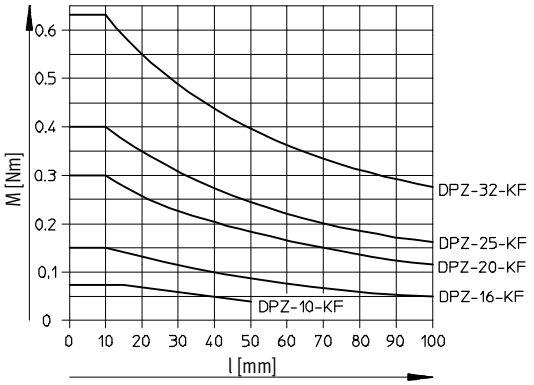


Piston rods at one end

Plain-bearing guide GF

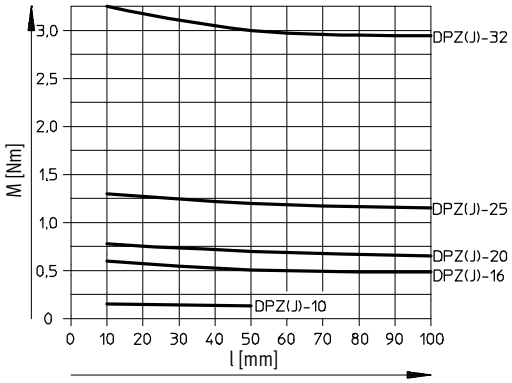


Recirculating ball bearing guide KF

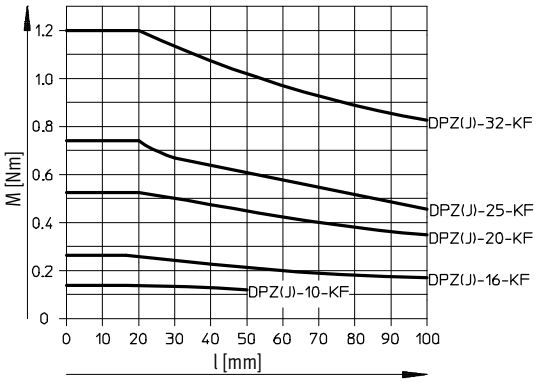


Through piston rods

Plain-bearing guide GF



Recirculating ball bearing guide KF

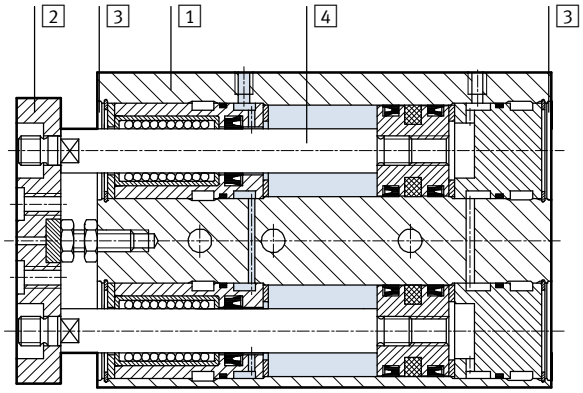


DPZ with plain-bearing guide GF					
Stroke	Piston ∅ [mm]				
[mm]	10	16	20	25	32
Weight [g]					
0	234	389	568	838	1389
10	257	416	607	891	1473
25	291	456	666	971	1598
40	325	496	725	1052	1723
50	348	523	764	1105	1806
80	417	603	882	1265	2057
100	463	657	960	1372	2223

DPZ with recirculating ball bearing guide KF					
Stroke	Piston ∅ [mm]				
[mm]	10	16	20	25	32
Weight [g]					
0	243	368	522	742	1200
10	266	395	561	795	1283
25	300	435	620	875	1408
40	334	475	679	955	1533
50	357	502	718	1009	1617
80	426	582	836	1169	1867
100	472	636	914	1276	2034

Materials

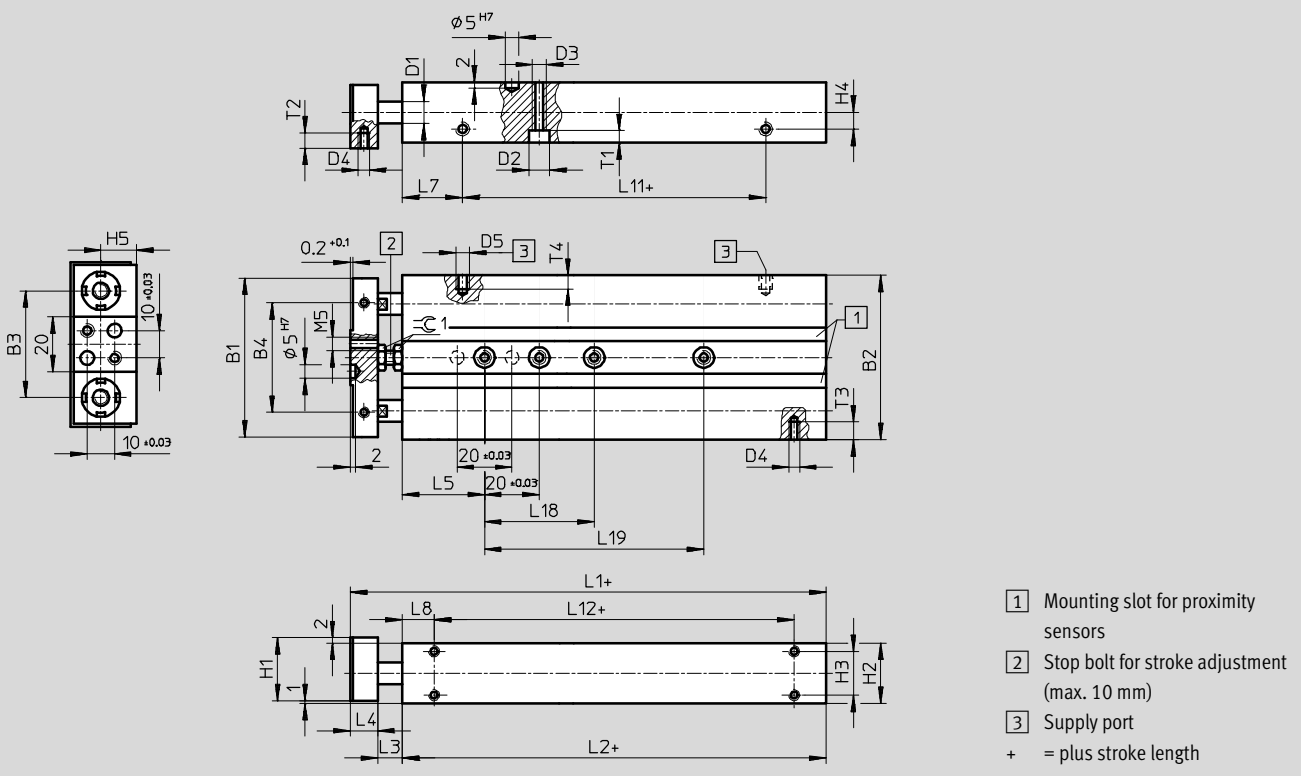
Sectional view



Twin cylinders			
1	Housing		Wrought aluminium alloy
2	Yoke plate		Tempered steel
3	Plug cap		Wrought aluminium alloy
4	Piston rod	GF	High-alloy stainless steel
		KF	Tempered steel
–	Seals		Polyurethane, nitrile rubber

Dimensions – Basic cylinders Download CAD data ➔ **www.festo.com**

Piston ∅ 10, 16 mm



1 Mounting slot for proximity sensors
2 Stop bolt for stroke adjustment (max. 10 mm)
3 Supply port
\+ = plus stroke length

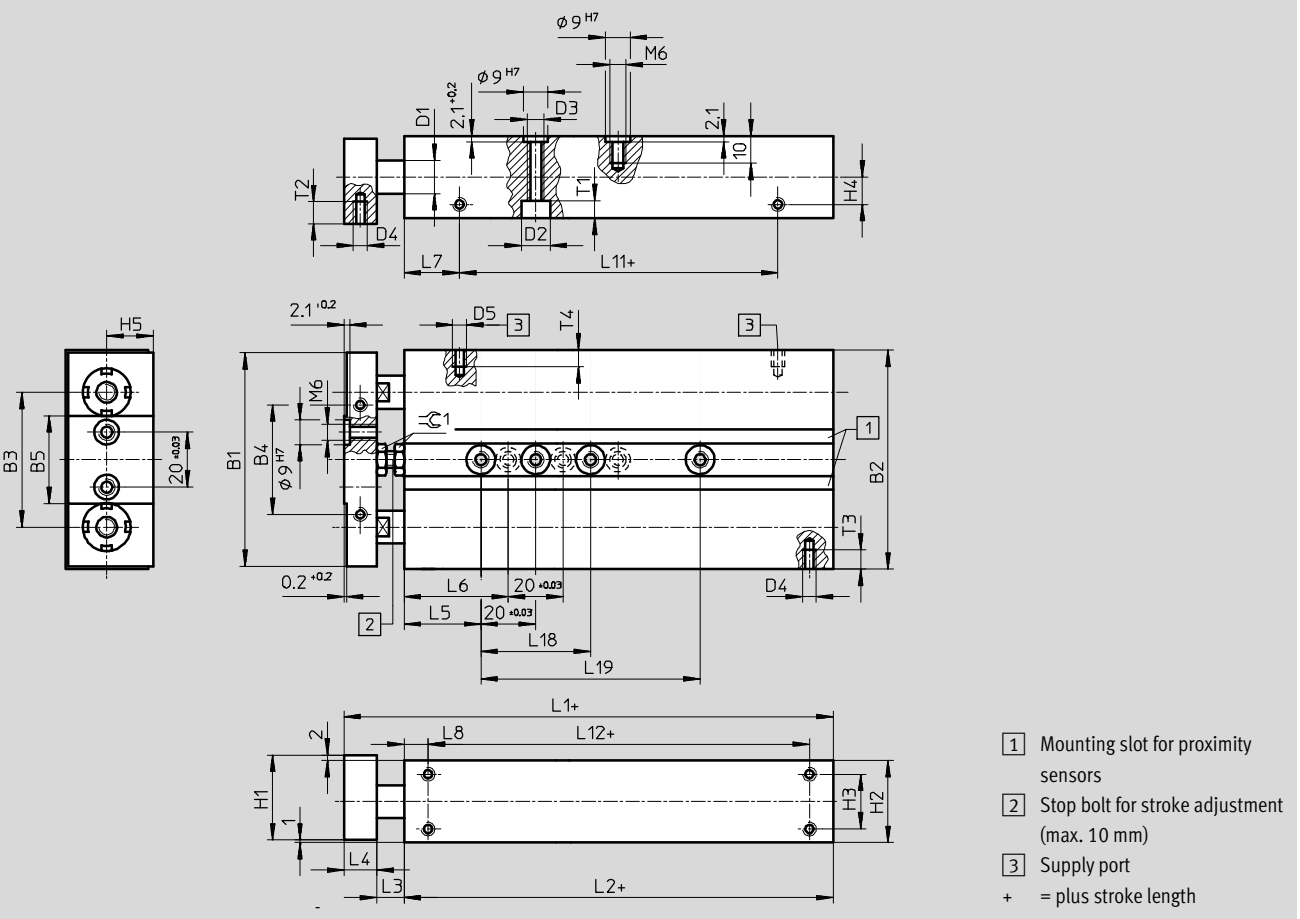
∅ [mm]	B1	B2	B3	B4	D1 ∅	D2 ∅	D3 ∅	D4	D5	H1	H2	H3	H4	H5	L1		L2	
															GF	KF	GF	KF
10	48	50	33	28	6	7.5	M5	M4	M5	20	19	13	4.5	11.5	89.6	100	71.6	82
16	58	60	39	40	8	7.5	M5	M4	M5	23	22	16	6	13	93.6	107	74.6	88

∅ [mm]	L3	L4	L5	L7		L8		L11		L12 ±0.2		T1	T2	T3	T4	=C1
				GF	KF	GF	KF	GF	KF	GF	KF					
10	8	10	30	23.4	40.7	13.1	30.8	24.8	24.4	45.4	44.2	4.4	6	5	5	7
16	9	10	30	22	38.9	11.6	25.5	30.6	30.6	51.4	54.4	4.4	5.5	6.5	5	8

Stroke [mm]	L18 ±0.03	L19 ±0.03
10	–	–
25	–	–
40	–	–
50	40	–
80	40	80
100	40	80

Dimensions – Basic cylinders Download CAD data ➔ **www.festo.com**

Piston ∅ 20, 25, 32 mm



∅ [mm]	B1	B2	B3	B4	B5	D1 ∅	D2 ∅	D3 ∅	D4	D5	H1	H2	H3	H4	H5	L1		L2	
																GF	KF	GF	KF
20	70	72	45.6	40	32	10	9	M6	M5	M5	25	24	16	7	14	98.6	115	76.6	93
25	78	80	49.2	40	32	12	10.5	6.4	M5	M5	31	30	20	10	17	98.6	116	76.6	94
32	96	98	57	40	35	16	10.5	6.4	M6	G1/8	39	38	26	11.5	21	110.1	130	80.1	100

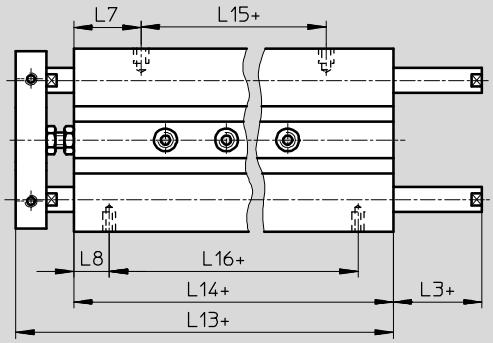
∅ [mm]	L3	L4	L5	L6	L7		L8		L11		L12 ±0.2		T1	T2	T3	T4	⟃1
					GF	KF	GF	KF	GF	KF	GF	KF					
20	10	12	30	–	22.8	43.4	12.9	33.5	31	30.7	50.8	50.5	5.4	6.5	7	6	10
25	10	12	28	38	20.2	40	8.7	28.8	36.2	33.8	59.2	56.5	6.4	8	7	6	10
32	15	15	35	45	25	44.9	10	26	30.1	30.1	60.1	64	6.4	8	9	9	10

Stroke [mm]	L18 ±0.03	L19 ±0.03
10	–	–
25	–	–
40	–	–
50	40	–
80	40	80
100	40	80

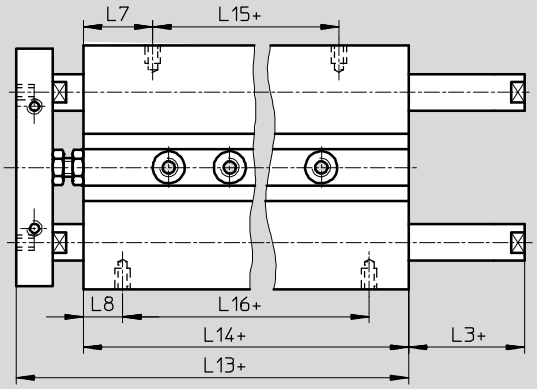
Dimensions – Variants DPZ Download CAD data ➔ **www.festo.com**

S2 – Through piston rods

∅ 10, 16 mm



∅ 20, 25, 32 mm



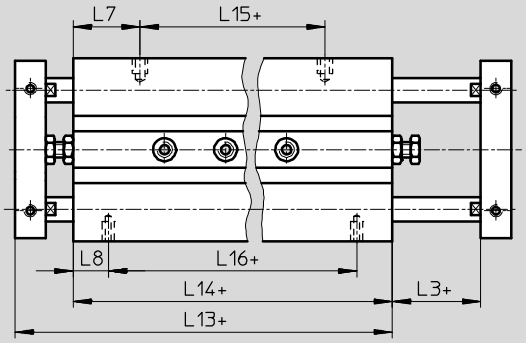
\+ = plus stroke length

∅	L3	L7		L8		L13		L14		L15		L16 ±0.2	
[mm]		GF	KF	GF	KF	GF	KF	GF	KF	GF	KF	GF	KF
10	8	23.4	40.7	13.1	30.8	89.6	124	71.6	106	24.8	24.7	45.4	44.4
16	9	22	38.9	11.6	25.5	93.6	127.4	74.6	108.4	30.6	30.6	51.4	57.4
20	10	22.8	43.4	12.9	33.5	98.6	139.2	76.6	117.2	31	30.4	50.8	50.2
25	10	20.2	40	8.7	28.8	98.6	135	76.6	113	36.2	33	59.2	55.4
32	15	25	44.9	10	26	110.1	149.9	80.1	119.9	30.1	30.1	60.1	67.9

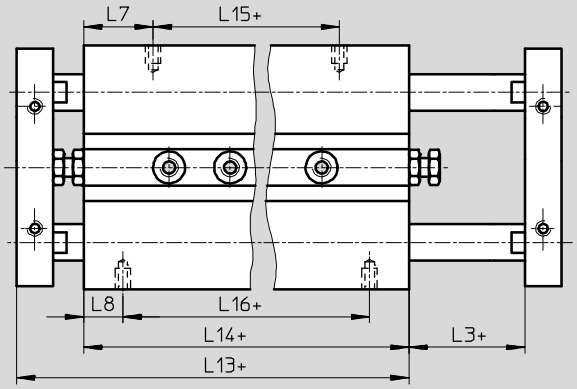
Dimensions – Variants DPZJ Download CAD data ➔ **www.festo.com**

S2 – Through piston rods

∅ 10, 16 mm



∅ 20, 25, 32 mm



\+ = plus stroke length

∅	L3	L7		L8		L13		L14		L15		L16 ±0.2	
[mm]		GF	KF	GF	KF	GF	KF	GF	KF	GF	KF	GF	KF
10	8	23.4	40.7	13.1	30.8	89.6	124	71.6	106	24.8	24.7	45.4	44.4
16	9	22	38.9	11.6	25.5	93.6	127.4	74.6	108.4	30.6	30.6	51.4	57.4
20	10	22.8	43.4	12.9	33.5	98.6	139.2	76.6	117.2	31	30.4	50.8	50.2
25	10	20.2	40	8.7	28.8	98.6	135	76.6	113	36.2	33	59.2	55.4
32	15	25	44.9	10	26	110.1	149.9	80.1	119.9	30.1	30.1	60.1	67.9

Ordering data – Basic version DPZ						
Type	Piston ∅ [mm]	Stroke [mm]	Plain-bearing guide GF		Recirculating ball bearing guide KF	
			Part No.	Type[1]	Part No.	Type[1]
	10	10	**32681**	**DPZ-10-10-P-A**	**162001**	**DPZ-10-10-P-A-KF**
		25	**32682**	**DPZ-10-25-P-A**	**162002**	**DPZ-10-25-P-A-KF**
		40	**32683**	**DPZ-10-40-P-A**	**162003**	**DPZ-10-40-P-A-KF**
		50	**32684**	**DPZ-10-50-P-A**	**162004**	**DPZ-10-50-P-A-KF**
	16	10	**32686**	**DPZ-16-10-P-A**	**162026**	**DPZ-16-10-P-A-KF**
		25	**32687**	**DPZ-16-25-P-A**	**162027**	**DPZ-16-25-P-A-KF**
		40	**32688**	**DPZ-16-40-P-A**	**162028**	**DPZ-16-40-P-A-KF**
		50	**32689**	**DPZ-16-50-P-A**	**162029**	**DPZ-16-50-P-A-KF**
		80	**32690**	**DPZ-16-80-P-A**	**162030**	**DPZ-16-80-P-A-KF**
		100	**32691**	**DPZ-16-100-P-A**	**162031**	**DPZ-16-100-P-A-KF**
	20	10	**32693**	**DPZ-20-10-P-A**	**162061**	**DPZ-20-10-P-A-KF**
		25	**32694**	**DPZ-20-25-P-A**	**162062**	**DPZ-20-25-P-A-KF**
		40	**32695**	**DPZ-20-40-P-A**	**162063**	**DPZ-20-40-P-A-KF**
		50	**32696**	**DPZ-20-50-P-A**	**162064**	**DPZ-20-50-P-A-KF**
		80	**32697**	**DPZ-20-80-P-A**	**162065**	**DPZ-20-80-P-A-KF**
		100	**32698**	**DPZ-20-100-P-A**	**162066**	**DPZ-20-100-P-A-KF**
	25	10	**32700**	**DPZ-25-10-P-A**	**162096**	**DPZ-25-10-P-A-KF**
		25	**32701**	**DPZ-25-25-P-A**	**162097**	**DPZ-25-25-P-A-KF**
		40	**32702**	**DPZ-25-40-P-A**	**162098**	**DPZ-25-40-P-A-KF**
		50	**32703**	**DPZ-25-50-P-A**	**162099**	**DPZ-25-50-P-A-KF**
		80	**32704**	**DPZ-25-80-P-A**	**162100**	**DPZ-25-80-P-A-KF**
		100	**32705**	**DPZ-25-100-P-A**	**162101**	**DPZ-25-100-P-A-KF**
	32	10	**159817**	**DPZ-32-10-P-A**	**162131**	**DPZ-32-10-P-A-KF**
		25	**159818**	**DPZ-32-25-P-A**	**162132**	**DPZ-32-25-P-A-KF**
		40	**159819**	**DPZ-32-40-P-A**	**162133**	**DPZ-32-40-P-A-KF**
		50	**159820**	**DPZ-32-50-P-A**	**162134**	**DPZ-32-50-P-A-KF**
		80	**159821**	**DPZ-32-80-P-A**	**162135**	**DPZ-32-80-P-A-KF**
		100	**159822**	**DPZ-32-100-P-A**	**162136**	**DPZ-32-100-P-A-KF**

1) 4 centring pins or sleeves are included in the scope of delivery.

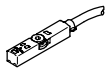
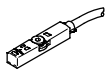
Ordering data – Variants DPZ							
Type	Piston ∅ [mm]	Stroke [mm]	Plain-bearing guide GF			Recirculating ball bearing guide KF	
			Part No.	Type[1]		Part No.	Type[1]
S2 – Through piston rods							
	10	10	**159862**	**DPZ-10-10-P-A-S2**		**162006**	**DPZ-10-10-P-A-KF-S2**
		25	**159863**	**DPZ-10-25-P-A-S2**		**162007**	**DPZ-10-25-P-A-KF-S2**
		40	**159864**	**DPZ-10-40-P-A-S2**		**162008**	**DPZ-10-40-P-A-KF-S2**
		50	**159865**	**DPZ-10-50-P-A-S2**		**162009**	**DPZ-10-50-P-A-KF-S2**
	16	10	**159867**	**DPZ-16-10-P-A-S2**		**162033**	**DPZ-16-10-P-A-KF-S2**
		25	**159868**	**DPZ-16-25-P-A-S2**		**162034**	**DPZ-16-25-P-A-KF-S2**
		40	**159869**	**DPZ-16-40-P-A-S2**		**162035**	**DPZ-16-40-P-A-KF-S2**
		50	**159870**	**DPZ-16-50-P-A-S2**		**162036**	**DPZ-16-50-P-A-KF-S2**
		80	**159871**	**DPZ-16-80-P-A-S2**		**162037**	**DPZ-16-80-P-A-KF-S2**
		100	**159872**	**DPZ-16-100-P-A-S2**		**162038**	**DPZ-16-100-P-A-KF-S2**
	20	10	**159874**	**DPZ-20-10-P-A-S2**		**162068**	**DPZ-20-10-P-A-KF-S2**
		25	**159875**	**DPZ-20-25-P-A-S2**		**162069**	**DPZ-20-25-P-A-KF-S2**
		40	**159876**	**DPZ-20-40-P-A-S2**		**162070**	**DPZ-20-40-P-A-KF-S2**
		50	**159877**	**DPZ-20-50-P-A-S2**		**162071**	**DPZ-20-50-P-A-KF-S2**
		80	**159878**	**DPZ-20-80-P-A-S2**		**162072**	**DPZ-20-80-P-A-KF-S2**
		100	**159879**	**DPZ-20-100-P-A-S2**		**162073**	**DPZ-20-100-P-A-KF-S2**
	25	10	**159881**	**DPZ-25-10-P-A-S2**		**162103**	**DPZ-25-10-P-A-KF-S2**
		25	**159882**	**DPZ-25-25-P-A-S2**		**162104**	**DPZ-25-25-P-A-KF-S2**
		40	**159883**	**DPZ-25-40-P-A-S2**		**162105**	**DPZ-25-40-P-A-KF-S2**
		50	**159884**	**DPZ-25-50-P-A-S2**		**162106**	**DPZ-25-50-P-A-KF-S2**
		80	**159885**	**DPZ-25-80-P-A-S2**		**162107**	**DPZ-25-80-P-A-KF-S2**
		100	**159886**	**DPZ-25-100-P-A-S2**		**162108**	**DPZ-25-100-P-A-KF-S2**
	32	10	**159891**	**DPZ-32-10-P-A-S2**		**162138**	**DPZ-32-10-P-A-KF-S2**
		25	**159892**	**DPZ-32-25-P-A-S2**		**162139**	**DPZ-32-25-P-A-KF-S2**
		40	**159893**	**DPZ-32-40-P-A-S2**		**162140**	**DPZ-32-40-P-A-KF-S2**
		50	**159894**	**DPZ-32-50-P-A-S2**		**162141**	**DPZ-32-50-P-A-KF-S2**
		80	**159895**	**DPZ-32-80-P-A-S2**		**162142**	**DPZ-32-80-P-A-KF-S2**
		100	**159896**	**DPZ-32-100-P-A-S2**		**162143**	**DPZ-32-100-P-A-KF-S2**

1) 4 centring pins or sleeves are included in the scope of delivery.

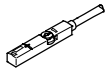
Ordering data – Variants DPZJ with additional yoke								
Type	Piston ∅ [mm]	Stroke [mm]	Plain-bearing guide GF				Recirculating ball bearing guide KF	
			Part No.	Type[1]			Part No.	Type[1]
S2 – Through piston rods								
	10	10	**159940**	**DPZJ-10-10-P-A-S2**			**162016**	**DPZJ-10-10-P-A-KF-S2**
		25	**159941**	**DPZJ-10-25-P-A-S2**			**162017**	**DPZJ-10-25-P-A-KF-S2**
		40	**159942**	**DPZJ-10-40-P-A-S2**			**162018**	**DPZJ-10-40-P-A-KF-S2**
		50	**159943**	**DPZJ-10-50-P-A-S2**			**162019**	**DPZJ-10-50-P-A-KF-S2**
	16	10	**159945**	**DPZJ-16-10-P-A-S2**			**162047**	**DPZJ-16-10-P-A-KF-S2**
		25	**159946**	**DPZJ-16-25-P-A-S2**			**162048**	**DPZJ-16-25-P-A-KF-S2**
		40	**159947**	**DPZJ-16-40-P-A-S2**			**162049**	**DPZJ-16-40-P-A-KF-S2**
		50	**159948**	**DPZJ-16-50-P-A-S2**			**162050**	**DPZJ-16-50-P-A-KF-S2**
		80	**159949**	**DPZJ-16-80-P-A-S2**			**162051**	**DPZJ-16-80-P-A-KF-S2**
		100	**159950**	**DPZJ-16-100-P-A-S2**			**162052**	**DPZJ-16-100-P-A-KF-S2**
	20	10	**159952**	**DPZJ-20-10-P-A-S2**			**162082**	**DPZJ-20-10-P-A-KF-S2**
		25	**159953**	**DPZJ-20-25-P-A-S2**			**162083**	**DPZJ-20-25-P-A-KF-S2**
		40	**159954**	**DPZJ-20-40-P-A-S2**			**162084**	**DPZJ-20-40-P-A-KF-S2**
		50	**159955**	**DPZJ-20-50-P-A-S2**			**162085**	**DPZJ-20-50-P-A-KF-S2**
		80	**159956**	**DPZJ-20-80-P-A-S2**			**162086**	**DPZJ-20-80-P-A-KF-S2**
		100	**159957**	**DPZJ-20-100-P-A-S2**			**162087**	**DPZJ-20-100-P-A-KF-S2**
	25	10	**159959**	**DPZJ-25-10-P-A-S2**			**162117**	**DPZJ-25-10-P-A-KF-S2**
		25	**159960**	**DPZJ-25-25-P-A-S2**			**162118**	**DPZJ-25-25-P-A-KF-S2**
		40	**159961**	**DPZJ-25-40-P-A-S2**			**162119**	**DPZJ-25-40-P-A-KF-S2**
		50	**159962**	**DPZJ-25-50-P-A-S2**			**162120**	**DPZJ-25-50-P-A-KF-S2**
		80	**159963**	**DPZJ-25-80-P-A-S2**			**162121**	**DPZJ-25-80-P-A-KF-S2**
		100	**159964**	**DPZJ-25-100-P-A-S2**			**162122**	**DPZJ-25-100-P-A-KF-S2**
	32	10	**159969**	**DPZJ-32-10-P-A-S2**			**162152**	**DPZJ-32-10-P-A-KF-S2**
		25	**159970**	**DPZJ-32-25-P-A-S2**			**162153**	**DPZJ-32-25-P-A-KF-S2**
		40	**159971**	**DPZJ-32-40-P-A-S2**			**162154**	**DPZJ-32-40-P-A-KF-S2**
		50	**159972**	**DPZJ-32-50-P-A-S2**			**162155**	**DPZJ-32-50-P-A-KF-S2**
		80	**159973**	**DPZJ-32-80-P-A-S2**			**162156**	**DPZJ-32-80-P-A-KF-S2**
		100	**159974**	**DPZJ-32-100-P-A-S2**			**162157**	**DPZJ-32-100-P-A-KF-S2**

1) 4 centring pins or sleeves are included in the scope of delivery.

Ordering data – Proximity sensors for T-slot, magneto-resistive — Technical data ➔ Internet: smt

	Type of mounting	Switch output	Electrical connection	Cable length [m]	Part No.	Type
N/O contact						
	Insertable in the slot from above, flush with cylinder profile, short design	PNP	Cable, 3-wire	2.5	**574335**	**SMT-8M-A-PS-24V-E-2,5-OE**
			Plug M8x1, 3-pin	0.3	**574334**	**SMT-8M-A-PS-24V-E-0,3-M8D**
			Plug M12x1, 3-pin	0.3	**574337**	**SMT-8M-A-PS-24V-E-0,3-M12**
		NPN	Cable, 3-wire	2.5	**574338**	**SMT-8M-A-NS-24V-E-2,5-OE**
			Plug M8x1, 3-pin	0.3	**574339**	**SMT-8M-A-NS-24V-E-0,3-M8D**
N/C contact						
	Insertable in the slot from above, flush with cylinder profile, short design	PNP	Cable, 3-wire	7.5	**574340**	**SMT-8M-A-PO-24V-E-7,5-OE**

Ordering data – Proximity sensors for T-slot, magnetic reed — Technical data ➔ Internet: sme

	Type of mounting	Switch output	Electrical connection	Cable length [m]	Part No.	Type
N/O contact						
	Insertable in the slot from above, flush with cylinder profile	Contacting	Cable, 3-wire	2.5	**543862**	**SME-8M-DS-24V-K-2,5-OE**
				5.0	**543863**	**SME-8M-DS-24V-K-5,0-OE**
			Cable, 2-wire	2.5	**543872**	**SME-8M-ZS-24V-K-2,5-OE**
			Plug M8x1, 3-pin	0.3	**543861**	**SME-8M-DS-24V-K-0,3-M8D**
	Insertable in the slot lengthwise, flush with the cylinder profile	Contacting	Cable, 3-wire	2.5	**150855**	**SME-8-K-LED-24**
			Plug M8x1, 3-pin	0.3	**150857**	**SME-8-S-LED-24**
N/C contact						
	Insertable in the slot lengthwise, flush with the cylinder profile	Contacting	Cable, 3-wire	7.5	**160251**	**SME-8-O-K-LED-24**

Ordering data – Connecting cables — Technical data ➔ Internet: nebu

	Electrical connection, left	Electrical connection, right	Cable length [m]	Part No.	Type
	Straight socket, M8x1, 3-pin	Cable, open end, 3-wire	2.5	**541333**	**NEBU-M8G3-K-2.5-LE3**
			5	**541334**	**NEBU-M8G3-K-5-LE3**
	Straight socket, M12x1, 5-pin	Cable, open end, 3-wire	2.5	**541363**	**NEBU-M12G5-K-2.5-LE3**
			5	**541364**	**NEBU-M12G5-K-5-LE3**
	Angled socket, M8x1, 3-pin	Cable, open end, 3-wire	2.5	**541338**	**NEBU-M8W3-K-2.5-LE3**
			5	**541341**	**NEBU-M8W3-K-5-LE3**
	Angled socket, M12x1, 5-pin	Cable, open end, 3-wire	2.5	**541367**	**NEBU-M12W5-K-2.5-LE3**
			5	**541370**	**NEBU-M12W5-K-5-LE3**

Ordering data – Slot cover for T-slot

	Mounting	Length	Part No.	Type
	Insertable from above	2x 0.5 m	**151680**	**ABP-5-S**

Ordering data – One-way flow control valves					Technical data ➔ Internet: grla
	Connection		Material	Part No.	Type
	Thread	For tubing O.D.			
	M5	3	Metal design	**193137**	**GRLA-M5-QS-3-D**
		4		**193138**	**GRLA-M5-QS-4-D**
		6		**193139**	**GRLA-M5-QS-6-D**
	G1/8	3		**193142**	**GRLA-1/8-QS-3-D**
		4		**193143**	**GRLA-1/8-QS-4-D**
		6		**193144**	**GRLA-1/8-QS-6-D**
		8		**193145**	**GRLA-1/8-QS-8-D**

Ordering data – Accessories					
	For ∅ [mm]	Material	Part No.	Type	PE[1]
Centring pin ZBS					Technical data ➔ Internet: zbs
	10, 16	Stainless steel Free of copper and PTFE	**150928**	**ZBS-5**	10
Centring sleeve ZBH					Technical data ➔ Internet: zbh
	20, 25, 30	Stainless steel Free of copper and PTFE	**150927**	**ZBH-9**	10

1) Packaging unit quantity

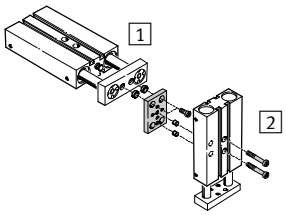
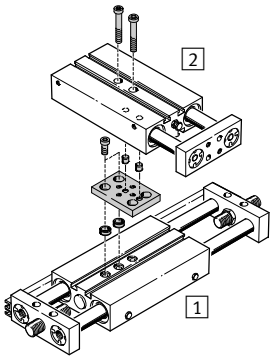
Adapter kit
BPL

Material:
Wrought aluminium alloy
Free of copper and PTFE
RoHS-compliant

- Note
The kit includes the individual mounting interface as well as the necessary mounting material.

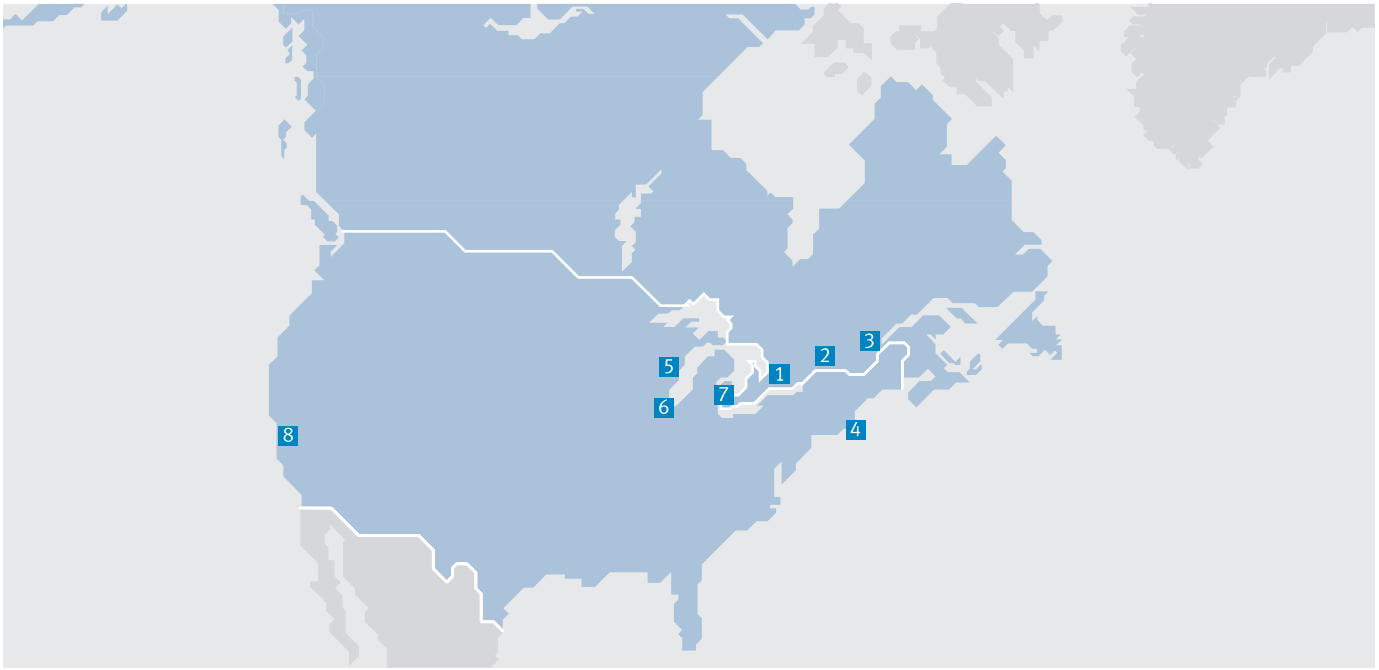
Permissible drive/drive combinations with adapter kit

Download CAD data ➔ **www.festo.com**

Combination	1 Drive	2 Drive	Adapter kit		
	Size	Size	CRC[1]	Part No.	Type
DPZ/DPZ	DPZ	DPZ	BPL		
	20, 25, 32	10, 16	2	**150929**	**BPL-1**
	20, 25, 32	20		**150930**	**BPL-2**
	25, 32	25		**150931**	**BPL-3**
	32	32		**150931**	**BPL-3**
SPZ/DPZ	SPZ	DPZ	BPL		
	20, 25, 32	10, 16	2	**150929**	**BPL-1**
	20, 25, 32	20		**150930**	**BPL-2**
	25, 32	25		**150931**	**BPL-3**
	32	32		**150931**	**BPL-3**

1) Corrosion resistance class CRC 2 to Festo standard FN 940070
Moderate corrosion stress. Indoor applications in which condensation may occur. External visible parts with primarily decorative requirements for the surface and which are in direct contact with the ambient atmosphere typical for industrial applications.

Festo North America



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Subject to change

Internet: **www.festo.com/us**

Parallel grippers HGPC

FESTO

Type discontinued
Available up until 2018

Parallel grippers HGPC

Key features

At a glance

General

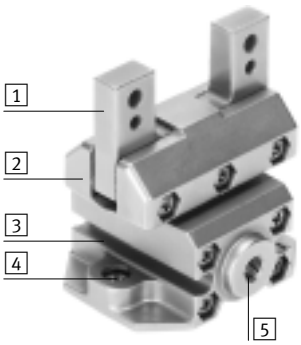
The compact and low-cost parallel gripper consists of a two-part symmetrical housing. The piston moves traverse to the half-shell casing in an optimum housing design that guarantees reliable operation, long service life and convenient sensing. The gripper jaws move along the half shells in backlash-free, preloaded ball bearing guides.

- Double-acting gripper
- Compression spring for supplementary or retaining gripping forces
- Internal fixed flow control, does away with the need for external flow control in 80% of applications
- High force with minimal volume
- Suitable for external and internal gripping
- Wide range of options for attaching drive units
- Repetition accuracy of 0.05 mm
- Slot for proximity sensor SME/SMT-10

Note

Sizing software
Gripper selection
➔www.festo.com

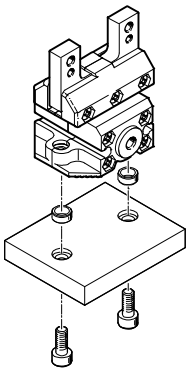
Details



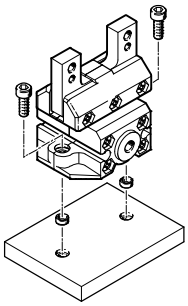
1 Gripper jaw with ball bearing guide
2 Housing based on half-shell principle
3 Slot for proximity sensor, for sensing the piston position
4 Mounting option
5 Supply port

Mounting option

from underneath

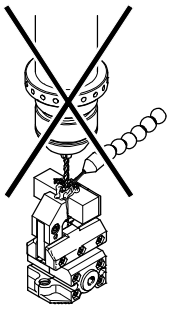


from above

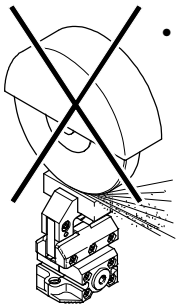


Note

Parallel grippers are not designed for the following applications:

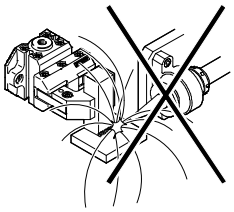


- Machining
- Aggressive media



- Grinding dust

- Welding spatter

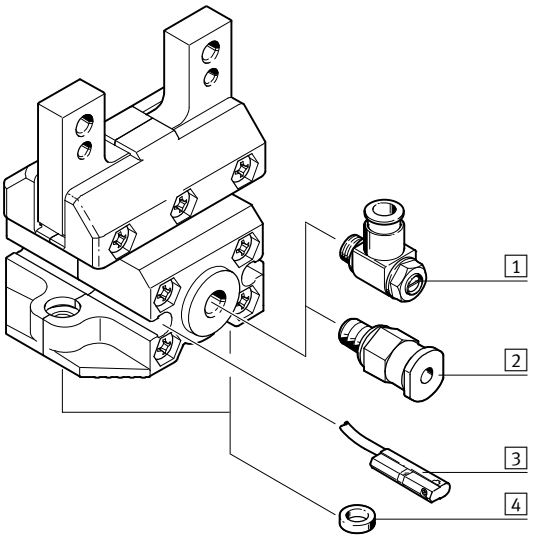


Parallel grippers HGPC

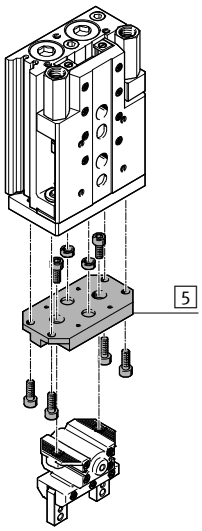
Peripherals overview and type codes

FESTO

Peripherals overview



System product for handling and assembly technology



Accessories

	Type	Description	➔ Page/Internet
1	One-way flow control valve GRLA	For regulating speed	grla
2	Push-in fitting QS	For connecting compressed air tubing with standard O.D.	qs
3	Proximity sensor SME/SMT-10	For sensing the piston position	13
4	Centring sleeve ZBH	For centring when attaching to a drive (2 included in the scope of delivery)	13
5	Adapter kit HMSV, HAPG	Drive/gripper connections	12

Type codes

HGPC – 12 – A – G2

Type

HGPC	Parallel gripper

Size

Position sensing

A	Via proximity sensor

Gripping force backup

G2	Closing

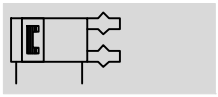
Type discontinued
Available up until 2018

Parallel grippers HGPC

Technical data

FESTO

Function
Double-acting
HGPC-...-A



Single-acting or
with gripping force retention
closing HGPC-...-G2

Size
12, 16, 20 mm

Stroke
6 ... 14 mm

General technical data				
Size		12	16	20
Constructional design		Wedge-shaped drive		
		Guided motion sequence		
Mode of operation		Double-acting		
Gripper function		Parallel		
Number of gripper jaws		2		
Max. load per external gripper finger[1]	[g]	20	50	80
Stroke per gripper jaw	[mm]	3	5	7
Pneumatic connection		M5		
Repetition accuracy[2]	[mm]	≤ 0.05		
Max. interchangeability	[mm]	≤ 0.2		
Max. gripper jaw backlash[3]	[mm]	0		
Max. gripper jaw angular backlash[4]	[°]	0		
Max. operating frequency	[Hz]	4		
Rotational symmetry	[mm]	< ∅ 0.2		
Position sensing		For proximity sensing		
Type of mounting		With female thread and centring sleeve		
Mounting position		Any		

1) Valid for unthrottled operation
2) End-position drift under constant conditions of use with 100 consecutive strokes in the direction of movement of the gripper jaws
3) Perpendicular to the direction of motion of the gripper jaws
4) Pretensioned, backlash-free ball bearing guide

Operating and environmental conditions			
Min. operating pressure	HGPC-...-A [bar]		2
	HGPC-...-G2 [bar]		4
Max. operating pressure		[bar]	8
Operating medium			Compressed air in accordance with ISO 8573-1:2010 [7:4:4]
Note on operating/pilot medium			Operation with lubricated medium possible (in which case lubricated operation will always be required)
Ambient temperature[1]		[°C]	+5 ... +60
Corrosion resistance class CRC[2]			2

1) Note operating range of proximity sensors
2) Corrosion resistance class 2 according to Festo standard 940 070
Components requiring moderate corrosion resistance. Externally visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment or media such as coolants or lubricating agents

Weights [g]			
Size	12	16	20
HGPC-...-A	152	241	473
HGPC-...-G2	154	244	477

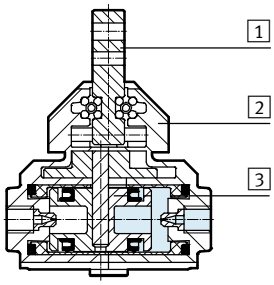
Parallel grippers HGPC

Technical data

FESTO

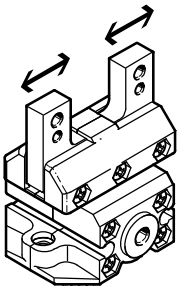
Materials

Sectional view



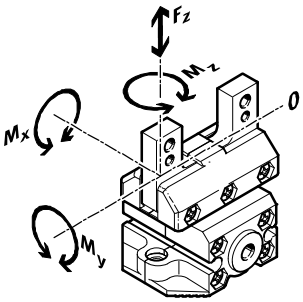
Parallel gripper		
1	Gripper jaw	High-alloy steel
2	Housing	Die-cast zinc
3	Piston	Polyamide
–	Seals	Polyurethane, nitrile rubber
–	Note on materials	Copper and PTFE-free
		Conforms to RoHS

Gripping force [N] at 6 bar



Size	12	16	20
Gripping force per gripper jaw			
Opening	22	41.5	63
Closing	22	41.5	63
Total gripping force			
Opening	44	83	126
Closing	44	83	126

Static characteristic load values at the gripper jaws



Indicated permissible forces and torques apply to a single gripper jaw. The indicated values include the lever arm, additional applied loads caused by the workpiece or external gripper fingers, as well as forces which occur during movement.
The zero coordinate line (gripper finger guide) must be taken into consideration for the calculation of torques.

Size		12	16	20
Max. permissible force F_z	[N]	40	80	120
Max. permissible torque M_x	[Nm]	1	2,5	5
Max. permissible torque M_y	[Nm]	1	2,5	5
Max. permissible torque M_z	[Nm]	1	2,5	5

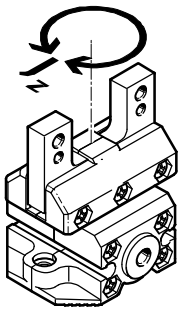
- 1 - **Type discontinued**
Available up until 2018

Parallel grippers HGPC

Technical data

FESTO

Mass moment of inertia [kgm²x10⁻⁴]

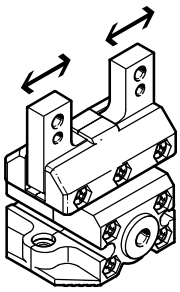


Mass moment of inertia [kgm²x10⁻⁴] of the parallel gripper in relation to the central axis with no load.

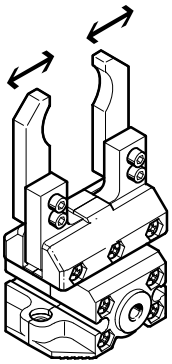
Size	12	16	20
HGPC-...-A	0.272	0.679	2.095
HGPC-...-G2	0.274	0.683	2.105

Opening and closing times [ms] at 6 bar

without external gripper fingers



with external gripper fingers



The indicated opening and closing times [ms] have been measured at room temperature and at 6 bar operating pressure with horizontally mounted gripper without additional gripper fingers. The grippers must be throttled for greater loads [g]. Opening and closing times must then be adjusted correspondingly.

Size		12	16	20
without external gripper fingers				
HGPC-...-A	Opening	30	60	90
	Closing	30	60	90
HGPC-...-G2	Opening	30	70	105
	Closing	30	50	75
with external gripper fingers (as a function of the load per gripper finger)				
HGPC-...	40 g	40	–	–
	50 g	60	–	–
	60 g	80	–	–
	70 g	–	80	–
	100 g	–	100	–
	120 g	–	–	100

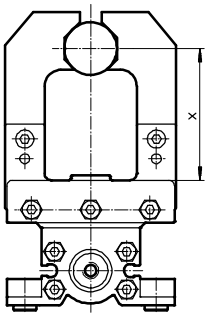
Parallel grippers HGPC

Technical data

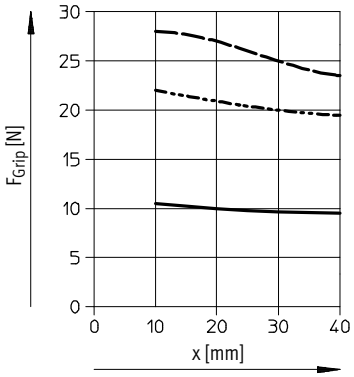
FESTO

Gripping force F_{Grip} per gripper jaw as a function of operating pressure and lever arm x

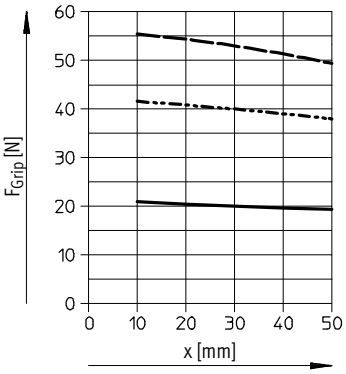
Gripping forces as a function of the operating pressure and the lever arm can be determined for the size using the following graph.



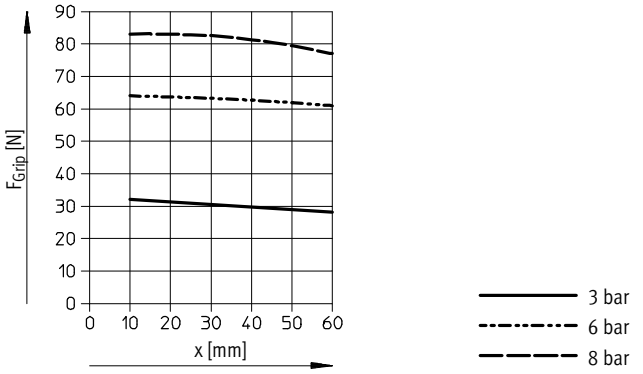
HGPC-12-A



HGPC-16-A



HGPC-20-A



Parallel grippers HGPC

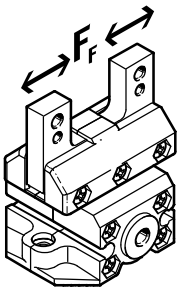
Technical data

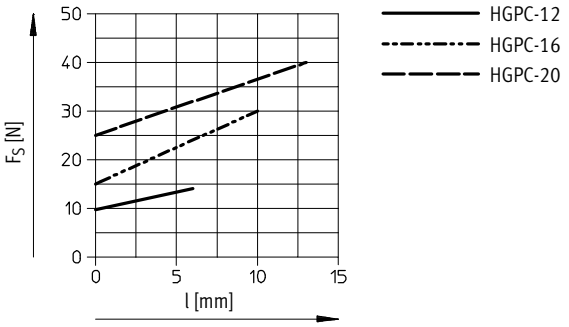
FESTO

Spring force F_S as a function of the gripper size and the overall stroke l

Gripping force retention for HGPC-...-G2

Spring forces F_S as a function of the gripper size and the overall stroke l for various gripper types (HGPC-...-G2) can be determined using the following graphs.





The lever arm x must be taken into consideration when determining the actual spring force F_{Stotal}.
The formulae for calculating the spring force are provided in the table opposite.

Size	F_{Stotal} =
12	$-0.02 * x + 0.5 * F_S$
16	$-0.05 * x + 0.5 * F_S$
20	$-0.05 * x + 0.5 * F_S$

Determination of the actual gripping forces F_{Gr} for HGPC-...-G2 depending on the application

Parallel grippers with integrated spring type HGPC-...-G2 (closing gripping force retention) can be used as:
- single-acting grippers
- grippers with supplementary gripping force
- grippers with gripping force retention

In order to calculate available gripping forces F_{Gr} (per gripper jaw), the gripping force (F_{Grip}) and spring force (F_{Stotal}) must be combined accordingly.

Application

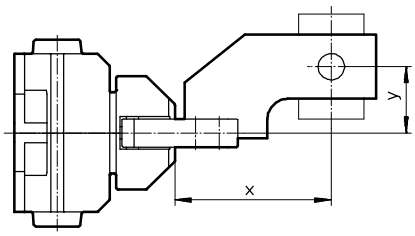
Single-acting	Supplementary gripping force	Gripping force retention
• Gripping with spring force: $F_{Gr} = F_{Stotal}$	• Gripping with pressure and spring force: $F_{Gr} = F_{Grip} + F_{Stotal}$	• Gripping with spring force: $F_{Gr} = F_{Stotal}$
• Gripping with pressure force: $F_{Gr} = F_{Grip} - F_{Stotal}$		

Parallel grippers HGPC

Technical data

FESTO

Gripping force F_{Grip} per gripper jaw at 6 bar as a function of lever arm x and eccentricity y



Gripping forces at 6 bar dependent upon eccentric application of force and the maximum permissible off-centre point of force application can be determined for the size using the following graph.

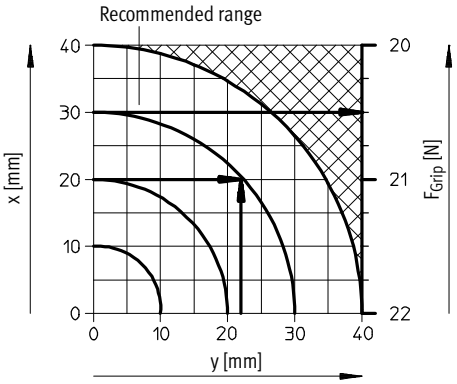
Calculation example

Given:
Lever arm x = 20 mm
Eccentricity y = 22 mm
To be found:
Gripping force at 6 bar

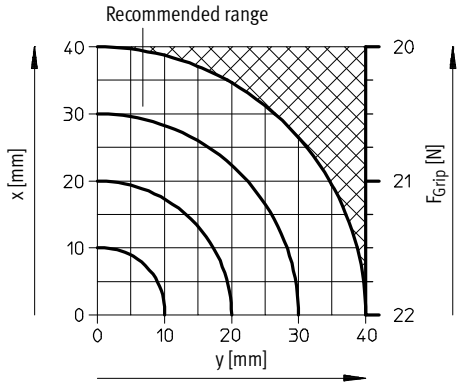
Procedure:

- Determine the intersection xy between lever arm x and eccentricity y in the graph for HGPC-12-A-...
- Draw an arc (with centre at origin) through intersection xy.
- Determine the intersection between the arc and the X axis.
- Read the gripping force.

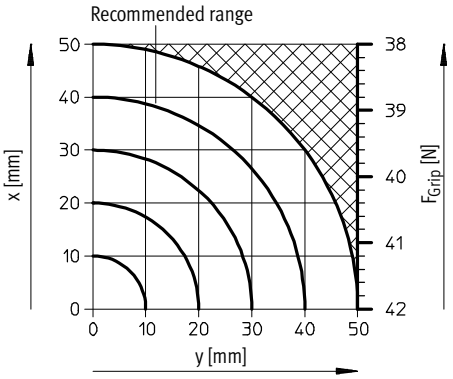
Result:
Gripping force F = approx. 20.5 N



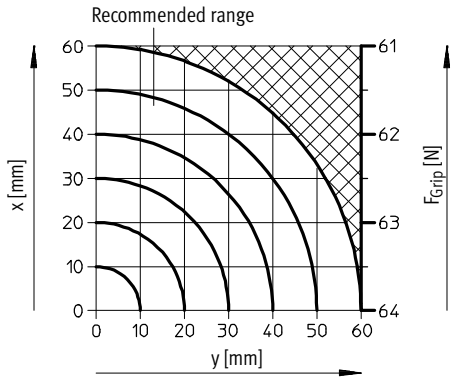
HGPC-12-A



HGPC-16-A



HGPC-20-A



Type discontinued
Available up until 2018

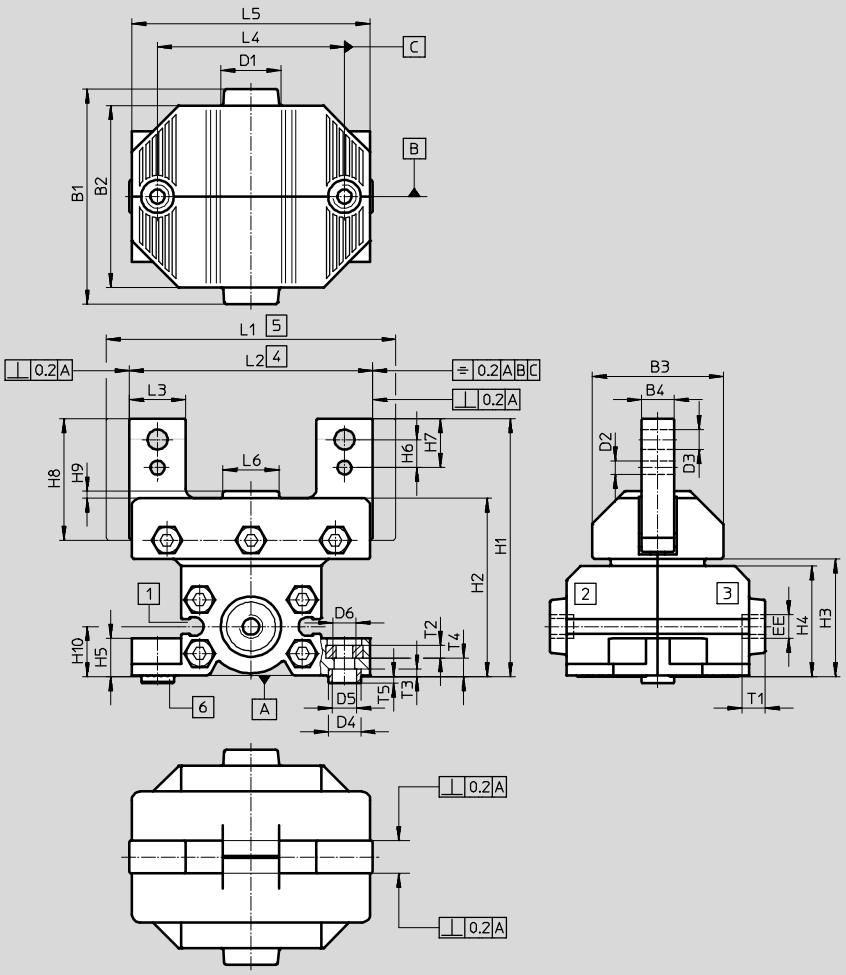
Parallel grippers HGPC

Technical data

FESTO

Dimensions

Download CAD data ➔ **www.festo.com**



1 Sensor slot for proximity sensor
2 Supply port, opening
3 Supply port, closing
4 Gripper jaw closed
5 Gripper jaw open
6 Centring sleeves ZBH
(2 included in scope of delivery)

Size	B1	B2	B3	B4	D1	D2	D3	D4	D5	D6
[mm]				±0.1			±0.1	∅ F10/h7	∅	
12	38	33	22.4	6	12	$2.5^{+0.04/+0.01}$	3.3	7	5.3	M4
16	46	39	28	7	12	3^{H8}	4.3	7	5.3	M5
20	57	50	35	8	12	4^{H8}	5.3	9	6.4	M6

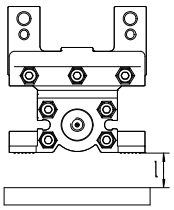
Size	EE	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
[mm]		±0.5							−0.2		
12	M5	48.2	33.6	21.7	20.2	6.9	$5_{+0.05/-0.1}$	$9_{+0.05/-0.1}$	25	1.2	9.2
16	M5	55.2	38.2	25.2	23.7	8.2	$6_{\pm 0.1}$	$10.5_{\pm 0.4}$	28.5	1.5	10.7
20	M5	68.7	48.2	32.5	30.5	10.2	$7.5_{\pm 0.1}$	$13_{\pm 0.4}$	34.5	1.5	13.7

Size	L1	L2	L3	L4[1)]	L5	L6	T1	T2	T3	T4	T5
[mm]	±0.5	±0.5					min.		±0.1	+0.4 −0.3	+0.1 −0.3
12	45	39	$10_{-0.02/-0.06}$	33	42	10	4.5	2.2	1.7	3.1	1.3
16	62	52	$12_{-0.05}$	40	51	12	4.5	2.7	1.8	3.8	1.2
20	77	63	$14_{-0.05}$	50	65	16	4.5	3.2	2.3	5.2	1.7

1) Tolerance for centring hole ±0.03
Tolerance for thread ±0.1

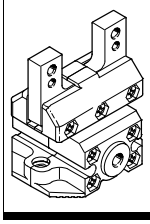
Parallel grippers HGPC

Technical data



Minimum distance l between gripper and ferritic object				
		12	16	20
Distance	[mm]	10		

Ordering data

	Size	Double-acting Without compression spring		Single-acting or with gripping force retention Closing	
	[mm]	Part No.	Type	Part No.	Type
	12	**539 267**	**HGPC-12-A**	**539 268**	**HGPC-12-A-G2**
	16	**539 269**	**HGPC-16-A**	**539 270**	**HGPC-16-A-G2**
	20	**539 271**	**HGPC-20-A**	**539 272**	**HGPC-20-A-G2**

Type discontinued
Available up until 2018

Parallel grippers HGPC

Accessories

Adapter kit
HAPG

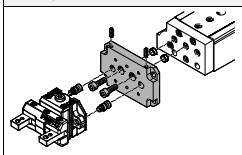
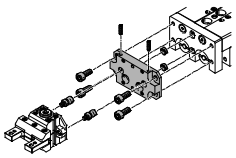
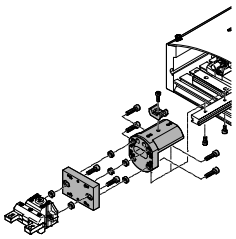
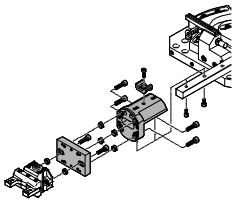
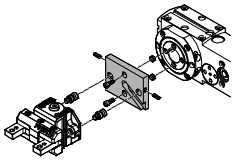
Material:
Wrought aluminium alloy
Free of copper and PTFE
RoHS-compliant

Note

The kit includes the individual mounting interface as well as the necessary mounting material.

Permissible drive/gripper combinations with adapter kit

Download CAD data ➔ **www.festo.com**

Combination	Drive	Gripper	Mounting option		Adapter kit		
	Size	Size			CRC[1]	Part No.	Type
DGSL/HGPC	DGSL	HGPC			HAPG		
	12, 16	12	■	■	2	**529018**	**HAPG-58**
	20, 25	16	■	■		**191267**	**HAPG-49**
	20, 25	20	■	■		**191269**	**HAPG-51**
SLT/HGPC	SLT	HGPC			HAPG		
	10	12	■	–	2	**542670**	**HAPG-100**
	16	12	■	–		**529018**	**HAPG-58**
	16	16	■	–		**542666**	**HAPG-101**
	20	16	■	–		**191267**	**HAPG-49**
	20	20	■	–		**542667**	**HAPG-102**
	25	20	■	–		**191269**	**HAPG-51**
HSP/HGPC	HSP	HGPC			HAPG		
	16	16	■	–	2	**191901**	**HAPG-55**
						540882	**HAPG-71-B**
	25	20	■	–		**191901**	**HAPG-55**
						540883	**HAPG-72-B**
HSW/HGPC	HSW	HGPC			HAPG		
	12, 16	16	■	–	2	**191901**	**HAPG-55**
						540882	**HAPG-71-B**
ERMB/HGPC	ERMB	HGPC			HAPG		
	20	16	■	■	2	**542668**	**HAPG-SD2-42**
	20	20	■	■		**542669**	**HAPG-SD2-43**
	25	20	■	■		**542758**	**HAPG-SD2-44**

1) Corrosion resistance class 2 according to Festo standard 940 070
Components subject to moderate corrosion stress. Externally visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment or media such as coolants or lubricating agents.

Parallel grippers HGPC

Accessories

FESTO

Ordering data – Centring sleeves					Technical data ➔ Internet: zbh
	For size [mm]	Weight [g]	Part No.	Type	PU[1]
	12, 16	1	**186717**	**ZBH-7**	10
	20	1	**150927**	**ZBH-9**	10

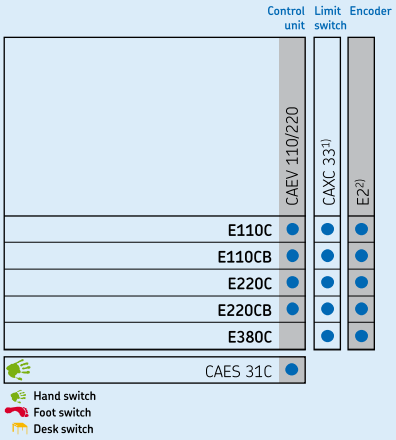
1) Packaging unit

Ordering data – Proximity sensors for C-slot						
	Type of mounting	Electrical connection, connection direction	Switching output	Cable length [m]	Part No.	Type
	N/O contact, magneto-resistive					Technical data ➔ Internet: smt
	Insertable in the slot from above	Cable, 3-wire, in-line	PNP	2.5	**551373**	**SMT-10M-PS-24V-E-2,5-L-OE**
		Plug M8x1, 3-pin, in-line		0.3	**551375**	**SMT-10M-PS-24V-E-0,3-L-M8D**
	N/O contact, magnetic reed					Technical data ➔ Internet: sme
	Insertable in the slot lengthwise	Cable, 3-wire, in-line	Contacting	2.5	**173210**	**SME-10-KL-LED-24**
		Plug M8x1, 3-pin, in-line		0.3	**173212**	**SME-10-SL-LED-24**

Ordering data – Proximity sensors for C-slot						
	Type of mounting	Electrical connection, connection direction	Switching output	Cable length [m]	Part No.	Type
	N/O contact, magneto-resistive					Technical data ➔ Internet: smt
	Insertable in the slot from above	Cable, 3-wire, lateral	PNP	2.5	**551374**	**SMT-10M-PS-24V-E-2,5-Q-OE**
		Plug M8x1, 3-pin, lateral		0.3	**551376**	**SMT-10M-PS-24V-E-0,3-Q-M8D**
	N/O contact, magnetic reed					Technical data ➔ Internet: sme
	Insertable in the slot lengthwise	Cable, 3-wire, lateral	Contacting	2.5	**173211**	**SME-10-KQ-LED-24**
		Plug M8x1, 3-pin, lateral		0.3	**173213**	**SME-10-SQ-LED-24**

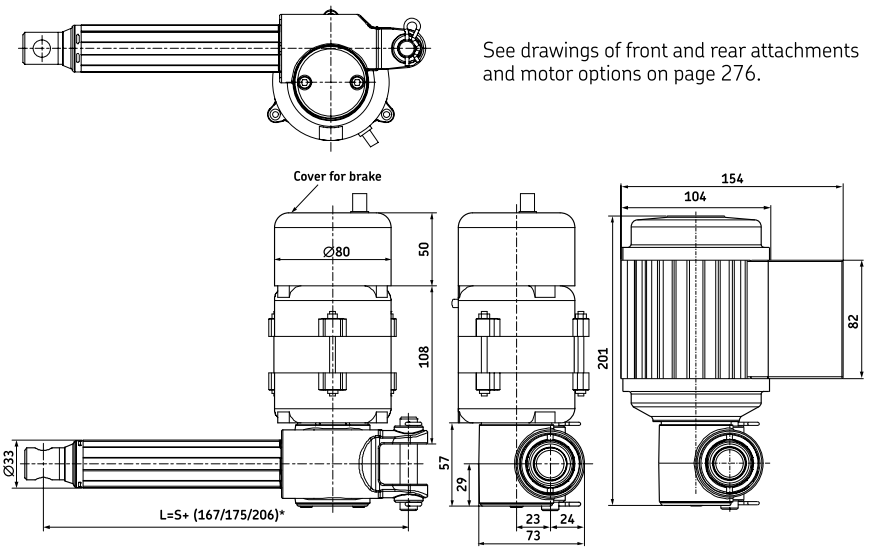
Ordering data – Connecting cables						Technical data ➔ Internet: nebu
	Electrical connection, left	Electrical connection, right		Cable length [m]	Part No.	Type
	Straight socket, M8x1, 3-pin	Cable, open end, 3-wire		2.5	**541333**	**NEBU-M8G3-K-2.5-LE3**
				5	**541334**	**NEBU-M8G3-K-5-LE3**
	Angled socket, M8x1, 3-pin	Cable, open end, 3-wire		2.5	**541338**	**NEBU-M8W3-K-2.5-LE3**
				5	**541341**	**NEBU-M8W3-K-5-LE3**

Suitable control units and accessories



[1)] See page 378
[2)] See page 380

Dimensional drawing – AC version



See drawings of front and rear attachments and motor options on page 276.

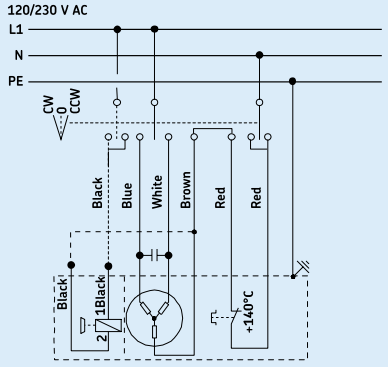
Legend:
S = stroke
L = retracted length

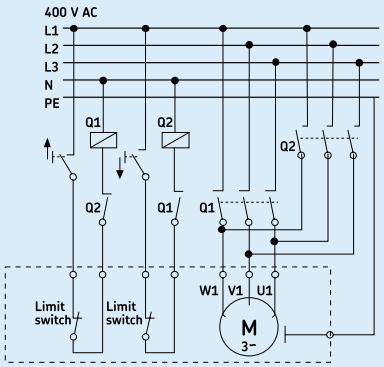
120 or 230 V AC motor

400 V AC motor

* Dimension depends on selected front attachment

Connecting diagrams – AC version





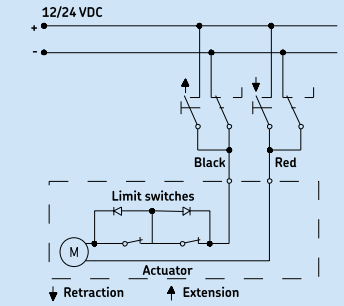
Technical data

		Unit	CAT 33 – AC version
Rated push load		N	800 to 3 000
Rated pull load		N	800 to 3 000
Speed (at full load)		mm/s	5 to 24[1)]
Stroke		mm	100 to 400
Retracted length		mm	S+150/158/189[2)]
Voltage		V AC	120, 230 or 400
Power consumption	120 V AC	W	98 (brake 133,2W)
	230 V AC	W	92 (brake 117,3W)
	400 V AC	W	80
Current consumption	120 V AC	A	0,82 (brake +0,29A)
	230 V AC	A	0,4 (brake + 0,11A)
	400 V AC	A	0,2
Duty cycle		%	30
Ambient temperature		°C	–20 to +50
Type of protection		IP	20/54/55
Weight		kg	2 to 2,7

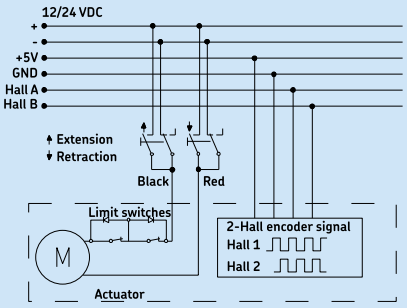
[1)] Depending on selected motor
[2)] Dimension depends on selected front attachment

Connecting diagram

Basic configuration

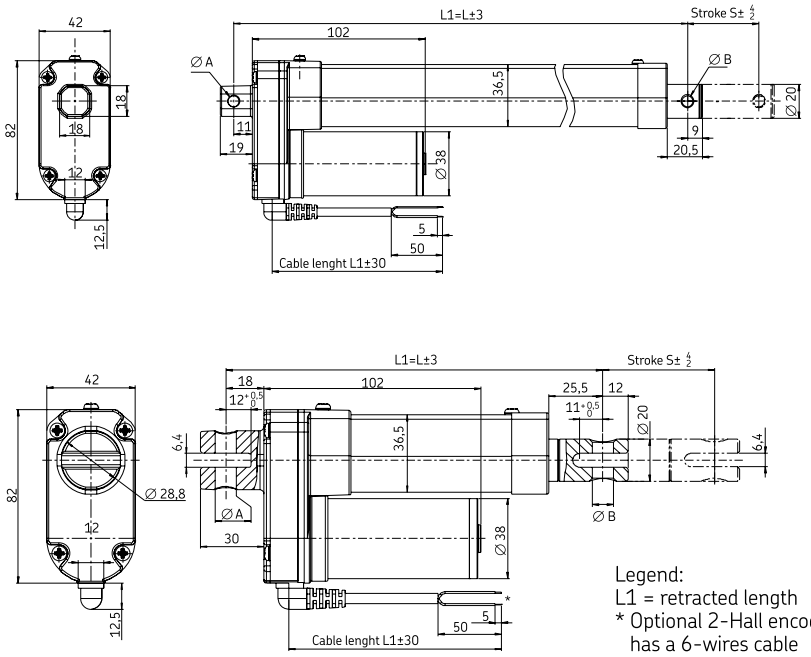


2-Hall encoder



Dimensional drawing

Basic configuration and optional 2-Hall encoder



Legend:
L1 = retracted length
* Optional 2-Hall encoder has a 6-wires cable

Stroke (mm)	50	100	150	200	250	300
Retracted length (L1)	158	209	260	311	362	413
Retracted length with fork head	179	230	281	332	383	434

Encoder resolution

Gear ratio	5:1	10:1	20:1	30:1	40:1
Mm/pulse	0,3	0,15	0,075	0,05	0,038

Technical data

	Unit	CAHB–10... 1	CAHB–10... 2	CAHB–10... 3	CAHB–10... 4	CAHB–10... 5
Push load	N	120	240	500	750	1 000
Pull load	N	120	240	500	750	1 000
Speed (full load to no load)	mm/s	45 to 56	24 to 30	13 to 16	8 to 10	6 to 8
Stroke	mm	50 to 300	50 to 300	50 to 300	50 to 300	50 to 300
Retracted length	mm	–*	–*	–*	–*	–*
Voltage	V DC	12 or 24	12 or 24	12 or 24	12 or 24	12 or 24
Power consumption	W	N/A	N/A	N/A	N/A	N/A
Current consumption 12 V DC	A	4	3,5	3,2	3	2,8
24 V DC	A	2,2	2,0	1,8	1,8	1,6
Duty cycle	%	25	25	25	25	25
Ambient temperature	°C	–40 to +85	–40 to +85	–40 to +85	–40 to +85	–40 to +85
Type of protection	IP	66s	66s	66s	66s	66s
Weight (at 300 mm stroke)	kg	1,5	1,5	1,5	1,5	1,5
Color	–	Silver	Silver	Silver	Silver	Silver
Limit switches	–	Yes	Yes	Yes	Yes	Yes
Thermal protection	–	Yes	Yes	Yes	Yes	Yes

* See above table

Stepped Bowls

Stepped bowls have a larger feeding track width and are particularly suited to pre-orientate components. The capacity is larger than that of a cylindrical bowl. A further advantage is that the components do not jam in the tracks. All stepped bowls are cast aluminium, which need to be coated (see also page 14, coating).

Please advise feed direction when ordering (see also page 5).

Type	TAG-Z 200-10-80	TAG-Z 200 (324)-20-105	TAG-N 250-20-105	TAG-N 250-32-130	TAG-N 250-32-145	TAG-ZA 250-32-165	TAG-ZA 250 (541)-32-180
Capacity [l]*	0,5	1	1	2	2	2	7
Material	Aluminium	Aluminium	Aluminium	Aluminium	Aluminium	Aluminium	Aluminium
A = Discharge height	66	71	77	90	107	126	135
B = Width of track	10	20	20	32	32	32	32
C = Discharge radius	115	166	168	206	206	206	275
D = Bowl diameter	228	330	330	400	400	400	545
H = Bowl height	81	95	102	122	140	160	177
S = Track pitch (Spiral distance)	20	32	34	42	42+15**	42+15**	50+15**
Bowl weight [kg]	0,8	2,6	1,65	2,9	3,4	6,9	8,2
Fixing	central	central	radial	radial	radial	central	central
Bottom (see page 13)	cast	cast	required	required	required	cast	cast
Suitable drive unit (see page.16)	SRC-N 200	SRC-B 200	SRC-N 250	SRC-N 250	SRC-N 250	SRC-N 250	SRC-B 250
Z = Total discharge height	254 (SRC-SRG) 271 (SRC-USJ)	259 (SRC-SRG) 281 (SRC-USJ)	327 (SRC-SRG) 345 (SRC-USJ)	340 (SRC-SRG) 358 (SRC-USJ)	357 (SRC-SRG) 375 (SRC-USJ)	376 (SRC-SRG) 394 (SRC-USJ)	385 (SRC-SRG) 403 (SRC-USJ)
Suitable base plate (see page 20)	SRG-N 200 USJ 200	SRG-N 200 USJ 200	SRG-N 250 USJ 250	SRG-N 250 USJ 250	SRG-N 250 USJ 250	SRG-N 250 USJ 250	SRG-N 250 USJ 250

* Larger capacities available, dependent on application and components
** Additional gradient on last 180 degrees

Operating principle

2. Transported product

Workpiece pallet (WT)

The workpiece pallet (WT) transports the workpiece from one processing station to the next on the transfer system. Rexroth workpiece pallets are available in several versions for different applications: The complete plastic WT 2/E handles the transportation and positioning of lighter workpieces. The more robust WT 2 and WT 2/H models, with their steel or aluminum carrying plates, are also suitable for medium and heavy loads.

The WT 2 series workpiece pallets can be configured from components for the individual workpieces. A selection of various frame modules and carrying plates is available for this purpose.

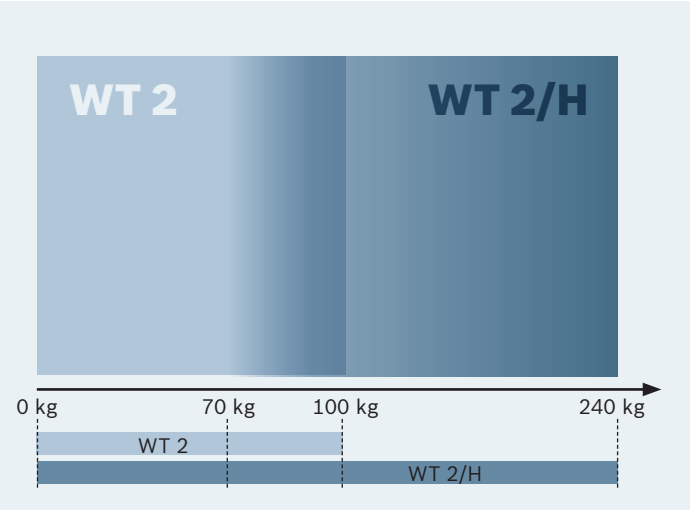
Because the workpiece pallets must be loaded as centrally as possible for optimal transportation, it is advisable to choose larger sized carrying plates for heavier workpieces or for those with uneven weight distribution.

Permitted weights

The WT total weight is limited for each WT size so that the permitted surface pressure is not exceeded.
The WT total weight results from the following:

- Workpiece pallet mass
- Workpiece pallet load (workpiece, pick-up, etc.)
- Weight of the special equipment (data storage, etc.)

For workpiece pallets that are not square, please note that the permissible WT total weight (m_G) may be different for longitudinal conveyors and transverse conveyors and the shorter side is the determining factor for the maximum WT load.

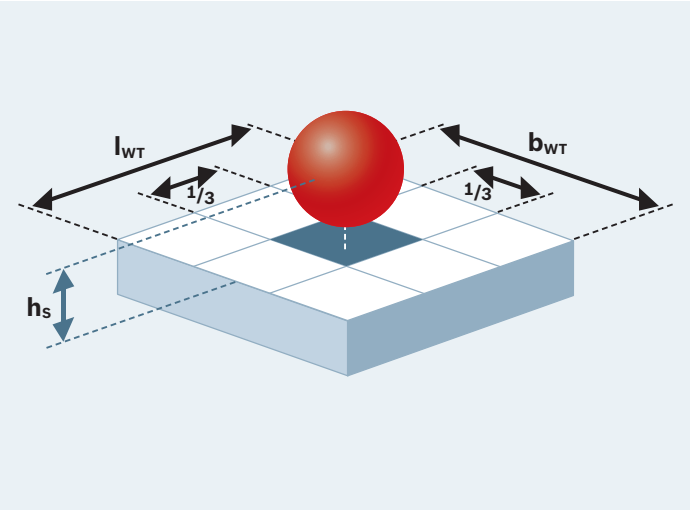


Permissible gravity center position

When separating pallets or changing directions, it is important to observe the position of the gravity center load on the workpiece pallet to ensure that the acceleration forces can be absorbed without any interferences.
Generally we recommend that:

- the load should be positioned in the center of the workpiece pallet
- the center of gravity should not exceed a height h_s of 1/2 b_{WT} (with $b_{WT} \leq l_{WT}$).

The specified performance data relate to the illustrated gravity center position.



Operating principle

5. Combination of conveyor media, glide profiles and components

Assignment of weight classes – products

Workpiece pallet	**WT 2 ≤ 400 mm**	**WT 2**	**WT 2-H**	**WT 2-H**
Typical total weights of the WT in the application	Load 0 – 30 kg	Load 30 – 100 kg	Load 30 – 100 kg	Load 100 – 240 kg
Lift positioning unit (HP)/ positioning unit (PE)	PE 2 (F ≤ 30 kg)			
		PE 2/X (F ≤ 100 kg)	PE 2/H (F ≤ 240 kg)	PE 2/H (F ≤ 240 kg)
	HP 2/L (F ≤ 40 kg)	HP 2/L (F ≤ 40 kg)		
	HP 2 (F ≤ 110 kg)	HP 2 (F ≤ 110 kg)		
	PE 2/XX (F ≤ bel)	PE 2/XX (F ≤ bel)	PE 2/XX (F ≤ bel)	PE 2/XX (F ≤ bel)
	PE 2/XP (F ≤ 100 kN)			
Stop gate (VE)	VE 2 (F ≤ 200 kg)	VE 2 (F ≤ 200 kg)	VE 2/D100-H	VE 2/D100-H
	VE 2/L (F ≤ 200 kg)	VE 2/L (F ≤ 200 kg)	VE 2/D250-H	VE 2/D250-H
	VE 2/M (F ≤ 200 kg)	VE 2/M (F ≤ 200 kg)		
	VE 2/S (F ≤ 140 kg)	VE 2/S (F ≤ 140 kg)		
	VE 2/X (F ≤ 450 kg)	VE 2/X (F ≤ 450 kg)		
	VE 2/D-60 (F ≤ 60 kg)	VE 2/D-60 (F ≤ 60 kg)		
	VE 2/D-175 (F ≤ 100 kg)	VE 2/D-175 (F ≤ 100 kg)		
	VE 2/D-200 (F ≤ 200 kg)	VE 2/D-200 (F ≤ 200 kg)		
Damper (DA)	DA 2/10 (F ≤ 20 kg)			
	DA 2/30 (F ≤ 60 kg)			
	DA 2/100 (F ≤ 100 kg)	DA 2/100 (F ≤ 100 kg)		
			DA 2/100-H (F ≤ 100 kg)	DA 2/100-H (F ≤ 100 kg)
			DA 2/250-H (F ≤ 240 kg)	DA 2/250-H (F ≤ 240 kg)
		DA 2/150-E	DA 2/150-E	
Switch bracket (SH)	SH 2/S	SH 2/S		
	SH 2/ST	SH 2/ST		
	SH 2/S-H	SH 2/S-H	SH 2/S-H	SH 2/S-H
	SH 2/U	SH 2/U		
	SH 2/UV	SH 2/UV		
	SH 2/U-H	SH 2/U-H		
	SH 2/SF	SH 2/SF		
Rocker (WI)	WI 2	WI 2		

Workpiece pallet selection

The workpiece pallet (WT) is used in the transfer system to convey the workpiece through the processing stations.
To guarantee an optimal transport, it should be loaded in the center.

Workpiece pallet applications

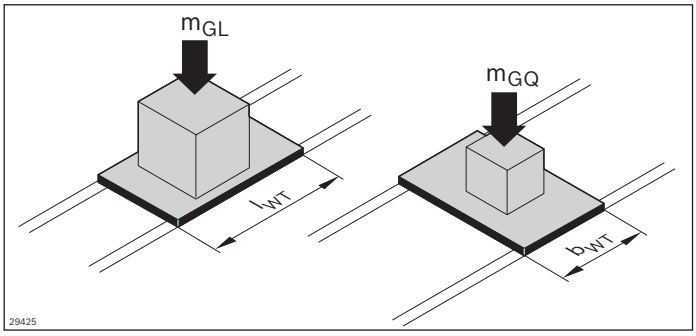
- Integrated positioning bushings enable defined positioning of the incoming workpiece in the processing station
- Optionally available data tags can provide work-related information during processing. This information can be evaluated on-site and also updated

Various WT workpiece pallets are available:
- The WT 2/E is an especially inexpensive, light-weight workpiece pallet with an all-plastic design that can be used for simple conveying and positioning tasks (see p. 2-6)
- The WT 2 is a sturdy and universally applicable workpiece pallet with a steel or aluminum carrying plate (see p. 2-8)
- The WT-2 components enable individual configuration of the WT using various frame modules and carrying plates, including those provided by the customer (see p 2-12) Total weight of workpiece pallets up to 100 kg
- The WT 2/H with aluminum carrying plate for applications with total weights up to 240 kg (see p 2-34)
- WT 2/F with an aluminum frame profile design can be used for large workpieces. Grooves throughout the frame profile make it easier to install parts holders (see p. 2-47). Total weight of workpiece pallets up to 100 kg
- WT 2/F-H with the same aluminum carrying plate, but in the heavy duty version up to 240 kg (see p 2-50)

Size, combination with conveyor medium

The permitted total weight m_G of a workpiece pallet results from the
- combination of conveyor medium, glide profiles, and workpiece pallet wear pad as well as
- the surface length on the conveyor medium (see p. 1-10)

The surface length on the conveyor medium may vary in longitudinal and transverse conveying with non-square pallets. The shorter side of the workpiece pallet determines the maximum permitted total weight.



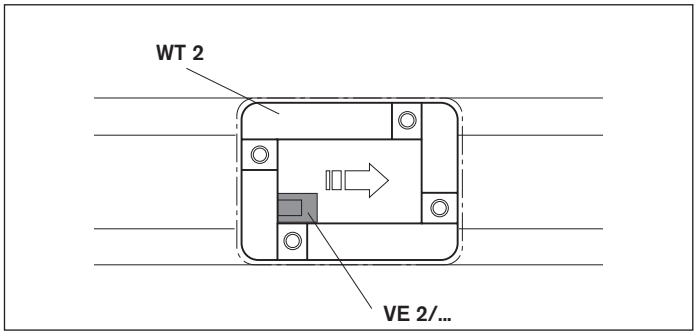
The following estimated parameters can be used:
- **Conveyor media belt and toothed belt:** A surface load of up to 1 kg/cm is permissible on workpiece pallets with PA wear pads.
- **Conveyor medium flat top chain:** PA wear pads on the workpiece pallets are recommended in the combination with a plastic flat top chain. This permits surface loads of up to 1 kg/cm in the standard design with plastic glide profiles in the section profile. Bearing loads of 1.5 kg/cm are possible with the optionally available version with steel glide profiles.
- **Conveyor medium accumulation roller chain:** In conjunction with PE wear pads on the workpiece pallets, the standard design with plastic glide profiles in the section profile permits surface loads of up to 1.5 kg/cm. The optionally available version with steel glide profiles and the accumulation roller chain with steel rollers can tolerate surface loads of 2 kg/cm

When WT 2/E, WT 2 and WT 2/F workpiece pallets are used, the VE 2/... stop gates are mounted directly on the section for lateral separation.
The WT 2/E, WT 2 and WT 2/F are used up to 100 kg.

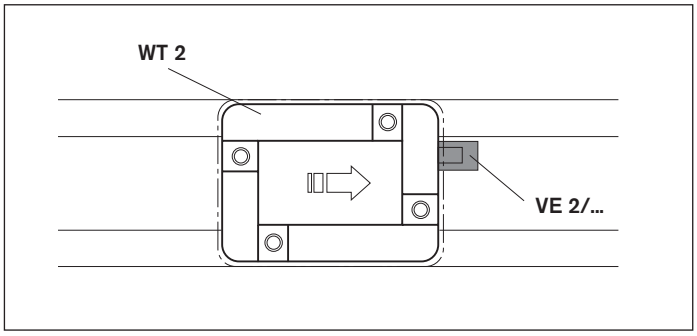
When WT 2/H and WT 2/F-H are used, the VE 2/D...-H stop gates are mounted by a cross strut for central separation.
WT 2/H or WT 2/F-H are used for heavy duty versions up to workpiece pallet total weights of 240 kg.

All VE 2/... (without VE 2/...-H) can be used for lateral separation.
All VE 2/D...-H can be used for central separation.

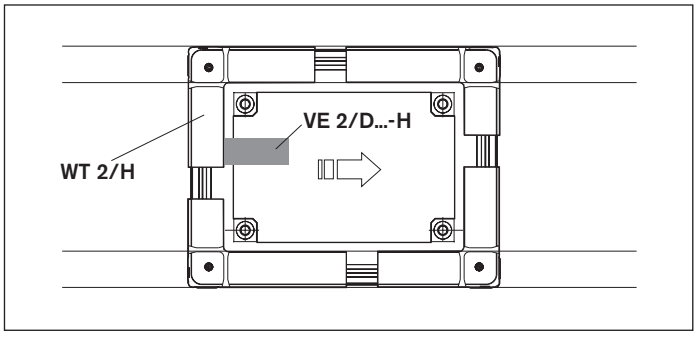
Mounting in rear right position in the direction of transport, on the **inside** of the workpiece pallet surface



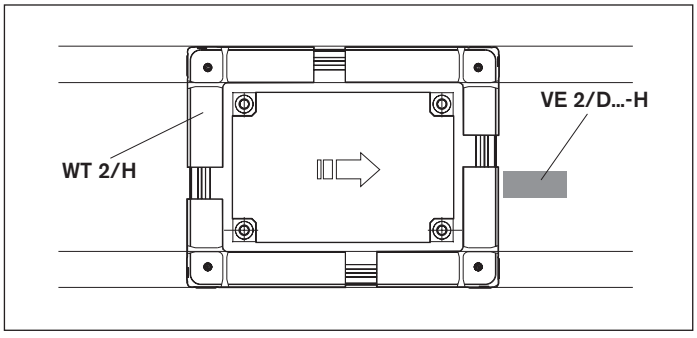
Mounting in front left position in the direction of transport, on the **outside** of the workpiece pallet surface



Mounting inside the workpiece pallet surface

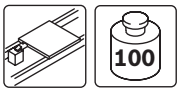


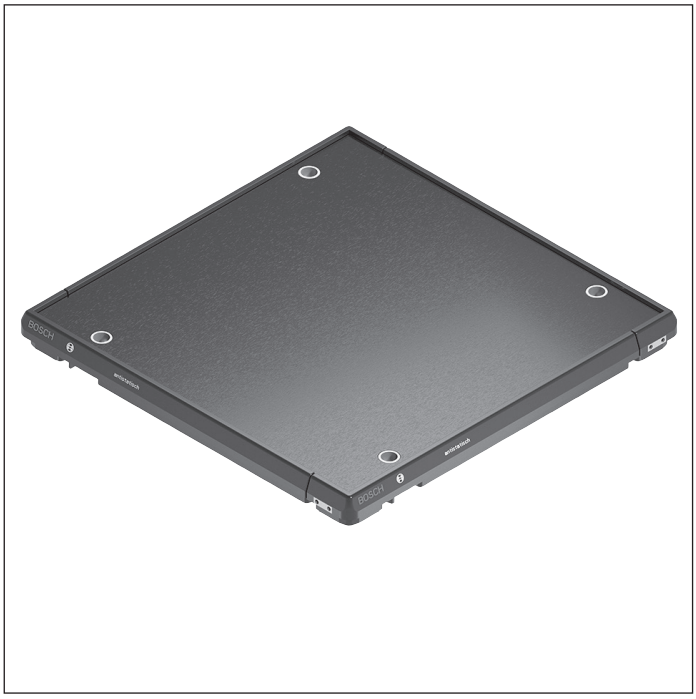
Mounting outside the workpiece pallet surface



The size and position of the positioning bushings is different for the workpiece pallets for lateral separation compared to the types for central separation. This must be considered when selecting the positioning units. For more information, see also the table on p. 1-11

WT 2 workpiece pallet, fully assembled





- Suitable for belt, toothed belt, and flat top chain
- Robust workpiece pallet with high rigidity
- Integrated positioning bushings
- Prepared for installation of mobile data tags from the ID 15, ID 40 and ID 200 identification systems
- Not suitable for accumulation roller chains
- Plastic frame modules with universal steel carrying plate
- 15 standard sizes
- Suitable for use in an EPA
- Material:
  - Frame module with polyamide (PA) wear pad
  - Steel carrying plate (4.8 mm)

WT 2 is a sturdy workpiece pallet with high rigidity in a composite plastic-steel construction used to pick up and convey workpieces in the TS 2*plus* transfer system.
From size 400 x 400 mm, the workpiece pallet plates are executed as standard with two or four additional threaded holes for reinforcing bolts. Number given in carrying plate table on page 2-27.

Delivery notes

Scope of delivery

- Carrying plate
- Frame modules
- Connection elements
- Positioning bushings

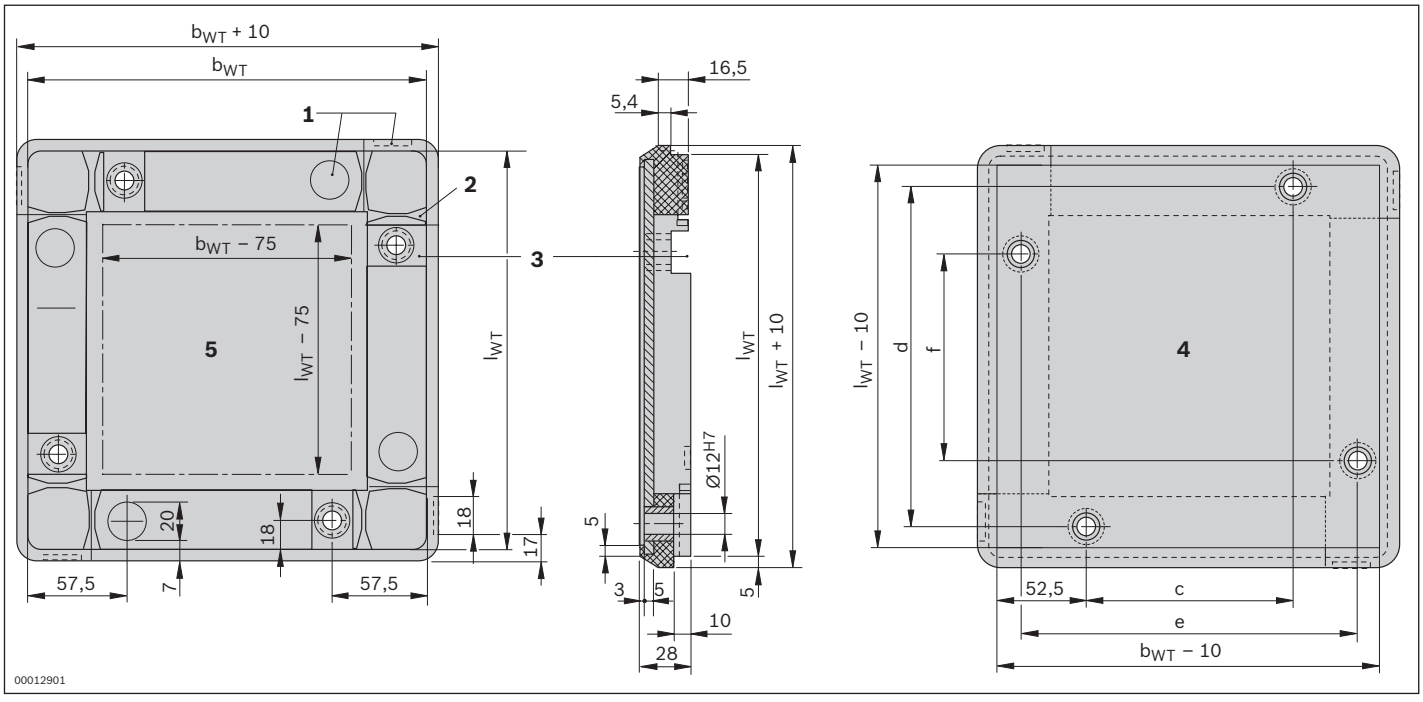
Condition on delivery

- Fully assembled

Ordering information

Product designation	Workpiece pallet b_{WT} x l_{WT}	Material number
WT 2 workpiece pallet	160 x 160	0842090030
WT 2 workpiece pallet	160 x 240	0842090032
WT 2 workpiece pallet	160 x 320	0842090034
WT 2 workpiece pallet	240 x 240	0842090039
WT 2 workpiece pallet	240 x 320	0842090041
WT 2 workpiece pallet	240 x 400	0842090043
WT 2 workpiece pallet	320 x 320	0842090048
WT 2 workpiece pallet	320 x 400	0842090050
WT 2 workpiece pallet	320 x 480	0842090051
WT 2 workpiece pallet	400 x 400	0842090080
WT 2 workpiece pallet	400 x 480	0842090081
WT 2 workpiece pallet	400 x 640	0842090083
WT 2 workpiece pallet	480 x 480	0842090086
WT 2 workpiece pallet	480 x 640	0842090088
WT 2 workpiece pallet	640 x 640	3842523405

Dimensions



No production drawing
1 Exciter plate
2 Guide groove
3 Stop gate aperture
4 Top clearance
5 Bottom clearance

Width of workpiece pallet b_{WT} (mm)	Length of workpiece pallet l_{WT} (mm)	Plate thickness d_{PI} (mm)	Flatness □ (mm)	Plate mass m_{PI} (kg)	Workpiece pallet mass m_{WT} (kg)	Dimension c (mm)	Dimension d (mm)	Dimension e (mm)	Dimension f (mm)
160	160	4.8	0.3	0.9	1.2	45	124	124	45
160	240	4.8	0.3	1.3	1.8	45	204	124	125
160	320	4.8	0.3	1.8	2.3	45	284	124	205
240	240	4.8	0.3	2.0	2.5	125	204	204	125
240	320	4.8	0.5	2.7	3.3	125	284	204	205
240	400	4.8	0.5	3.4	4.1	125	364	204	285
320	320	4.8	0.5	3.6	4.4	205	284	284	205
320	400	4.8	0.6	4.6	5.4	205	364	284	285
320	480	4.8	0.6	5.5	6.4	205	444	284	365
400	400	4.8	0.6	5.9	6.6	285	364	364	285
400	480	4.8	0.6	7.0	8.0	285	444	364	365
400	640	4.8	0.8	9.3	11.0	285	604	364	525
480	480	4.8	0.8	8.3	9.7	365	444	444	365
480	640	4.8	1.0	11.4	12.4	365	604	444	525
640	640	4.8	1.0	15.3	16.3	525	604	604	525

BS 2 belt section

- Ready for operation conveyor section with own drive
- Accumulation operation possible
- Conveyor medium: Toothed belt (suitable for use in an EPA)
- Reversible operation possible
- Right, left or central motor mounting (central from track width of 240 mm)
- Motor connection: optionally with cable/plug or terminal box
- Special models on request

The belt section is a ready for operation conveyor section with own drive for the transportation of workpiece pallets in the longitudinal direction or for the transverse conveying of the workpiece pallet between parallel conveyor sections in connection with two HQ 2 lift transverse units.

Accessories

Recommended accessories

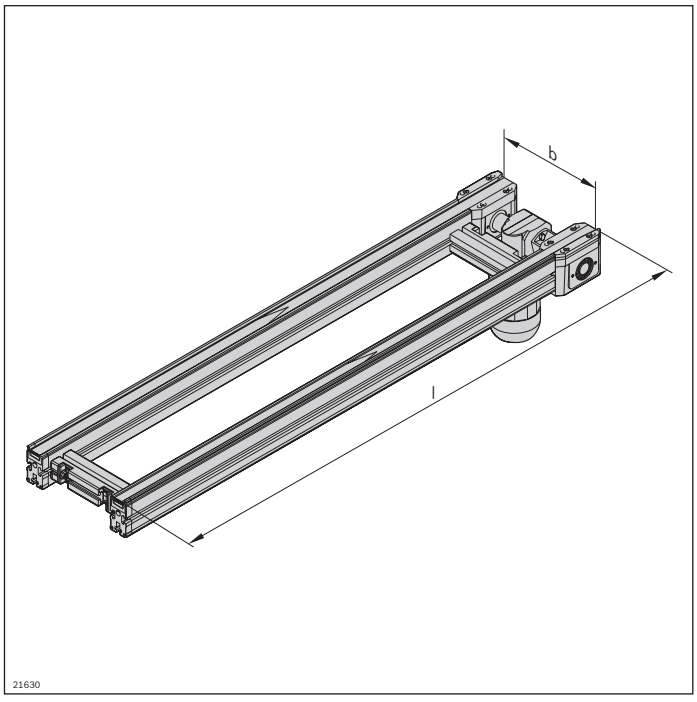
- Connection kit, see page 3-236
- SZ 2 leg sets, see page 6-2

Delivery notes

Condition on delivery

- Fully assembled

Ordering information



Material number		3842999716
b (mm)	Track width in direction of transport	160; 240; 320; 400; 480; 640; 800; 1040; 1200
		160 ... 1200[1)]
l (mm)	Length	240 ... 6000[2)]
v_N (m/min)	Nominal speed	0[3)]; 6; 9; 12; 15; 18
U (V)	Voltage	See motor data, p. 11-24ff
f (Hz)	Frequency	See motor data, p. 11-24ff
AT	Motor connection S = cable/plug K = terminal box	S; K
MA	Motor mounting R = right L = left M = center	R; L; M[4)]

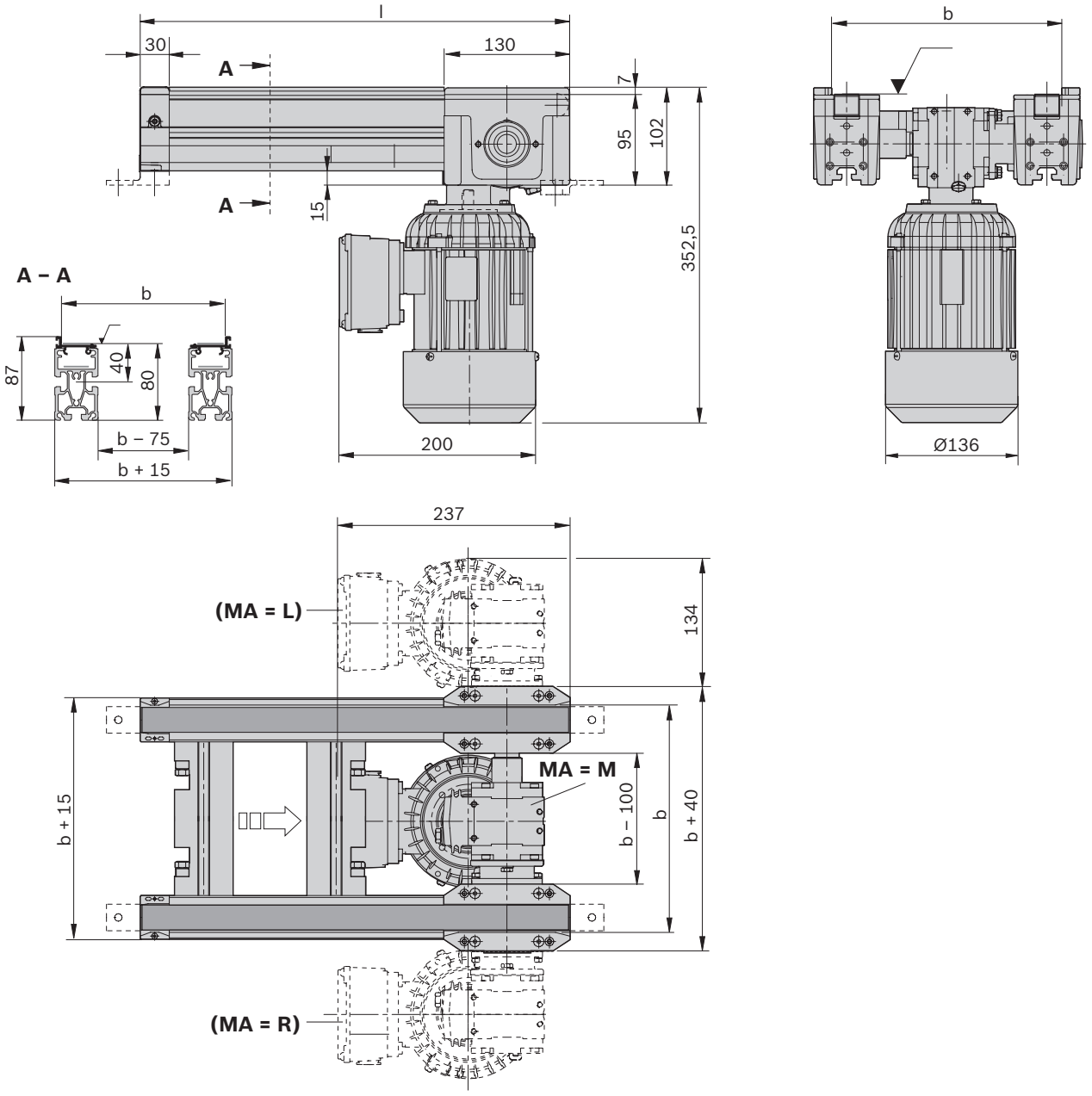
[1)] Individual width variants available
[2)] l is rounded in accordance with the toothed belt pitch
[3)] v_N = 0: without motor or gear
[4)] When MA = M and b = 160 mm, the max. section load is only 30 kg

Technical data

Material number			3842999716
Load			
Max. section load in accumulation operation		kg	60[5]
Features			
ESD			Yes
Material specification			Section profile: Aluminum, natural; anodized Guide profile: polyamide Glide profile: polyamide
Dimensions			
Length	l	mm	240 ... 6000

[5)] When MA = M and b = 160 mm, the max. section load is only 30 kg

Dimensions


l
30
130
A
A
7
95
102
15
352,5
200
b
Ø136
A – A
b
87
40
80
b – 75
b + 15
237
(MA = L)
134
MA = M
b + 15
b – 100
b
b + 40
(MA = R)
00012812

EQ 2/T electric transverse conveyor

- Pre-assembled module for connecting two parallel longitudinal sections
- Tandem design with driven belt section for greater distances from 320 mm
- Size 2 from ≥ 480 x 480 mm with two lifting cylinders per lift transverse unit
- Conveyor medium: Toothed belt (suitable for use in an EPA)
- Pneumatic equipment for 2 (top, center) or 3 (top, center, bottom) lift positions
- Suitable for mounting on an ST 2/... section with a profile width of 45 mm or an ST 2/...-H section with a profile width of 50 mm
- Can be combined with WT 2, WT 2/E and WT 2/F

Note:

- Reversible operation possible
- Accumulation operation not permitted on the lift transverse units.

Accessories

Required accessories

- 1x M12x1 sensor with rated sensing range S_N = 4 mm for each (top/bottom) position sensing location, see p. 8-108/8-110

Recommended accessories

- DA 2/60 damper (see p. 8-62) for outfeeding workpiece pallets at v_N > 9 m/min
- WI/2 (see p. 8-131ff) or WI/M (see p. 8-133) rocker, DA 2/60 (see p. 8-62) or DA 2/100-C dampers for BG 2 (see p. 8-71) for infeeding workpiece pallets

Delivery notes

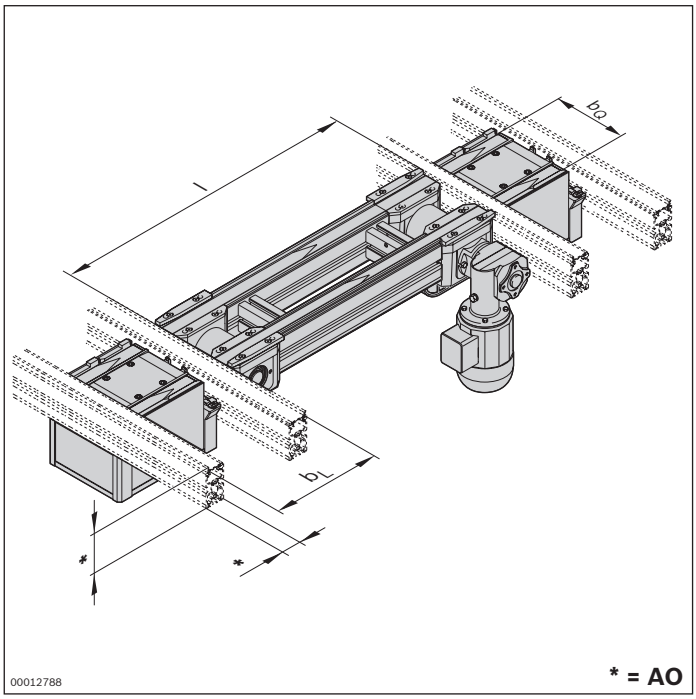
Scope of delivery

- Incl. fastening material
- 2x HQ 2/O
- 1x BS 2/T tandem belt section
- 2x connection kit
- 2x SK 2/B housing element
- Pneumatic equipment for two or three positions
- Kit for electric position sensing

Condition on delivery

- Pre-assembled in modular units

Ordering information



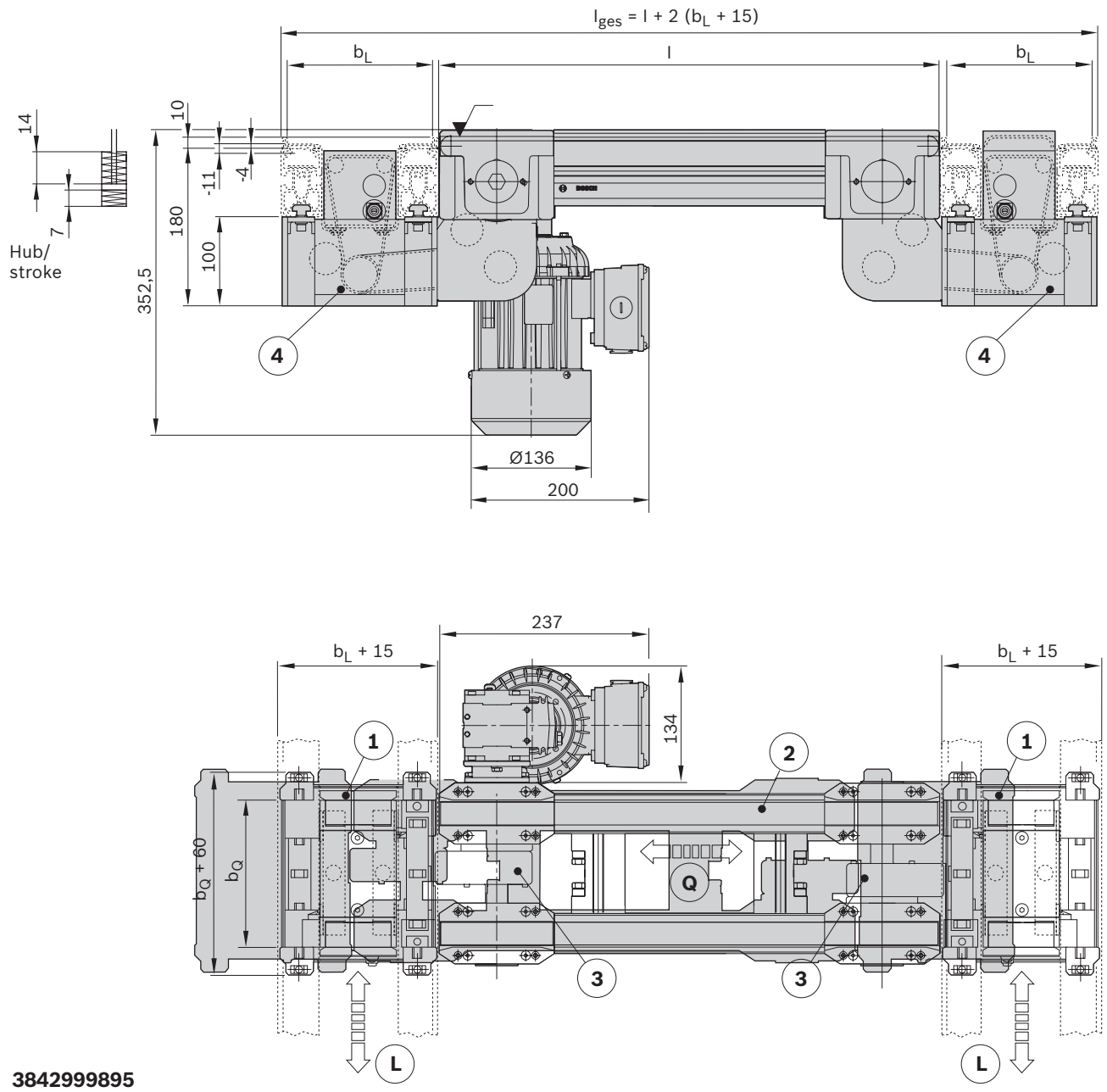
Material number		3842999895
b_Q (mm)	Track width in the transverse conveyor	160; 240; 320; 400; 480; 640; 800
b_L (mm)	Track width in the longitudinal conveyor	160; 240; 320; 400; 480
b_Q x b_L (mm x mm)	Combination options	BG 1: 160 x 160; 240; 320 240 x 160; 240; 320; 400 320 x 160; 240; 320; 400 400 x 240; 320; 400; 480 480 x 320; 400 BG 2: 480 x 480 640 x 400; 480 800 x 400; 480
l (mm)	Length	320 ... 6000
AO	Installation location, profile 0 = profile 45x80 1 = profile 45x100 2 = profile 50x100	0; 1; 2
PN	Pneumatic equipment	2[1]; 3[2]
v_N (m/min)	Nominal speed	0; 6; 9; 12; 15; 18
U (V)	Voltage	See motor data, p. 11-24ff
f (Hz)	Frequency	See motor data, p. 11-24ff
AT	Motor connection S = cable/plug K = terminal box	S; K
MA	Motor mounting R = right L = left M = center	R; L; M[3]

[1] PN = 2: Upper and middle lift position
[2] PN = 3: Upper, middle and lower lift position
[3] MA = M when $b_Q \geqq 320$ mm

Technical data

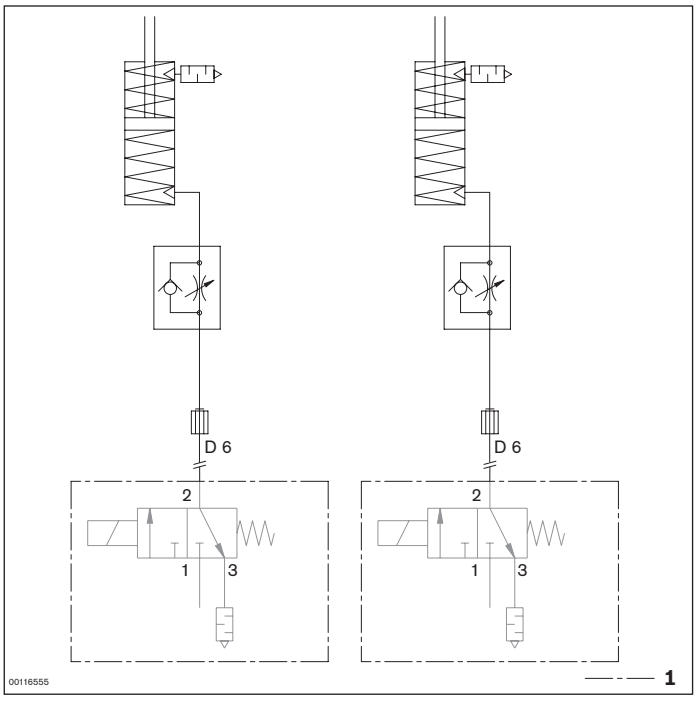
Material number			3842999895
Load			
Max. section load in accumulation operation		kg	60
Max. total weight of workpiece pallet	m_G	kg	BG 1: 30 BG 2: 50
Features			
ESD			Yes
Design			
Size	BG		BG 1; BG 2
Additional information			
Required compressed air connection	p	bar	4 ... 6
Pneumatic connector	Ø	mm	6

Dimensions



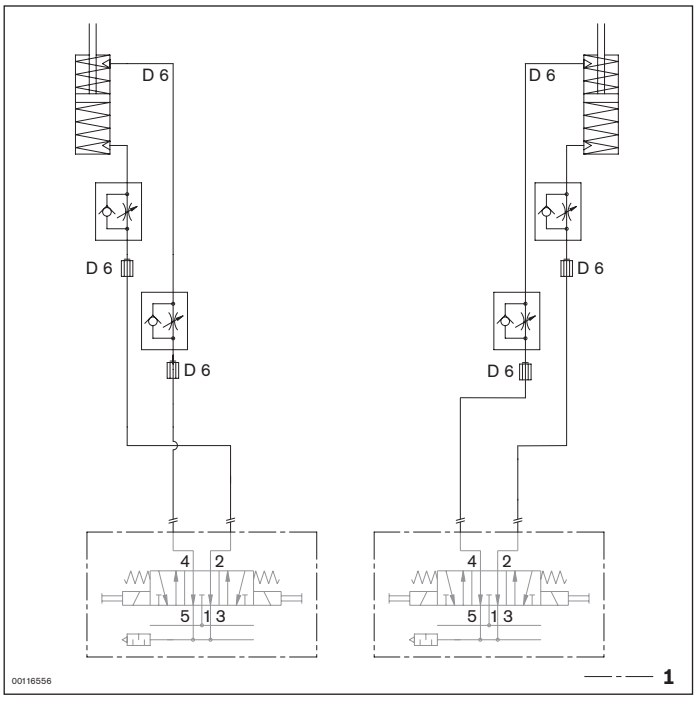
L Longitudinal conveyor transport direction
Q Transport direction of transverse conveyor
1 HQ 2/O lift transverse unit
2 BS 2/T tandem belt section
3 Connecting kit
4 Housing element

Circuit diagram for unit with pneumatic equipment for two positions (PN = 2), BG 1



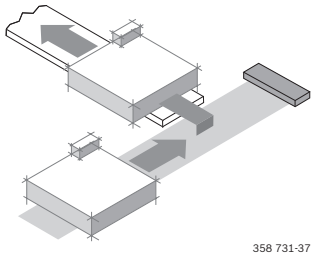
1 Not included in delivery

Circuit diagram for unit with pneumatic equipment for three positions (PN = 3), BG 1

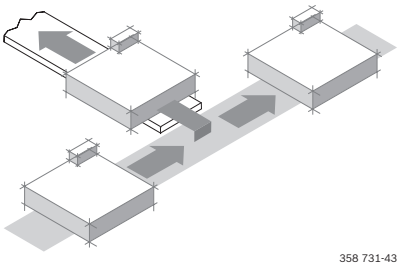


1 Not included in delivery

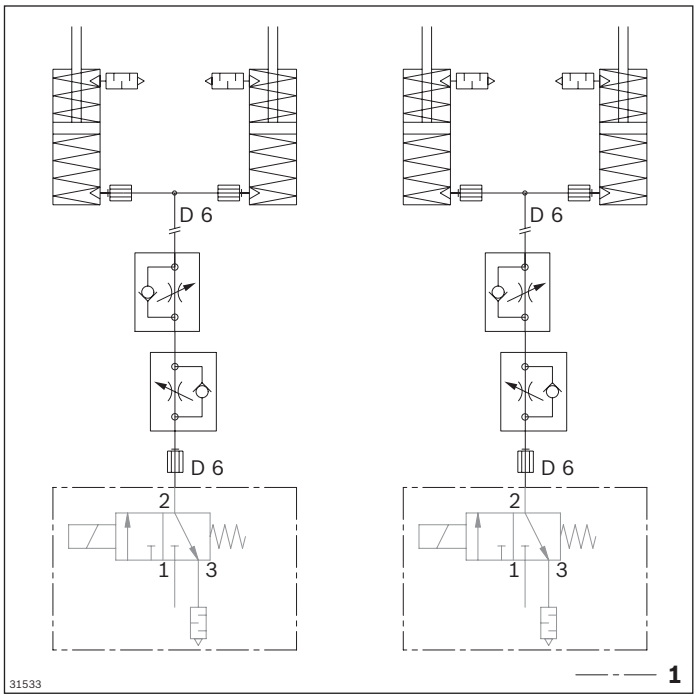
PN = 2



PN = 3

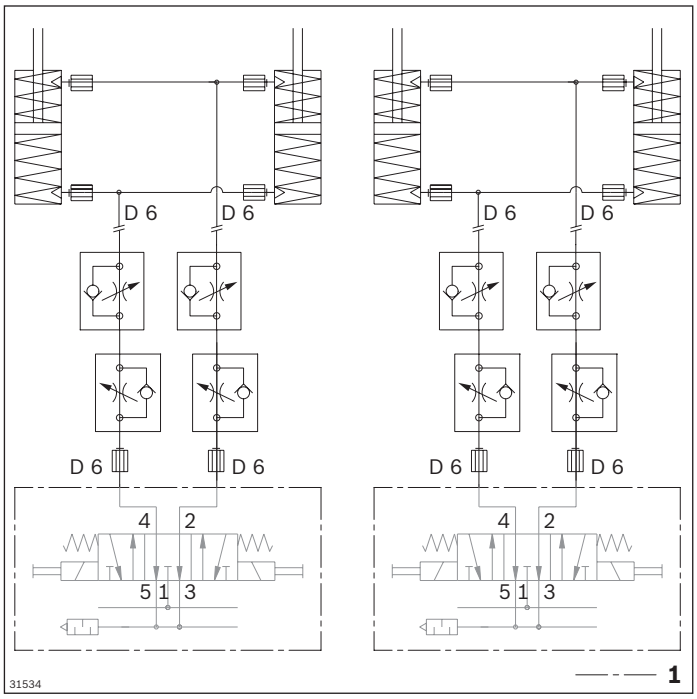


Circuit diagram for unit with pneumatic equipment for two positions (PN = 2), BG 2



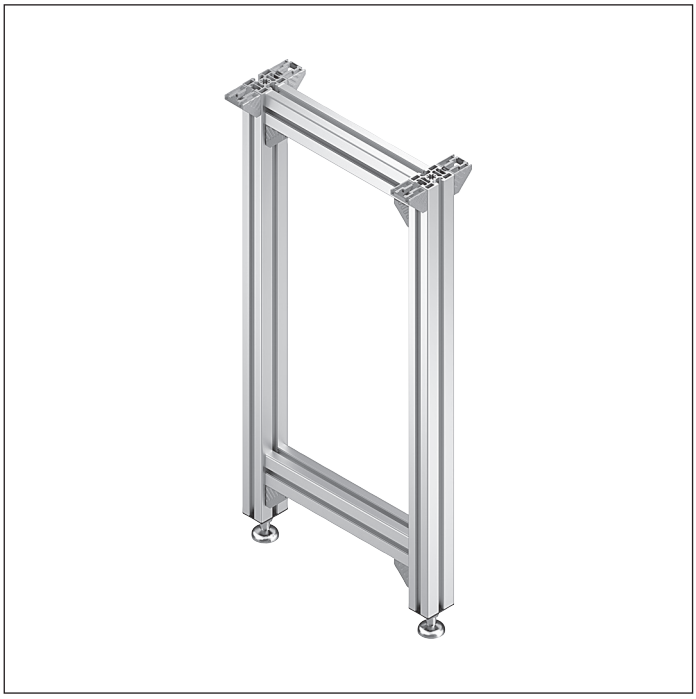
1 Not included in delivery

Circuit diagram for unit with pneumatic equipment for three positions (PN = 3), BG 3



1 Not included in delivery

SZ 2 leg set



- Leg set for single-track conveyor sections on a single conveying level
- Standard version

The leg sets support one belt section or one conveyor unit.

Accessories

Required accessories

- Foundation bracket (3842146848, see p.) 6-28
- Floor dowel (3842526560, see p.) 6-30

Recommended accessories

- Bracket caps, see p. 6-33

Delivery notes

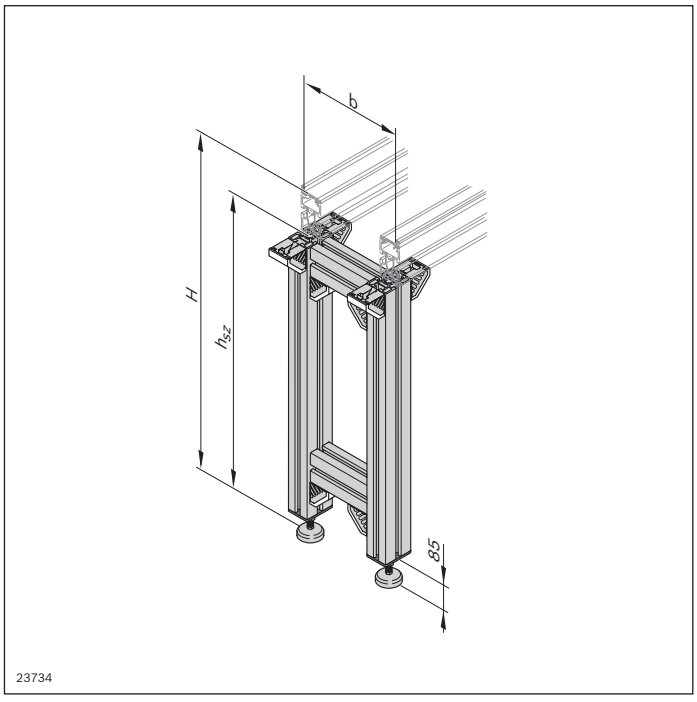
Scope of delivery

- Incl. height-adjustable leveling foot
- Incl. all fastening material to mount on conveyor section, drive module or return unit

Condition on delivery

- Assembled (MT = 1)
- Not assembled (MT = 0)

Ordering information



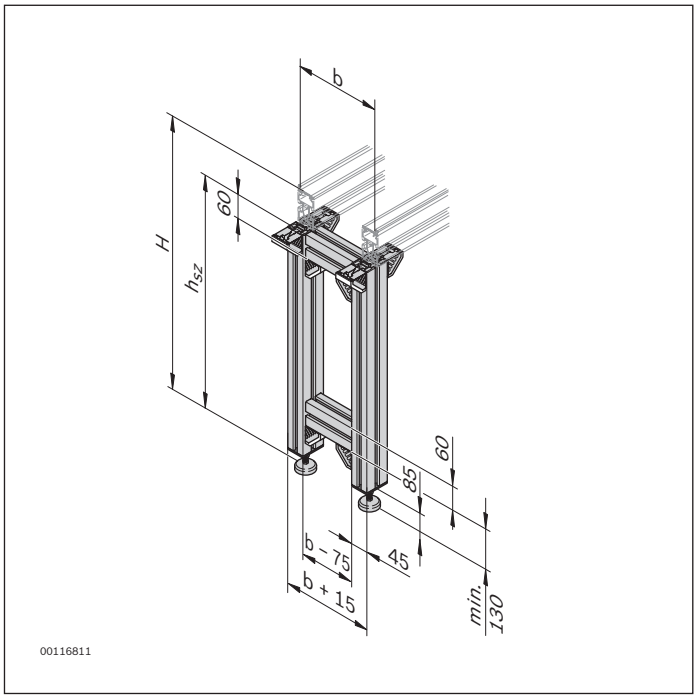
Material number		**3842996320**	
b (mm)	Track width in direction of transport	160 ... 1200	
H (mm)	Transportation height	ST 2/B-50:	350 ... 2000
H = h_{SZ}+ AO*		Lift gate:	355 ... 2000
		ST 2/B:	375 ... 2000
		ST 2/B-100:	395 ... 2000
AO	Installation location	55; 60; 80; 100	
	SP 2/B-50:	AO = 55	
	Lift gate:	AO = 60	
	ST 2/B; SP 2/BH		
	BS 2; BS 2/M:	AO = 80	
	ST 2/B-100; ST 2/C-100;		
	ST 2/R-100; ST 2/C-H;		
	ST 2/R-H; ST 2/R-V;		
	BS 2/C; BS 2/C-H;		
	BS 2/R; BS 2/R-H;		
	BS 2/R-V; CS/C:	AO = 100	
MT	Kit	0; 1	
	0 = not assembled		
	1 = assembled		

*h_{SZ} = leg set height

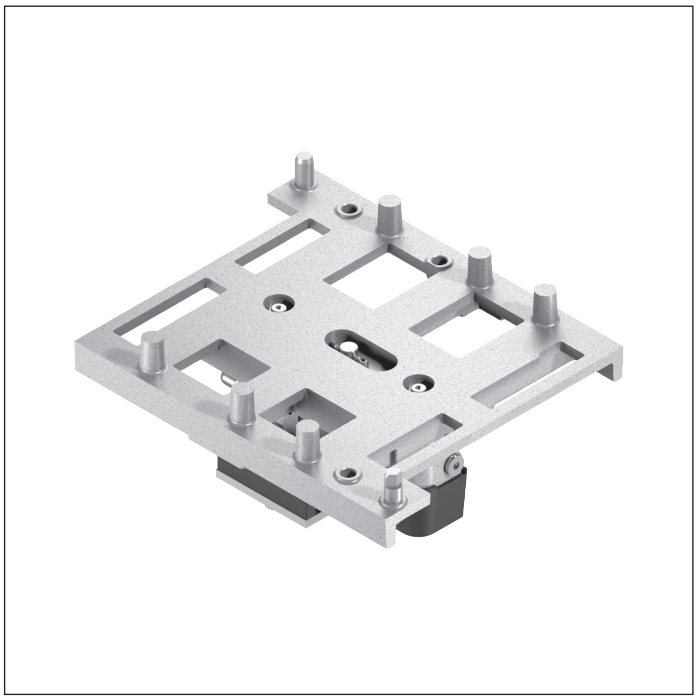
Technical data

Material number	**3842996320**
Features	
ESD	Yes

Dimensions



PE 2 positioning unit



- To position a workpiece pallet in a manual/automatic processing station
- For high positioning accuracy requirements up to ±0.1 mm
- Can be combined with all WT 2 and WT 2/F workpiece pallets up to 400 x 400 mm

Accessories

Required accessories

- VE 2/... stop gate, see p. 8-4
- Pneumatic equipment, connectors

Recommended accessories

- Position sensor kit for PE 2, see p. 7-12

Delivery notes

Scope of delivery

- Incl. fastening material

Condition on delivery

- Fully assembled

Ordering information

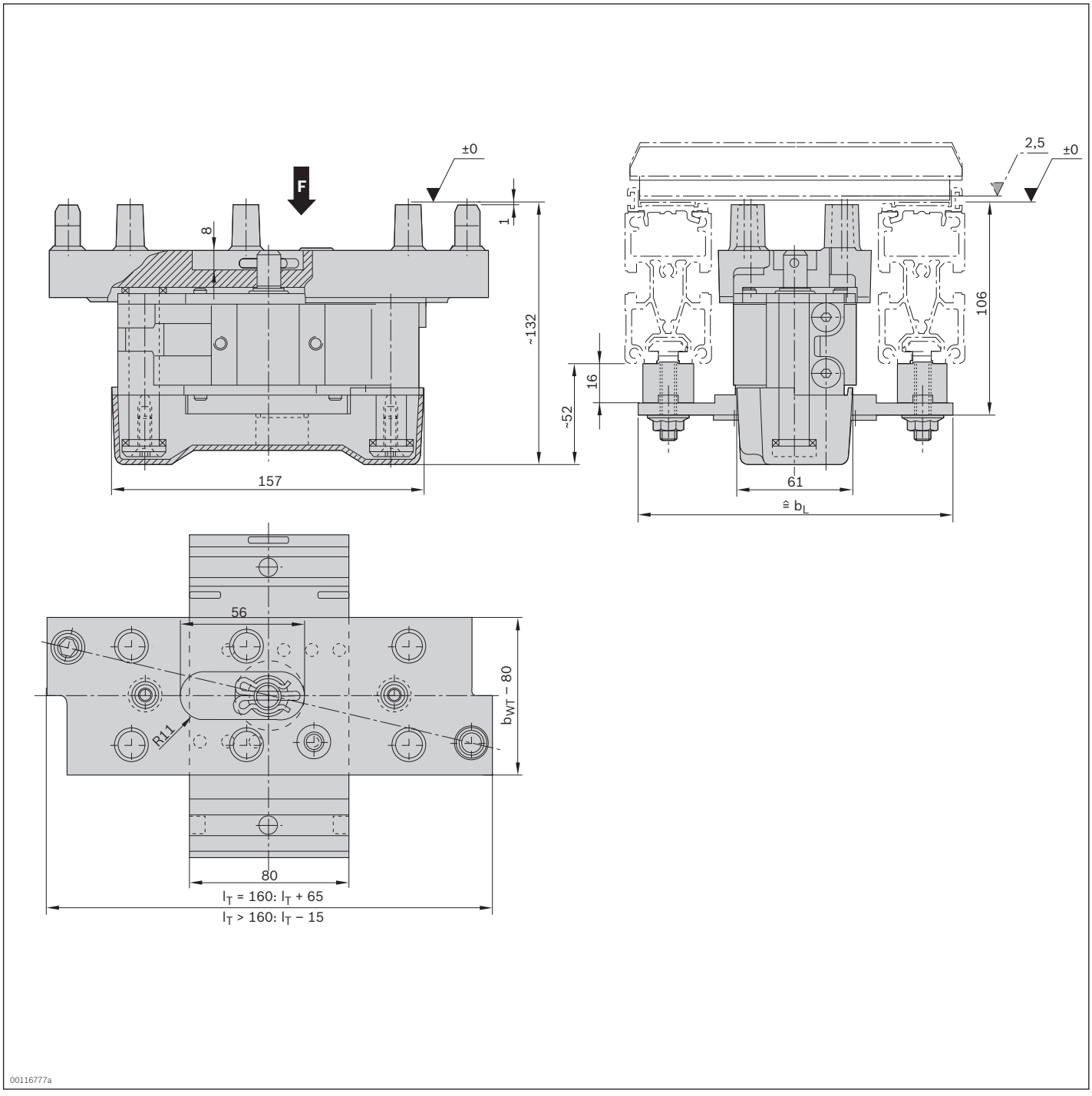
Product designation	Positioning unit w x l_d (mm)	Material number
PE 2 positioning unit	160 x 160	3842504706
PE 2 positioning unit	160 x 240	3842504707
PE 2 positioning unit	160 x 320	3842504708
PE 2 positioning unit	240 x 160	3842504710
PE 2 positioning unit	240 x 240	3842504711
PE 2 positioning unit	240 x 320	3842504712
PE 2 positioning unit	240 x 400	3842504713
PE 2 positioning unit	320 x 160	3842504714
PE 2 positioning unit	320 x 240	3842504715
PE 2 positioning unit	320 x 320	3842504716
PE 2 positioning unit	320 x 400	3842504717
PE 2 positioning unit	400 x 320	3842504718
PE 2 positioning unit	400 x 400	3842504719

Technical data

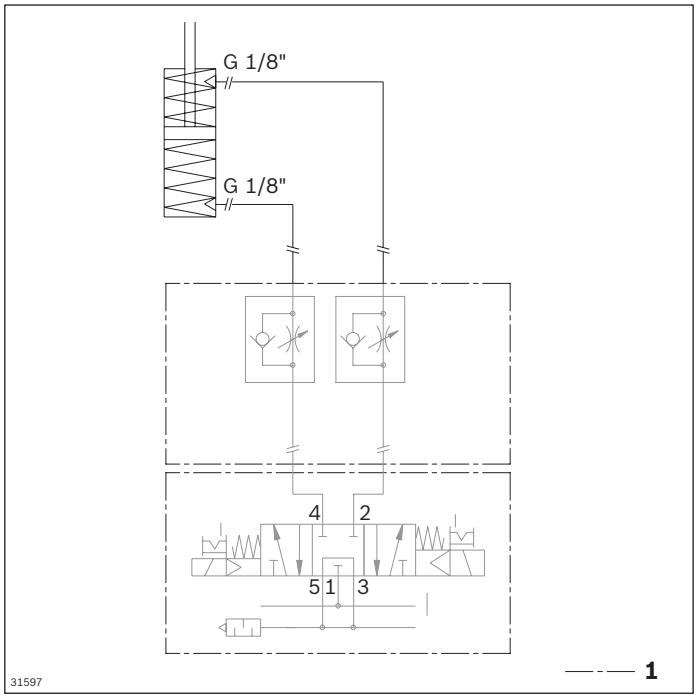
Material number			**3842504706 3842504712 3842504716 3842504707 3842504713 3842504717 3842504708 3842504714 3842504718 3842504710 3842504715 3842504719 3842504711**
Load			
Max. total workpiece pallet weight	m_G	kg	30
Features			
ESD			Yes
Additional information			
Required compressed air connection	p	bar	4 ... 6
Pneumatic connector[1]	Ø	mm	G1/8"
WT lift above conveying level		mm	2.5
Repeat accuracy		mm	±0.1
Permissible vertical process forces[2]		N	300

[1] Connector for G1/8" thread must be attached by customer
[2] Incl. WT 2

Dimensions

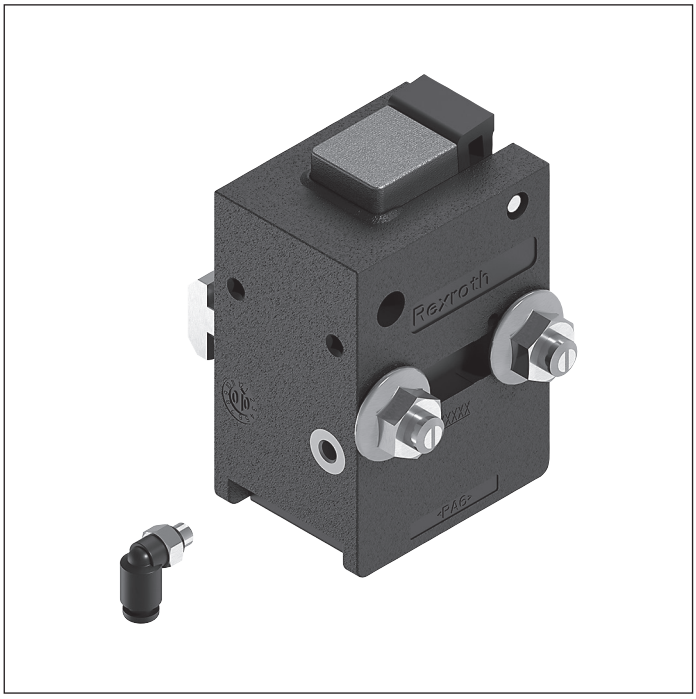

±0
F
8
1
~132
157
~52
16
2,5
±0
106
61
≙ b_L
56
R11
b_{WT} – 80
80
l_T = 160: l_T + 65
l_T > 160: l_T – 15
00116777a

Circuit diagram



1 Not included in delivery

VE 2 stop gate



- Pneumatic stop gate
- Tilting stop gate; can be opened without causing abrasion on the surface of the workpiece pallet stop surface
- Reversible operation not permitted
- Can be combined with WT 2/E, WT 2 and WT 2/F

Stops one or more accumulating workpiece pallets at the defined stop surface of the workpiece pallet. When the pressure is released the stop gate is closed by a spring and the workpiece pallet is stopped. Mounted inside the tracks, directly on the conveyor section.

Accessories

Recommended accessories

- VE 2/RS return stop, see p. 8-40
- SH 2 switch bracket, see p. 8-88
- Position sensor, see p. 8-18

Delivery notes

Scope of delivery

- Incl. all fastening material to mount on ST 2 conveyor section
- Pneumatic elements

Condition on delivery

- Fully assembled

Ordering information

Product designation	Material number
VE 2 stop gate	0842900300

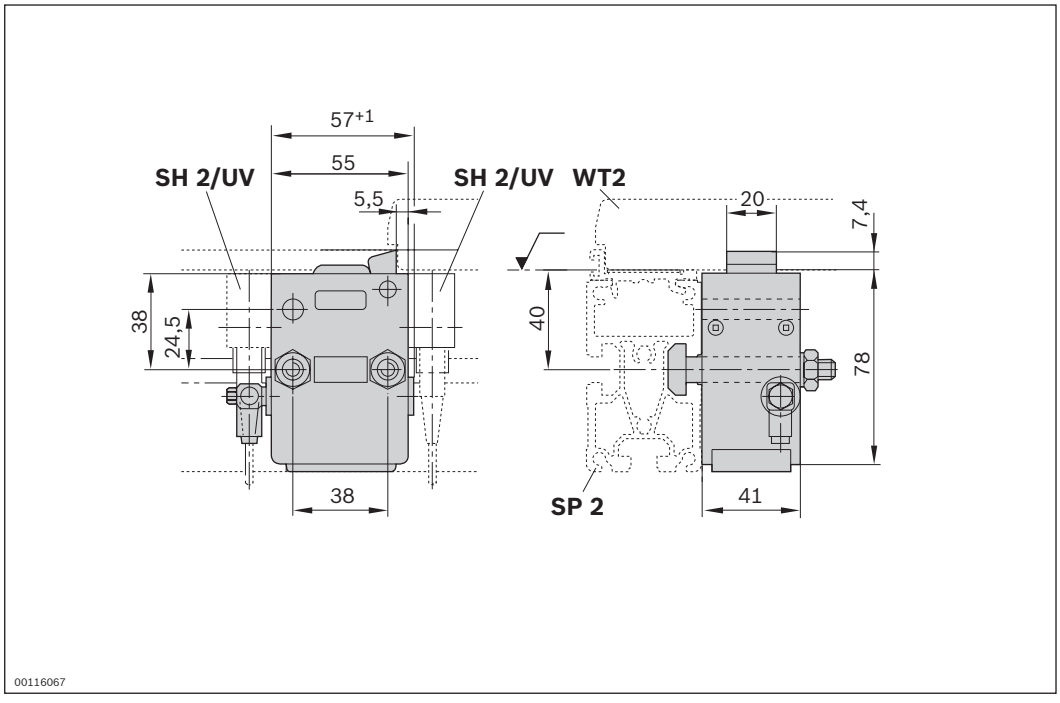
Technical data

Material number			**0842900300**
Load			
Max. total weight of workpiece pallet	m_G	kg	200
Features			
Material specification			Housing: PA6 Safety catch: Brass Lug cam: PA66
Operating temperature[1]		°C	0 ... +60
Additional information			
Required compressed air connection	p	bar	4 ... 6
Pneumatic connector	d	mm	4

[1] High-temperature stop gate on request

Permitted total weight of workpiece pallet m_G (kg)	**Nominal speed v_N (m/min)**
200	6
140	9
100	12
70	15
50	18

Dimensions



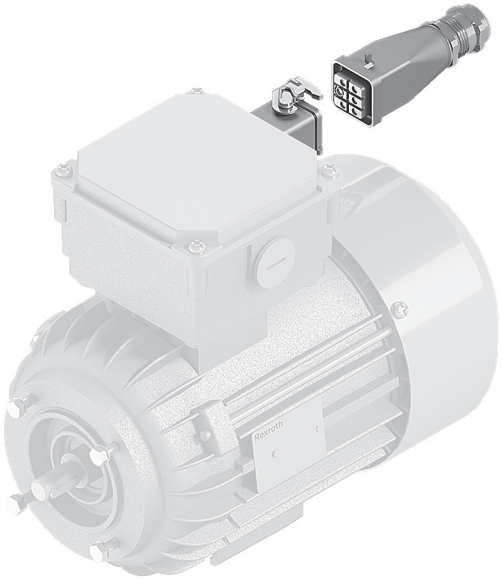
Motor data

Electrical connection requirements:
Connection to a 3-phase, 5-wire system (L1, L2, L3, N, PE); a connection plan is included in the terminal box.
All motors are equipped with a thermal contact*, which has to be connected to an overload switch-off.

All of the motors have an IP 55 rating.

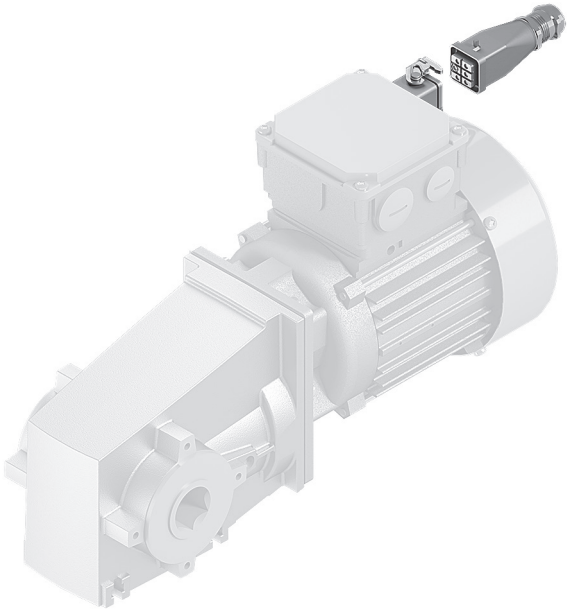
* Bi-metal thermal contact, tripping at 150 °C ± 5 °C

Motor types without Index b



Motor connection with plug (AT = S) and 3A metal industrial plug-in connector for motor types without Index b, e.g., 734

Motor types with Index b



Motor connection with plug (AT = S) and 3A metal industrial plug-in connector for motor types without Index b, e.g., 734b

Motor data

Performance data

Note: Values are typical. Subject to change. See motor type plate for official data. Please note the country assignment.

Voltage class	**A**	**A**	**B**	**D**
Circuit	**Δ**	**Y**	**Y**	**Y**
Voltage U at f = 50 Hz	200 V ±10%		400 V ±10%	
	200 V ±10%		400 V +10...-12%	
Voltage U at f = 60 Hz	220 V ±10%	400 V ±10%	460 V ±10%	575 V ±10%
	220 V ±10%	400 V ±10%	460 V +10...-12%	575 V ±10%

			Current consumption at rated power				**Power factor**	**Power output at**	
	Motor type	**IE3**	**I_N** (A)	**I_N** (A)	**I_N** (A)	**I_N** (A)	**cos** φ	**(50Hz) P** (kW)	**(60Hz) P** (kW)
	524	x	0.65	0.35	0.32	0.24	0.6	0.09	0.1
	614b	–	–	–	0.49	–	0.56	0.12	0.14
	624	x	1.15	0.65	0.55	0.45	0.66	0.18	0.22
	634	x	1.65	0.9	0.85	0.65	0.6	0.25	0.29
	644b	–	–	–	–	0.75	0.6	0.25	0.29
	714b	–	1.75	1	0.8	–	0.64	0.25	0.3
	716b	–	1.45	0.85	0.6	0.55	0.66 ... 0.68	0.18	0.22
	716	x	1.3	0.75	0.6	0.62	0.68	0.18	0.22
	734b	–	2.3	1.35	0.95	0.95	0.72 ... 0.77	0.37	0.45
	734	x	1.9	1.05	0.95	0.72	0.74	0.37	0.42
	734a	x	2.5	1.4	1.3	1	0.66	0.45	0.52
	738b	–	1.4	0.8	0.55	0.5	0.60 ... 0.63	0.12	0.14
	744b	–	–	–	1.4	–	0.77	0.55	0.68
	814b	–	3	1.75	–	1.27	0.68 ... 0.69	0.55	0.64
	814	x	3.1	1.7	1.45	1.1	0.69	0.55	0.63
	824	x	4.1	2.25	2	1.6	0.66	0.75	0.86

Suitable for continuous operation, start-stop operation with an operating time of up to 70% and frequency converter operation.

Certification for the motor, cable and plug components:

IE3 motors: CE, cURURS, CCC

Motors with Index b: CE/CCC (50 Hz), CE/cURUS (60 Hz)

< 40	1[1]
45	0.95
50	0.90
55	0.85
60	0.8

[1] Rated motor power (0.37; 0.25; 0.12 kW)

Rated motor power

The ambient operating temperature T_U influences the rated power P_N of the gear motors.

Transportation and nominal speeds v_N

Modular unit	v_N (m/min)	50 Hz v [m/min]	Motor type	60 Hz v [m/min]	Motor type
AS 2/B–150	18	18.5	734a	18.9	734
	15	15.7	734	13.4	734
	12	11.2	734	13.4	734
	9	8.5	734	10.2	734
	6	5.7	716	6.8	716
AS 2/B–250	18	18.5	824	18.9	824
	15	15.7	824	15.7	824
	12	10.9	824	11.1	814
	9	9.2	814	8.9	734
	6	5.9	734	5.9	716
AS 2/C–100	18	18.5	634	16.6	624
BS 2/C–100	15	13.9	624	13.3	624
CS/C	12	11.1	624	11.1	624
AS 2/R–300	9	9.2	624	8.3	624
BS 2/R–300	6	5.5	624	6.7	624
KU 2/90					
KU 2/180					
BS 2/C–H	18	16.8	744b[1]/814b[2]	15.8	734b
AS 2/C–400	15	13.2	734b	15.8	734b
BS 2/R–H	12	10.4	734b	12.5	734b
AS 2/R–1200	9	8.1	714b	9.8	714b
	6	5.4	716b	6.5	716b
AS 2/C–700	18	16.8	824	17.2	824
AS 2/R–2200	15	14.4	824	14.3	824
	12	11.9	824	12.0	824
	9	8.4	814	8.1	734
	6	5.4	734	6.5	734
AS 2/C–250	18	18.5	734b	17.5	734b
BS 2/C–250	15	14.6	734b	14.5	734b
AS 2/R–700	12	12.0	734b	11.5	734b
BS 2/R–700	9	9.6	734b	9.0	734b
	6	5.9	734b	5.5	714b
BS 2	18	18.0	634	18.0	634
BS 2/M, BS 2/M	15	15.0	634	14.4	634
BS 2/T, BS 2/TE	12	12.0	634	10.8	624
CU 2/90	9	9.0	624	8.7	624
BS 2/K	6	6.0	624	5.4	624
EQ 2/T, EQ 2/TE					
EQ 2/M					
BS 2/130					

v_N = nominal speed
v = conveyor medium speed
[1] For voltage class: B (see p. 11-25)
[2] For voltage class: A, D (see p. 11-25)

Transportation and nominal speeds v_N

Modular unit	v_N (m/min)	50 Hz v [m/min]	Motor type	60 Hz v [m/min]	Motor type
HQ 2/U	18	15.8	524	19.0	524
	15	13.2	524	15.8	524
	12	10.6	524	12.7	524
	9	8.3	524	10.0	524
	6	5.7	524	6.8	524
KE 2	18	18.0	524	18.0	524
EQ 2/TR, EQ 2/TR-90	15	15.0	524	14.4	524
	12	12.0	524	10.8	524
	9	9.0	524	9.0	524
HQ 2/S, HQ2/U2	6	6.0	524	5.7	524
HQ 2/C-H	18	18.5	634	16.6	624
	15	13.9	624	13.3	624
	12	11.1	624	11.1	624
	9	9.2	624	8.3	624
	6	5.5	624	6.7	624
HQ 2/U-H	18	16.7	624	20.4	624
	15	16.7	624	15.3	624
	12	12.5	624	10.2	624
	9	8.4	624	7.6	624
	6	6.3	624	6.1	624

v_N = nominal speed
v = conveyor medium speed

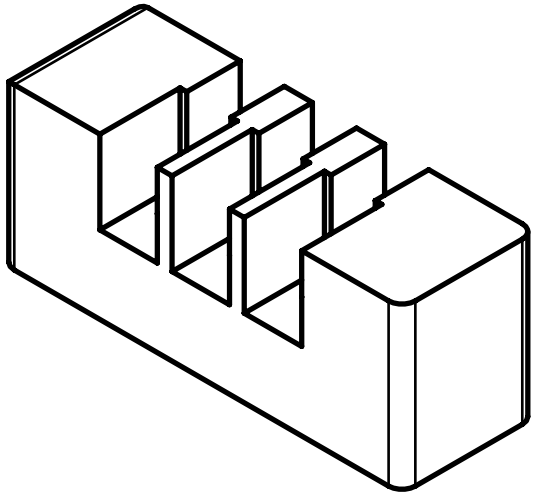
Modular unit	v_N (m/min)	50 Hz v [m/min]	50 Hz v_T (m/min)	Motor type	60 Hz v [m/min]	60 Hz v_T (m/min)	Motor type
BS 2/R–V–1200	18	16.8	42.0	744b[1]/814b[2]	–	–	–
AS 2/R–V–1200	15	13.2	33.0	734b	15.8	39.5	734b
	12	10.4	26.0	734b	12.5	31.3	734b
	9	8.1	20.3	714b	9.8	24.5	714b
	6	5.4	13.5	716b	6.5	16.3	716b
AS 2/R–V–2200	18	16.8	42.0	824	17.2	43.0	824
	15	14.4	36.0	824	14.3	35.8	824
	12	11.9	29.8	824	12.0	30.0	824
	9	8.4	21.0	814	8.1	20.3	734
	6	5.4	13.5	734	6.5	16.3	734

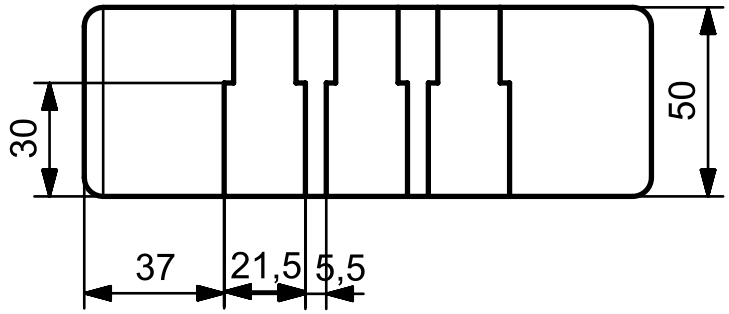
v_N = nominal speed
v = conveyor medium speed
v_T = max. transportation speed
[1] For voltage class: B (see p. 11-25)
[2] For voltage class: A, D (see p. 11-25)

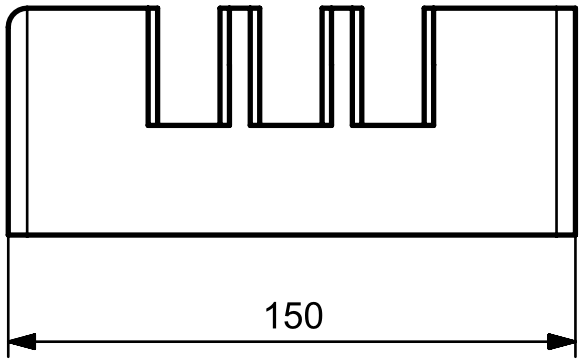
Compressed air consumption of TS 2*plus* units

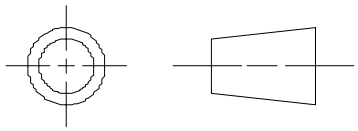
Unit	Type	Rotation angle (°)	Diameter d (mm)	Lift (mm)	Volume* (cm³)
Block cylinder	PE 2, HQ 2 (BG 1)	–	50	25	59
	EQ 2, HQ 2 (BG 2) HQ 2/U2	–	2 x 50	25	118
	HQ 2/U-H	–	2 x 50	25	118
		–	3 x 50	25	177
		–	4 x 50	25	236
HP 2 lift positioning unit		–	63	80	249
				125	390
				175	546
				225	701
				275	856
				325	1011
				375	1166
				425	1321
PE 2/X, PE 2/H positioning unit, HQ 2/C-H lift transverse unit		–	4 x 63	33	103
PE 2/XP positioning unit	BG 1	–	40	34	43
	BG 2	–	50	34	67
HD 2 lift rotate unit		–	50	40	201
		–	50	90	452
		90	80	125	628
		180	80	180	905
HD 2/H lift rotate unit	BG 1 rotating cylinder	90; 180	–	–	146
	BG 2, 3 rotating cylinder	90; 180	–	–	283
	BG 1 lifting cylinder	90	40	185	232.4
		180	40	80	100.5
	BG 2 lifting cylinder	90	63	185	576
		180	63	80	249.4
	BG 3 lifting cylinder	90	100	185	1452.9
		180	100	80	628.3
Stop gate	VE 2, VE 2/L, VE 2/M	–	32	20	16
	VE 2/X	–	44	9	11
	VE 2/D-60	–	34	8	5
	VE 2/D-175	–	38	6	5
	VE 2/D-200	–	50	10	16
	VE 2/D-100H	–	25	20	10
	VE 2/D-250H	–	40	24	30
	DA 2/100H	–	35	24	20
	DA 2/250H, VA 2/250-H	–	40	24	30
Damper	DA 2/60	–	20	18	6
	DA 2/100	–	35	35	34
VA 2 slide stop	3 842 528 808	–	32	20	16
	3 842 191 721	–	20	17	5

* Details on request









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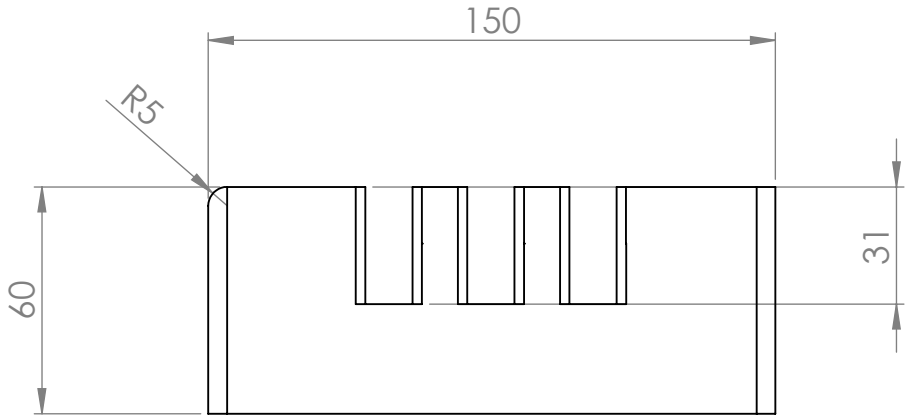

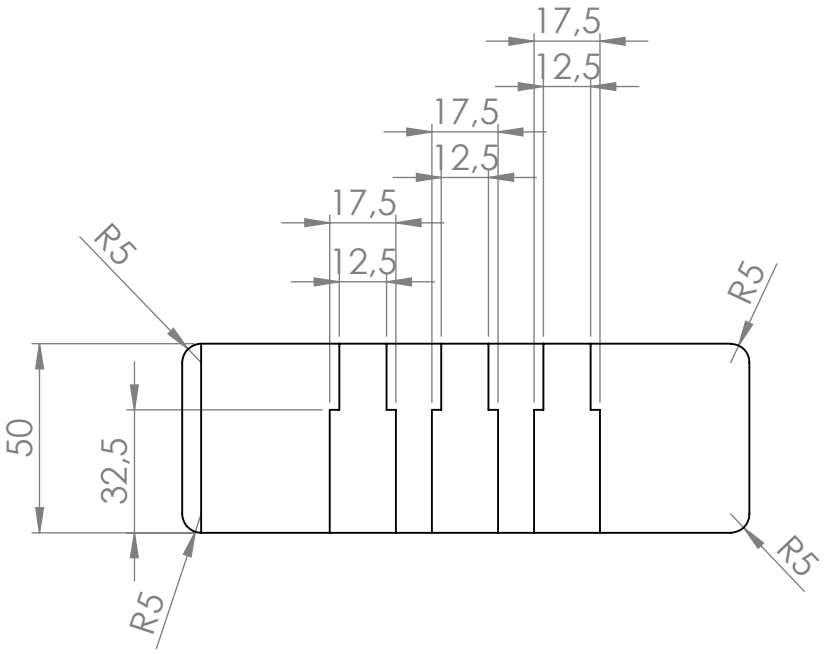

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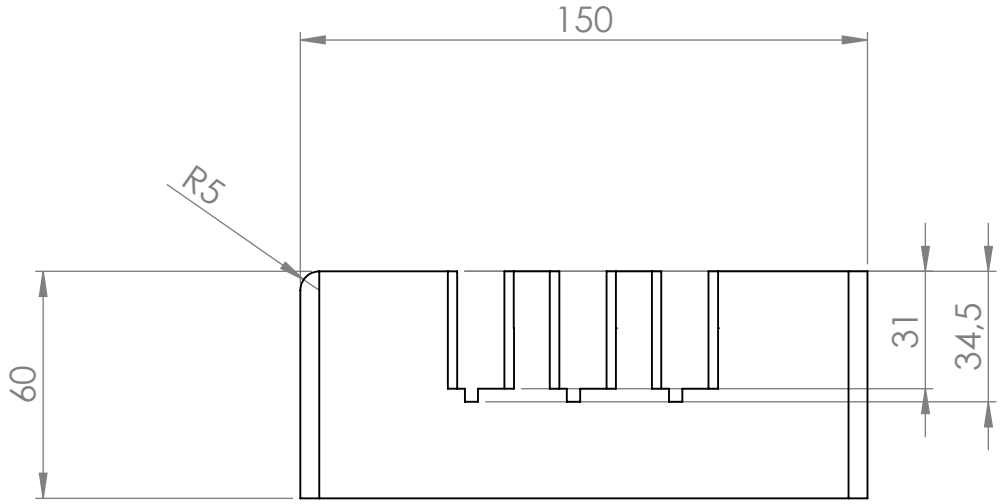
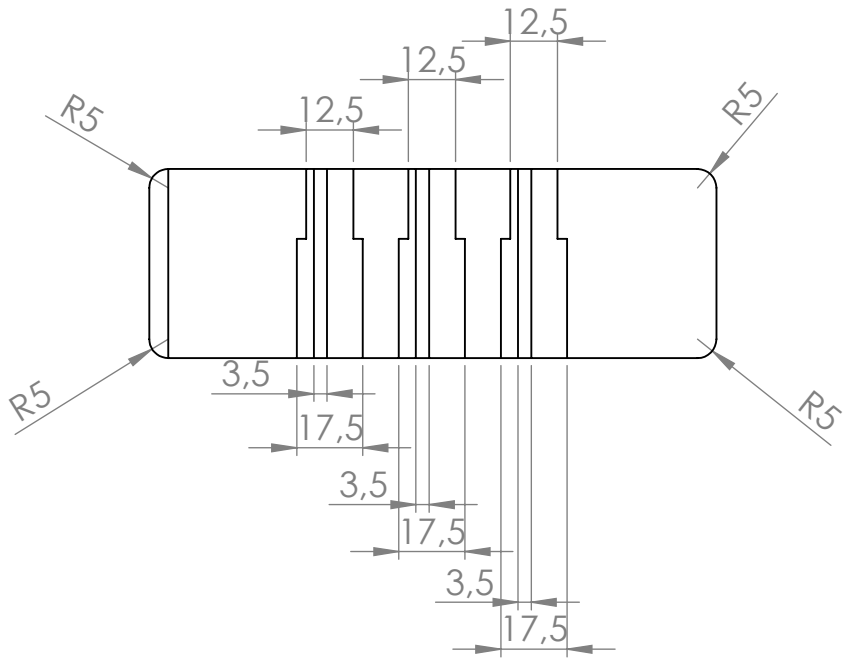
Tampereen Teknillinen Yliopisto Koneensuunnittelun laitos	Lehti Lehtiä	Arkki **A3**	Tiedosto DISTANCE FIXER up Hakemisto \\intra.tut.fi\home\saatsim\My Documents\Desktop\proda\screw terminal assembl	Piir. no.	Versio





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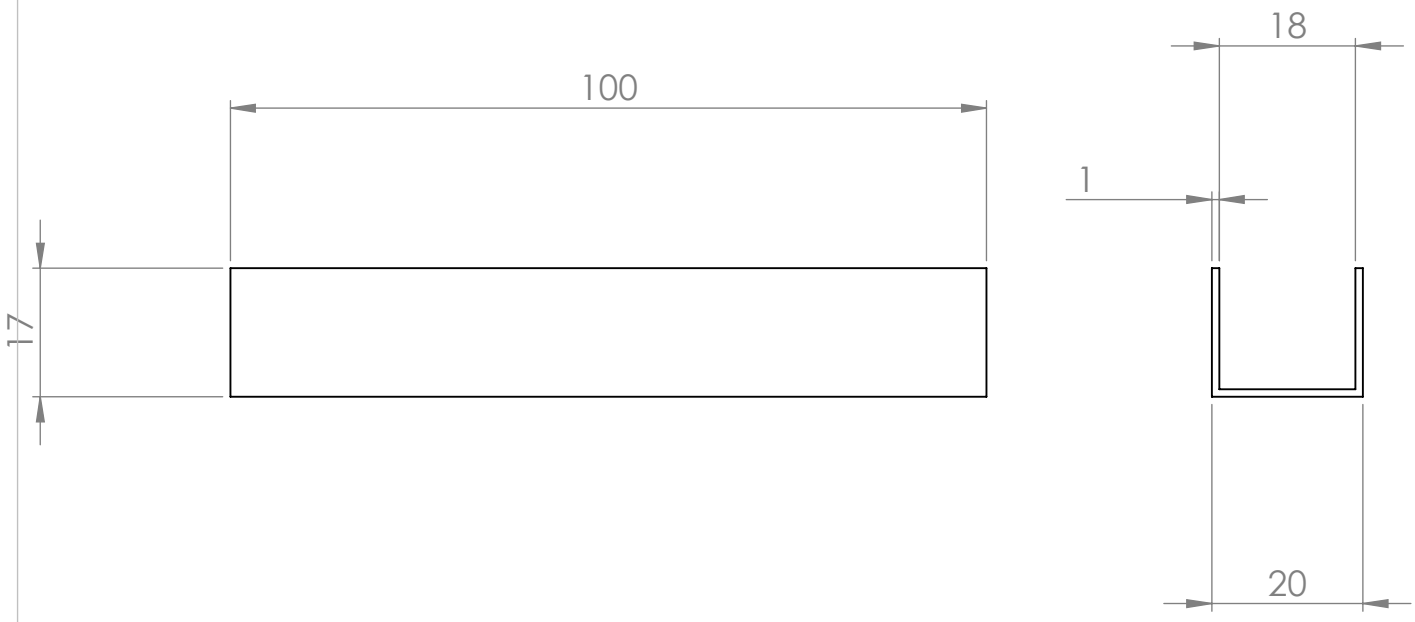
Tampereen Teknillinen Yliopisto Koneensuunnittelun laitos	Lehti Lehtiä	Arkki **A3**	Tiedosto DISTANCE FIXER down Hakemisto \\intra.tut.fi\home\saatsim\My Documents\Desktop\proda\screw terminal assembl	Piir. no. **Number** Versio



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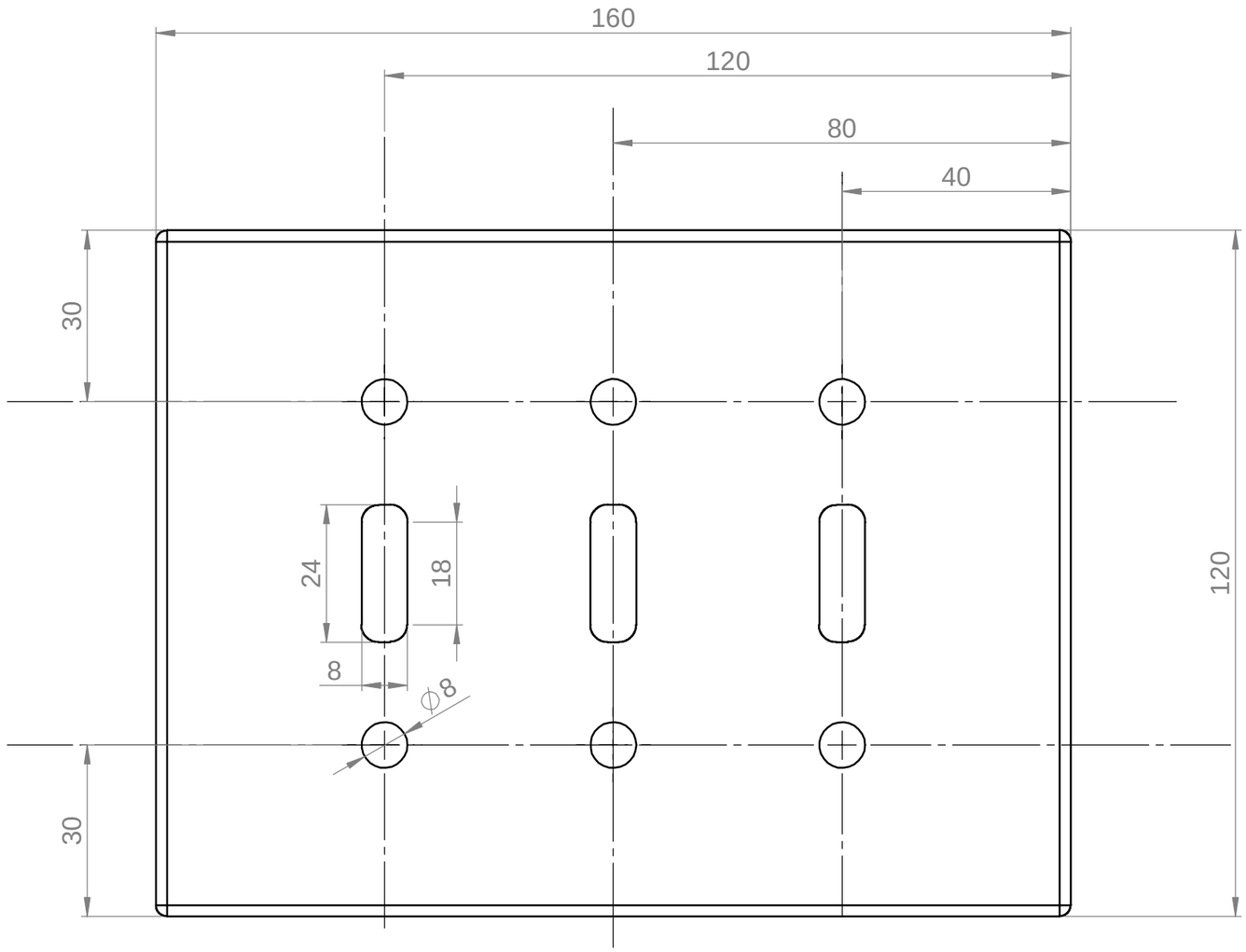

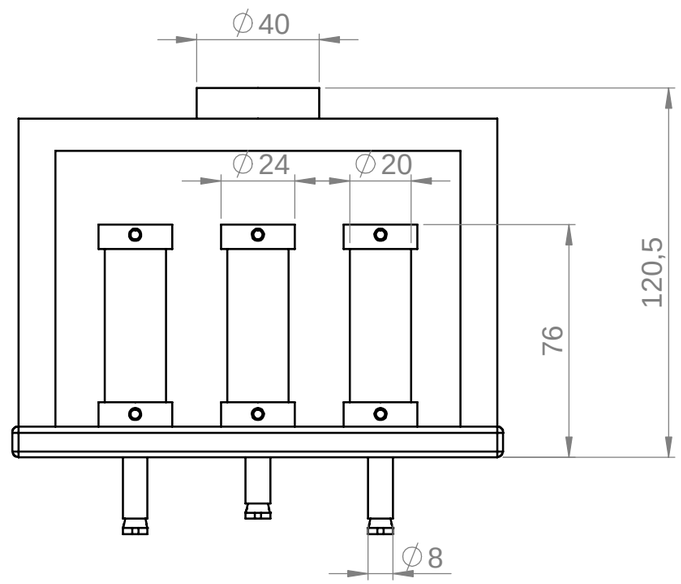

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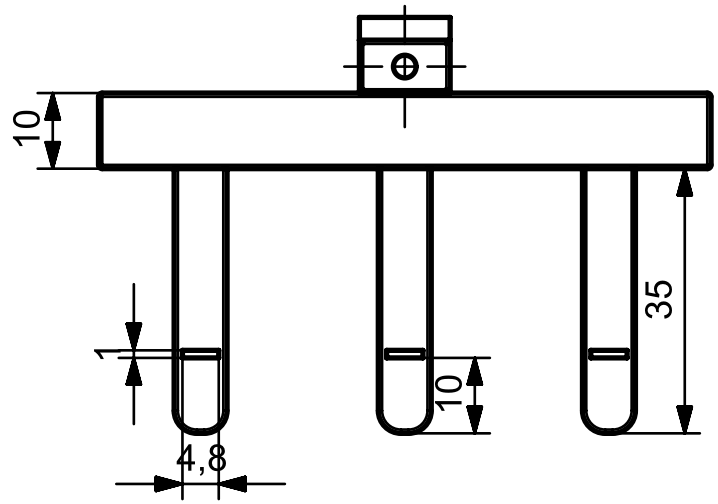

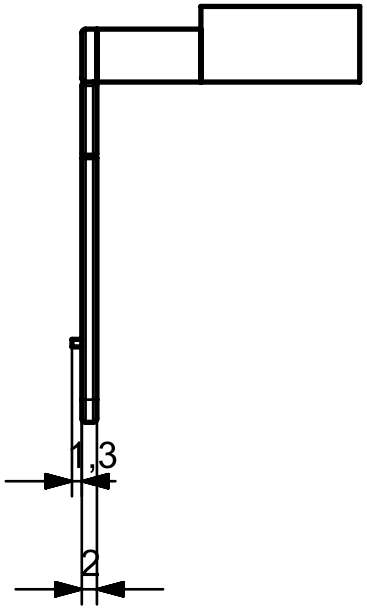

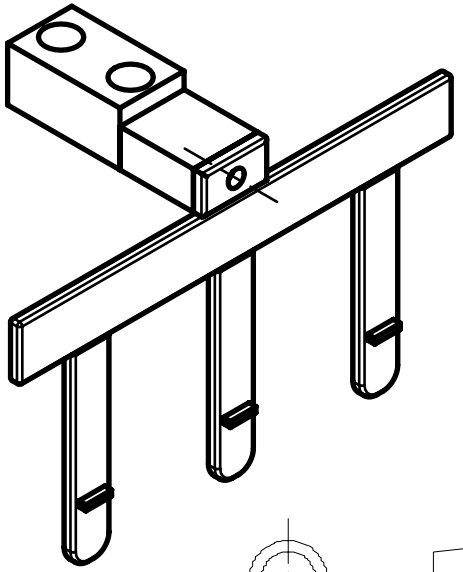

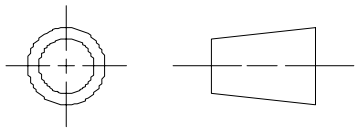

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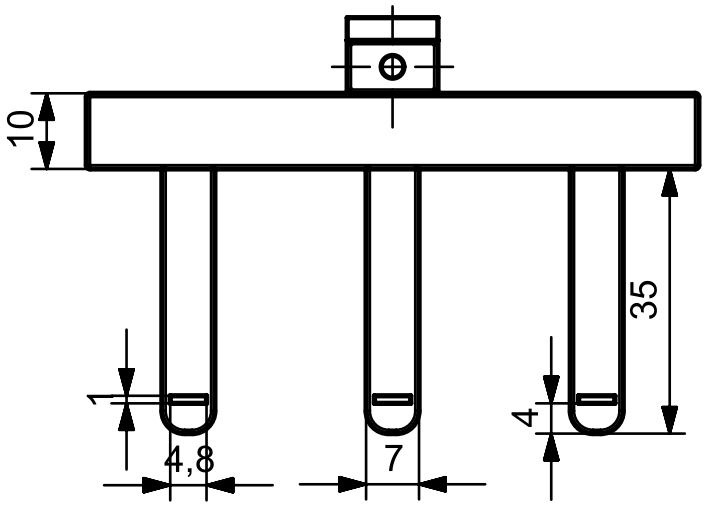
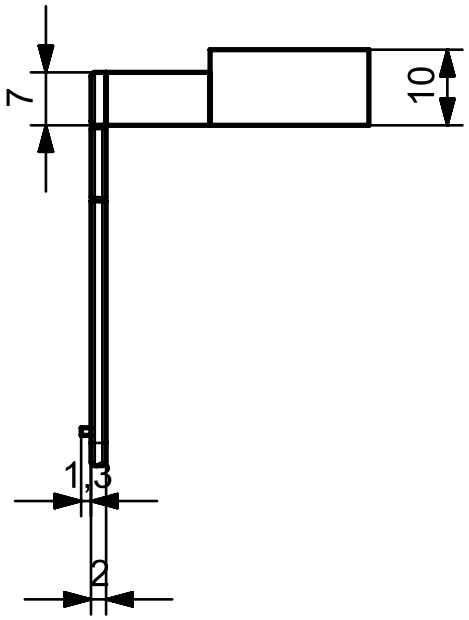
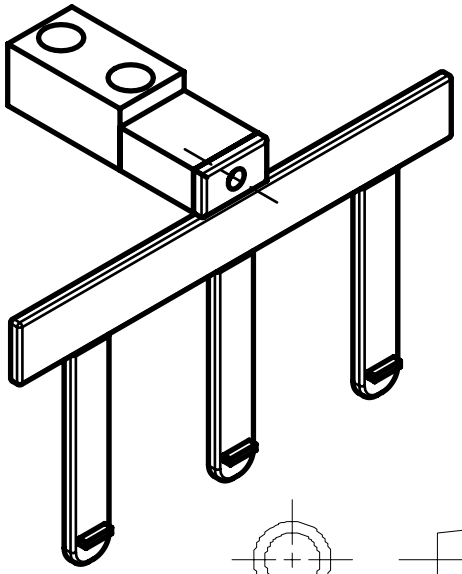
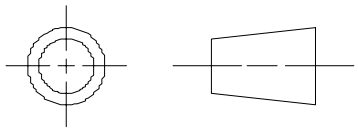
A4









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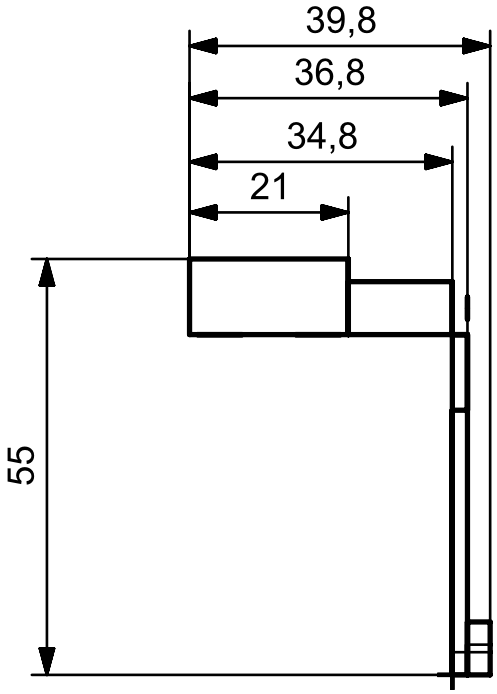
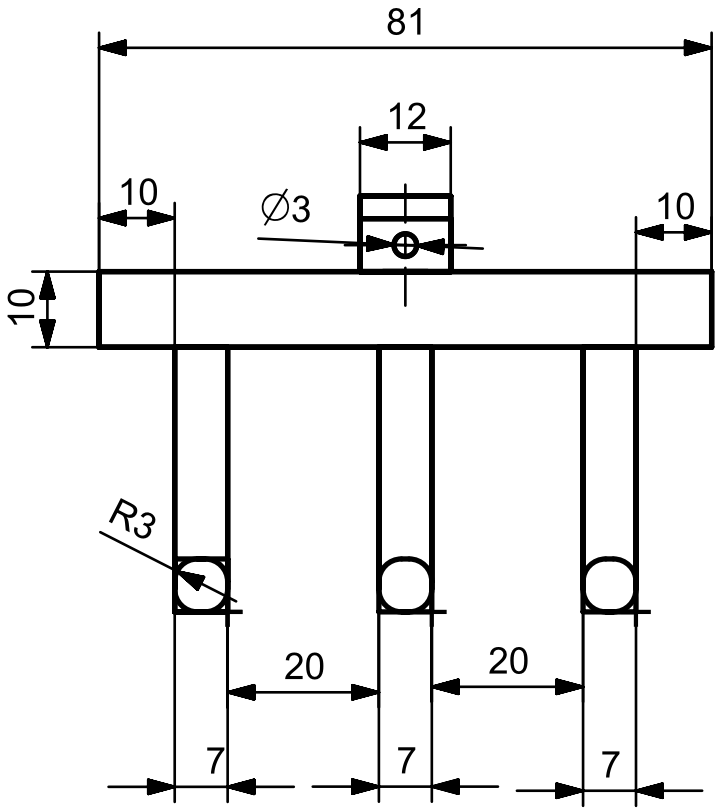
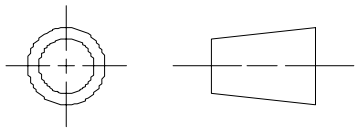
A4







ALL DIMENSIONS IN MM

SIEMENS

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FIRST ISSUED	
DRAWN BY	
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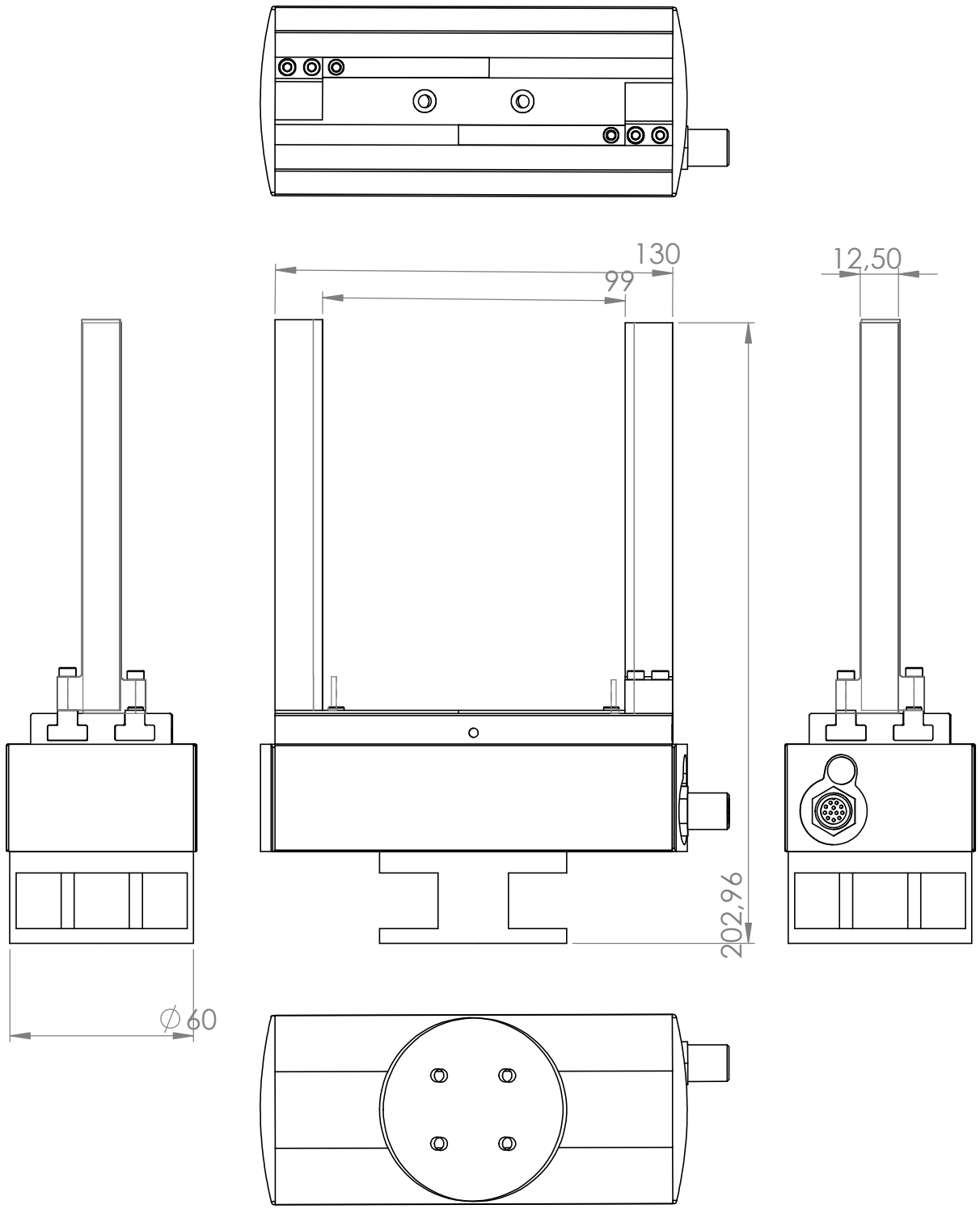
APPROVED BY	

TITLE

SIZE	DRG NO.	SHEET REV
A4	Multi gripper for screw terminals	A

SCALE 1:1 | SHEET 1 OF 1

A4



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

TITLE:

BASE GRIPPER

MATERIAL:

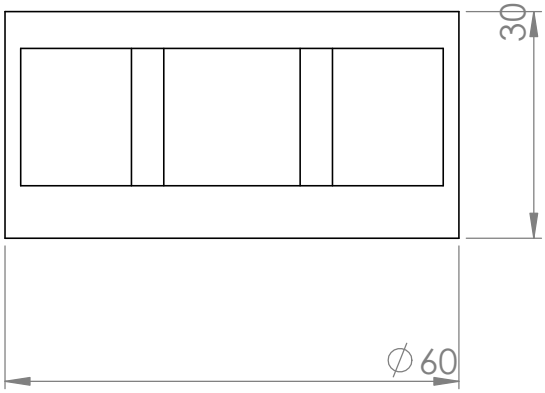
DWG NO. 537316_BUB_HGPL_14

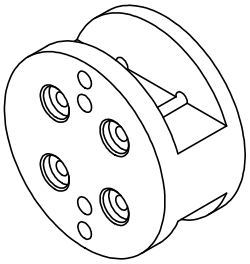
A4

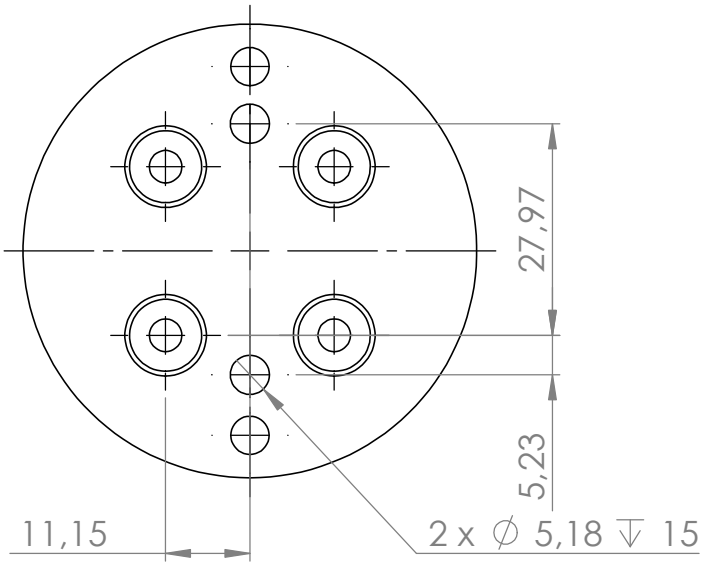
WEIGHT:

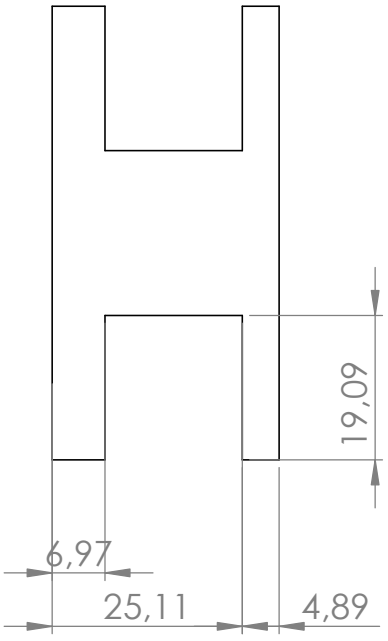
SCALE:1:5

SHEET 1 OF 4









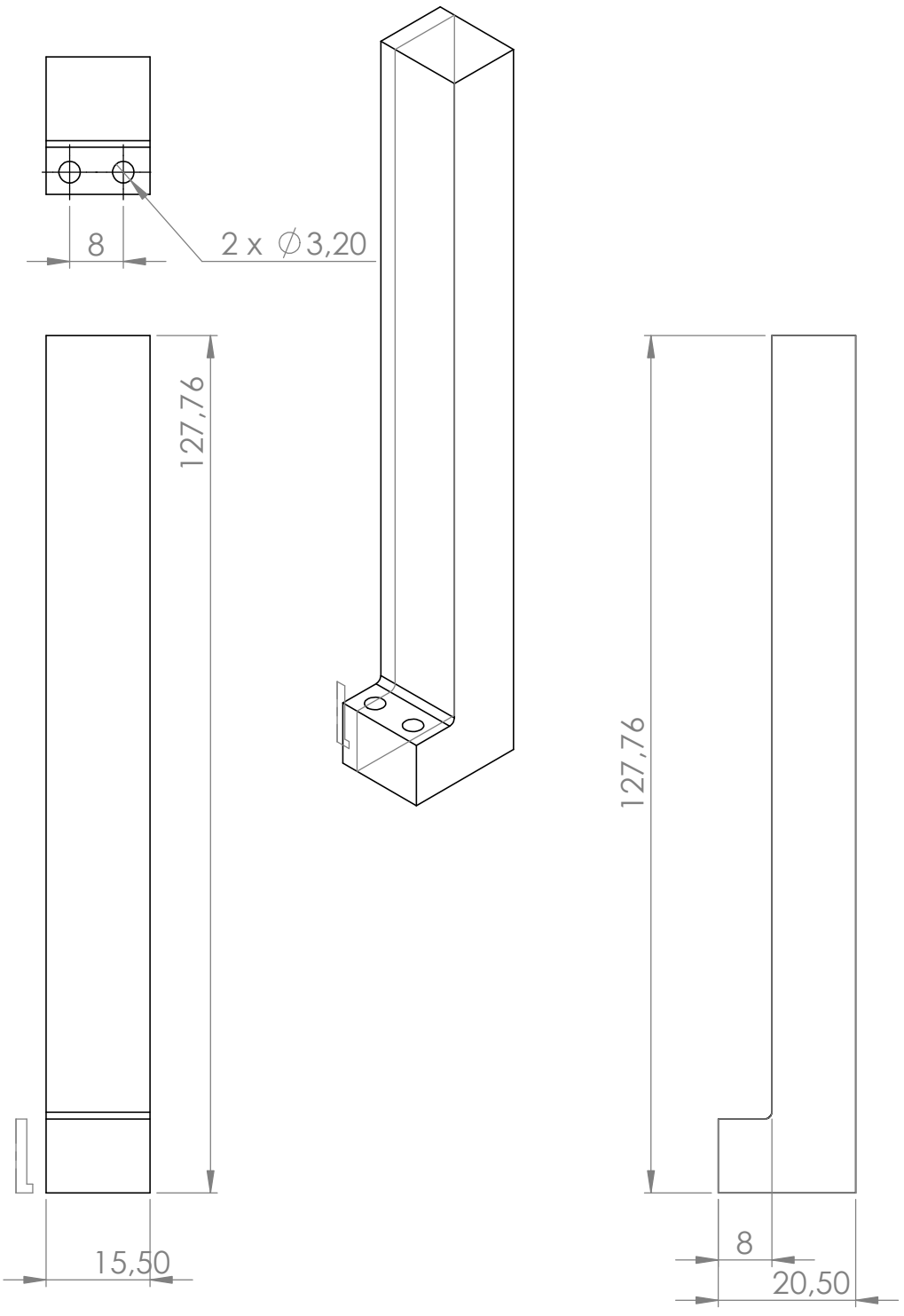
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

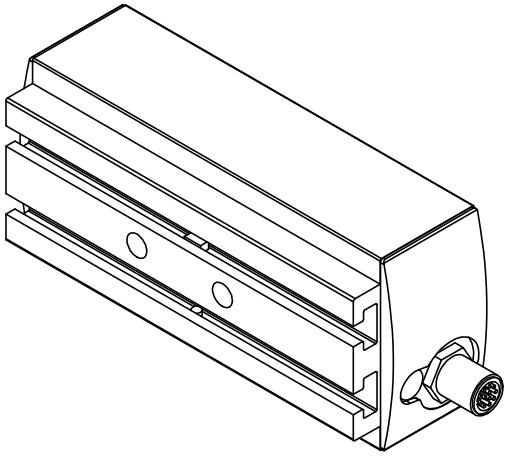
TITLE:

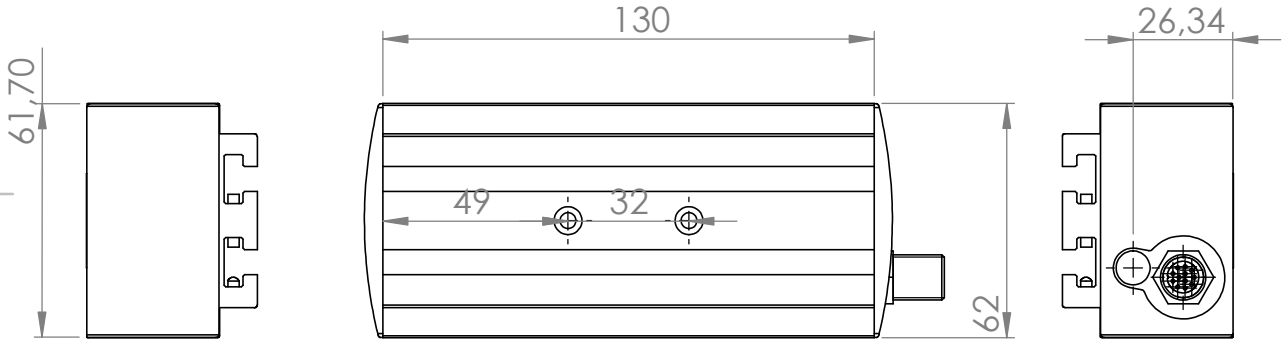
BASE GRIPPER

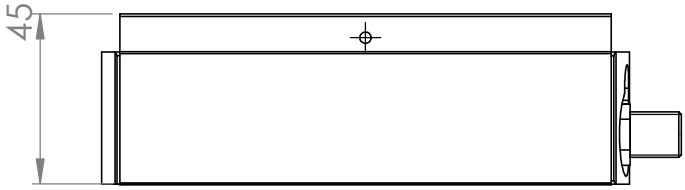
MATERIAL:	DWG NO. 537316_BUB_HGPL_14	A4
WEIGHT:	SCALE:1:5	SHEET 2 OF 4



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN						BASE GRIPPER	
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO.	A4
						537316_BUB_HGPL_14	
				WEIGHT:		SCALE:1:5	SHEET 3 OF 4







UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

TITLE:

BASE GRIPPER

MATERIAL:

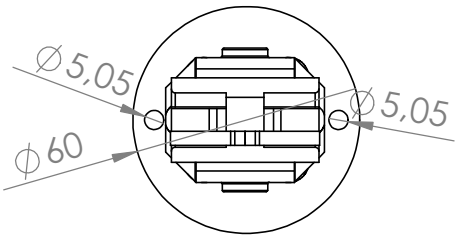
DWG NO. 537316_BUB_HGPL_14

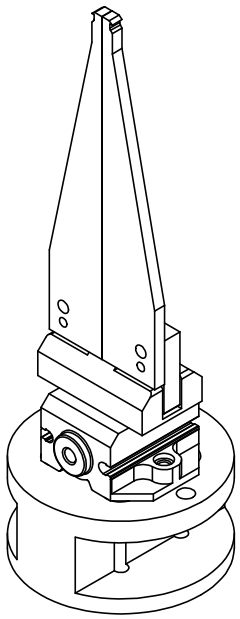
A4

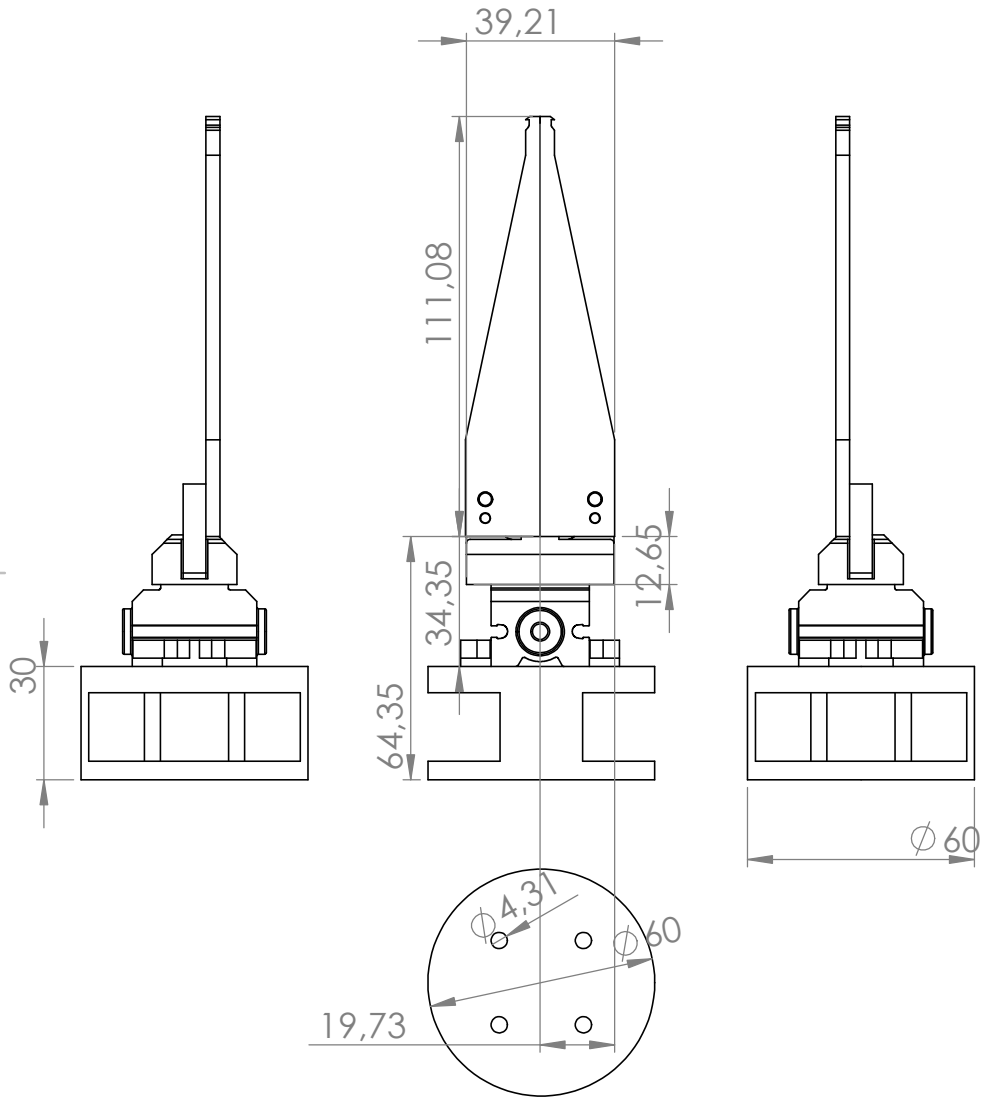
WEIGHT:

SCALE:1:5

SHEET 4 OF 4







UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

TITLE:

MATERIAL:

DWG NO.

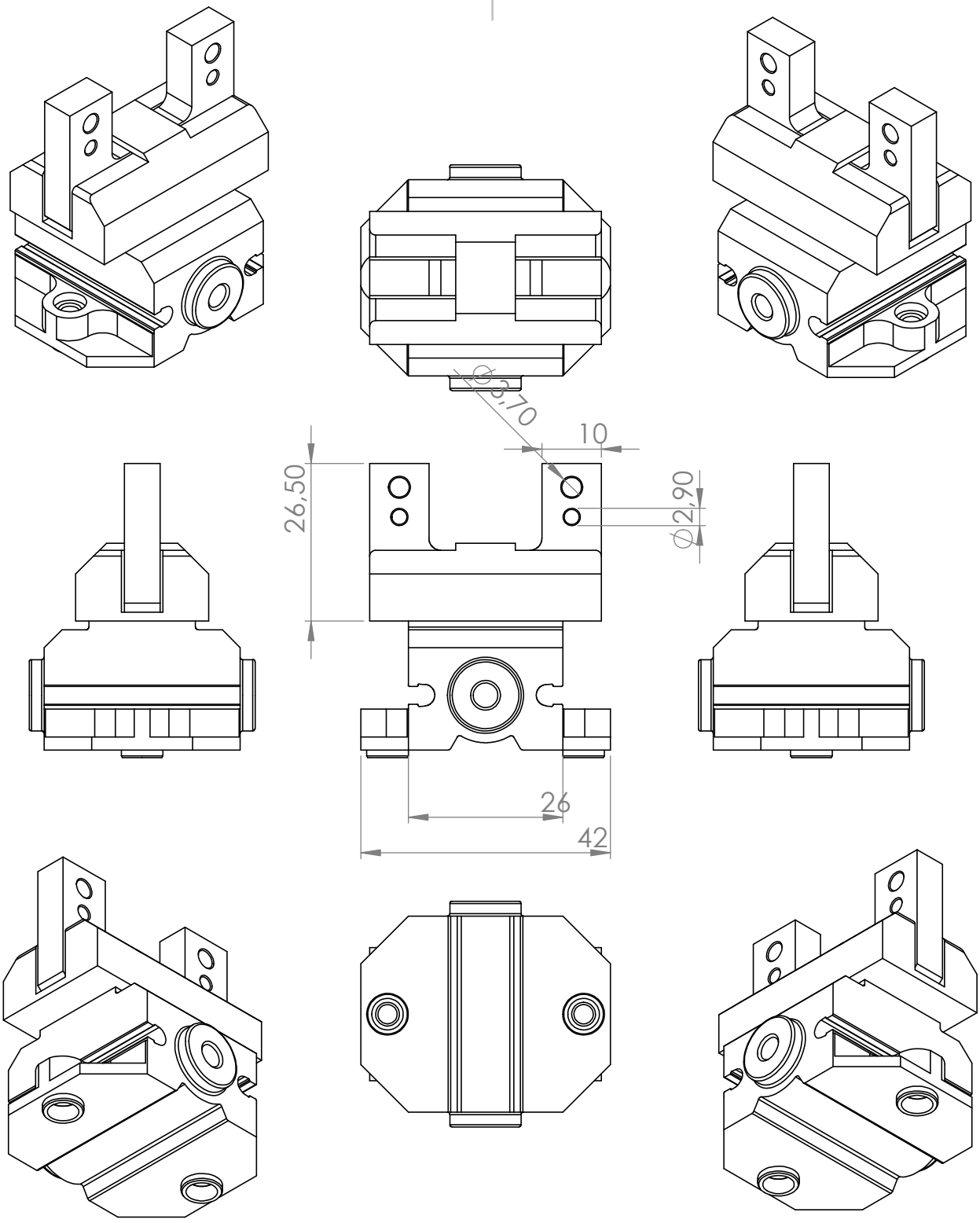
Railslide gripper

A4

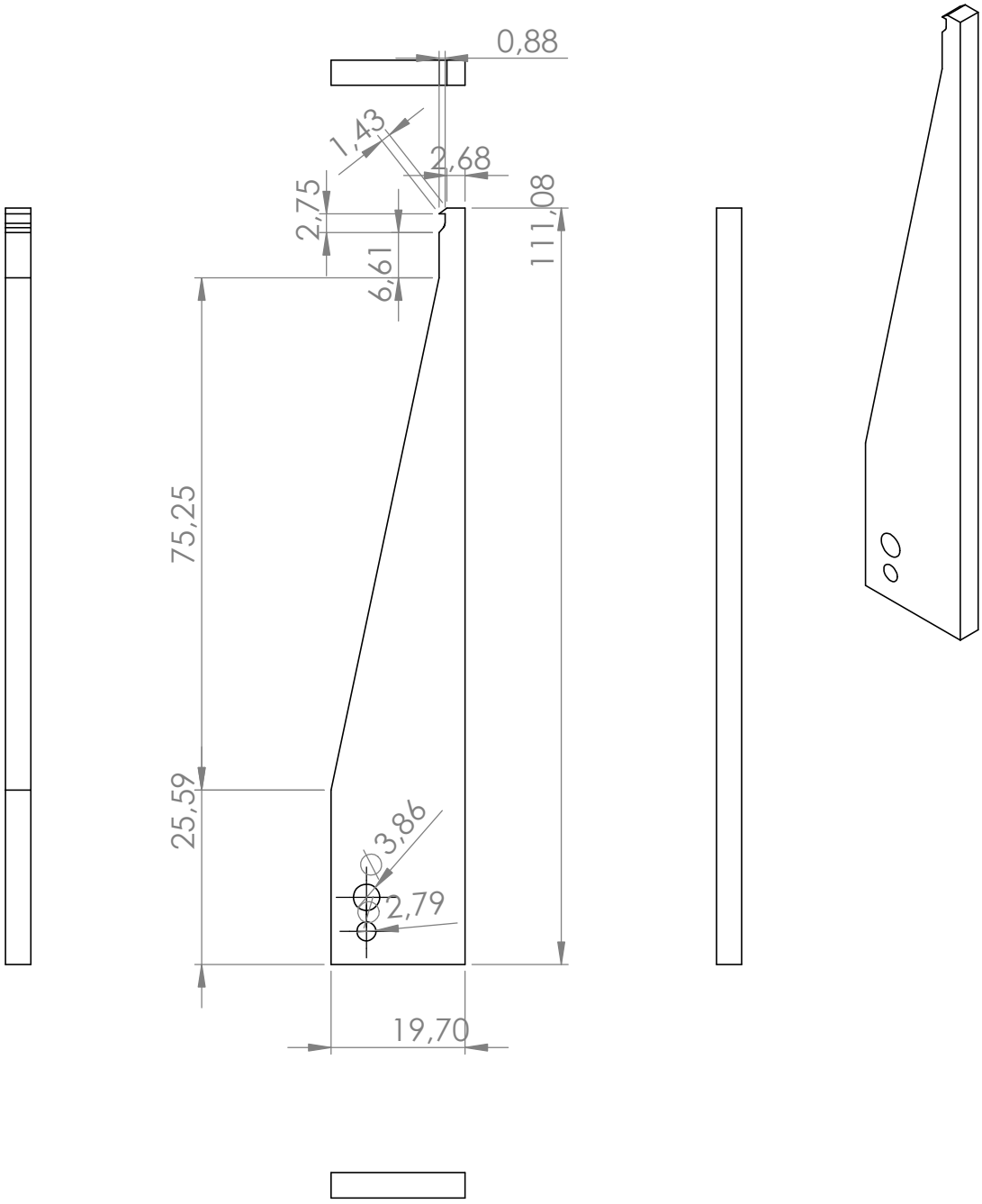
WEIGHT:

SCALE:1:2

SHEET 1 OF 3



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION		
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO. Railslide gripper	A4
				WEIGHT:		SCALE:1:2	SHEET 2 OF 3



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:	DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

TITLE:

MATERIAL:

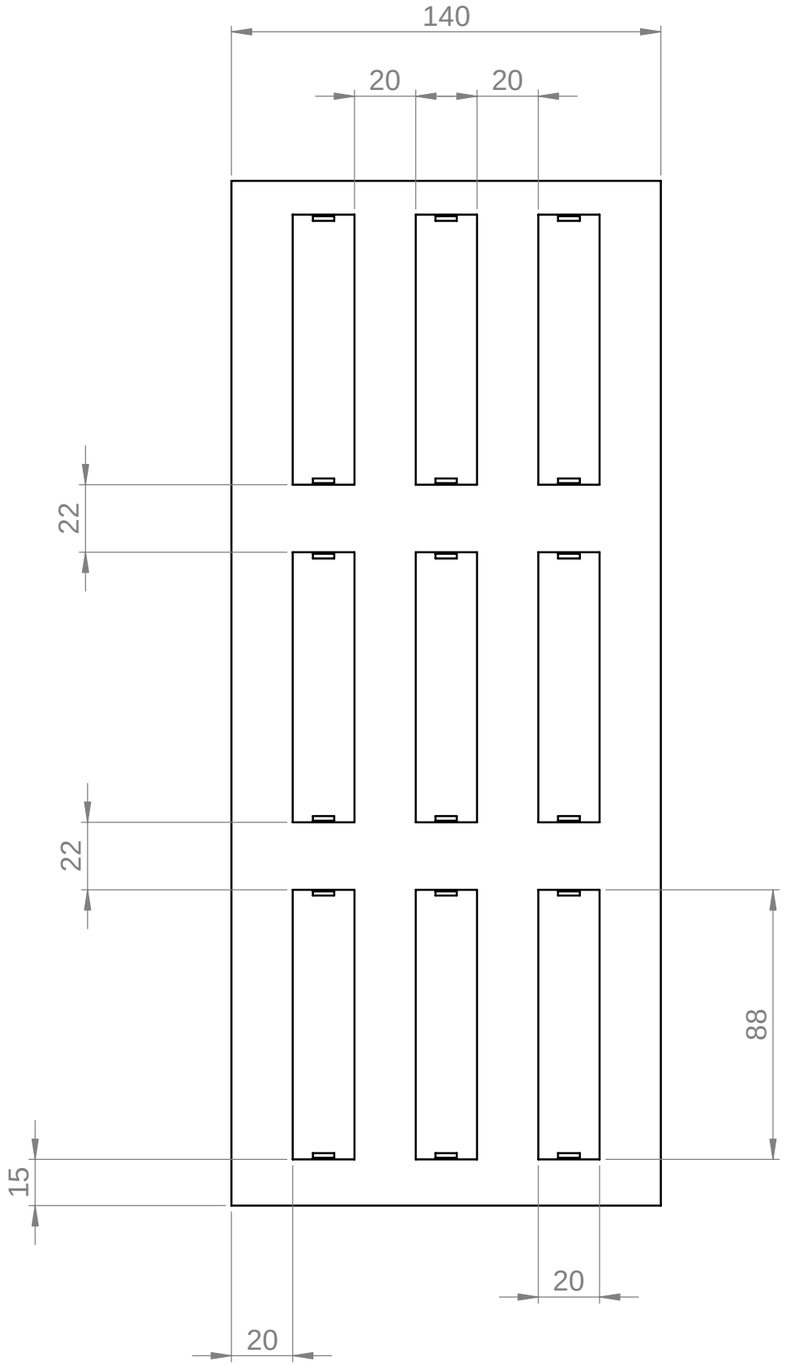
DWG NO. Railslide gripper

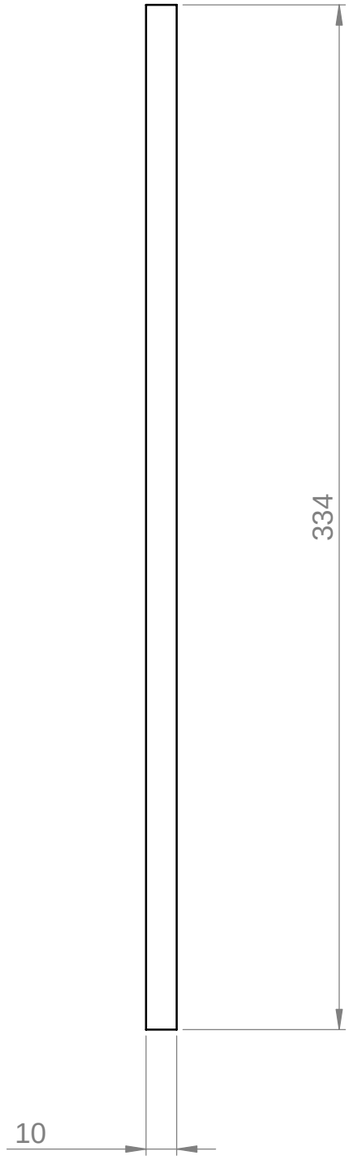
A4

WEIGHT:

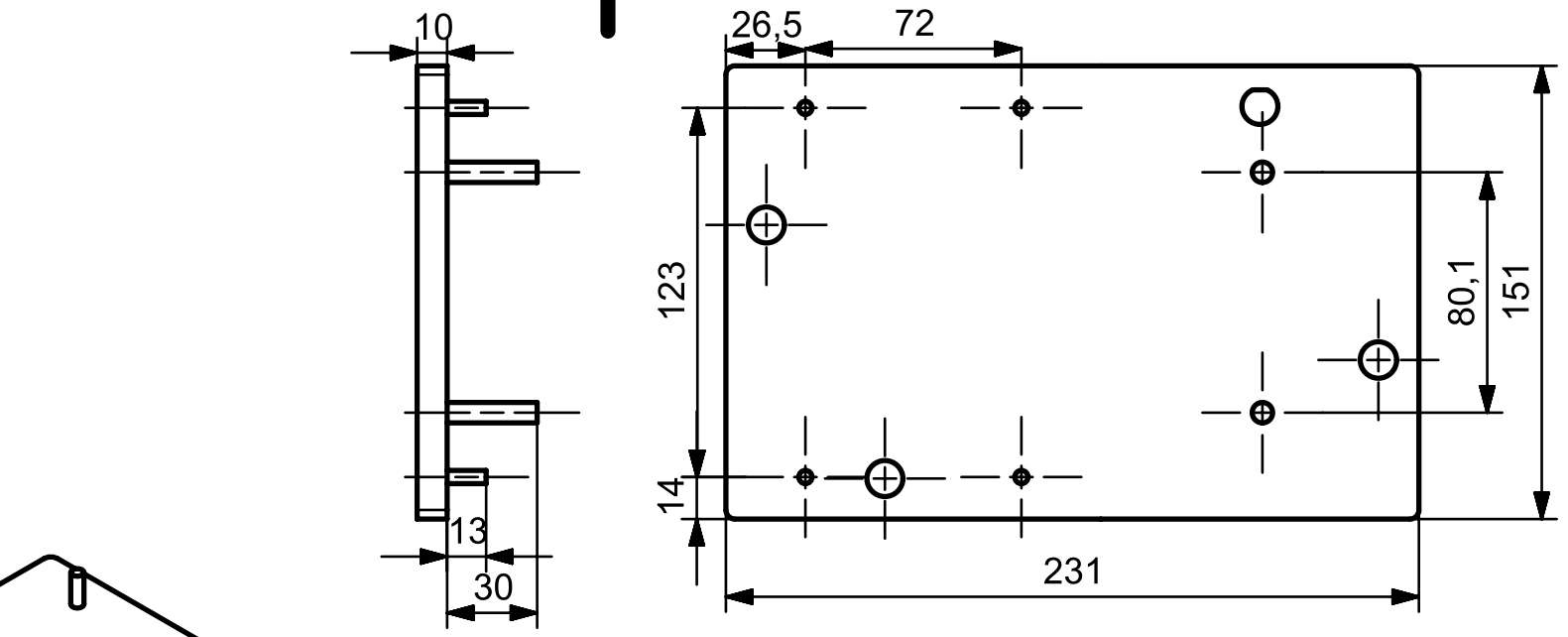
SCALE:1:2

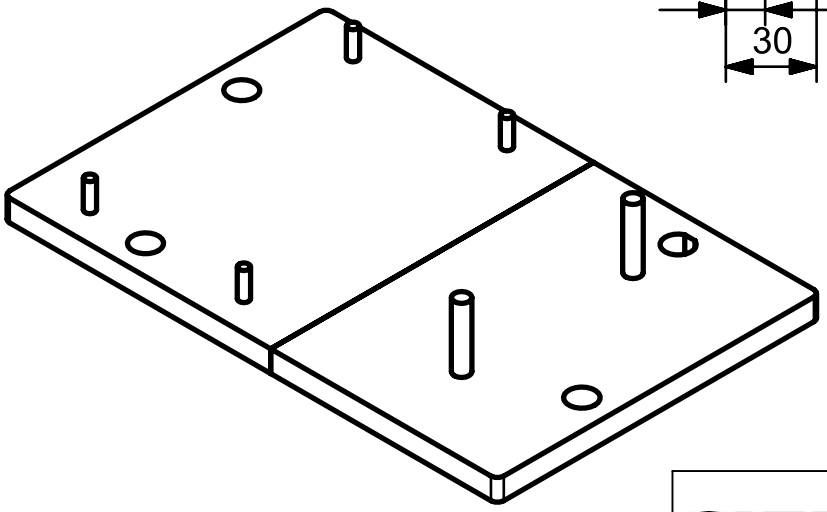
SHEET 3 OF 3

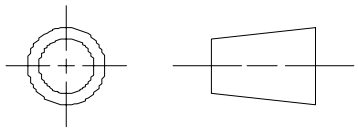




Yleistoleranssit: Koneistus ISO 2768 M Hitsaus SFS-EN ISO 13920-B	Nimike Description Material Dimensions		Suhde 1:5	Piirt. DrawnBy Pvm. DrawnDate Tark. CheckedBy Pvm. CheckedDate	
Tampereen Teknillinen Yliopisto Koneensuunnittelun laitos	Lehti Lehtiä	Arkki A3	Tiedosto tray_window Hakemisto \\intra.tut.fi\home\eko\My Documents\Desktop\gripper\	Piir. no. Number	Versio







ALL DIMENSIONS IN MM

SIEMENS

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TITLE

SIZE	DRG NO.	SHEET REV
A4	JIG	A

SCALE 2:5 | SHEET 1 OF 1

A4