





# Seventh Axis

# **Advantages**



## Increase a robot's range of motion.

By utilizing a shuttle system, a robot can be moved over long distances with a high range of dynamics. Available in 7 different sizes, Rollon Seventh Axis is easy to integrate and can move any type of robot weighing up to 2000 Kg.



# Protection for every work environment

The Seventh Axis can be configured with different options to protect it from different types of environmental factors.



#### Simplified mounting and alignment

Due to adjustable leveling systems integrated into the rigid, factory-aligned cross-members.





#### Potentially infinite strokes

Thanks to jointable, self-centering inserts.

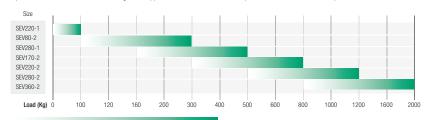


#### **High quality components**

Designed with carefully selected high quality components: hardened racks with helical teeth, rails with recirculating rollers and planetary or hypoid bevel gearboxes.

#### LOAD CAPACITY ACCORDING TO DYNAMICS

Reported data must be verified according to the application. For more information, please contact our technical department.



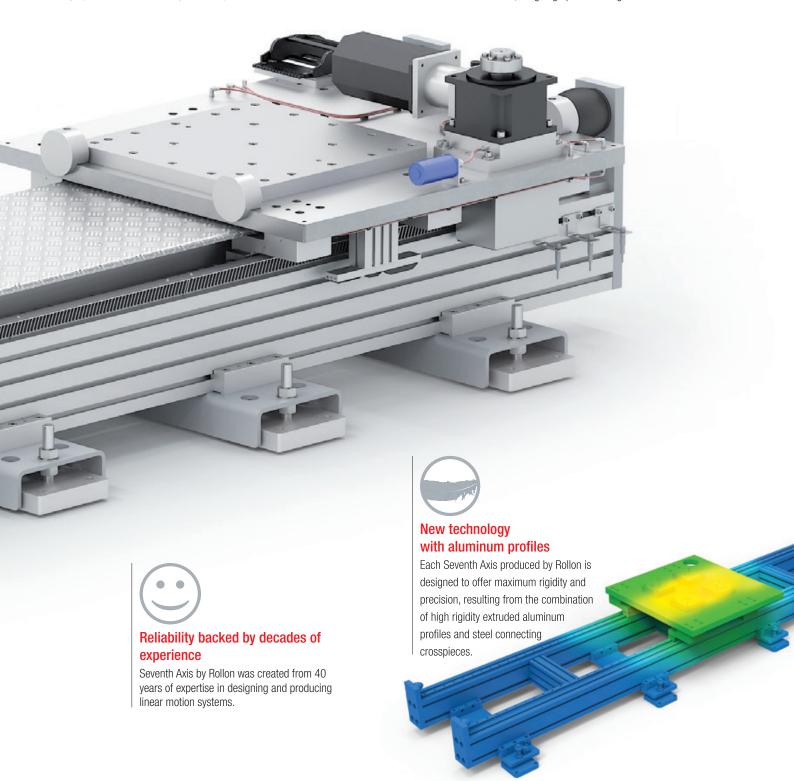
Lower load - Higher dynamics

ligher load - Lower dynamic



# Easily integrated with any type of robot

A complete range of 7 different sizes guarantees simple integration for any type of robot, weighing up to 2000 Kg.



# Seventh Axis

# Technical Features /



Refere	ence	Linear	guides	Dr	rive	Anti-corrosion		Prote	ection		Size	Number of
Family	Product	Rollers	Balls	Rack	Belt		Sealing Strip	Simple	Partial	Total	00	profiles
	SEV220-1					•	V				220x100	1
	SEV80-2				Onnanana O	<b>*</b>	V				80x80	2
Seventh Axis	SEV280-1							V			170x280	1
	SEV170-2							V	V	V	170x120	2
	SEV220-2							√	V	$\checkmark$	220x120	2
	SEV280-2							V	V	V	280x170	2
	SEV360-2							V	V	$\checkmark$	360x200	2

The data shown must be verified on the basis of the application.

<sup>\*1</sup> Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Maximum			Maximum		Robot examples*1		
speed [m/s]	acceleration [m/s <sup>2</sup> ]	[mm]	stroke [mm]	Brand	Model	Payload [Kg]	Weight [Kg]
2	4	+/-0.05	5600	ABB COMAU FANUC	IRB 120; IRB 140; IRB 1100; IRB 1200; Racer-5-0.63; Racer 5-0.80; Racer-3-0.63; LR Mate 200 iD	3-6 3-5 4-7	20.5-98 30-32 19.27
2	4	+/-0.05	5680	KAWASAKI KUKA MITSUBISHI NACHI STÄUBLI UNIVERSAL ROBOTS YASKAWA	RS003N; RS005N; RS005L; RS007N; RS007L Agilus Serie KR3; KR6; KR10 RV-2FR; RV-2FRL; RV-4FR; RV-4FRL;RV-7FR; RV-7FRL; RV-7FRLL MZ07-01; MZ07L-01; MZ07P-01; MZ07LP-01; TX2-40; TX2-60; TX2-60L UR3/3e; UR5/5e; UR10/10e; UR16e GP7; GP8	3-7 3-10 3-7 7 2-4.5 3-16 7-8	20-37 26-57 19-130 30-32 29-53 11-34 32-34
2	4	+/-0.05	∞	COMAU FANUC KAWASAKI KUKA MITSUBISHI NACHI STÄUBLI YASKAWA	Racer 7-1.0; Racer-7-1.4; SIX-6-1.4 ARC Mate 100iC/12; M-10iA/10M; M-10iA/12; M-10iD 12 RS010N; RS006L KR6 – KR10 CYBERTECH nano; KR6 – KR8 CYBERTECH ARC nano RV13FR(-L); RV20FR NB04; NV06; TP80; TX2-90; TX2-90L; TX2-90XL MH12/-F; GP12	6-7 10-12 6-10 6-10 13-20 10 7-14	160-180 130-145 150 145-180 120-130 160-170 111-119 130-150
2	4	+/-0.05	∞	ABB FANUC KAWASAKI KUKA NACHI STÄUBLI YASKAWA	IRB 1600; IRB 1660ID; IRB 2600-12/-20; IRB 2600ID-8/-15; M-20iA; M-20iA/20M; ARC Mate 120C; M-20iB/25; M-20iB/25C; M-20iA/35M RS020N; RS010L KR CYBERTECH / KR CYBERTECH arc MC10L; MC20; MR20-02; MR20L-01; NB04L; NV06L RX160; RX160HD; RX160L; GP25; GP25-12; HP20F/-RD 2	4-20 20-25 10-20 8-22 10-20 14-20 12-25	250-284 210-250 230 250-270 220-280 248-250 250-268
2	4	+/-0.05	∞	ABB COMAU FANUC KAWASAKI NACHI STÄUBLI	IRB 2400; IRB 4600; IRB 6620LX; NS-12-1.85; NS-16-1.65; NJ-16-3.1; NJ-40-2.5; NJ-60-2.2 M-710 all types RS030N; RS050N; RS080N, RS15X MC35-01; MC50-01; MC70-01 RX160; RX160HD; RX160L;	10-150 12-60 12-70 30-80 35-70 14-20	380-610 333-680 410-570 555 640 248-250
2	2	+/-0.05	∞	ABB FANUC KUKA STÄUBLI	IRB460 M-710 all types KR 30 and KR 60 - all types TX200L	110 12-70 16-60 80	925 410-570 600-700 1000
2	2	+/-0.05	∞	ABB COMAU FANUC KUKA STÄUBLI	IRB460, IRB6620 NJ130 2.6 R2000 all types; M900ib/360; R2000ic/210L; R2000ic/270F KR 120, 150, 180, 210, 240, 270, 300 TX200, TX200L	110-150 100-270 165-360 120-300 80	900-925 1090-1470 1090-1540 677-1154 1000

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# Seventh Axis



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# **SEV** series - Belt driven



### Seventh Axis for robots up to 130 Kg



Fig. 1

Belt driven Seventh Axis is designed to extend the working area of smaller industrial robots, with weight around 10 - 130 Kg or payload around 2 - 16 Kg. It is the best choice to improve the robot's productivity in applications such as small machine tool feeding, pick and place and assembly operations in different industrial sectors.

Seventh Axis is made of one or two self-supporting extruded aluminum profiles joined together by means of rigid connecting crosspieces. It is available in different sizes: 220-1 and 80-2. The aluminum profiles are resistant to corrosion, and are extruded to make highly elaborate geometries that guarantee an high moment of inertia and a low weight. Thanks to its lightness and high rigidity, Seventh Axis operates smoothly even in applications that require wall or ceiling mounting.

The thrust force is transmitted by a steel reinforced polyurethane belt. The carriage runs on two parallel linear guides with four self-lubricated recirculating ball bearing blocks, positioned to support the carriage and all incident loads and moments. The polyurethane belt eliminates the need to lubricate the driving system.

#### The main advantages of Seventh Axis are:

- Suitable for all the smaller industrial robots (eg. weight up to 130 Kg or payload up to 16 Kg)
- Two different sizes.
- High quality components and competitive performances.
- Easy and quick assembly.
- Customizations possible, please contact our technical department.

### The components

#### Extruded aluminum bodies

Seventh Axis is created using extruded and anodized Rollon profiles, designed and manufactured to optimize weight while maintaining mechanical strength. The dimensional tolerances comply with UNI EN 755-9.

#### **Driving belt**

Seventh Axis features a steel reinforced polyurethane drive belt with AT pitch. This belt is ideal due to its high load transmission characteristics and compact size. Used in conjunction with backlashfree pulleys, smooth alternating motion can be achieved. Optimization of the maximum belt width / body dimension ratio enables to achieve high speed while maintaining low levels of noise and wear. The provision of guidance for the belt within the body causes it to run central on the pulley, there by ensuring long service life.

#### Carriage

The carriage of the Seventh Axis is made of anodized aluminum. A dedicated connecting plate allows to assemble the robot on the carriage. The plate is customized to accomodate the different kinds of robots.

#### Protection

The linear units that compose belt driven Seventh Axis are equipped with a polyurethane sealing strip to protect all of the internal components from dust, contaminants, and other foreign objects. The sealing strip runs the length of the body and is kept in position by micro-bearings located within the carriage. This minimizes frictional resistance as the strip passes through the carriage while providing maximum protection.

#### Gearbox

Each size of Seventh Axis is available with a pre-selected gearbox (see pg. SV-20, tab. 43).

## The linear motion system

The linear motion system has been designed to meet the load capacity, speed, and maximum acceleration conditions of a wide variety of applications.

#### SEV series with ball bearings guides

- Two ball bearing guides with high load capacity are mounted in a dedicated seat inside or outside the body.
- The carriage is assembled on four pre-loaded ball bearing blocks.
- The ball bearing blocks enable the carriage to withstand loading in the main directions.
- The blocks have seals on both sides and, if necessary, an additional scraper can be fitted for very dusty conditions.
- Lubrication reservoirs (pockets) installed on the front of the ball bearing blocks supply the right amount of grease, thus promoting long maintenance interval.

#### The linear motion system described offers:

- High speed and acceleration
- High load capacity
- High bending permissible moments
- Low friction
- Long lifetime
- Low maintenance (depending on application)
- Low noise

# SEV 220-1

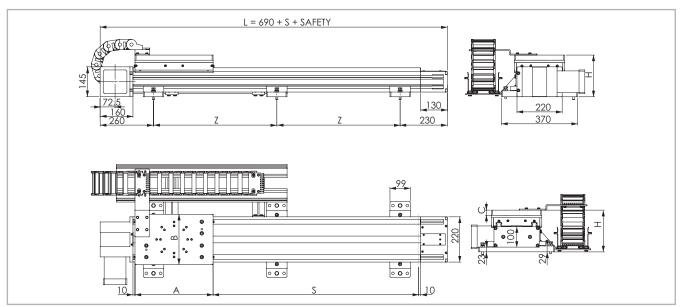


Fig. 2

#### **Examples of robots**

			Robot examples		
Туре	Size	Brand Model		Payload [Kg]	Weight [Kg]
		ABB	IRB 120; IRB 140; IRB 1100; IRB 1200;	3-6	20.5-98
		COMAU	Racer-5-0.63; Racer 5-0.80; Racer-3-0.63;	3-5	30-32
	220-1	FANUC	LR Mate 200 iD	4-7	19-27
		KAWASAKI	RS003N; RS005N; RS005L; RS007N; RS007L	3-7	20-37
SEV		KUKA	Agilus Serie KR3; KR6; KR10	3-10	26-57
SEV		MITSUBISHI	RV-2FR; RV-2FRL; RV-4FR; RV-4FRL;RV-7FR; RV-7FRL; RV-7FRLL	3-7	19-130
		NACHI	MZ07-01; MZ07L-01; MZ07P-01; MZ07LP-01;	7	30-32
		STÄUBLI	TX2-40; TX2-60; TX2-60L	2-4.5	29-53
		UNIVERSAL ROBOTS	UR3/3e; UR5/5e; UR10/10e; UR16e	3-16	11-34
		YASKAWA	GP7; GP8	7-8	32-34

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 1

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]	
SEV	220-1	2	4	+/-0.05	25	
					Tab. 2	

#### **Belt specifications**

Туре	Size	Belt type	Belt width [mm]	Belt weight [Kg/m]	Pulley pitch diameter [mm]	Carriage displacement per pulley turn [mm]
SEV	220-1	100 AT 10	100	0.58	79.58	250

#### Axis dimensions

Туре	Size	Profile length P [mm]	Stroke S [mm]	Total length L [mm]	Height H [mm]	Weight [Kg]
		1000	600	1290		78
		1500	1100	1790		93
		2000	1600	2290		108
		2500	2100	2790	120 135 205 150 165 180 195 207 222	120
	220-1 3	3000	2600	3290		135
SEV		3500	3100	3790		150
		4000	3600	4290		165
		4500	4100	4790		180
		5000	4600	5220		195
		5500	5100	5790		207
		6000	5600	6290		222

Tab. 4

#### Carriage dimensions

Туре	Size	A [mm]	B [mm]	C [mm]	Weight [Kg]
SEV	220-1	380	245	25	20

Tab. 5

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		1000	3	400
		1500	4	433.3
		2000	5	450
	220-1	2500	5	575
		3000	6	560
SEV		3500	7	550
		4000	8	542.9
		4500	9	537.5
		5000	10	533.3
		5500	10	588.9
		6000	11	580

## **SEV 80-2**

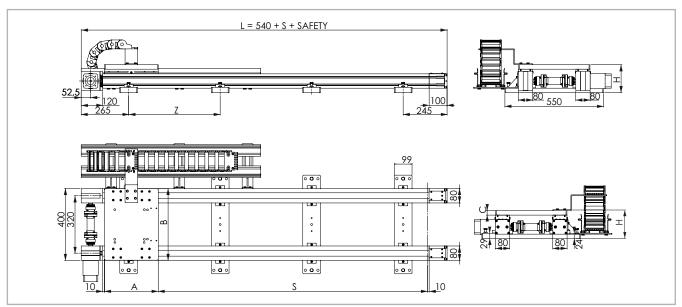


Fig. 3

#### **Examples of robots**

			Robot examples		
Туре	Size	Brand Model		Payload [Kg]	Weight [Kg]
		ABB	IRB 120; IRB 140; IRB 1100; IRB 1200;	3-6	20.5-98
		COMAU	Racer-5-0.63; Racer 5-0.80; Racer-3-0.63;	3-5	30-32
	80-2	FANUC	LR Mate 200 iD	4-7	19-27
		KAWASAKI	RS003N; RS005N; RS005L; RS007N; RS007L	3-7	20-37
SEV		KUKA	Agilus Serie KR3; KR6; KR10	3-10	26-57
SEV		MITSUBISHI	RV-2FR; RV-2FRL; RV-4FR; RV-4FRL;RV-7FR; RV-7FRL; RV-7FRLL	3-7	19-130
		NACHI	MZ07-01; MZ07L-01; MZ07P-01; MZ07LP-01;	7	30-32
		STÄUBLI	TX2-40; TX2-60; TX2-60L	2-4-5	29-53
		UNIVERSAL ROBOTS	UR3/3e; UR5/5e; UR10/10e;	3-10	11-34
		YASKAWA	GP7; GP8	7-8	32-34

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 7

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	80-2	2	4	+/-0.05	20
					Tah 8

#### Belt specifications\*

Туре	Size	Belt type	Belt width [mm]	Belt weight [Kg/m]	Pulley pitch diameter [mm]	Carriage displacement per pulley turn [mm]
SEV	80-2	32 AT 10	32	0.185	60.48	190

<sup>\*</sup> SEV80-2 features two identical belts, one in each linear axis. The data shown refers to the single belt.

#### Axis dimensions

Туре	Size	Profile length P [mm]	Stroke S [mm]	Total length L [mm]	Height H [mm]	Weight [Kg]
		1000	680	1220		60
		1500	1180	1720		73
		2000	1680	2220		83
		2500	2180 2720 96	96		
	80-2	3000	2680	3220	155	109
SEV		3500	3180	3720		123
		4000	3680	4220		136
		4500	4180	4720		149
		5000	4680	5220		159
		5500	5180	5720		172
		6000	5680	6220		186

Tab. 10

#### Carriage dimensions

Туре	Size	A [mm]	B [mm]	C [mm]	Weight [Kg]
SEV	80-2	300	398	25	13.4

Tab. 11

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		1000	3	355
		1500	4	403.3
		2000	4	570
		2500	5	552.5
		3000	6	542
SEV	80-2	3500	7	535
		4000	8	530
		4500	9	526.3
		5000	9	588.8
		5500	10	578.9
		6000	11	571

# SEV series - Rack and pinion driven



### Seventh Axis for robots up to 2000 Kg

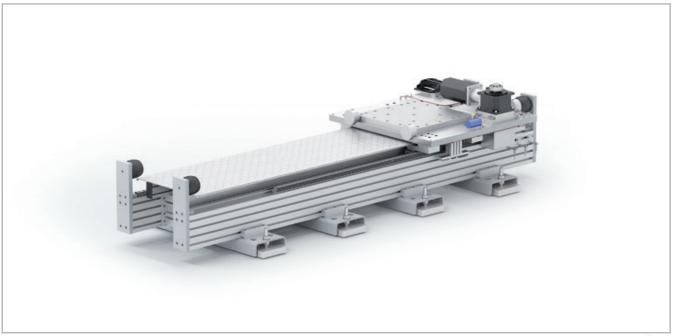


Fig. 4

Rack and pinion driven Seventh Axis is designed to extend the operating range of every robot up to 2.000 kg. From the feeding of industrial machines in the production lines to painting or welding applications in the automotive or metal sheet industry, it improves the productivity of the robots by increasing their range of motion.

Seventh Axis is made of one or two self-supporting extruded aluminum profiles joined together by means of rigid connecting crosspieces. It is available in different sizes: 280-1, 170-2, 220-2, 280-2 and 360-2. The aluminum profiles are resistant to corrosion, and are extruded to make highly elaborate geometries that guarantee the greatest moment of inertia and the least weight possible. Thanks to its lightness and high rigidity, Seventh Axis operates smoothly even in applications that require wall or ceiling mounting.

The rack and pinion transmission allows to withstand heavy loads and to reach potentially infinite strokes. The carriage runs on two parallel recirculating roller linear guides with six blocks positioned to support it and all incident loads and moments. The blocks can be lubricated with an automatic system.

#### The main advantages of Seventh Axis are:

- Suitable for every robot up to 2.000 kg.
- Five different sizes.
- Three lubrication options to reduce and simplify maintenance.
- Three types of covers to protect the axis.
- High quality components and competitive performances.
- Easy and quick assembly.
- Potentially infinite strokes achievable.
- Customizations possible, please contact our technical department.

### The components

#### Extruded aluminum bodies

Seventh Axis is created using extruded and anodized Rollon profiles, designed and manufactured to optimize weight while maintaining mechanical strength. The dimensional tolerances comply with UNI EN 755-9.

#### Rack and pinion

The steel racks are hardened and ground (Q6), have helical teeth for higher load capacity and low noise and are available with three different modules: m3, m4 and m5. Racks are assembled with pinions made of hardened steel. For more information on the driving system lubrication see pg. SV-25).

#### Carriage

The carriage of the Seventh Axis is made of anodized aluminum and its dimensions may vary according to the sizes and the type of protection chosen. A dedicated connecting plate allows to assemble the robot on the carriage. The plate is customized to accomodate the different kinds of robots.

#### Protection

Rack and pinion driven Seventh Axis can be equipped with three different level of protection to cover the driving system and the linear motion components against contaminants. For more information see pg. SV-24.

#### Gearbox

Each size of Seventh Axis is available with a pre-selected gearbox (see pg. SV-20, tab. 43).

## The linear motion system

The linear motion system has been designed to meet the load capacity, speed, and maximum acceleration conditions of a wide variety of applications.

#### SEV series with recirculating roller guides

Two recirculating roller guides with high load capacity are mounted in two dedicated seats on the outer sides of the body.

- Two recirculating roller guides with high load capacity are mounted in two dedicated seats on the outer sides of the body.
- By using rollers, which are less subject to deformation, the guides achieve very high rigidity.
- The carriage is assembled on six pre-loaded blocks.
- The rolling elements configuration enable the carriage to withstand loading in the main directions.
- The six blocks have seals on both sides and, if necessary, an additional scraper can be fitted for very dusty conditions.

#### The linear motion system described offers:

- High speed and acceleration
- High load capacity
- High bending permissible moments
- Low friction
- Long lifetime
- Low maintenance (depending on application)
- Low noise

# SEV 280-1

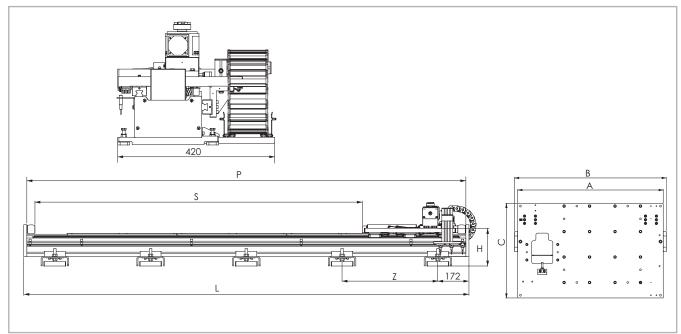


Fig. 5

#### **Examples of robots**

		Robot examples							
Туре	Size	Brand	Model	Payload [Kg]	Weight [Kg]				
		COMAU	Racer 7-1.0; Racer-7-1.4; SIX-6-1.4	6-7	160-180				
		FANUC	ARC Mate 100iC/12; M-10iA/10M; M-10iA/12; M-10iD 12	10-12	130-145				
		KAWASAKI	RS010N; RS006L	6-10	150				
SEV	280-1	KUKA	KR6 - KR10 CYBERTECH nano; KR6 - KR8 CYBERTECH ARC nano	6-10	145-180				
SEV	200-1	MITSUBISHI	RV13FR(-L); RV20FR	13-20	120-130				
		NACHI	NB04; NV06;	10	160-170				
		STÄUBLI	TP80; TX2-90; TX2-90L; TX2-90XL	7-14	111-119				
		YASKAWA	MH12/-F; GP12	12	130-150				

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 13

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	280-1	2	4	+/-0.05	30

Tab. 14

#### **Rack specifications**

Tuno	Sizo			Rack		Pin	ion
Туре	Size	Module	Quality	Туре	Module	Ø [mm]	Stroke per revolution [mm]
SEV	280-1	m3	Q6	Helical teeth, hardenend and ground	m3	89.13	280

#### Axis dimensions

Туре	Size	Profile length P [mm]	Stroke*¹ S [mm]	Total length L [mm]	Height*² H [mm]	Weight*² [Kg]
		2000	848	2012		290
		2500	1348	1348 2512	321	
		3000	1848	3012		369
		3500	2348	3512		399
SEV	280-1	4000	2848	4012	304	447
		4500	3348	4512		478
		5000	3848	5012		526
		5500	4348	5512		556
		6000	4848	6012		628

Tab. 16

#### Carriage dimensions

Туре	Size	A [mm]	B [mm]	C [mm]	Weight [Kg]
SEV	280-1	800	834	520	118

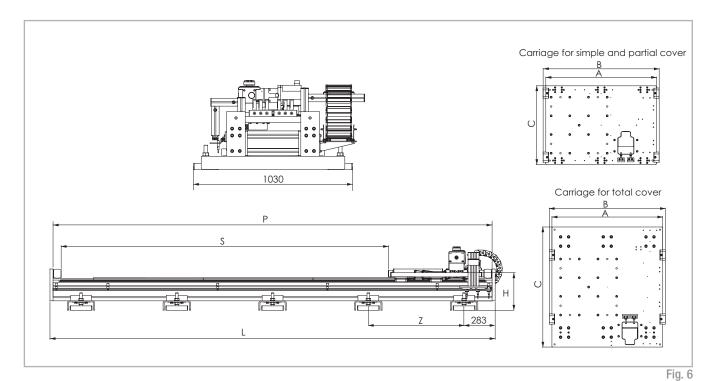
Tab. 17

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		2000	3	834
	280-1	2500	3	1084
		3000	4	889.3
		3500	4	1056
SEV		4000	5	917
		4500	5	1042
		5000	6	933.6
		5500	6	1033.6
		6000	7	944.7

<sup>\*1</sup> Longer strokes can be made by joining profiles (see pg. SV-23).
\*2 Height and weight without robot connecting plate. For more information see pg. SV-21.

## **SEV 170-2**



**Examples of robots** 

			Robot examples							
Туре	Size	Brand	Model	Payload [Kg]	Weight [Kg]					
		ABB	IRB 1600; IRB 1660ID; IRB 2600-12/-20; IRB 2600ID-8/-15;	4-20	250-284					
		FANUC	M-20iA; M-20iA/20M; ARC Mate 120C; M-20iB/25; M-20iB/25C; M-20iA/35M	20-25	210-250					
		KAWASAKI	RS020N; RS010L	10-20	230					
SEV	170-2	KUKA	KR CYBERTECH / KR CYBERTECH arc	8-22	250-270					
		NACHI	MC10L; MC20; MR20-02; MR20L-01; NB04L; NV06L	10-20	220-280					
		STÄUBLI	RX160; RX160HD; RX160L;	14-20	248-250					
		YASKAWA	GP25; GP25-12; HP20F/-RD 2	12-25	250-258					

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

#### Tab. 19

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	170-2	2	4	+/-0.05	25

Tab. 20

#### **Rack specifications**

Туре	Size	Rack			Pinion		
турс	0120	Module	Quality	Туре	Module	Ø [mm]	Stroke per revolution [mm]
SEV	170-2	m3	Q6	Helical teeth, hardenend and ground	m3	89.13	280

#### Axis dimensions

Type Size		Profile length	Stroke*1	Total length	Height*² H [mm]		Weight*² [Kg]	
турс	3126	P [mm]	S [mm]	L [mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
		2000	982	2056			476	567
	2500	1486	2556			509	605	
		3000	1982	3056	347	410	602	705
		3500	2486	3556			636	743
SEV	170-2	4000	2982	4056			736	843
		4500	3482	4556			762	880
		5000	3982	5056			843	950
		5500	4482	5556			860	990
*11		6000	4982	6056			950	1090

Tab. 22

#### Carriage dimensions

Typo	Size	А	В		C m]	Wei [K	
Туре	3126	[mm]		Simple and partial cover	Total cover	Simple and partial cover	Total cover
SEV	170-2	830	870	590	900	123	191

Tab. 23

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		2000	3	745
	170-2	2500	3	995
		3000	4	830
		3500	4	996.7
SEV		4000	5	872.5
		4500	5	997.5
		5000	6	989
		5500	6	998
		6000	7	915

 <sup>\*1</sup> Longer strokes can be made by joining profiles (see pg. SV-23).
 \*2 Height and weight without robot connecting plate. For more information see pg. SV-21.

# SEV 220-2

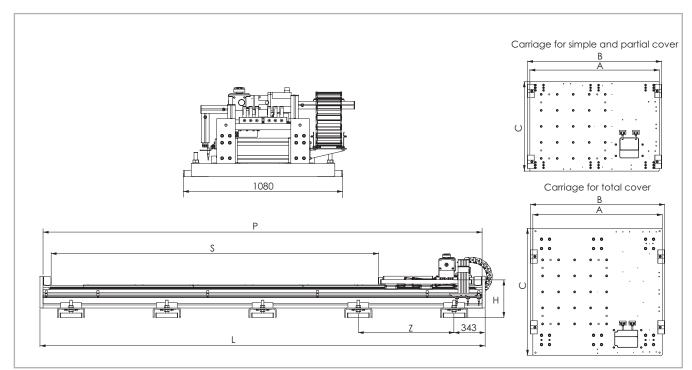


Fig. 7

#### **Examples of robots**

			Robot examples									
Туре	Size	Brand	Model	Payload [Kg]	Weight [Kg]							
		ABB	IRB 2400; IRB 4600; IRB 6620LX;	10-150	380-610							
		COMAU	NS-12-1.85; NS-16-1.65; NJ-16-3.1; NJ-40-2.5; NJ-60-2.2	12-60	333-680							
SEV	220-2	FANUC	M-710 all types	12-70	410-570							
SLV	220-2	KAWASAKI	RS030N; RS050N; RS080N; RS15X	30-80	555							
		NACHI	MC35-01; MC50-01; MC70-01	35-70	640							
		STÄUBLI	RX160; RX160HD; RX160L;	14-20	248-250							

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 25

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	220-2	2	4	+/-0.05	30
					Tob 26

Tab. 26

#### **Rack specifications**

Type Size		Rack				Pinion		
туре	0120	Module	Quality	Туре	Module	Ø [mm]	Stroke per revolution [mm]	
SEV	220-2	m3	Q6	Helical teeth, hardenend and ground	m3	89.13	280	

#### Axis dimensions

Type Size		Profile length	Stroke*1	Total length	Height*² H [mm]		Weight*² [Kg]	
турс	3126	P [mm]	S [mm]	L [mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
		2000	794	2056			622	713
	2500	1294	2556			670	765	
		3000	1794	3056	347	410	780	882
		3500	2294	3556			830	934
SEV	220-2	4000	2794	4056			940	1050
		4500	3294	4556			990	1102
		5000	3794	5056			1097	1219
		5500	4294	5556			1120	1245
*11		6000	4794	6056			1227	1359

Tab. 28

#### Carriage dimensions

Total cover partial cover   Simple and partial c	Туре	Size	A	В	C [mn	n]	Weiq [Kç	
SEV 220.2 070 1004 670 050 174 240	турс	3126	[mm]			Total cover	Simple and partial cover	Total cover
	SEV	220-2	970	1004	670	950	174	249

Tab. 29

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		2000	3	685
		2500	3	935
	220-2	3000	4	790
		3500	4	956.7
SEV		4000	5	842.5
		4500	5	967.5
		5000	6	874
		5500	6	974
		6000	7	895

 <sup>\*1</sup> Longer strokes can be made by joining profiles (see pg. SV-23).
 \*2 Height and weight without robot connecting plate. For more information see pg. SV-21.

# **SEV 280-2**

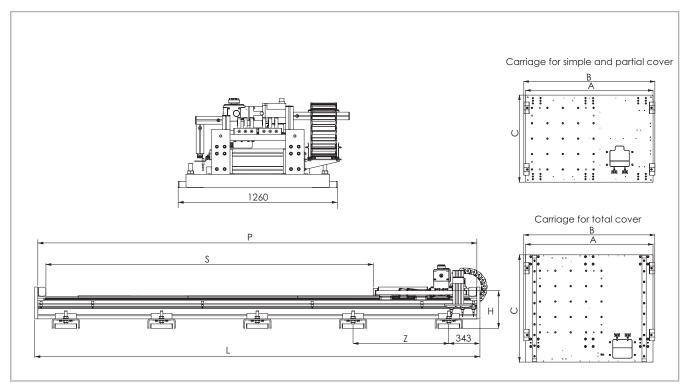


Fig. 8

#### **Examples of robots**

			Robot examples						
Туре	Size	Brand	Model	Payload [Kg]	Weight [Kg]				
		ABB	IRB460	110	925				
SEV	280-2	FANUC	M-710 all types	12-70	410-570				
SEV	200-2	KUKA	KR 30 and KR 60 - all types	16-60	600-700				
		STÄUBLI	TX200L	80	1000				

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 31

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	280-2	2	4	+/-0.05	35
					T-I- 00

Tab. 32

#### **Rack specifications**

Туре	Size	Rack			Pinion		
туре	3126	Module	Quality	Туре	Module	Ø [mm]	Stroke per revolution [mm]
SEV	280-2	m4	Q6	Helical teeth, hardenend and ground	m4	76.39	240

#### Axis dimensions

Туре	Size	Profile length	Stroke*1	,	Height*² H [mm]		Weight*² [Kg]	
турс	3126	P [mm]	S [mm]	L [mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
		2000	564	2056			830	982
		2500	1064	2556			945	1055
		3000	1564	3056			1043	1211
		3500	2064	3556			1160	1285
SEV	280-2	4000	2564	4056	578	634	1257	1442
		4500 3064 4556		1370	1515			
		5000	3564	5056			1470	1673
		5500	4064	5556			1559	1728
*11		6000	4564	6056			1653	1885

Tab. 34

#### Carriage dimensions

Type Size	, A	В	[n	C [mm]		g]
	[mm]	[mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
<b>SEV</b> 280-	2 1200	1234	820	1010	244	345

Tab. 35

#### Levelling feet

Туре	Size	Profile length P [mm]	Nb. of feet	Z [mm]
		2000	3	685
	280-2	2500	3	935
		3000	4	790
		3500	4	956.7
SEV		4000	5	842.5
		4500	5	967.5
		5000	6	874
		5500	6	974
		6000	7	895

 <sup>\*1</sup> Longer strokes can be made by joining profiles (see pg. SV-23).
 \*2 Height and weight without robot connecting plate. For more information see pg. SV-21.

# **SEV** 360-2

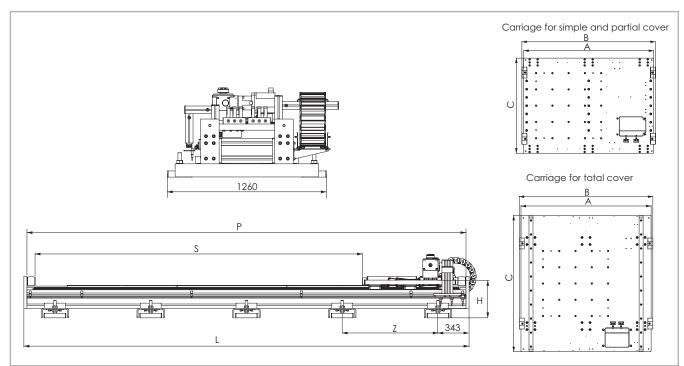


Fig. 9

#### **Examples of robots**

			Robot examples		
Туре	Size	Brand	Model	Payload [Kg]	Weight [Kg]
		ABB	IRB460, IRB6620	110-150	900-925
		COMAU	NJ130 2.6	100-270	1090-1470
SEV	360-2	FANUC	R2000 all types; M900ib/360; R2000ic/210L; R2000ic/270F	165	1090
		KUKA	KR 120, 150, 180, 210, 240, 270, 300	120-300	677-1154
		STÄUBLI	TX200, TX200L	80	1000

Robot examples mentioned are approximate and refer to floor mounted version. For a correct choice and size of the robot please contact our technical department.

Tab. 37

#### Technical data

Туре	Size	Max speed [m/s]	Max acceleration [m/s²]	Repeatability [mm]	Rail size [mm]
SEV	360-2	2	4	+/-0.05	45

Tab. 38

#### **Rack specifications**

Туре	Size		Rack			Pinion		
турс	3126	Module	Quality	Туре	Module	Ø [mm]	Stroke per revolution [mm]	
SEV	360-2	m5	Q6	Helical teeth, hardenend and ground	m5	127.32	400	

#### Axis dimensions

Туре	Size	Profile length	Stroke*1	Total length	Height*² H [mm]		Weight*² [Kg]	
турс	3126	P [mm]	S [mm]	L [mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
		2000	464	2056			1160	1345
		2500	964	2556			1252	1445
		3000	1464	3056			1446	1645
		3500	1964	3556			1542	1747
SEV	360-2	4000	2464	4056	347	410	1733	1947
		4500	2964	4556			1826	2048
		5000	3464	5056			2020	2248
		5500	3964	5556			2090	2323
*11		6000	4464	6056			2278	2519

Tab. 40

#### Carriage dimensions

Туре	Size	A	В	C [mm]		Weight [Kg]	
турс	3126	[mm]	[mm]	Simple and partial cover	Total cover	Simple and partial cover	Total cover
SEV	360-2	1300	1334	950	1360	368	528

Tab. 41

#### Levelling feet

Туре	Size	Profile length	Nb.	Z [mm]		
Type	3126	P [mm]	of feet	Simple and partial cover	Total cover	
		2000	3	635	685	
		2500	3	884	935	
		3000	4	756.7	790	
		3500	4	923.3	956.7	
SEV	360-2	4000	5	817.5	842.5	
		4500	5	942.5	967.5	
		5000	6	654	874	
		5500	6	954	974	
		6000	7	878.3	895	

 <sup>\*1</sup> Longer strokes can be made by joining profiles (see pg. SV-23).
 \*2 Height and weight without robot connecting plate. For more information see pg. SV-21.

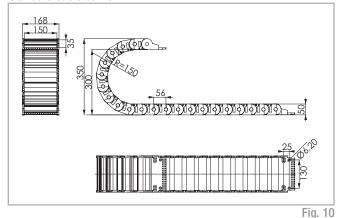
# Accessories

#### Cable carrier

Seventh Axis features a high stability, low-noise, long service life cable carrier. As standard the cable carrier is available with snap-open along inner or outer radius. On request, a special version for heavy duty applica-

tions is available. The cable carrier can be mounted on the left or the right side of the axis, according to the application requirements.

#### Standard cable carrier



Heavy duty cable carrier

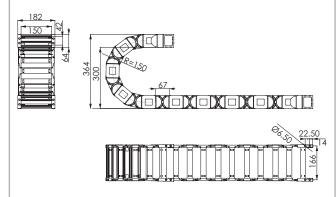
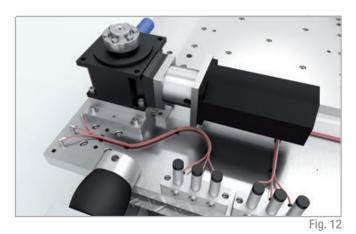


Fig. 11

#### Gearboxes

Each size of Seventh Axis is available with a pre-selected gearbox. Type MP planetary gearboxes have low backlash and a wide range of reduction ratio. Type D are hypoid bevel gearboxes, also featuring low backlash and a wide range of reduction ratio, ideal for high load applications. Reduction ratio has to be determined in function of the application.



Туре	Size	Gearbox	Weight [Kg]
	220-1	MP105	6.5
	80-2	MP80	5.2
	280-1	D090	9.5
SEV	170-2	D090	9.5
	220-2	D115	15.5
	280-2	D130	23.5
	360-2	D140	32.5
			T I 40

Tab. 43

#### Sensors and cams



Promixity sensors holders and cams are available as accessories for all sizes of Seventh Axis. The sensors housing kit is in aluminum and features T-Nuts for fixing on the axis profile. The cams are made of steel, with hardened and ground surface. Proximity sensors are not supplied by Rollon.

Fig. 13

## Robot connecting plate

The robot connecting plate allows to assemble the robot on the carriage of the Seventh Axis and it's customized to perfectly fit the mounting holes on every robot base. For belt driven Seventh Axis the plate dimensions are equal to the carriage (see pg. SV-4, SV-6 quotes A,B,C). For rack and pinion driven Seventh Axis the plate is available in steel or aluminum, to be defined depending on the shape and dimensions of the robot base, and it is positioned as shown in the following figures.

Type of robot plate	Height [mm]
Aluminum	50
Steel	32

Tab. 44

#### SEV280-1

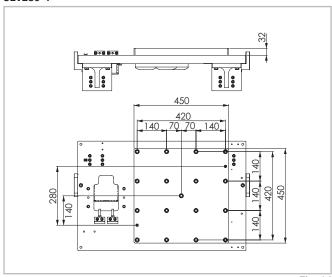
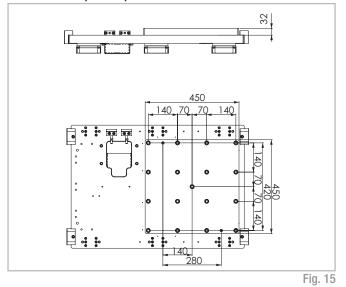


Fig. 14

#### SEV170-2 - Simple and partial cover



SEV170-2 - Total cover

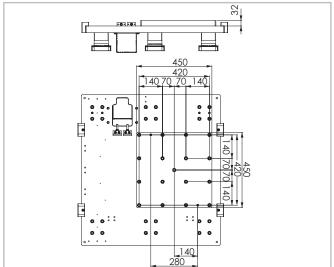
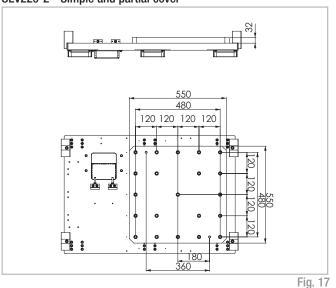


Fig. 16

#### SEV220-2 - Simple and partial cover



#### SEV220-2 - Total cover

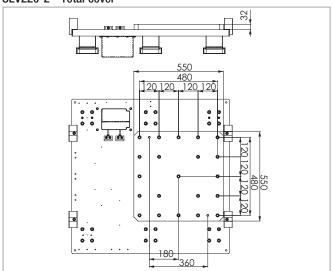
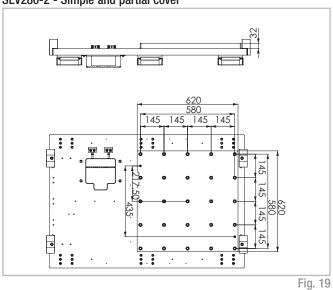


Fig. 18

#### SEV280-2 - Simple and partial cover



SEV280-2 - Total cover

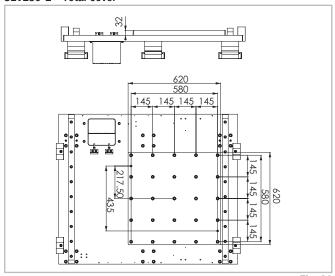
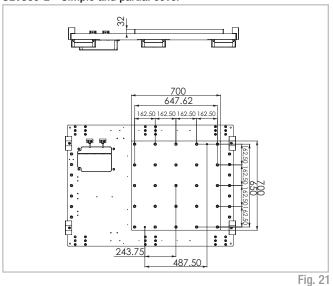


Fig. 20

SEV360-2 - Simple and partial cover



SEV360-2 - Total cover

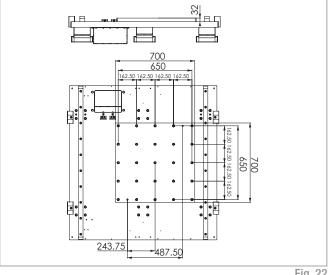


Fig. 22

# **Technical instructions**



# Mounting options

All robot examples in the catalog refer to floor mounted version. For more details on wall and ceiling mounting please contact our technical department.

#### Floor mount



#### Wall mount



Ceiling mount



Fig. 25

# Standard lengths and joint profiles

Туре	Size	Min. profile length [mm]	Max. profile length [mm]	Available standard lengths [mm]	
	220-1	1000	6000	1000 - 1500 - 2000 - 2500 - 3000 - 3500	
	80-2	1000	0000	- 4000 - 4500 - 5000 - 5500 - 6000	
	280-1				
SEV	SEV 170-2 220-2 2000 6000 280-2			0000 0500 0000 0500 4000	
		6000	2000 - 2500 - 3000 - 3500 - 4000 - 4500 - 5000 - 5500 - 6000		
	360-2				

Tab. 45

Longer lengths can be achieved for rack and pinion driven Seventh Axis by means of standardized Rollon joints. In this case, it is desirable to use the smallest possible number of joints by choosing pieces in maximum length. Joint profile has two supports plates at joint position.

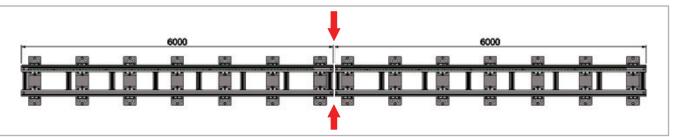


Fig. 26

## Leveling feet

#### SEV series - Belt driven

Prior to placing the axis in the work position all Leveling screws must be set at the end of the stroke. Once the Seventh Axis is in place, the levelling screw can be used to level it and compensate eventual

misalignments caused by imprecise mounting surfaces and/or normal misalignment of the support crosspieces. After levelling, the two fixing screws must be blocked.

Leveling screw Fixing screw	
	Eig 27

Туре	Size	Levelling screw	Fixing screws
SEV	220-1	M10	2 x M12
SEV	80-2	M10	2 x M12

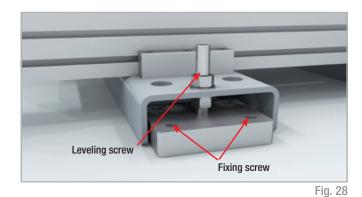
Tab. 46

Fig. 27

#### SEV series - Rack and pinion driven

Once the Seventh Axis is in place, the fixing screws must be tightened. Then, the nuts and counter nuts on the leveling screw can be used to level it and compensate eventual misalignments caused by imprecise mount-

ing surfaces and/or normal misalignment of the support crosspieces. After levelling, all screws must be blocked. To obtain optimal fixing, all holes in the levelling plate must be used.

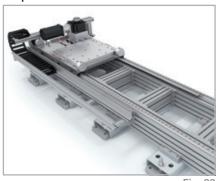


Туре	Size	Leveling screw	Fixing screws
	280-1	M12	2 x M12
	170-2	M24	4 x M16
SEV	220-2	M24	4 x M16
	280-2	M30	4 x M24
	360-2	M30	2 x M24
			Tob 47

Tab. 47

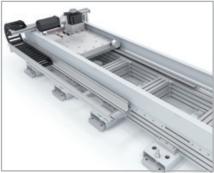
# Protection options for rack and pinion driven Seventh Axis

Simple cover - Code S

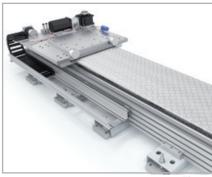


protected.

Partial cover - Code P







The rack and pinion driving system is protected.

The rack and pinion driving system and the rails are The rack and pinion driving system and the rails are protected, and a walkable cover is added.

#### Lubrication of the rack and pinion driving system

The grease is distributed evenly on the rack through a felt pinion placed at the very side of the driving pinion and fed by a 125 ml grease tank installed in the upper side of the carriage. The grease tank can be regulated to distribute the lubricant over time according to the application requirements (average life ca. 1 year).

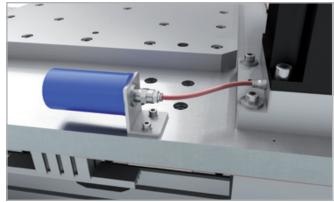


Fig. 32

#### Lubrication of the blocks

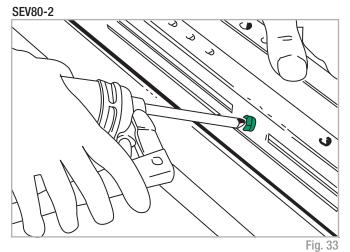
#### SEV series - Belt driven

Special lubrication reservoirs are mounted on the front plates of the linear blocks which continuously provide the necessary amount of grease to the ball raceways under load. These lubrication reservoirs considerably reduce the frequency of lubrication of the module. This system guarantees a long interval between maintenances: every 5000 km or 1 year of use, based on the value reached first. Lubrication must be delivered manually, using lithium soap grease of class NLGI 2, through the specific nipples placed on the side of the carriage for SEV 80-2 and on the front for SEV 220-1.

Quantity of lubricant necessary for re-lubrication of each block:

Туре	Size	Lubricant [cm³]
SEV	80-2	2.8
SEV	220-1	2.4

Tab. 48



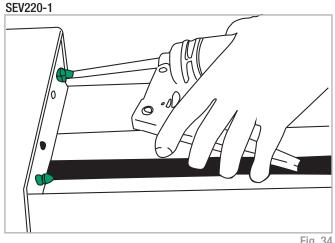


Fig. 34

#### SEV series - Rack and pinion driven

Lubrication must be applied manually, using grease type Shell Gadus S4 V45AC, through the specific nipples mounted on a distribution kit on the upper side of the carriage. This system guarantees an interval between maintenances of 2000 km or 1 year of use, based on the value reached first. On request, grease can be delivered automatically by means of 15ml tanks, one for each block. The tanks are mounted on a distribution kit and each greasing point is independent from the others. To further reduce the need for maintenance, grease can also be delivered by an automatic battery operated lubricator with a capacity of 250 ml. The lubricator is programmed on its display panel and a special distribution kit feeds the blocks. The lubrication unit also notifies when it's empty or if any inconvenience occurs in one of the lubrication channels.

#### Quantity of lubricant necessary for re-lubrication of each block:

Туре	Size	Lubricant [cm³]
	280-1	5.0
	170-2	3.0
SEV	220-2	5.0
	280-2	3.9
	360-2	6.5

Tab. 49

#### Manual lubrication



#### **Automatic Iubrication**



Fig. 36

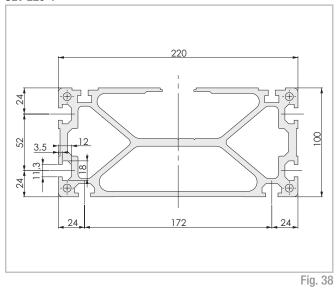
#### **Automatic Iubrication with CPU**



Fig. 37

# Profile specifications

#### SEV 220-1



#### SEV 80-2

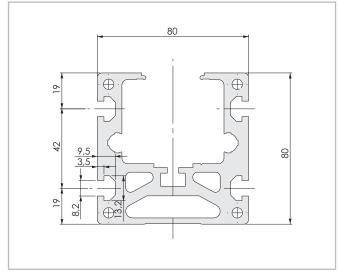
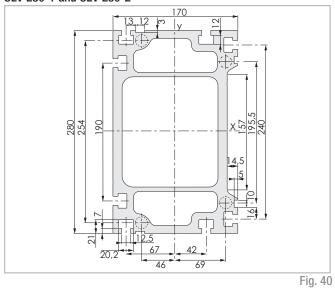
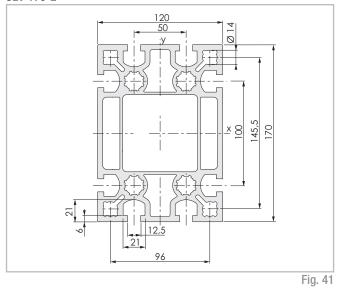


Fig. 39

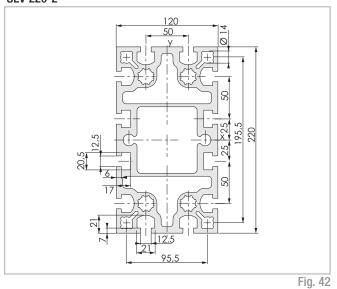
#### SEV 280-1 and SEV 280-2



#### SEV 170-2



SEV 220-2



#### SEV 360-2

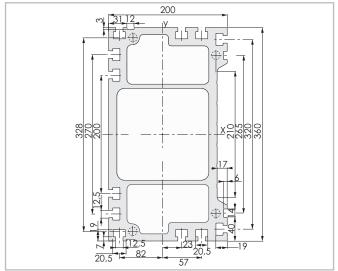


Fig. 43

#### General data about aluminum used: AL 6060

### Chemical composition [%]

Al	Mg	Si	Fe	Mn	Zn	Cu	Impurites
Remaining	0.35-0.60	0.30-0.60	0.30	0.10	0.10	0.10	0.05-0.15

Tab. 50

#### Physical characteristics

Density	Coeff. of elasticity	Coeff. of thermal expansion (20°-100°C)	Thermal conductivity (20°C)	Specific heat (0°-100°C)	Resistivity	Melting point
kg —	kN —	10-6	W	J	$\Omega$ . m . 10-9	°C
dm <sup>3</sup>	mm² 69	K 23	m . K 200	kg . K 880-900	33	600-655

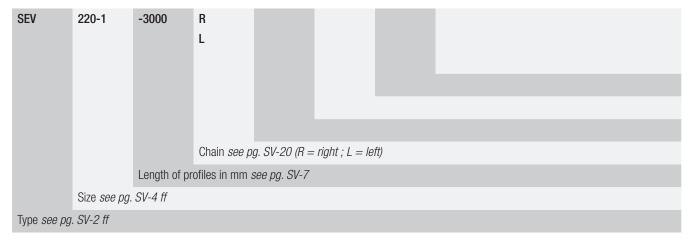
Tab. 51

#### Mechanical characteristics

Rm	Rp (02)	А	НВ
N — mm²	N — mm²	%	_
205	165	10	60-80

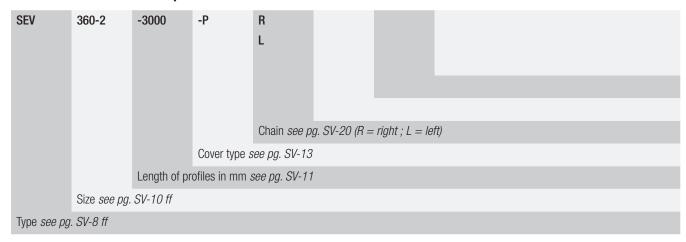
# Ordering key // ~

### SEV series - Belt driven



Ordering example: SEV220-1-3000-R.

# SEV series - Rack and pinion driven

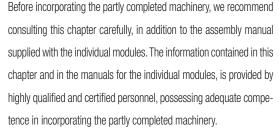


Ordering example: SEV360-2-3000-PR.

# Warnings and legal notes









The manufacturer cannot be considered responsible for any consequences derived from improper use or any use other than the purpose the axis or system of axes was designed for, or derived from failure to comply, during incorporation phases, with the rules of Good Technique and with what is indicated in this manual.



Precaution in installation and handling operations. Significantly heavy equipment.



Avoid damage. Do not operate with inadequate tools



When handling the axis or system of axes, always make sure that the support or anchoring surfaces do not leave room for bending.



Warning: moving parts. Do not leave objectson the axis



In order to stabilize the axis or system of axes, before handling it is mandatory to securely block the mobile parts. When moving axes with vertical translation, it is mandatory to use the vertical movement to put all of the axes at the corresponding lower limit switch.



Special installations: check the depth of the threads on moving elements



Make sure that the system has been installed on a level floor surface.



Do not overload. Do not subject to torsion stress.



In use, accurately comply with the specific performance values declared in the catalog or, in particular cases, the load and dynamic performance characteristics requested in the phase prior to design.



Do not leave exposed to atmospheric agents.



For modules or parts of modular systems with vertical movement, it is mandatory to mount self-braking motors to neutralize the risk of the axis dropping.



Before mounting the motor on the gearbox, it is advisable to perform a pre-test of the motor itself, without connection to the gear unit. The testing of this component was not carried out by the manufacturer of the machine. It will therefore be the responsibility of the customer of Rollon to perform the testing of the same, in order to verify its correct operation.



The images in this manual are to be considered merely an indication and not binding; therefore, the supply received could be different from the images contained in this manual, and Rollon S.p.A has deemed it useful to insert only one example.



Systems supplied by Rollon S.p.A. were not designed/envisaged to operate in ATEX environments.

#### Residual risks

- Mechanical risks due to the presence of moving elements.
- Risk of fire resulting from the flammability of the belts used on the axes, for temperatures in excess of 250 °C in contact with the flame.
- The risk of the Z axis dropping during handling and installation operations on the partly completed machinery, before commissioning.
- Risk of the Z axis dropping during maintenance operations in the case

of a drop in the electrical power supply voltage.

- Crushing hazard near moving parts with divergent and convergent motion.
- Shearing hazard near moving parts with divergent and convergent motion.
- Cutting and abrasion hazards.

### Basic components



The Partly Completed Machinery shown in this catalog is to be considered a mere supply of simple Cartesian axes and their accessories agreed when the contract is stipulated with the client. The following are therefore to be considered excluded from the contract:

- 1. Assembly on the client's premises (direct or final)
- 2. Commissioning on the client's premises (direct or final)
- 3. Testing on the client's premises (direct or final)

  It is therefore understood that the aforementioned operations in points 1.,2., and 3. are not chargeable to Rollon.

Rollon is the supplier of Partly Completed Machinery, the (direct or final) client is responsible for testing and safely checking all equipment which, by definition, cannot be theoretically tested or checked at our facilities where the only movement possible is manual movement (for example: motors or reduction gears, cartesian axes movements that are not manually operated, safety brakes, stopper cylinders, mechanical or induction sensors, decelerators, mechanical limit switches, pneumatic cylinders, etc.). The partly completed machine must not be commissioned until the final machine, in which it is to be incorporated, has been declared compliant, if necessary, with the instructions in Machinery Directive 2006/42/CE.

#### Instructions of an environmental nature

Rollon operates with respect for the environment, in order to limit environmental impact. The following is a list of some instructions of an environmental nature for correct management of our supplies. Our products are mainly composed of:

Material	Details of the supply
Aluminum alloys	Profiles, plates, various details
Steel with various composition	Screws, racks and pinions, and rails
Plastic	PA6 – Chains PVC – Covers and sliding block scrapers
Rubber of various types	Plugs, seals
Lubrification of various types	Used for the lubrication of sliding rails and bearings
Rust proof protectione	Rust proof protection oil
Wood, polyethylene, cardboard	Transport packaging

At the end of the product's life cycle, it is therfore possible to recover the various elements, in compliance with current regulations on waste issues.

#### Safety warnings for handling and transport

- The manufacturer has paid the utmost attention to packaging to minimize risks related to shipping, handling and transport.
- Transport can be facilitated by shipping certain components dismantled and appropriately protected and packaged.
- Handling (loading and unloading) must be carried out in compliance with information directly provided on the machine, on the packing and in the user manuals.
- Personnel authorized to lift and handle the machine and its components shall possess acquired and acknowledged skills and experience in the specific sector, besides having full control of the lifting devices used.
- During transport and/or storage, temperature shall remain within the allowed limits to avoid irreversible damage to electric and electronic components.
- Handling and transport must be carried out with vehicles presenting adequate loading capacity, and the machines shall be anchored to the established points indicated on the axes.
- DO NOT attempt to bypass handling methods and the established lifting points in any way.
- During handling and if required by the conditions, make use of one or more assistants to receive adequate warnings.
- If the machine has to be moved with vehicles, ensure that they are adequate for the purpose, and perform loading and unloading without risks for the operator and for people directly involved in the process.
- Before transferring the device onto the vehicle, ensure that both the
  machine and its components are adequately secured, and that their
  profile does not exceed the maximum bulk allowed. Place the necessary
  warning signs, if necessary.
- DO NOT perform handling with an inadequate visual field and when there are obstacles along the route to the final location.
- DO NOT allow people to either transit or linger within the range of action when lifting and handling loads.
- Download the axes just near the established location and store them in an environment protected against atmospheric agents.
- Failure to comply with the information provided might entail risks for the safety and health of people, and can cause economic loss.
- The Installation Manager must have the project to organize and monitor all operative phases.
- The Installation Manager shall ensure that the lifting devices and equipment defined during the contract phase are available.
- The Manager of the established location and the Installation Manager shall implement a "safety plan" in compliance with the legislation in force for the workplace.
- The "safety plan" shall take into account all surrounding work-related

- activities and the perimeter spaces indicated in the project for the established location.
- Mark and delimit the established location to prevent unauthorized personnel from accessing the installation area.
- The installation site must have adequate environmental conditions (lighting, ventilation, etc.).
- Installation site temperature must be within the maximum and minimum range allowed.
- Ensure that the installation site is protected against atmospheric agents, does not contain corrosive substances and is free of the risk of explosion and/or fire.
- Installation in environments presenting a risk of explosion and/or of fire must ONLY be carried out if the machine has been DECLARED COMPLIANT for such use.
- Check that the established location has been correctly fitted out, as defined during the contract phase and based on indications in the relative project.
- The established location must be fitted out in advance to carry out complete installation in compliance with the defined methods and schedule.

#### Note

- Evaluate in advance whether the machine must interact with other production units, and that integration can be implemented correctly, in compliance with standards and without risks.
- The manager shall assign installation and assembly interventions ONLY to authorized technicians with acknowledged know-how.
- State of the art connections to power sources (electric, pneumatic, etc.)
   must be ensured, in compliance with relevant regulatory and legislative requirements.
- "State of the art" connection, alignment and leveling are essential to avoid additional interventions and to ensure correct machine function.
- Upon completion of the connections, run a general check to ascertain that all interventions have been correctly carried out and compliance with requirements.
- Failure to comply with the information provided might entail risks for the safety and health of people, and can cause economic loss.

### Transport

- Transport, also based on the final destination, can be done with different vehicles.
- Perform transport with suitable devices that have adequate loading capacity.
- Ensure that the machine and its components are adequately anchored to the vehicle.

### Handling and lifting

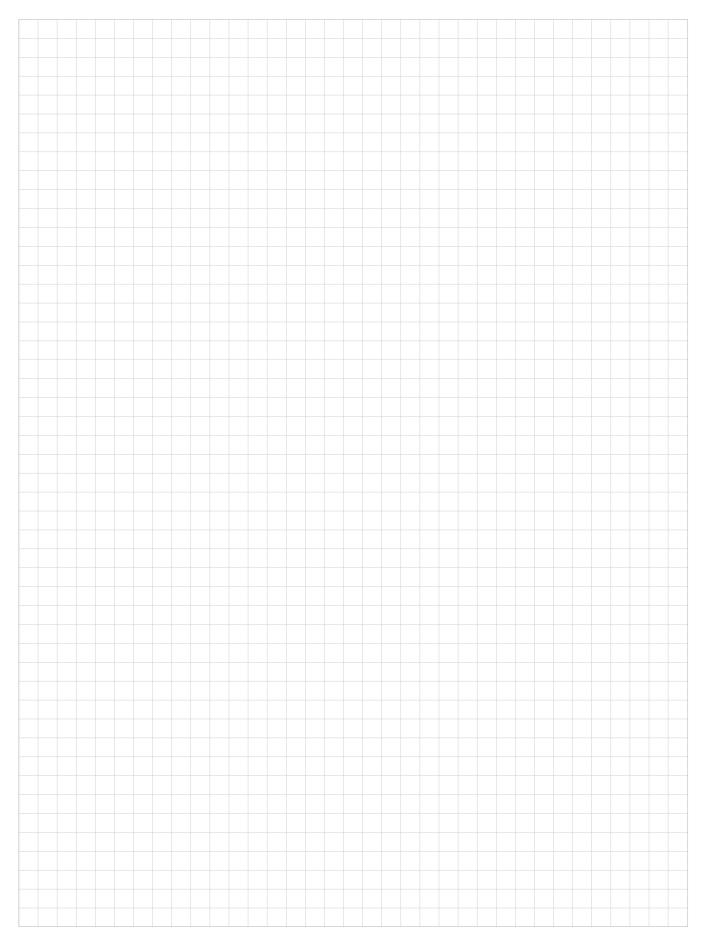
- Correctly connect the lifting devices to the established points on the packages and/or on the dismantled parts.
- Before handling, read the instructions, especially safety instructions, provided in the installation manual, on the packages and/or on the dismantled parts.
- DO NOT attempt, in any way, to bypass handling methods and the established lifting, moving and handling points of each package and/or dismantled part.
- Slowly lift the package to the minimum necessary height and move it with the utmost caution to avoid dangerous oscillations.
- DO NOT perform handling with an inadequate visual field and when there are obstacles along the route to reach the final location.
- DO NOT allow people to either transit or linger within the range of action when lifting and handling loads.
- Do not stack packages to avoid damaging them, and reduce the risk of sudden and dangerous movements.
- In case of prolonged storage, regularly ensure that there are no variations in the storage conditions of the packages.

# Check axis integrity after shipment

Every shipment is accompanied by a document ("Packing list") with the list and description of the axes.

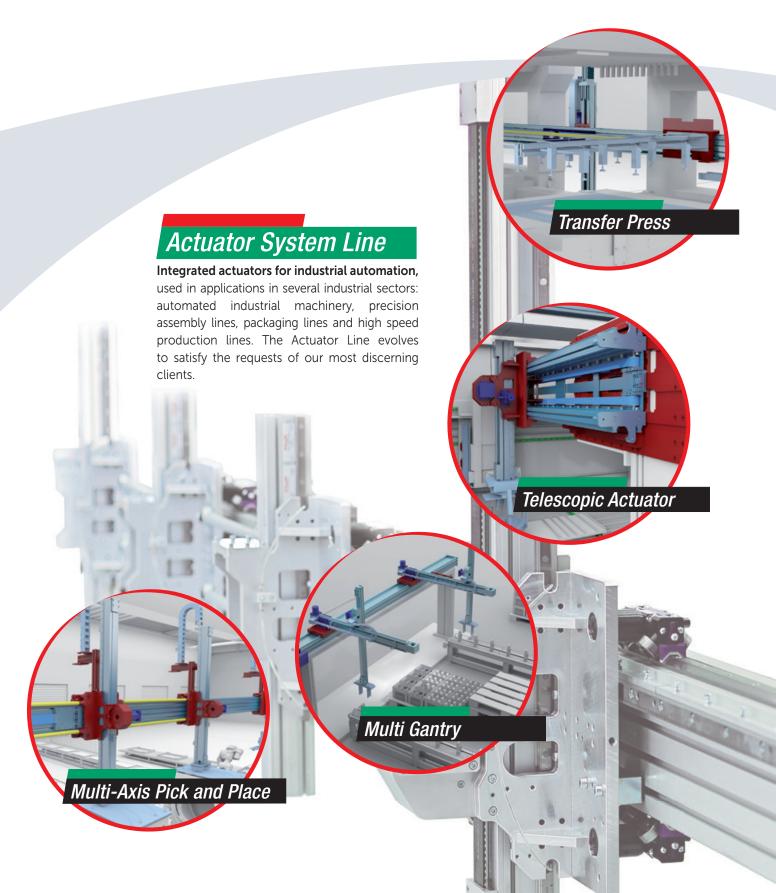
- Upon receipt check that the material received corresponds to specifications in the delivery note.
- Check that packaging is perfectly intact and, for shipments without packaging, check that each axis is intact.
- In case of damages or missing parts, contact the manufacturer to define the relevant procedures.

Notes / ~



Are you out of space on your production layout?
Do you need to manage higher payloads?
Do you need to have higher speed and acceleration?

Cartesian robots can be the perfect solution for these requirements. When the outreach of an anthropomorphic robot exceeds its moments limitation, then you have the option to switch to a multi-axis solution.





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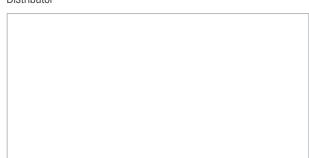
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