

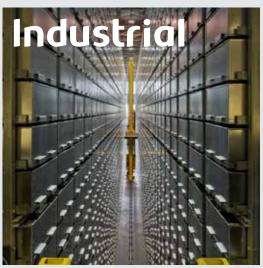


Bonfiglioli
Forever Forward



# **Bonfiglioli solutions**











# Bonfiglioli, one name for a large international group.

It was back in 1956 that Clementino Bonfiglioli established in Bologna, Italy, the company that still bears his name. Now, some fifty years later, the same enthusiasm and dedication is driving Bonfiglioli to become the world's top name in power transmission and control solutions. Through directly controlled subsidiaries and production plant around the world, Bonfiglioli designs, manufactures and distributes a complete range of gearmotors, drive systems and planetary gearboxes, and boasts the most integrated offering on the market today.

Now, to emphasise its commitment to health, safety and environmental sustainability, Bonfiglioli is adding the term "green" to the description of its offering.

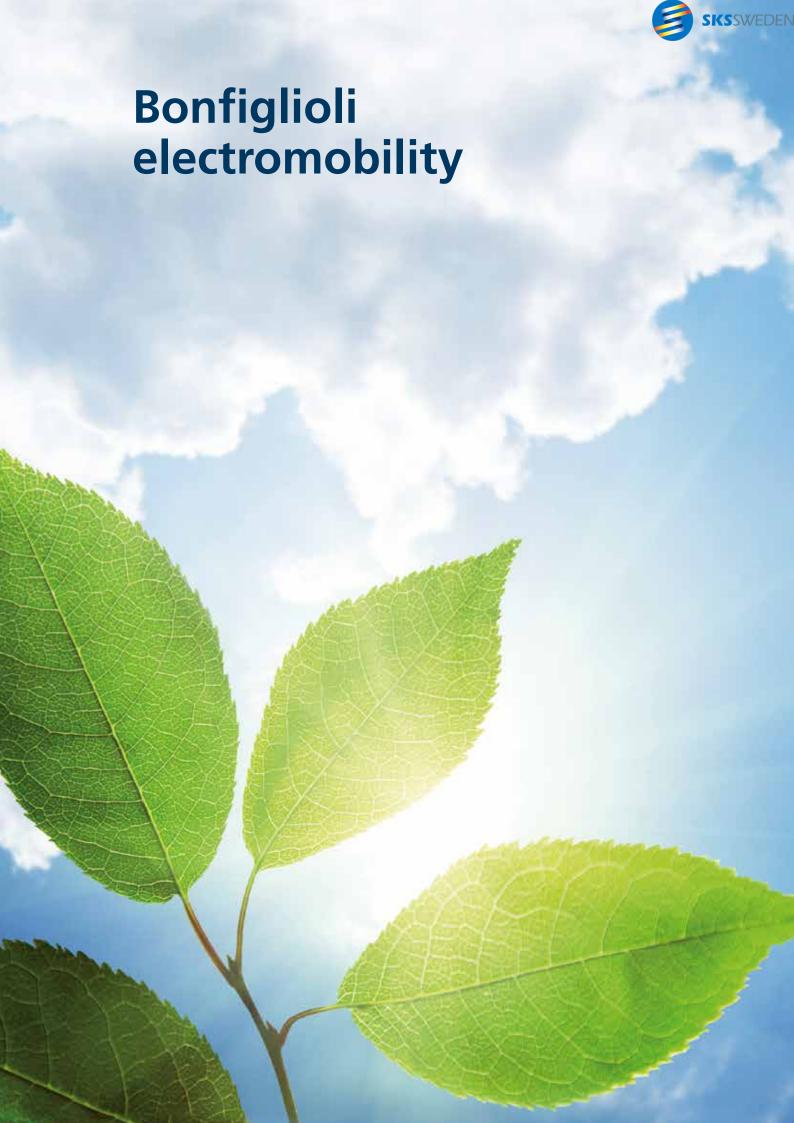
In a market in which excellent product quality alone is no longer sufficient, Bonfiglioli also provides experience, know-how, an extensive sales network, excellent pre-sales and after-sales service and modern communication tools and systems to create high level solutions for industry, mobile machinery and renewable energy.

This committment becomes now more visible and evident thanks to the solutions that can respect the environment: hybrid and electric vehicles are now an important drive for electric piece of Bonfiglioli offer. This is our way to contribute to a better world.











### **Electric powertrain solutions**



Heavy duty vehicle manufacturers are eagerly seeking improvements in efficiency. OEMs are looking for solutions that can increase productivity and reduce the total cost of ownership for the end user. Over the next few years we can also expect the emission regulations currently applied to the automotive industry to be extended to heavy duty vehicles too, and the strict standards involved can only be met by improving powertrain efficiency. Heavy duty powertrains are therefore being electrified: the hydraulic motors conventionally installed in these machines are gradually being replaced by electric motors which are intrinsically more efficient.

Bonfiglioli Trasmital began developing and producing powertrains consisting of planetary gearboxes driven by electric and hydraulic motors back in the 1980s. More recently, Bonfiglioli Mobile Solutions also began investing in the personnel, tools and technologies needed to develop electric powertrain technology. As a result, Bonfiglioli Mobile Solutions can now serve the electric powertrain market with two different but complementary offerings.

### Standard products for various applications

Various products have been designed specifically for use with electric motors, and offer a wide range of performance specifications and deliverable torque ratings. The latest products include a series of planetary drives for electric material handling vehicles and planetary drives with integrated electric motors for hybrid agricultural machines. These solutions have been shown to deliver numerous benefits in terms of machine manoeuvrability, reliability, operating costs and sustainability, thanks to low emissions and low working noise levels.

### **Custom solutions**

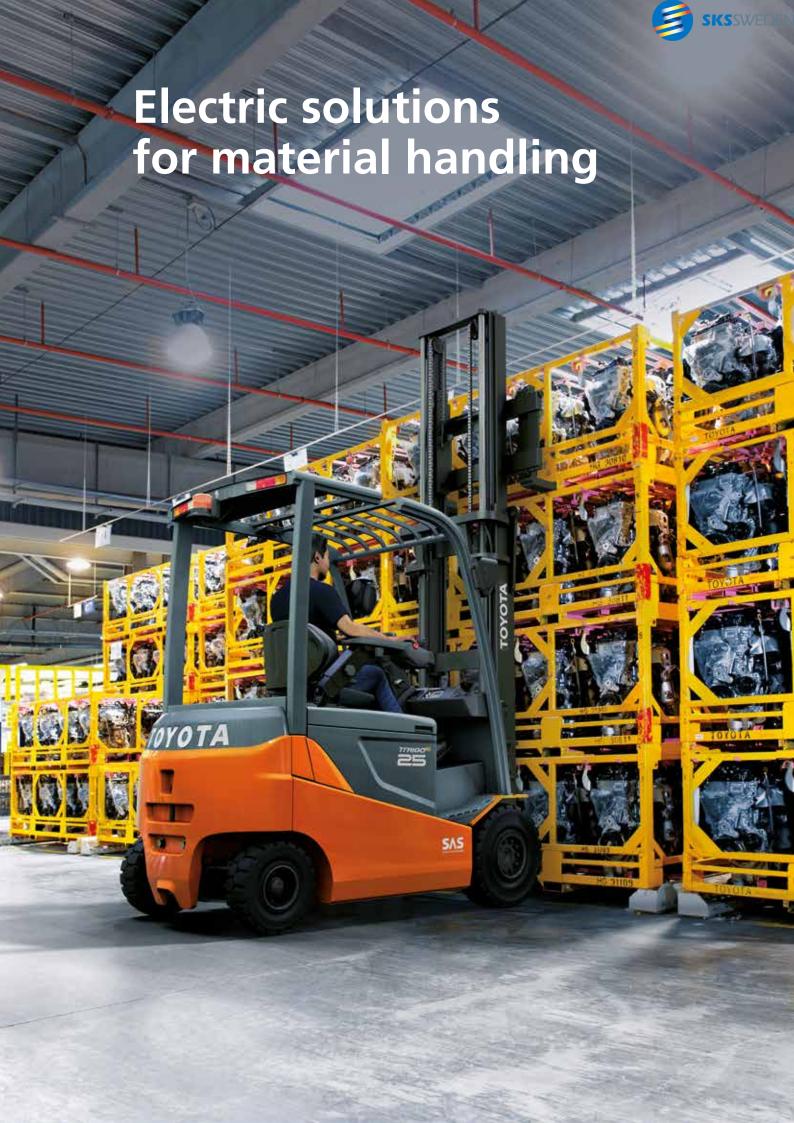
Wherever a custom solution is required, manufacturers benefit from Bonfiglioli's vast technical expertise. Bonfiglioli works closely with powertrain designers and component suppliers to develop innovative, tailored solutions. Bonfiglioli can draw on years of experience in powertrain design for light and medium duty vehicles, and the concepts and technologies involved are likely to be scaled up to heavy duty applications over the medium term.

















# Electric powertrains for material handling trucks

Bonfiglioli supplies high efficiency, low noise planetary axles and drives with integrated, high performance electric motors and low maintenance braking systems for Class 1 material handling vehicles. Typical applications include 3 and 4 wheel counterbalance lift trucks and ground support equipment. Bonfiglioli electric powertrains are fully tested in the factory and guarantee reduced energy consumption. This, in turn, means longer battery operating times, extended service intervals and a lower total cost of ownership. Bonfiglioli's 600F Series drives are complemented by a range of idle steering systems based on axles or steering units, depending on the number of wheels on the vehicle.

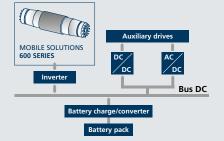


#### Lift capacity [kg] Type 601 F 2000 602 F 3500 5000 603 F 9000 605 W

Туре	Max deliverable torque [Nm]				
601 F	3000				
602 F	5500				
603 F	7000				
605 W					18000

Туре	Max input speed	Rated motor power	Typical wheel size
	[min <sup>-1</sup> ]	[kW, S2-60']	[inches]
601 F	5500	2x4.5	18
602 F	5500	18	23
603 F	4500	26	28
605 W	4500	2x14	35

### **Functional diagram**



### **Application**

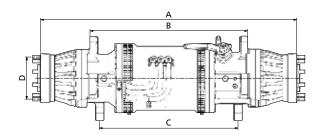
- Material handling vehicles (CB forklifts, articulated forklifts, airport equipment)
- Indoor and outdoor use
- CB trucks with lift capacity from 1.6 to 9.0 tons
- GSE vehicles with draw bar pull from 6000 to 25000 kgf
- Vehicle speeds up to 20 km/h

### **Standard features**

- Dual planetary gearbox
- Optimised gear design for maximum efficiency and minimum noise
- Wet disc service brake with low displacement actuation
- Parking brake with mechanical lever actuation
- Integrated, customised mast support
- Integrated AC traction motor in IP20 or IP43 protection ratings
- Integrated, high accuracy, silicon based, KTY temperature sensor
- · Integrated, high resolution, Hall effect speed sensor

### Optional features available on request

- Spring applied hydraulic release parking brake
- · Mechanical disengagement for towing, with no need to remove the wheel and without oil drop



Туре	<b>A</b> Flange to flange	<b>B</b> Frame mounting	<b>C</b> Mast mounting	<b>D</b> Wheel stud PCD
	[mm]	[mm]	[mm]	[mm]
601 F	1015	610	630	120
602 F	1090	640	600	170
603 F	1150	670	620	225
605 W	1440	1200	/	275





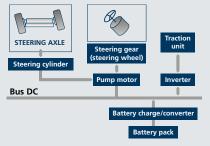




### CB Truck Lift capacity [kg] Type 601W0C 3000 602W0C 603W0C 3500

Туре	Number of wheels
601W0C	3
602W0C	4
603W0C	4

### **Functional diagram**



# 600W0C series Idle steering systems for material handling trucks

Bonfiglioli has been building idle steering systems for material handling vehicles since decades. These solutions are typically applied in the rear part of 3- and 4-wheel counterbalanced forklifts. They can be axles or steering units for twin wheels. Depending on the steering unit model, anti-vibration parts can be included and they serve as support for fixing brackets. The steering is realized by means of hydraulics that guarantees a high steering angle, in order to minimize the steering radius of the vehicle and allow the truck to move easily inside narrow aisles.

Depending on customer requests, it is possible to customize main dimensions and other characteristics of the units, like the presence of a potentiometer to read out the steering angle.

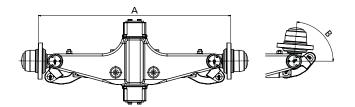
- Material handling vehicles (forklifts)
- Indoor and outdoor use
- Counterbalanced trucks with lift capacity from 1.0 to 3.5 tons

### **Standard features**

- Steering by means of hydraulics
- Optimised design for steering angle

### Optional features available on request

- Anti-vibration parts
- Potentiometer for steering angle



Туре	<b>A</b> Flange distance	<b>B</b> Max steering angle
	[mm]	[deg]
601W0C	175	85
602W0C	830	95
603W0C	930	85







### **EL** series Electric powertrains for warehousing trucks

Bonfiglioli EL powertrains have been proved to be fit for the most demanding warehousing application for decades. Warehousing trucks require high manoeuvrability in tight spaces and are therefore demanding drives like EL series, capable of smallest operating radius both in its vertical and horizontal arrangements. Bonfiglioli, thanks to its capabilities, represents a system supplier capable of cooperating with OEM and of supplying all electromechanical components, from the brake, up to the maintenancefree electric motor and to the gearbox, specially designed for low maintenance and optimized gear profiles for noise reduction. All systems are tested at the end of assembly line before they are released for shipment.

#### Max wheel load [kg] Type 1200 **EL100 EL96** 1500 2200 **EL300** 3000 **EL92 EL93** 3000 3000 **EL94**

#### Max wheel torque [Nm] Type 450 **EL100** 500 **EL96 EL300** 1100 **EL92** 1500 1500 **EL93 EL94** 1500

Туре	Max wheel load [kg]			
EL98	800			
EL20	1100			
EL14	1000			
EL140			2000	
EL150			2000	

Туре	Max wheel torque [Nm]			
EL98				600
EL20		!	55	50
EL14		40	0	
EL140				850
EL150				850

### **DRIVES WITH VERTICAL MOTOR**

### **Application**

- Stackers, Reach Trucks, Pallet Movers
- Multidirectional Forklifts, Sideloaders
- Other warehousing / material handling trucks
- Indoor and outdoor use

### Standard features

- Two stages helical & bevel gearboxes
- Manual Steer and Power Steer versions
- Optimized gear design for efficiency and noise
- Integrated low voltage electric motor
- Integrated parking brake
- Complete system supply with tire/ pneumatic

### Optional features (available on request)

- Cold environment versions
- Integrated tiller or castor wheels supports

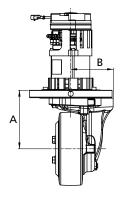
### **DRIVES WITH HORIZONTAL MOTOR**

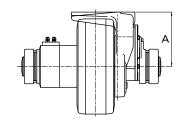
### **Application**

- Pallet Movers
- Sweepers
- Other warehousing / material handling trucks
- Indoor and outdoor use

### Standard features

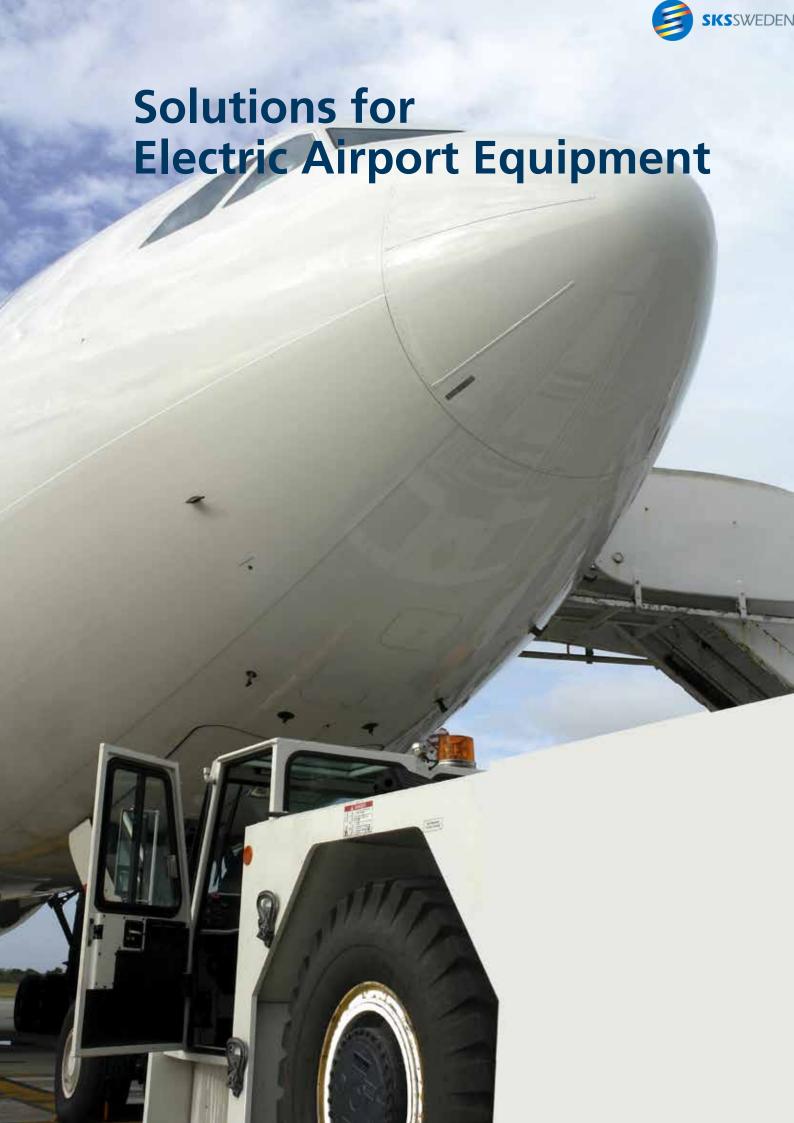
- Optimized gear design for efficiency and noise
- Integrated low voltage electric motor
- Integrated parking brake
- Complete system supply with tire/ pneumatic





Туре	Max wheel dim.	Max ratio	Max power	A	В
	inc	i	kW	mm	mm
EL100	9"	32	2	184	134.5
EL96	10"	24	3	215	147
EL300	12"	24	4.5	249	175
EL92	14"	25	7	277	187
EL93	16"	25	7	304	187
EL94	18"	25	7	325	187

Туре	Max wheel dim.	Max ratio	Max power	Envelope radius	A
	inc	i	kW	mm	mm
EL98	10"	32	0.5	134	141
EL20	10"	27	2	302	150
EL14	10"	34	0.85	238	170
EL140	12"	29.3	2	177	164
EL150	14"	29.3	2	183	200









# Powertrains for electric vehicles used at airports

Bonfiglioli supplies high efficiency, low noise axles with integrated, high performance electric motors and low maintenance braking systems for ground support equipment (Industrial Trucks Class VI, electric type) and other material handling electric machinery used at airports. Bonfiglioli electric axles are fully tested in the factory. All drives guarantee reduced energy consumption, this means longer battery operating times, extended service intervals and a lower total cost of ownership.

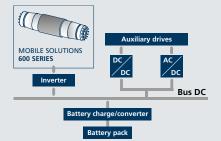


Туре	Max deliverable torque [Nm]				
600D	1000				
602WE			3500		
602F				5500	
605WE				8500	

Туре	Max draw bar pull force [kN]				
600D	5 8				
602WE	10 17				
602F	20 30				
605WE	30 40				

Туре	Rated motor power	Number & type of drive
	[kW, S2-60']	
600D	5.5	1 axle
602WE	2x 5.5	2 wheel drives
602F	25	1 axle
605WE	2x 15	2 wheel drives

### **Functional diagram**



### **Application**

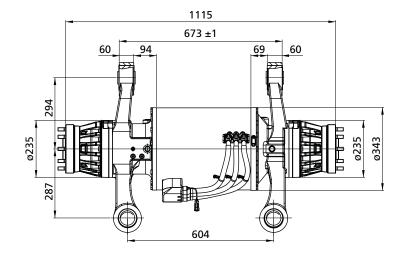
Electric vehicles for internal use at airport:

- Luggage trolley collection
- Other utility vehicle (police, passenger transport) Electric vehicles for external use at airport:
- Towing tractors for baggage carts, container dollies
- Passengers fingers

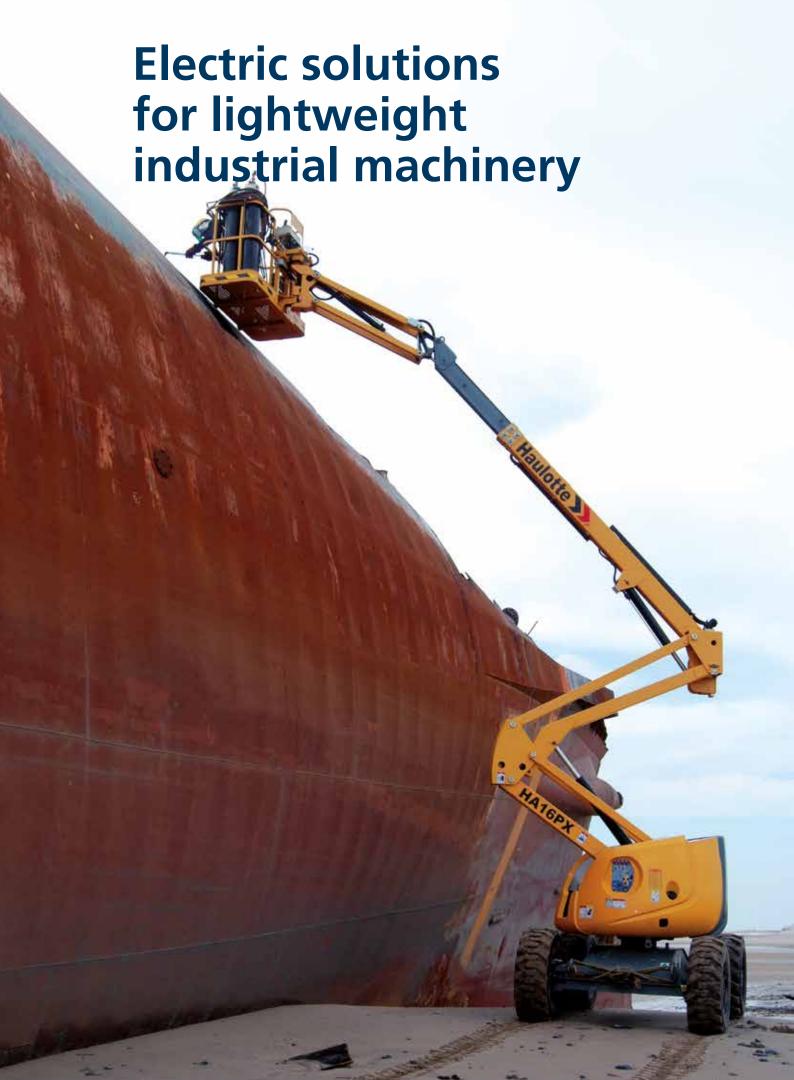
Other utility vehicles (refilling, power units)

### **Standard features**

- Output torque from 1000 to 8500 Nm
- Draw bar pull from 5 to 40 kN
- Vehicle speeds up to 20 km/h
- Optimised gear design for maximum efficiency and minimum noise
- Parking and/or service brake depending on configuration
- Integrated AC traction motor with different protection ratings
- Low voltage electric motors with inverter control









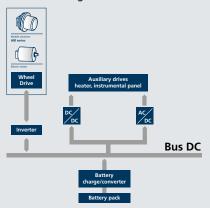




#### Max deliverable torque [Nm] Type **600 WE** 900 601 RE 3000 3500 602 RE 4500 **602 WE 604 WE** 7000 **605 WE** 10000

Туре	Rated motor data							
	[kW, S2-60']							
600 WE	0.9 3.4							
601 RE	2.5 4.3							
602 RE	3.4 5.4							
602 WE	3.4 5.4							
604 WE	4.3 6.2							
605 WE	5.4 9.1							

### **Functional diagram**



### 600 series

# Electric powertrains for lightweight industrial machinery

Bonfiglioli's 600 planetary drives incorporate an integrated, maintenance-free electric motor and offer significant benefits in terms of compact dimensions, low noise and high efficiency. 600 Series drives are designed for use with all kinds of aerial platforms and other kinds of industrial machinery, for indoor and outdoor use. This advanced powertrain solution uses a two or three stage gearbox offering reduction ratios of up to 1:95 to satisfy the widest possible range of needs. The gearbox is coupled to a low voltage induction motor (BT Series) specially developed for traction power and control applications.

- Aerial platforms (vertical, scissor, articulated or telescopic)
- Industrial equipment (airport, sweepers, modular trailers)
- Light construction equipment
- Indoor and outdoor use

### Standard features

- Two or three stage planetary drive with reduction ratios of up to 1:95
- Optimised gear design for maximum efficiency and minimum noise
- Integrated, low voltage, 3 phase induction motor with inverter
- Integrated, high accuracy, KTY temperature sensor
- Integrated, high resolution, Hall effect speed sensor

### Optional features available on request

• Speed sensor-bearing

604 WE

605 WE

110

106

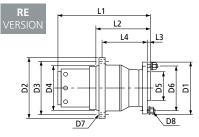
315

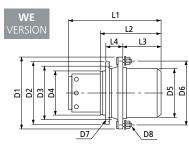
300

300

231

- Other types of temperature sensor
- Mechanical disengagement for towing, with no need to remove the wheel and without oil drop
- Parking brake (spring applied with hydraulic or electromagnetic release)





			BT 1	135-				BT 1	50-				BT 17	0-			BT 200	
		50	10	00	150	5	50	10	0 1	50	50	)	100	15	0	50	100	150
P <sub>n</sub> (S2 60') (k	kW)	0.9	1.	.6	2.3	1	.5	2.5	5 3	3.4	2.	4	4.3	5.	4	3.1	6.2	9.1
T <sub>n</sub> (Nm)		3	5.	.6	8.5	4	1.8	9.1	1 1	2.5	7.	7	14	22	2	10	20	29.5
V <sub>batt</sub> (V)		24	2	4	24	2	24	24		24	48	3	48	48	3	80	80	80
I <sub>n</sub> (A)		55	9	5	128	8	30	130	0 1	75	6	7	110	14	3	53	98	137
n (rpm)		2930	29	27	2632	28	394	261	7 2	610	294	45	2952	23	57	2957	2963	2958
cosφ		0.77	0,	,8	0.81	0.	.85	0.8	6 0	.87	0.7	77	0.83	0.	8	0.77	0.8	0.84
η (%)		86.9	89	).5	90.0	8	5.5	88.	7 8	9.2	88	.3	89.6	91	.3	88.8	91.6	92.5
Туре										ī	.1							
600 WE		275	32	25	375	2	90	340	о 3	90								
601 RE								453		03	41	_	462					
602 RE									5	24	43	4	484	53				
602 WE									4	55	37	5	425	47	_			
604 WE				$\rightarrow$		$\perp$					_		464	51		446	496	
605 WE														52	4	456	506	556
	L2	L	3	L4		D1	D	2	D3	- 1	04		)5	D6		D7		D8
600 WE	134	39	9	89	)	240	20	7.5	190.5	17	1.45	18	4.15	216		M8 n°6	М	12 n°9
601 RE	247	1.	2	20	0	189	26	65	245	2	225	1	10	160		Ø13 n°8	M14	x1.5 n°8
602 RE	269	1:	5	19	3	210	29	95	265	7	235	1	30	170		M16 n°8	М	18 n°6
602 WE	210.5	104	1,5	88	3	260	2	71	248	2	220	2	00	230	(	Ø15 n°12	М	14 n°9

275

250

220

275

M16x2 n°12 M20x1.5 n°8

M16x2 n°12 M20x1.5 n°8



# Electric powertrains for off-highway hybrid machinery













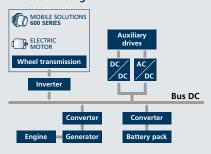
### Gearbox data

Туре	Max deliverable torque [Nm]							
606W		1200	00					
607W			17000					
609W				2300	00			
610W					36000			
611W					42000			

### **Motor data**

Technology	BPD <sup>®</sup> Hairpin Stator Winding
DC bus operating voltage	400 - 700 V <sub>DC</sub>
Max power output	25 - 85 kW
Max torque output	200 - 400 Nm
Max operating speed	8000 rpm
Max efficiency	95.6 %
Cooling	PGW 50/50 or oil

### **Functional diagram**



# 600W series with BPD® electric motor Electric powertrains for off-highway hybrid machinery

Bonfiglioli's 600W planetary wheel drives can be coupled to a high power density electric motor, instead of conventional hydraulic.

This complete mechatronic solution is designed for a high voltage hybrid powertrain system and was originally conceived for use on self propelled crop sprayers. It can, however, also be applied to other types of new generation off highway machinery for use in industrial and construction sectors.

Using this solution can deliver many advantages and assure interesting benefits both to the machine manufacturer and to the end user. Thanks to the compact dimensions, the technology development phase is faster because it is easier to convert a off-highway equipment from traditional into a innovative hybrid electric one.

Hybrid-electric wheeled off highway machinery:

- construction sector (bucket loaders, road building equipment, etc)
- agriculture sector (sprayers, trailed or self propolled harvesters, etc)
- industrial / material handling field (forwarders, aerial lifts, mobile cranes, etc)

### **Advantages for OEM**

- Possibility of downsizing and downspeeding of the combustion engines
- Ease of installation: electric solution dimensions comparable to standard hydrostatics
- Higher system reliability: fewer mechanical parts
- Virtually maintenance-free electric motors
- From wheel bolt to electric wire with only one supplier

### Advantages for final user

- Reduction of fuel consumption
- Increase of productivity
- · Better machine manoeuvrability
- Electric solution is cleaner: lower danger of oil spills













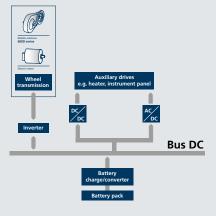




Туре	Max deliverable torque [Nm]						
600D	1000						
601D			1500				
602D			3000				

Туре	Rated motor power	Vehicle weight
	[kW, S2-60']	[kg]
600D	5 20	700 1250
601D	20 30	1300 1750
602D	30 45	1800 3500

### **Functional diagram**



### 600D series

### Electric powertrains for lightweight vehicles

Bonfiglioli supplies versatile, low noise drives coupled to electric motors for all-electric, battery powered vehicles like urban passenger cars, commercial vehicles and delivery trucks. This solution ensures more energy-efficient operation and extended autonomy from the battery thanks to optimised, low backlash helical gears and high speed bearings. Bonfiglioli's 600D Series of drives is extremely lightweight thanks to cast aluminium casings developed using all of Bonfiglioli's vast process expertise. 600D drives allow vehicle manufacturers to satisfy even the toughest restrictions on gross vehicle weight. They are complemented by a range of electric motors, inverters and matched mechanical joints and shafts to provide vehicle OEMs with complete powertrain solutions.

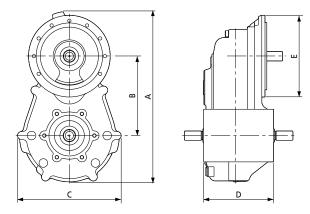
- Light duty, lightweight, battery powered vehicles
- Passenger transport and/or commercial deliveries
- Urban or suburban use
- Vehicle weights from 700 to 3500 kg
- Vehicle speeds up to 100 km/h
- Battery autonomy from 100 to over 200 km

#### Standard features

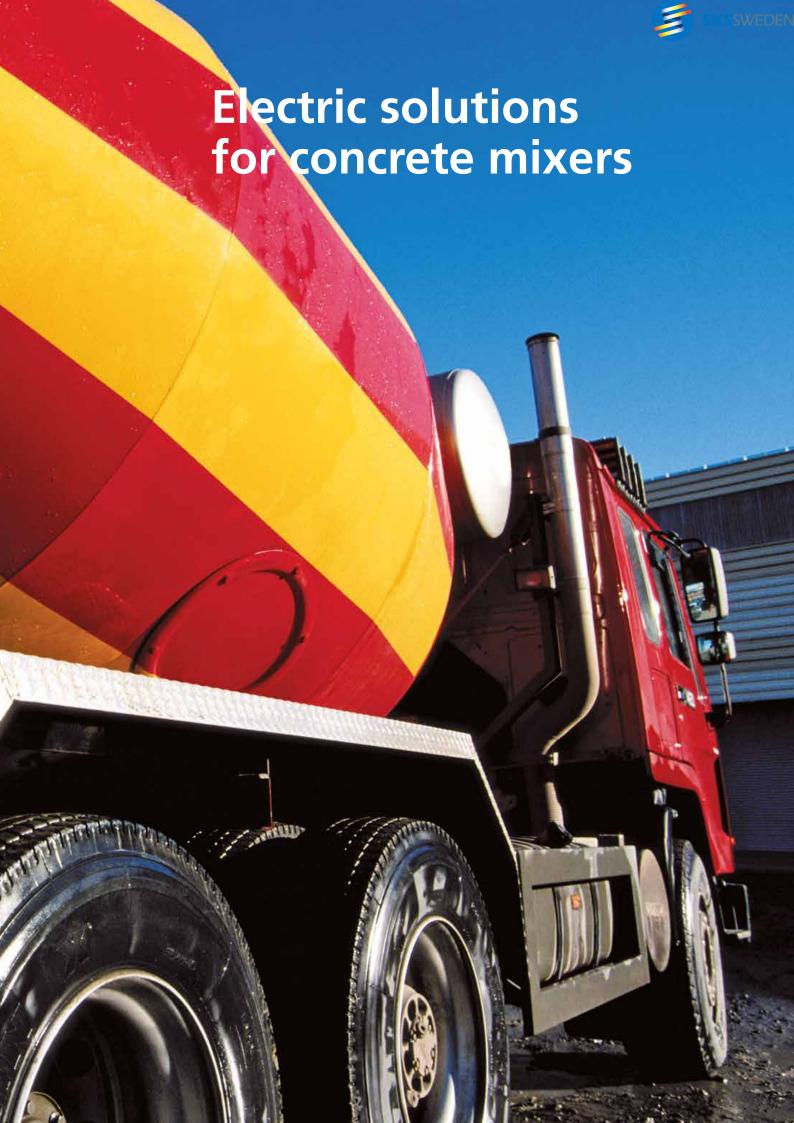
- Multi-stage, parallel shaft gearbox with reduction ratios of up to 1:15
- Optimised gear design for maximum efficiency and minimum noise
- Integrated mechanical differential
- Lightweight cast aluminium housing
- Versatile gearbox installation in the chassis
- Low voltage electric traction motor with inverter control

### Optional features available on request

- Integrated mechanical parking brake
- Integrated, high resolution, Hall effect speed sensor
- Matched mechanical joints and shafts
- Matched electric motors and inverters



Туре	Α	В	C	D	E
	[mm]	[mm]	[mm]	[mm]	[mm]
600 D	375	175	229	154	180
601 D	445	175	235	190	205
602 D	462	175	314	224	252

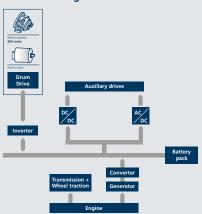








### **Functional diagram**



# 500 series drum drive with electric motor Solutions for hybrid concrete mixers

This solution is designed for use with medium/large mixer trucks that have medium/ long delivery distances to travel. Drum rotation speed is between 15 and 22 rpm and capacity between 6 and 14 m<sup>3</sup>.

Bonfiglioli innovative solution comprises a gearbox of Bonfiglioli's historical 500 Series coupled to an AC electric motor that provides normal power and a DC electric motor for emergency use. This solution not only guarantees greater energy efficiency and reduced fuel consumption, but also helps cut cement mixer truck operating costs (for example by extending service intervals and making servicing simpler than on hydraulic drive solutions). Performance is improved too: rotation speed control is more accurate, operating noise levels are significantly lower (thanks to the electric motor and the helical tooth profile of the high speed gearbox stage). Finally, functionality remains higher in the event of a failure: the presence of a second, backup DC motor gives reassuring redundancy and eliminates the risks and potentially hazardous situations caused by failures of the drum emptying system (if the drum cannot rotate, the cement can solidify and put the mixer truck out of action).

### Main benefits

- Increased Energy Efficiency
- Reduced fuel consumption
- Service intervals less frequent and simplified vs the standard hydraulic solution
- Better drum rotation speed control
- Optimised gear design for maximum efficiency and minimum noise
- The emergency electric DC motor allows a higher availability in case of machine

### **Solution main features**

### Gearbox data

### Ratio

Main: 1:220 Emergency: 1:2200

### Max output torque Main: 60000 Nm Emergency: 10500 Nm

Max input speed

Main: 3500 rpm Emergency: 2000 rpm

### Oil quantity

8 lt

### Dry weight

328 kg

### Motor data

### Type

Main: Induction AC Emergency: PM DC motor

### **Rated Power**

Main: 40 kW Emergency: 2 kW

### Voltage

Main: 170 Vac Emergency: 24 Vdc

### **Protection degree**

IP66

### Cooling

Main: Liquid Emergency: Air forced







### **Bonfiglioli Worldwide**





### **Headquarters**

ITALY • Lippo di Calderara, Bologna



### **Branches**

**AUSTRALIA** • Sydney

**BRAZIL** • São Paulo

**CANADA** • Toronto

**CHINA** • Shanghai

**FRANCE** • Paris

GERMANY • Neuss GERMANY • Krefeld

INDIA • Chennai, Tamil Nadu

INDIA • Mannur, Tamil Nadu

INDIA • Bangalore, Karnataka

ITALY • Milano

ITALY • Rovereto

 $\textbf{NEW ZEALAND} \bullet \text{Auckland}$ 

**SOUTH AFRICA** • Johannesburg

**SINGAPORE** • Singapore

**SPAIN** • Barcelona

TURKEY • Izmir

UNITED KINGDOM • Redditch

**UNITED KINGDOM** • Warrington

**USA** • Hebron, Kentucky **VIETNAM** • Ho Chi Minh



### **Production facilities**

ITALY • Calderara di Reno, Bologna

Casting and gearcutting plant Assembly HDP, HDO, 300 series

ITALY • Vignola, Modena

Gearmotor assembly plant

Precision gearbox manufacturing and assembly plant

ITALY • Forlì

Planetary gearboxes manufacturing and assembly plant

ITALY • Rovereto, Trento

Brushless motor and precision gearboxes production

**GERMANY** • Krefeld

Inverter plant

Photovoltaic Inverter assembly

**GERMANY** • Hattingen

Large planetary gearboxes manufacturing and assembly plant

SLOVAKIA • Považská Bystrica

Large gearboxes manufacturing plant

INDIA • Chennai, Tamil Nadu

Planetary gearbox manufacturing and assembly plant

INDIA • Mannur, Tamil Nadu

Gearmotors manufacturing and assembly plant

INDIA • Bangalore, Karnataka

Photovoltaic Inverter assembly **VIETNAM** • Ho Chi Minh

Electric motor plant

**CHINA** • Shanghai

Photovoltaic Inverter assembly

**BRAZIL** • São Paulo

Planetary gearboxes manufacturing and assembly plant

USA • Hebron, Kentucky

Planetary gearboxes manufacturing and assembly plant

### Resellers

**AFRICA** • Algeria, Egypt, Kenya, Morocco, South Africa, Tunisia

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## **Bonfiglioli Worldwide Locations**

### **Bonfiglioli Australia**

2, Cox Place Glendenning NSW 2761 Locked Bag 1000 Plumpton NSW 2761 Tel. (+ 61) 2 8811 8000 - Fax (+ 61) 2 9675 6605 www.bonfiglioli.com.au

### **Bonfiglioli Brasil**

Travessa Cláudio Armando 171 Bloco 3 - CEP 09861-730 - Bairro Assunção São Bernardo do Campo - São Paulo Tel. (+55) 11 4344 2323 - Fax (+55) 11 4344 2322 www.bonfigliolidobrasil.com.br

### **Bonfiglioli Canada**

2-7941 Jane Street - Concord, Ontario L4K 4L6 Tel. (+1) 905 7384466 - Fax (+1) 905 7389833 www.bonfigliolicanada.com

### **Bonfiglioli China**

Bonfiglioli Drives (Shanghai) Co., Ltd. #68, Hui-Lian Road, QingPu District, Shanghai, China, 201707 Ph. (+86) 21 6700 2000 - Fax (+86) 21 6700 2100 www.bonfiglioli.cn

### **Bonfiglioli Deutschland**

Industrial, Mobile, Wind Sperberweg 12 - 41468 Neuss

Tel. +49 (0) 2131 2988 0 - Fax +49 (0) 2131 2988 100 www.bonfiglioli.de

### Industrial, Photovoltaic

Europark Fichtenhain B6 - 47807 Krefeld Tel. +49 (0) 2151 8396 0 - Fax +49 (0) 2151 8396 999 www.bonfiglioli.de

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Ruhrallee 8-12 - 45525 Hattingen Tel. +49 (0) 2324 2050 1 - Fax +49 (0) 2324 2054 29 www.oundka.com

### Bonfiglioli España

Industrial, Mobile, Wind Tecnotrans Bonfiglioli S.A. Pol. Ind. Zona Franca sector C, calle F, n°6 08040 Barcelona Tel. (+34) 93 4478400 - Fax (+34) 93 3360402 www.tecnotrans.bonfiglioli.com

### **Bonfiglioli France**

14 Rue Eugène Pottier

Zone Industrielle de Moimont II - 95670 Marly la Ville Tel. (+33) 1 34474510 - Fax (+33) 1 34688800 www.bonfiglioli.fr

### **Bonfiglioli India**

### Industrial

Bonfiglioli Transmission PVT ltd. Survey No. 528, Perambakkam High Road Mannur Village, Sriperambudur Taluk, Chennai - 602105, Tamil Nadu

Tel. +91(0) 44 6710 3800 - Fax +91(0) 44 6710 3999

www.bonfiglioli.in

### Mobile, Wind

Bonfiglioli Transmission PVT ltd. PLOT AC7-AC11 Sidco Industrial Estate Thirumudivakkam - Chennai 600 044 Tel. +91(0) 44 24781035 - 24781036 - 24781037 Fax +91(0) 44 24780091 - 24781904 www.bonfiglioli.in

### Photovoltaic

Bonfiglioli Renewable Power Conversion India (P) Ltd No. 543, 14th Cross, 4th Phase, Peenya Industrial Area, Bangalore - 560 058 Tel. +91 80 2836 1014/15 - Fax +91 80 2836 1016 www.bonfiglioli.in

### **Bonfiglioli Italia**

### Headquarters

Bonfiglioli Riduttori S.p.A. Via Giovanni XXIII, 7/A 40012 Lippo di Calderara di Reno - Bologna (Italy)

Tel. +39 051 647 3111 - Fax +39 051 647 3126 www.bonfiglioli.it

Mobile, Wind

Via Enrico Mattei, 12 Z.I. Villa Selva

Forlì, 47100 Italy Tel. +39 0543 789111 - Fax +39 0543789242

www.bonfiglioli.it

### Industrial

Via Bazzane, 33/A

Calderara di Reno (BO), 40012 Italy Tel. +39 051 6473111 - Fax +39 051 6473330 www.bonfiglioli.it

Industrial

Via Trinità, 1 - Vignola (MO), 41058 Italy Tel. +39 059 768511 - Fax +39 059 768522

www.bonfiglioli.it

### Industrial, Photovoltaic

Via Sandro Pertini lotto 7b - 20080 Carpiano (Milano) Tel. (+39) 02 985081 - Fax (+39) 02 985085817 www.bonfiglioli.it

### **Bonfiglioli Mechatronic Research**

Via F. Zeni 8 - 38068 Rovereto (Trento) Tel. (+39) 0464 443435/36 - Fax (+39) 0464 443439 www.bonfiglioli.it

### **Bonfiglioli New Zealand**

88 Hastie Avenue, Mangere Bridge, Auckland 2022, New Zealand - PO Box 11795, Ellerslie Tel. (+64) 09 634 6441 - Fax (+64) 09 634 6445 www.bonfiglioli.co.nz

### **Bonfiglioli South East Asia**

24 Pioneer Crescent #02-08 West Park Bizcentral - Singapore, 628557 Tel. (+65) 6268 9869 - Fax. (+65) 6268 9179 www.bonfiglioli.com

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55 Galaxy Avenue,

Linbro Business Park - Sandton Tel. (+27) 11 608 2030 OR - Fax (+27) 11 608 2631 www.bonfiglioli.co.za

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### Bonfiglioli United Kingdom

### Industrial

Unit 7, Colemeadow Road North Moons Moat - Redditch, Worcestershire B98 9PB Tel. (+44) 1527 65022 - Fax (+44) 1527 61995 www.bonfiglioli.co.uk

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3 - 7 Grosvenor Grange, Woolston Warrington - Cheshire WA1 4SF Tel. (+44) 1925 852667 - Fax (+44) 1925 852668 www.bonfiglioli.co.uk

### **Bonfiglioli USA**

3541 Hargrave Drive Hebron, Kentucky 41048 Tel. (+1) 859 334 3333 - Fax (+1) 859 334 8888 www.bonfiglioliusa.com

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Lot C-9D-CN My Phuoc Industrial Park 3 Ben Cat - Binh Duong Province Tel. (+84) 650 3577411 - Fax (+84) 650 3577422 www.bonfiglioli.vn





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