



# Bonfiglioli

## Mobile

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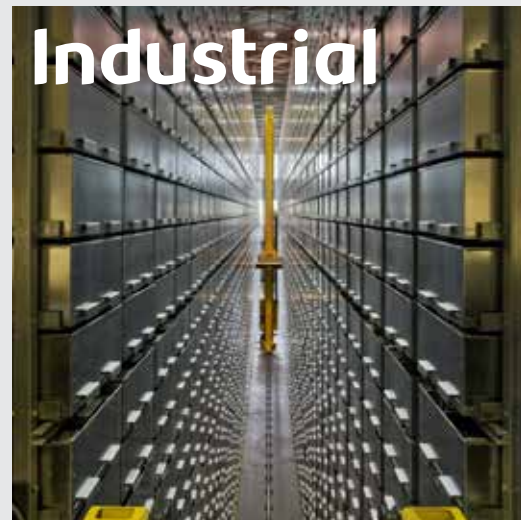
Solutions for electromobility



# Bonfiglioli

power, control and green solutions

# 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 commitment 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.



# **Bonfiglioli electromobility**



## 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 solutions for material handling



# 600F series

## Electric powertrains for material handling trucks



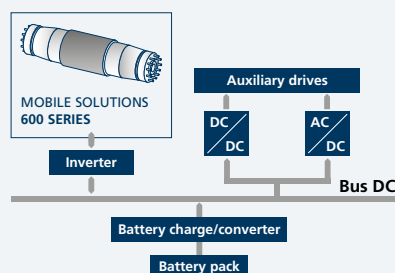
Bonfiglioli supplies high efficiency, low noise planetary axles and drives with integrated, high performance electric motors and low maintenance braking systems for Class 1 material handling vehicles. Typical applications include 3 and 4 wheel counterbalance lift trucks and ground support equipment. 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.

Type	Lift capacity [kg]
601 F	2000
602 F	3500
603 F	5000

Type	Max deliverable torque [Nm]
601 F	3000
602 F	5500
603 F	7000

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

### Functional diagram



### Application

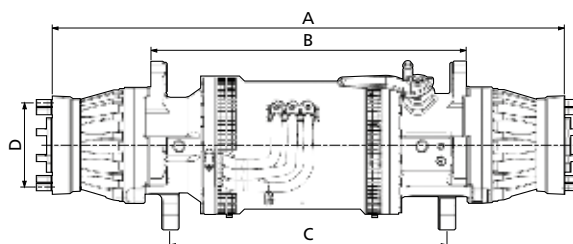
- Material handling vehicles (CB forklifts, articulated forklifts, airport equipment)
- Indoor and outdoor use
- CB trucks with lift capacity from 1.6 to 5.0 tons
- GSE vehicles with draw bar pull from 6000 to 25000 kgf
- Vehicle speeds up to 20 km/h

### 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

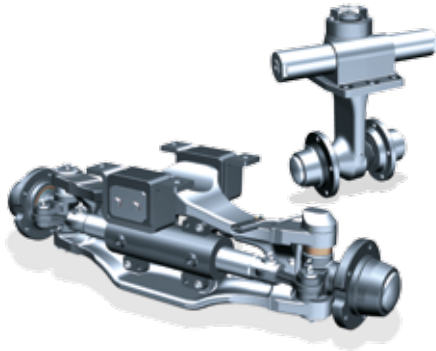


Type	A	B	C	D
	Flange to flange	Frame mounting	Mast mounting	Wheel stud PCD
	[mm]	[mm]	[mm]	[mm]
601 F	1015	610	630	120
602 F	1090	640	600	170
603 F	1150	670	620	225

# Idle steering solutions for material handling







## 600W0C series

### Idle steering systems for material handling trucks

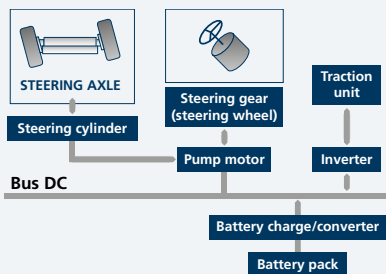
Bonfiglioli has been building idle steering systems for material handling vehicles since decades. These solutions are typically applied in the rear part of 3- and 4-wheel counterbalanced forklifts. They can be axles or steering units for twin wheels. Depending on the steering unit model, anti-vibration 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.

Type	CB Truck Lift capacity [kg]
601W0C	2000
602W0C	3000
603W0C	3500

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

#### Functional diagram



#### Application

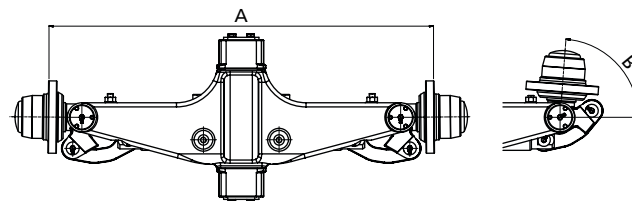
- Material handling vehicles (forklifts)
- Indoor and outdoor use
- Counterbalanced trucks with lift capacity from 1.0 to 3.5 tons

#### Standard features

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

#### Optional features available on request

- Anti-vibration parts
- Potentiometer for steering angle



Type	A Flange distance [mm]	B Max steering angle [deg]
601W0C	175	85
602W0C	830	95
603W0C	930	85

# Electric Steering Solutions for warehouse





## 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 maintenance-free 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.

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

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

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

Type	Max wheel torque [Nm]
EL98	600
EL20	550
EL14	400
EL140	850
EL150	850

#### DRIVES WITH VERTICAL MOTOR

##### Application

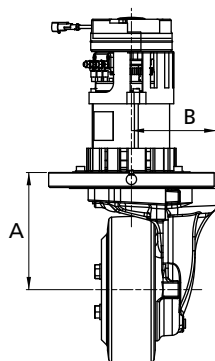
- Stackers, Reach Trucks, Pallet Movers
- Multidirectional Forklifts, Sideloaders
- Other warehousing / material handling trucks
- Indoor and outdoor use

##### 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



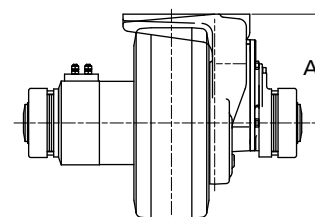
#### DRIVES WITH HORIZONTAL MOTOR

##### 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



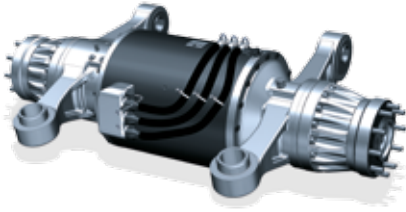
Type	Max wheel dim.	Max ratio	Max power	A	B
	inc	i	kW	mm	mm
EL100	9"	32	2	184	134.5
EL96	10"	24	3	215	147
EL300	12"	24	4.5	249	175
EL92	14"	25	7	277	187
EL93	16"	25	7	304	187
EL94	18"	25	7	325	187

Type	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

# Solutions for Electric Airport Equipment



# 600 series Powertrains for electric vehicles used at airports



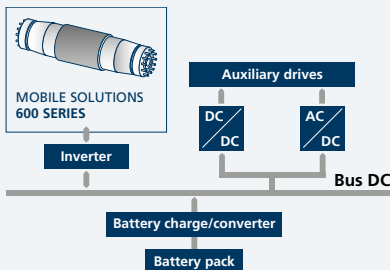
Bonfiglioli supplies high efficiency, low noise axles with integrated, high performance electric motors and low maintenance braking systems for ground support equipment (Industrial Trucks Class VI, electric type) and other material handling electric machinery used at airports. Bonfiglioli electric axles 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.

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

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

Type	Rated motor power [kW, S2-60']	Number & type of drive
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)

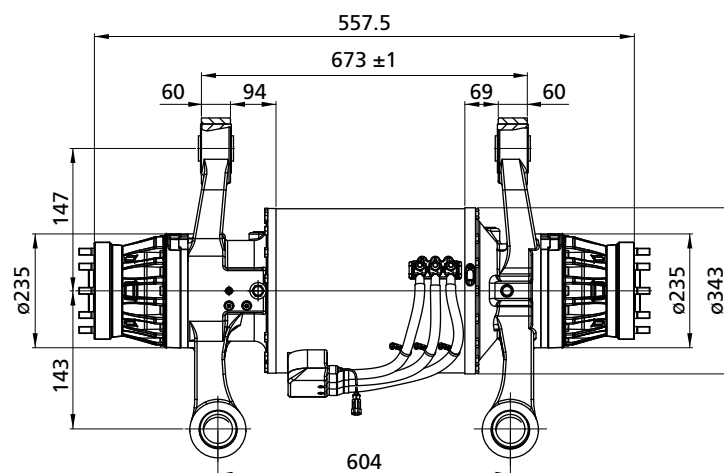
Electric vehicles for external use at airport:

- 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



# Electric solutions for lightweight industrial machinery



# 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.



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

### Application

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

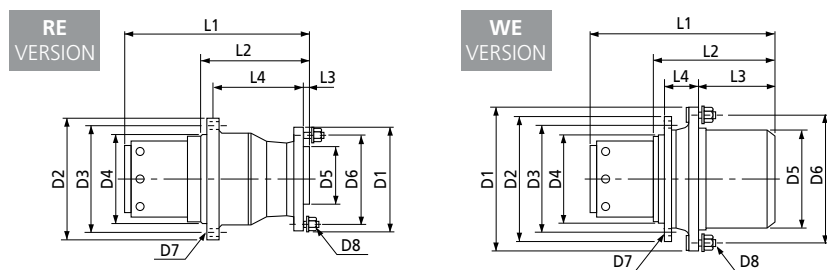
### Standard features

- 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

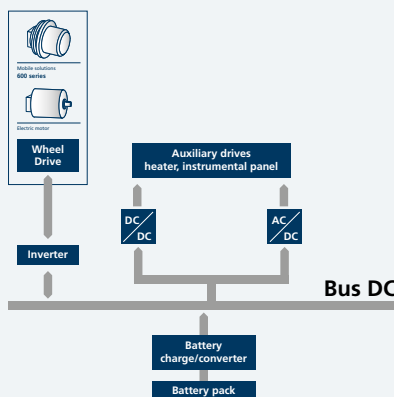
Type	Rated motor data [kW, S2-60']
600 WE	0.9 ... 3.4
601 RE	2.5 ... 4.3
602 RE	3.4 ... 5.4
602 WE	3.4 ... 5.4
604 WE	4.3 ... 6.2
605 WE	5.4 ... 9.1

### Optional features available on request

- Speed sensor-bearing
- 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)



### Functional diagram



	BT 135-			BT 150-			BT 170-			BT 200-		
	50	100	150	50	100	150	50	100	150	50	100	150
$P_n$ (S2 60') (kW)	0.9	1.6	2.3	1.5	2.5	3.4	2.4	4.3	5.4	3.1	6.2	9.1
$T_n$ (Nm)	3	5.6	8.5	4.8	9.1	12.5	7.7	14	22	10	20	29.5
$V_{batt}$ (V)	24	24	24	24	24	24	48	48	48	80	80	80
$I_n$ (A)	55	95	128	80	130	175	67	110	143	53	98	137
$n$ (rpm)	2930	2927	2632	2894	2617	2610	2945	2952	2357	2957	2963	2958
$\cos\phi$	0.77	0.8	0.81	0.85	0.86	0.87	0.77	0.83	0.8	0.77	0.8	0.84
$\eta$ (%)	86.9	89.5	90.0	85.5	88.7	89.2	88.3	89.6	91.3	88.8	91.6	92.5

Type	L1											
600 WE	275	325	375	290	340	390						
601 RE					453	503	412	462				
602 RE						524	434	484	534			
602 WE						455	375	425	475			
604 WE								464	514	446	496	
605 WE									524	456	506	556
	L2	L3	L4	D1	D2	D3	D4	D5	D6	D7	D8	
600 WE	134	39	89	240	207.5	190.5	171.45	184.15	216	M8 n°6	M12 n°9	
601 RE	247	12	200	189	265	245	225	110	160	Ø13 n°8	M14x1.5 n°8	
602 RE	269	15	193	210	295	265	235	130	170	M16 n°8	M18 n°6	
602 WE	210.5	104.5	88	260	271	248	220	200	230	Ø15 n°12	M14 n°9	
604 WE	231	110	106	315	300	275	250	220	275	M16x2 n°12	M20x1.5 n°8	
605 WE	241	154	72	315	300	275	250	220	275	M16x2 n°12	M20x1.5 n°8	

# Electric powertrains for off-highway hybrid machinery





# 600W series with BPD<sup>®</sup> 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.

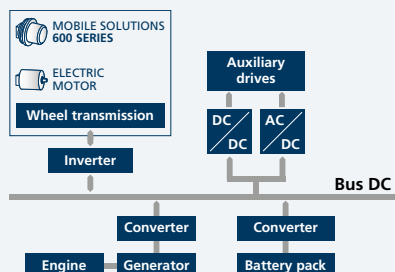
### Gearbox data

Type	Max deliverable torque [Nm]
606W	12000
607W	17000
609W	23000
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



### Applications

Hybrid-electric wheeled off highway machinery:

- construction sector (bucket loaders, road building equipment, etc)
- agriculture sector (sprayers, trailed or self propelled 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

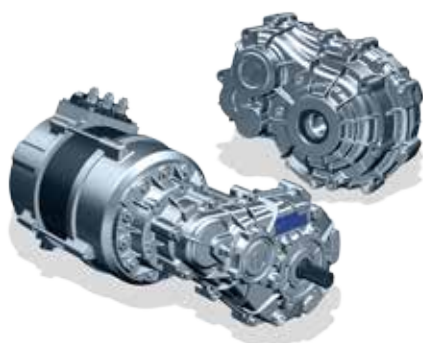


# Electric solutions for lightweight vehicles



## 600D series

### Electric powertrains for lightweight vehicles

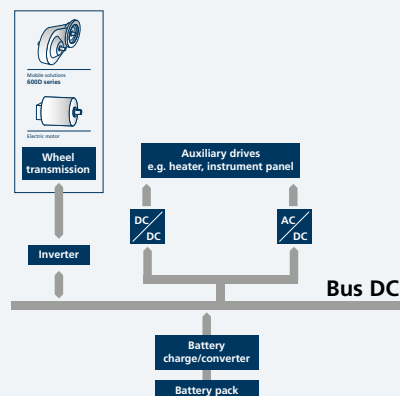


Bonfiglioli supplies versatile, low noise drives coupled to electric motors for all-electric, battery powered vehicles like urban passenger cars, commercial vehicles and delivery trucks. This solution ensures more energy-efficient operation and extended autonomy from the battery thanks to optimised, 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.

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

Type	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



#### Application

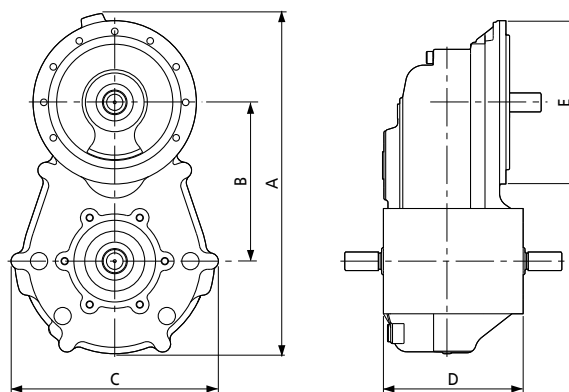
- Light duty, lightweight, battery powered vehicles
- Passenger transport and/or commercial deliveries
- Urban or suburban use
- Vehicle weights from 700 to 3500 kg
- Vehicle speeds up to 100 km/h
- Battery autonomy from 100 to over 200 km

#### 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

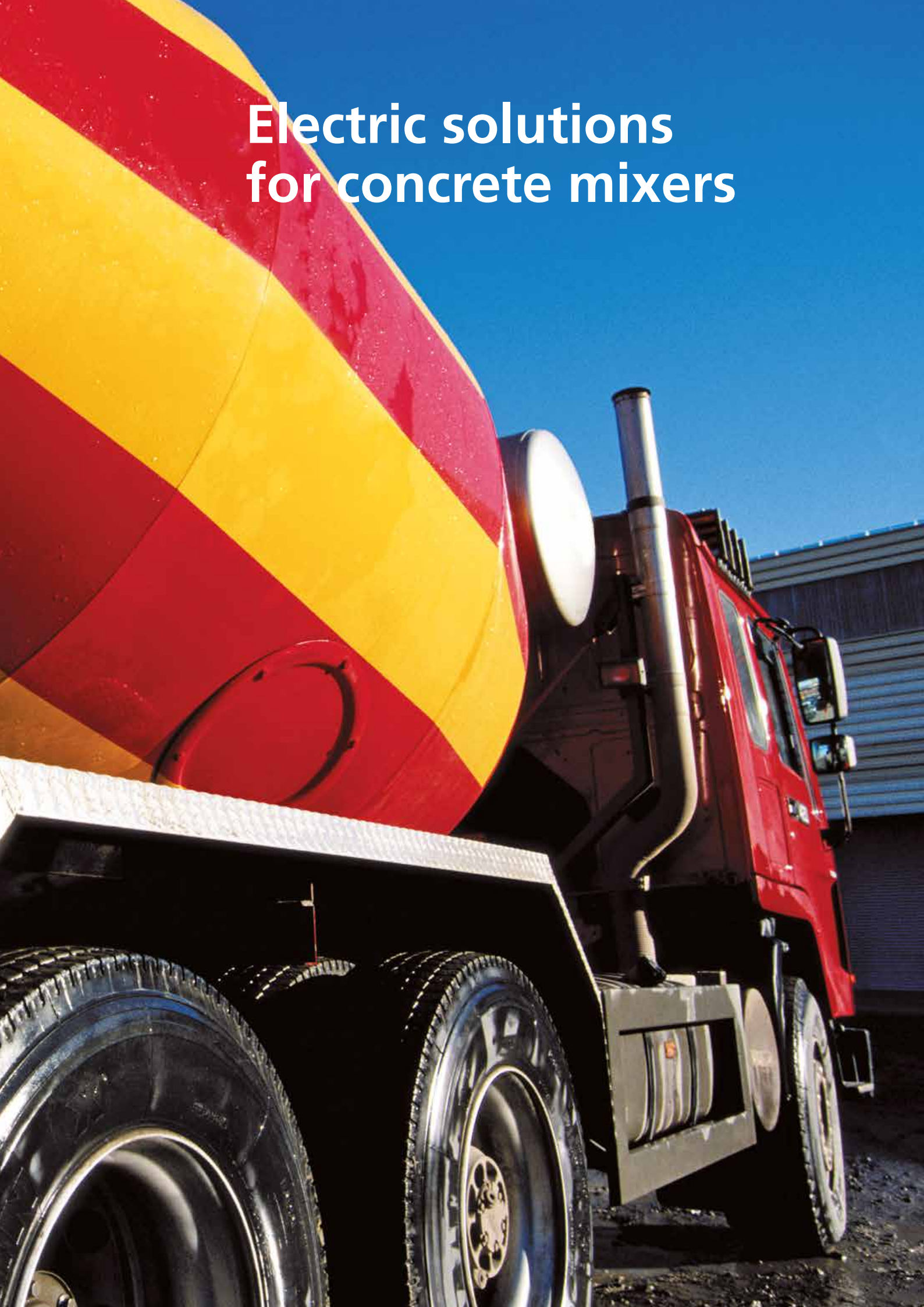
#### Optional features available on request

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



Type	A	B	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

# Electric solutions for concrete mixers

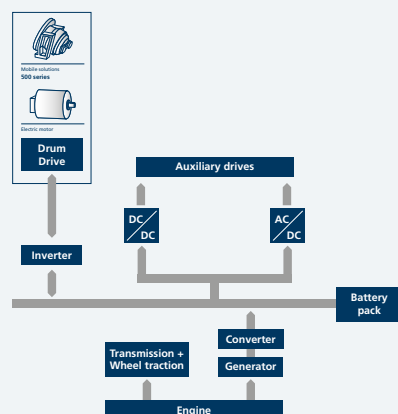


# 500 series drum drive with electric motor

## Solutions for hybrid concrete mixers



### Functional diagram



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 failure

### 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

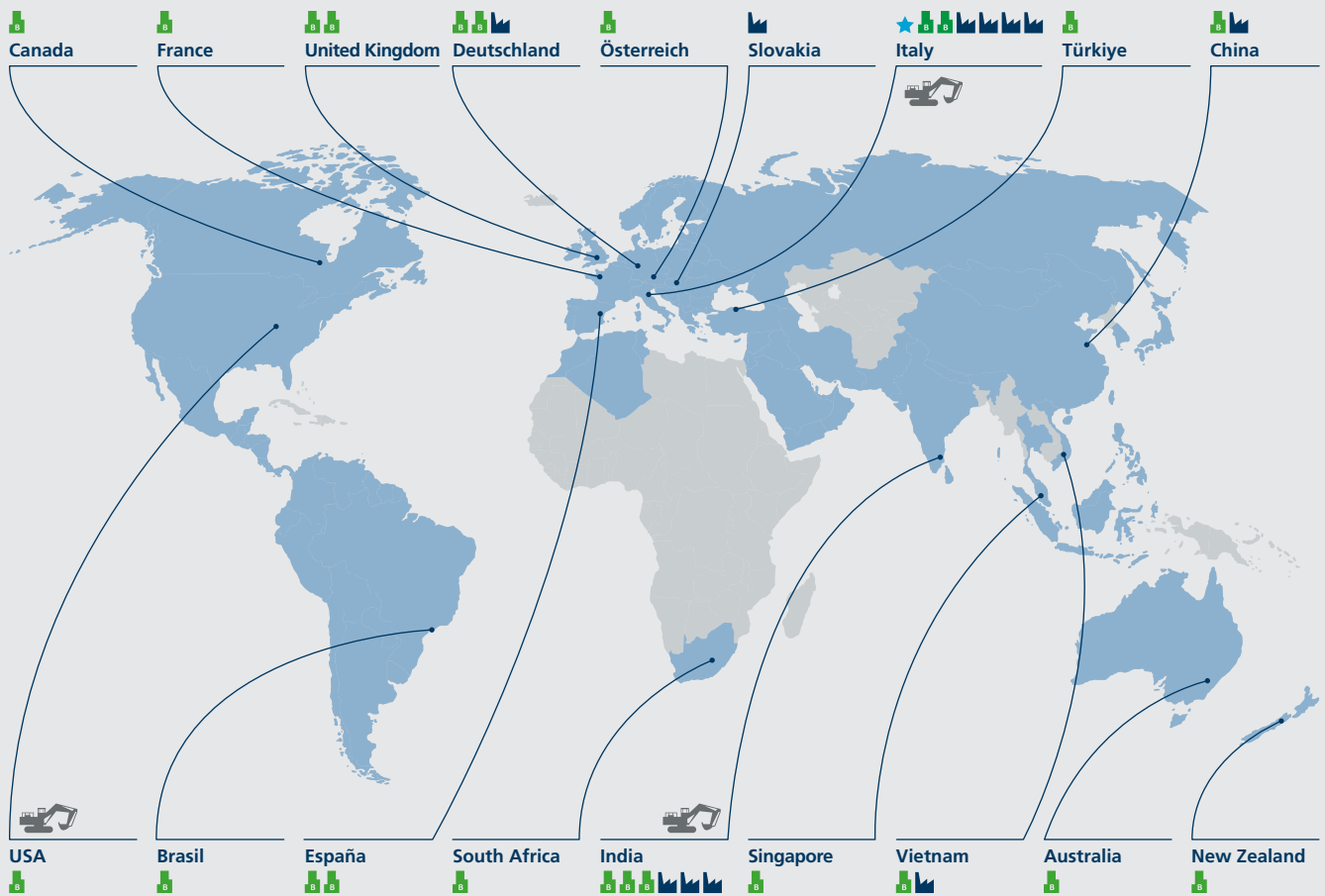
**Voltage**  
Main: 170 Vac  
Emergency: 24 Vdc

**Protection degree**  
IP66

**Cooling**  
Main: Liquid  
Emergency: Air forced



# Bonfiglioli Worldwide



## Headquarters

ITALY • Lippo di Calderara, Bologna



## Branches

**AUSTRALIA** • Sydney  
**AUSTRIA** • Wiener Neustadt  
**BRAZIL** • São Paulo  
**CANADA** • Toronto  
**CHINA** • Shanghai  
**FRANCE** • Paris  
**GERMANY** • Neuss  
**GERMANY** • Krefeld  
**INDIA** • Chennai  
**INDIA** • Mannur  
**INDIA** • Bangalore  
**ITALY** • Milano  
**ITALY** • Rovereto  
**NEW ZEALAND** • Auckland  
**SOUTH AFRICA** • Johannesburg  
**SINGAPORE** • Singapore  
**SPAIN** • Barcelona  
**SPAIN** • Madrid  
**TURKEY** • Izmir  
**UNITED KINGDOM** • Redditch  
**UNITED KINGDOM** • Warrington  
**USA** • Cincinnati  
**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  
 Precison gearbox manufacturing and assembly plant

**ITALY** • Forli  
 Planetary gearboxes manufacturing and assembly plant

**ITALY** • Rovereto, Trento  
 Brushless motor production

**GERMANY** • Krefeld  
 Inverter plant

**SLOVAKIA** • Považská Bystrica  
 Large gearboxes manufacturing plant

**INDIA** • Chennai  
 Planetary gearbox manufacturing and assembly plant

**INDIA** • Mannur  
 Gearmotors manufacturing and assembly plant

**INDIA** • Bangalore  
 Photovoltaic Inverter assembly

**VIETNAM** • Ho Chi Minh  
 Electric motor plant

**CHINA** • Shanghai  
 Photovoltaic Inverter assembly



## Mobile dept.

**INDIA** • Chennai  
**ITALY** • Forli  
**USA** • Cincinnati



## Resellers

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