DOPAG

A MEMBER OF THE
HILGER&KERNGROUP

Wind power industry

SOLUTIONS FOR THE PRODUCTION OF ROTOR BLADES

Quality you can trust

Customized high standard metering and mixing systems

Rotor blades are subjected to the toughest stresses during operation. They must withstand any weather conditions. At rotor speeds of up to 400 km/h, even rain drops can be a threat. With our metering and mixing solutions, we help to ensure that everything runs smoothly – even under extreme ambient conditions.

Since several decades we know the production requirements for rotor blades so that they withstand these high demands in long-term operation. One out of three rotor blades in the world is produced with a DOPAG machine. This makes DOPAG one of the world's leading manufacturer of metering and mixing machines for rotor blades.

As a member of the HILGER & KERN GROUP, DOPAG has been a reliable supplier as well as an experienced development- and service-partner for industrial enterprises across various market segments since 1927. The company is represented in more than 40 countries across the world.

Our commitment to quality is uncompromising and we manufacture according to the highest quality and compliance standards. Our machines are continuously optimized to improve the production processes of rotor blades. This focus is evident at every stage of the development and production of our machines.

All of our manufacturing processes are validated and products are tested and certified, using state-of-the-art testing equipment throughout the manufacturing process designed to ensure adherence to the highest quality and compliance standards. We accompany our customers from project development to commissioning and long-term maintenance of the machines. Our worldwide subsidiaries ensure that we are present on site for our customers.

One partner for all applications

Efficient solutions for rotor blade production

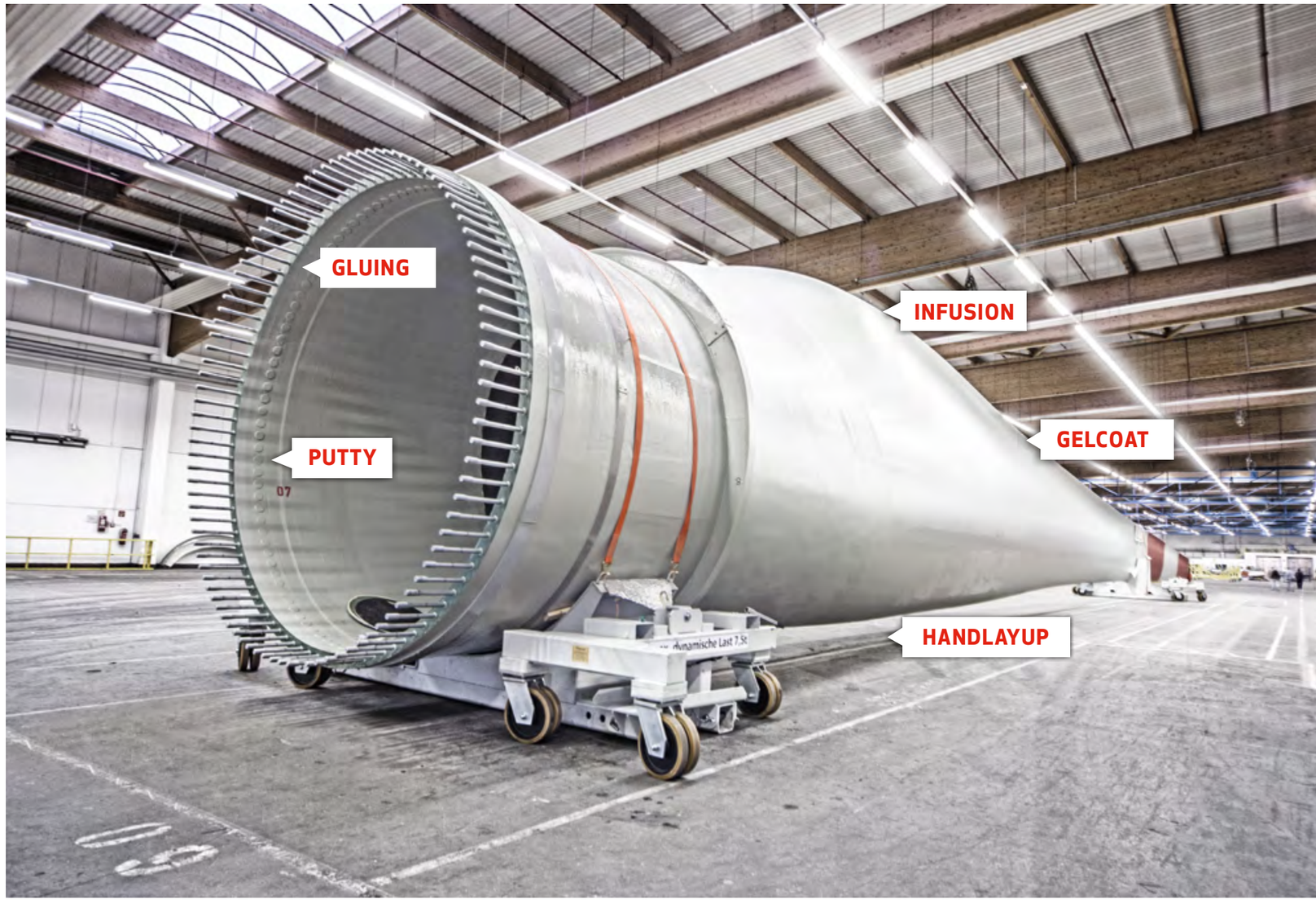
As leading manufacturer of custom build metering and mixing systems for the wind power industry, DOPAG provides the comprehensive portfolio needed for the various applications for the production of rotor blades.

In general, rotor blades consist of glass- and carbon fibre reinforced plastics and reinforcement materials such as Balsa or foamed materials, that absorb total mechanical load while also optimizing weight. The production process begins with the manufacture of the upper and lower shells. As the first layer, a gel coat may be applied using the gelcomix metering system to give the component a high-quality surface finish. Afterwards, dry fibre preforms are placed into the mould and provided with so-called auxiliary means, before the complete component is vacuum sealed with a foil and evacuated. This guarantees minimum porosity.

Further steps are degassing of the infusion resin and the actual infusion process. Degassing is required because various air bubbles may form both due to the contact with air and to the transport and these bubbles might lead to undesired air enclosements in the fibre composite during the vacuum build-up.

Degassing removes even the finest bubbles from the material with high reliability. By means of hoses, the compomix-type infusion system is directly connected to the mould. As an alternative, surge drums may be used that are fed with mixed material and are also connected using infusion hoses. After the infusion, the shell halves are cured. During this process, the temperature is precisely monitored and controlled to make sure the material is not damaged due to the exothermic reaction of the resin.

After the components have completely cured, any excessive auxiliary means are removed and the bonding of the stiffening members and the two shell halves begins. Adhesive beads are applied with an adhesive mixing system of the gluemix type. After this process has been finished, the mould is closed and the rotor blade as a final unit is ready for surface finishing.



Your benefits:

- Decades‘ worth of industry experience
- Reliable and precise quality
- Broad product portfolio
- Global distribution and service
- Dedicated technical center

State-of-the-art products

For the optimal production of rotor blades

For the production of rotor blades in the wind power industry, DOPAG offers the cutting-edge technology for manufacturing, bonding and surface finishing of the rotor blade segments or of the rotor blade halves.

The production requires three main demands on automated metering and mixing systems:

- Precise maintenance of a consistent mixing ratio
- High flexibility in terms of the flow rate
- Minimal delay in achieving working point

DOPAG provides infusion systems with flow rates of more than 60 l/min and adhesive-paste systems being able to process more than 24 l/min. Due to the high resin consumption of the infusion process and the high quality requirements of composite fibre composites components, resin degassing systems must be used. Here, DOPAG offers a validated system that is capable to degas more than 40 liters of resin per minute.

Furthermore, for surface finishing of the turbine blades, a broad range of gel coat systems and systems that mix antierosion coatings and filling compounds is offered. Moreover, DOPAG offers efficient solutions e.g. for leading-edge protection to avoid damage caused by water drops on the blade tips rotating at incredible high speeds after installation.

gluemix
for bonding the rotor blades or blade segments

gelcomix
for coating the rotor blade surface

puttymix
for application of putty for rotor blade surface

compomix DI
for vacuum-assisted direct infusion
(saturation of the fibre mats placed into the mould)

compomix DI

Perfect dispensing of epoxy and polyurethane

DOPAG developed the compomix DI specifically for use in infusion processes in the production of rotor blades for wind power generators. The metering and mixing system can be used for direct infusion process with a deviation of less than ±1 % of the mixing ratio. Depending on the system configuration, magnetically-coupled, leakage-free pumps that are hermetically sealed at the drive end are used to feed hygroscopic hardeners. The metering system range for the processing of unfilled infusion resins combines highly accurate metering pumps with extremely fast control technology. Metering is carried out from a regulated by-pass so that the normal initial process of filling the mixing tube is avoided and the long distance between metering and mixing point does not impact the mixing ratio. In addition, the output rate can be changed during the metering process at pre-defined levels – without exceeding the permitted tolerance limits of the metering ratio.

Standard

- 2K system
- Output rate 30 l/min and 60 l/min
- Automatic ratio check with weighing scales
- Control cabinet mounted onto a completely enclosed, mobile chassis
- Metering pumps with overpressure protection
- Metering pump of the B-component with magnetic coupling
- Three-phase asynchronous motor
- Control and regulation of mixing ratio by use of high resolution volume counters
- Multiple dosing line
- Feeding directly from IBC's or local ring feeding line
- Emergency backup of control parameters in case of a power failure

Optional

- Remote monitoring and analytics with production reports
- Remote diagnostics
- Cabinet cooling

Technical specifications

Flow rate *	5 - 60 l/min (approx. 6 – 70 kg/min)
Mixing ratio	100:15 – 100:80, volumetric as per typical infusion resins
Material supply	Circular pipeline, original container, pressure vessels
Viscosity range	10 mPas – 5.000 mPas
Material characteristics	Unfilled
Power supply	3 × 400 V / 50 Hz
Air supply	6 bar
Dimensions L × W × H	1.350 × 1.850 × 2.100 mm (compomix)
Weight	Approx. 1.500 kg

* Depending on mixing ratio and viscosity

gluemix

2K adhesive dispensing system for rotor blade bonding

The gluemix is a compact gear pump driven metering and mixing system, which has been specially developed for the production of rotor blades in the wind industry. It is used to handle medium to high viscosity multi component media such as polyurethane or epoxy very precise and reliably. Progressive cavity pumps are used for pulsation free supply of the material. The available filling station is suitable for original 200 l drums.

Standard

- 2K system
- Output rate 14 l/min and 24 l/min
- Control cabinet and 400 l buffer vessels mounted onto a mobile chassis
- Metering pumps with overpressure protection and LifeCycleLogger
- Vertically foldable crane with up to 6 m reach mounted on the chassis
- High pressure pump rams with level control
- Three-phase asynchronous motors with forced cooling for PC-feeding pumps
- Control and regulation of mixing ratio by use of high resolution volume counters
- Portable refilling unit that works while connected to main machine for process safety
- Emergency backup of control parameters in case of a power failure
- On board compressor
- Electric cable reel up to 70 m
- Automatic ratio check with weighing scales
- Emergency backup of control parameters in case of a power failure

Optional

- 3K system with 400 l buffer vessels for all components
- Hose and cable reels
- Cabinet cooling
- Remote monitoring and analytics with production reports
- Remote diagnostics

Technical specifications

Flow rate *	3 – 24 l/min (approx. 5 – 30 kg/min)
Mixing ratio	100:10 - 100:100, volumetric
Material supply	Original container
Viscosity range	10.000 – 500.000 mPas **
Material characteristics	Filled, abrasive
Power supply	3 × 400 V / 50 Hz
Air supply	6 bar
Dimensions L × W × H	5.500 x 1.330 x 5.180 mm (for 2K version) 7.475 x 1.330 x 5.180 mm (for 3K version)
Weight	Approx. 4.500 kg (for 2K version) Approx. 5.600 kg (for 3K version)

* Depending on mixing ratio and viscosity
** Depending on rheology

gelcomix

For coating the rotor blade surface

The gelcomix has been especially developed for processing highly thixotropic materials onto the untreated surfaces of rotor blades. Output rates of up to 5 l/min can be achieved with gear metering pumps, which are also suitable for abrasive fillers. Depending on the configuration, the following pumps can be used for the B component, also magnetically coupled: axial piston pumps, radial piston pumps or gear pumps. The material is supplied from material pressure vessels that are installed on the chassis of this mobile system. With gelcomix technology, materials with viscosities of up to the flow limit can not only be applied but the mixing ratios are also adjustable within a wide range.

Standard

- Control cabinet and material supply mounted onto a mobile chassis
- Material pressure vessel with level control monitoring
- Metering pumps with overpressure protection
- Coated metering pump of the A-component with ceramic glide ring sealing
- Three-phase asynchronous motor
- Control and regulation of mixing ratio by use of high resolution volume counters
- Material feed detection sensor to ensure process safety
- Mast, boom and balancer to handle the manual mixing-gun mounted on the chassis
- Emergency backup of control parameters in case of a power failure

Optional

- Metering pump of the B-component with magnetic coupling
- On chassis 200 kg direct feeding for A-component
- Automatic refilling
- Electrical heating system
- Cabinet cooling
- Hose and cable reel system
- On board compressor
- Remote monitoring and analytics with production reports
- Remote diagnostics

Technical specifications

Flow rate *	1 – 5 l/min (approx. 1.3 – 7 kg/min)
Mixing ratio	100:10 – 100:100, volumetric
Material supply	Drum pump, pressure vessels
Viscosity range	100 mPas – 80.000 mPas
Material characteristics	Unfilled, filled, abrasive
Power supply	3 × 400 V / 50 Hz
Air supply	6 bar
Dimensions L × W × H	2.500 × 1.100 × 4.100 mm
Weight	Approx. 1.500 kg

* Depending on mixing ratio and viscosity

puttymix

For application of putty on rotor blade surface

The finishing process of rotor blades has become more and more important based on the increasing blade lengths. To protect the surface of the rotor blade particularly well, small unevennesses are filled with putty material at the end of the production process. Based on decades of experience in metering and mixing a wide variety of materials, DOPAG has developed a specific system, the puttymix, which perfectly meters and mixes the two-component putty material with its high viscosity variance. An optional high speed injection of an accelerator using needle metering valves is possible. In addition, the metering and mixing system can be used to apply pore fillers.

Standard

- Control cabinet and material supply mounted onto a mobile chassis
- On chassis 200 kg direct feeding for A-component
- Material pressure vessel for B-component with level control monitoring
- Specially abrasive resistant coated gear pump for A-component
- Control and regulation of mixing ratio by use of high resolution volume counters
- Balancer to handle the manual mixing gun mounted on the chassis
- Emergency backup of control parameters in case of a power failure

Optional

- 2K with accelerator
- Metering pump of the B-component with magnetic coupling
- Automatic refilling for B-component
- Electrical heating system
- Cabinet cooling
- Hose and cable reel system
- On board- compressor
- Remote monitoring and analytics with production reports
- Remote diagnostics

Technical specifications

Flow rate *	1 – 2.6 l/min (approx. 1.5 – 4 kg/min)
Mixing ratio	100:10 – 100:100, volumetric as per material properties
Material supply	Drum pump, pressure vessels
Viscosity range	100 mPas – 80.000 mPas
Material characteristics	Unfilled, filled, abrasive
Power supply	3 × 400 V / 50 Hz
Air supply	6 bar
Dimensions L × W × H	2.500 × 1.100 × 4.100 mm
Weight	Approx. 1.500 kg

* Depending on mixing ratio and viscosity

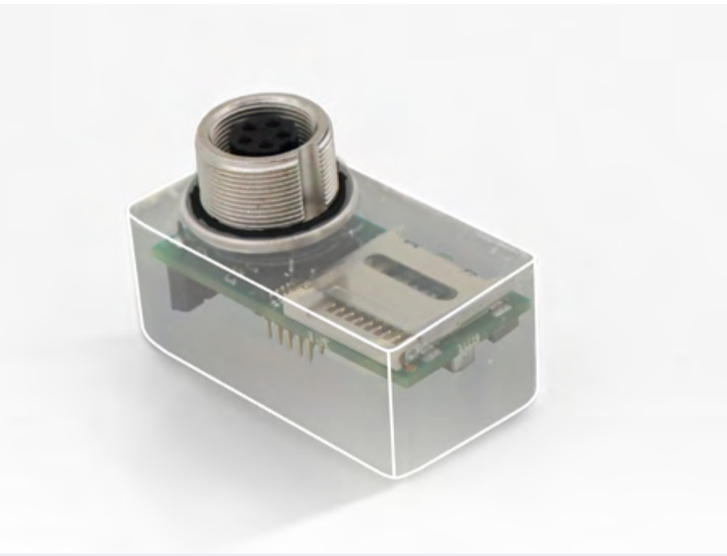
Ready for integration

Efficient production processes

With increasing production quantities, larger rotor blades and rising quality requirements, automated production processes are becoming more and more important. All DOPAG systems can be integrated into automated production cycles. The modular configuration of our machines allows us to meet the various requirements of robot-supported manufacturing processes. For example, the material supply can be placed separately from the dispensing system if required, or hose packages of different lengths can be provided.

Constant process control ensures high production reliability

During the production process, all key product-related technical data from the respective component is recorded on the DOPAG LifeCycleLogger 4.0 as a final step and transmitted to the machine control unit when connected to the system. This includes: size, specific volumes or pressures, test bench results regarding efficiency, and other performance data. There is no need for manual selection or input processes, which removes the potential for error. For example, once a gear pump is in use, DOPAG LifeCycleLogger 4.0 provides further operating data to the system control via integrated temperature and acceleration sensors. The plant operator can access all key data at all times, respond immediately in case of any irregularities, and thus guarantee high production and process reliability.



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Benefits for predictive maintenance

The entire history of the operating and performance data is stored directly on LifeCycleLogger 4.0 as well as on a storage device in the DOPAG plant control system. Operators or DOPAG service staff therefore have a complete overview of the relevant machine status and previous events. All data is regularly transmitted to an analysis and monitoring platform via the integrated cloud concept. Data storage offers significant benefits, especially with regard to predictive maintenance. By comparing the data, potential critical wear or extraordinary disruptions can be identified at an early stage and unplanned machine downtime can thus be prevented. By comparing the actual data with the established target data, individual maintenance intervals can be defined and the entire life cycle can be optimized.

All-round carefree service

From testing and training via installation up to maintenance and repair

For a hassle-free start

- Material testing
- Installation of the entire system
- All-round start-up: We accompany you until your series production is running stably
- Customer-specific training

For long-term stable production

- Preventive inspections and maintenance contracts
- KPI analysis
- Complete overhaul

For short repair times

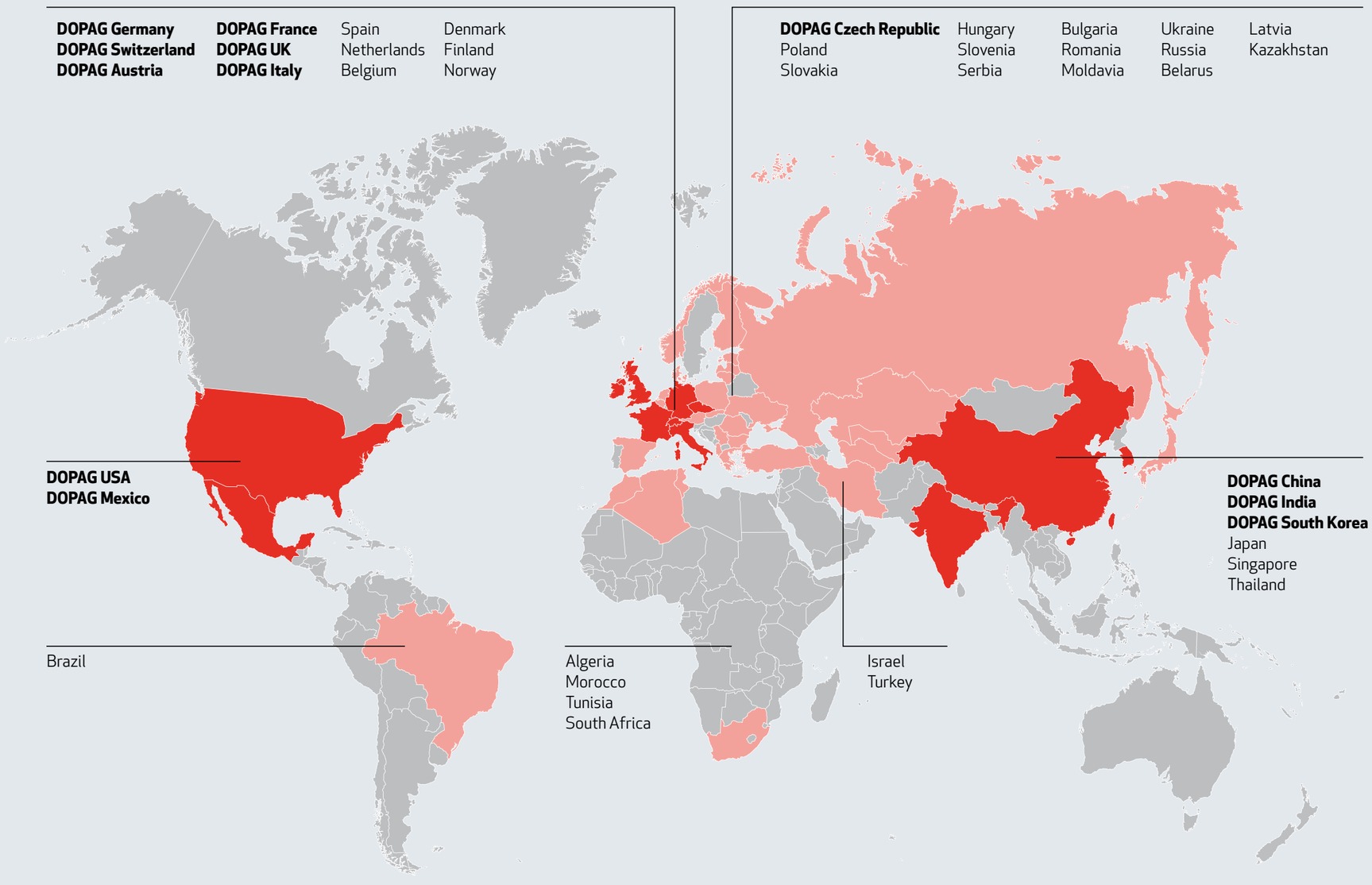
- High accessibility
- Fast execution of repairs
- Short-term availability of original DOPAG parts
- Worldwide delivery of spare parts

For the same standards worldwide

- Inspection, maintenance and repair in the worldwide DOPAG branches, at sales partners or at your site

Worldwide availability

DOPAG experts are on site for you



Notes

Legal notice

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We are one of the world's most experienced manufacturers of high-quality metering technology. Wherever adhesives, resins, silicones or lubricants are metered and applied in industrial production, we offer reliable, precise solutions. We provide systems and components for highly automated production processes, including for the automotive, wind, household appliances and electrical industries, as well as for aviation.

DOPAG is part of the HILGER & KERN GROUP, a reliable supplier and a development and service partner to industrial companies in a variety of market segments for almost 100 years. The group employs around 350 people and has subsidiaries and distributors in more than 40 countries.

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