



ELECTRIC DRIVES

FOR EVERY DEMAND



**The future relies on drive –
progress relies on motors**

With VEM, you benefit from a unique product range
covering outputs from 0.06 kW to 60 MW.



ELECTRIC DRIVES
FOR EVERY DEMAND

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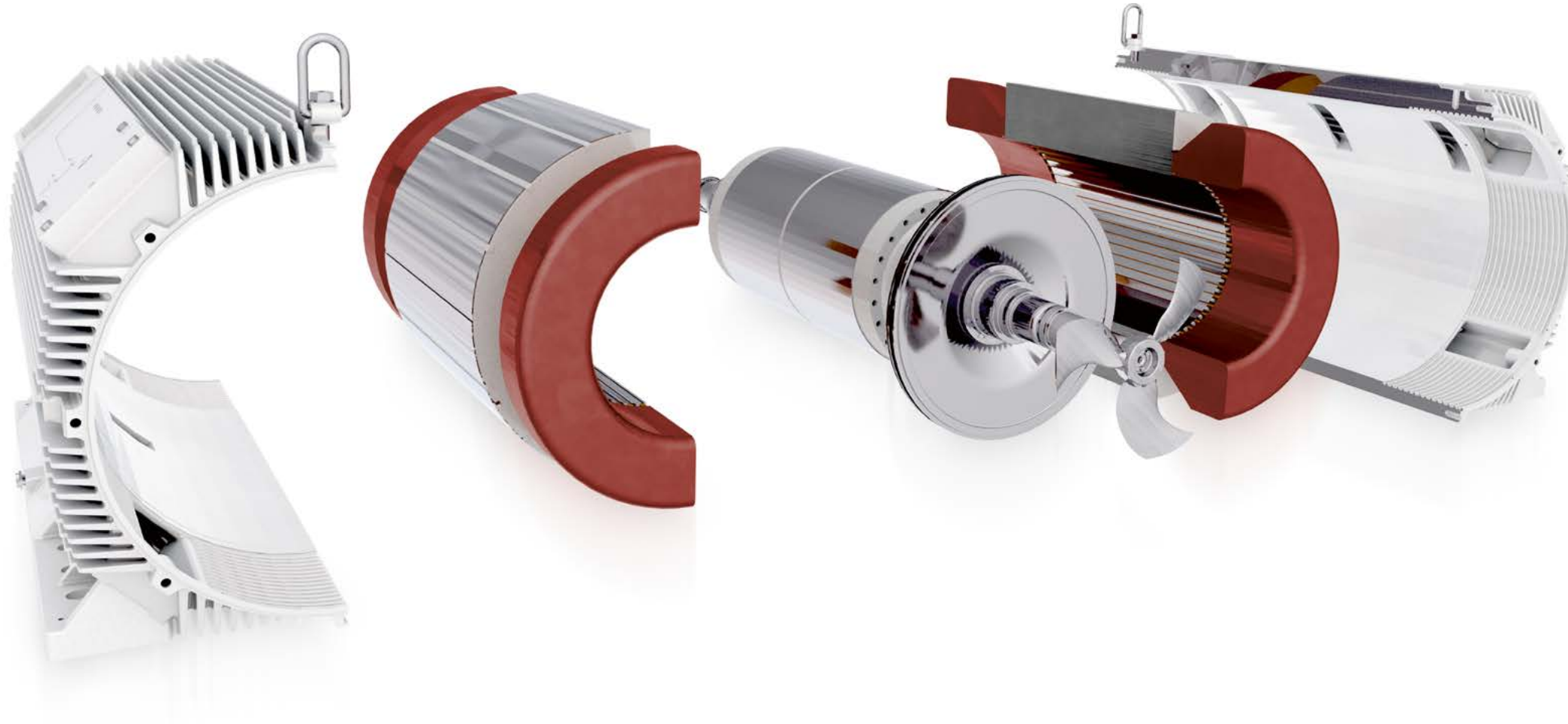
The stationary, magnetically effective part of an electric motor. The length of the stator is decisive in determining the torque. VEM as a company operates within a similarly stable frame, formed by tradition and experience, by success and expertise.

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The moving part of an electric motor, which rotates around the motor axis. The rotation of the drive shaft defines the essence of a motor. The characteristic of constant motion also describes the fundamental innovative drive of VEM.

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03 WINDING

An electrical conductor is wound into a coil. The construction and laying of a winding are among the most demanding tasks in motor manufacture. Skills and experience are here absolutely imperative. As a company, too, VEM is shaped by the skills and experience of highly qualified machine operators, engineers and designers.

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04 DRIVE

Drive is a prerequisite for future progress. Everywhere in the world. Accordingly, local teams are on hand in every economic region to ensure that VEM motors are able to deliver their full potential. And to guarantee the best possible service. Distance is never an argument for us. We are always at your side.

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Electrifying times

Ever since its founding in the late 19th century, VEM has stood for innovation. Two examples from the abundance of ground-breaking achievements are the building of the first German hydropower generators and development of the world's first standard motor series. Most recently, in July 2017, the list was extended further when the "Bosch Global Supplier Award 2017" was received for a hydraulic power unit with Industry 4.0 capabilities. VEM motors Thurm was here the only company to be honoured in the category "Innovation".

We design and manufacture electric motors across the entire spectrum from low to high voltages. But however different those individual motors may be, there is one driving force which has remained the same for more than 130 years now: Our commitment to progress. Or to put it another way: You can only score goals if you stay on the ball.

Throughout our past, we have always been quick to acknowledge current developments, and have then sought to define new standards ourselves. That is why we are today one of the most important players in the front row of European electric motor manufacture, with customers all over the world and constantly growing international business. On top of this, our new owner will no doubt facilitate broader access to one of the largest markets in Asia.

We are living in electrifying times. You, our partners and customers, are approaching us with new expectations: Motors with ever lower energy consumption, optimised solutions for complete drive systems, and the fast realisation of special wishes. We are no longer just motor manufacturers – we have long since evolved into your competent partner for all manner of complex drive projects.

There are still major global challenges ahead. Electric drives account for around 70 per cent of the electricity consumption in industry. And we are also standing on the threshold to e-mobility. But rest assured: In times like these, we will again be setting the standards and convincing the world with outstanding achievements.

We owe that to our traditions.
And to you!

Best regards from Dresden



Falk Lehmann
Geschäftsführung



Dr. Torsten Kuntze
Geschäftsführung



01

STATOR

The stator is the stationary, magnetically effective part of an electric motor. It is decisive in determining the torque, in other words the power of the motor. VEM as a company looks back over a rich history of success and draws its strength from the decades in which it has built up experience, refined its expertise and acquired true mastery.

Progress depends on drive. And we supply the motors.

Today, we design and manufacture electric motors for outputs ranging from 0.06 kW to 60 MW. We are one of the top German manufacturers of electric motors and enjoy an excellent reputation both in Germany and abroad. But the times in which it was already sufficient to build first-class electric motors are over. Our continued success on today's fiercely competitive international market is attributable not least to the further-reaching support we offer our partners and customers. This support takes many forms. We develop drive solutions for complex systems, for example in the steel industry, chemical plants and construction. We assume responsibility for an increasing scope of project planning services on behalf of our customers. We have structured our production processes to enable fast response to even unusual customer requests. The motor prototype already arrives at the customer while we are still busy with forms and certificates. Our relationships with customers and partners are based on absolute trust, high product quality and a strong, internationally established service network. In many cases, relationships have already developed to a level which could even be described as integration.

Electric motors have always and will always remain our core competency. The high proportion of in-house manufacturing at our three locations permits immediate reaction to market developments and customer wishes. At the same time, it places the means to guarantee sustained high quality in our own hands.

In motor development, we are pursuing the following principal goals:

- High efficiency through electromagnetic optimisation
- Reduced installation space requirements
- Constant technical advancement in cooperation with colleges and universities
- Development of energy-saving motors with efficiency classifications IE3, IE4 and IE5
- Consistent environmental awareness in production
- Development of new applications (e-mobility) and drive systems



Cooperation with colleges and universities

The development of VEM has always been very closely tied to the region's standing as an economic and scientific centre. For many decades, partnerships with colleges and universities have flourished through cooperation agreements, joint research projects and regular internship opportunities for students and employees. In Saxony alone, VEM cooperates with institutes of the Universities of Technology in Dresden, Freiberg and Chemnitz, as well as with the University of Applied Sciences in Zittau, to mention just some of the most prominent university locations in the region. In Dresden, for example, there are close relationships to the chairs of electrical machines and drives, power electronics, high-voltage engineering, electric railways, machine elements and machine dynamics. Thanks to this unique regional concentration, VEM is able to transfer current research results directly into product development, and

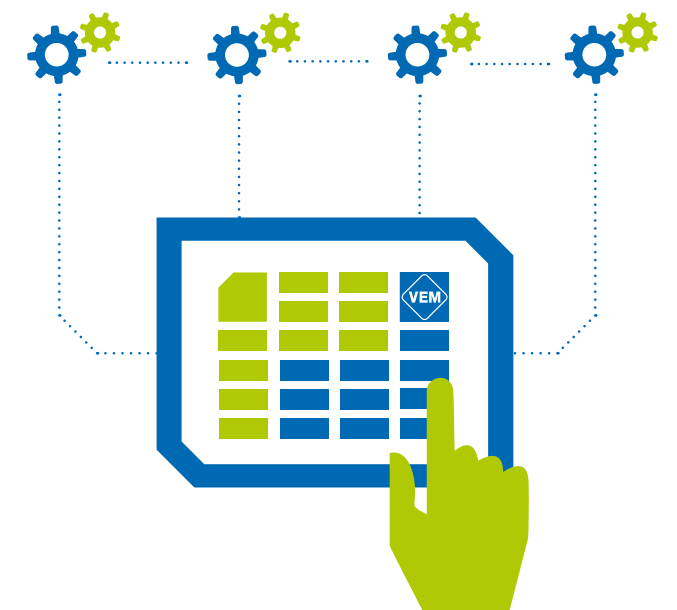
can initiate targeted scientific investigation of the future demands to be met by products and systems. Interdisciplinary networking is becoming increasingly important as a foundation for our understanding and mastering of ever more complex systems. In the field of power electronics, for example, that includes an understanding of the influences of power electronics on the operating behaviour of drives, the ageing mechanisms which impact insulation systems, or mechanical-technological demands with regard to the use of modern, high-quality materials. VEM is an active contributor to the scientific communities in Saxony and Saxony-Anhalt. That is expressed in the promotion of application-oriented research and practice-oriented learning, and in intensive, mutually beneficial cooperation with scientific institutions in both federal states and beyond.



Today's customer expects a partner like VEM to provide competent support far beyond the motor itself. It is a question of system solutions and the joint development of complex projects.

Efficient drive solutions for complex projects

Large-scale investments in the steel, construction or chemical industries demand a multitude of very different electric drives. The customer expects a company like VEM to supply the optimum solution for efficient and reliable control of its complex system of drives. VEM possesses the necessary expertise. Highly qualified and specialised engineers take care of the design, planning, manufacturing procedures, commissioning and worldwide service for drive systems, irrespective of the complexity. Such a system may comprise motors, converters, transformers, drive-related switchgear, operating devices and – typically – also programmable logic controllers.

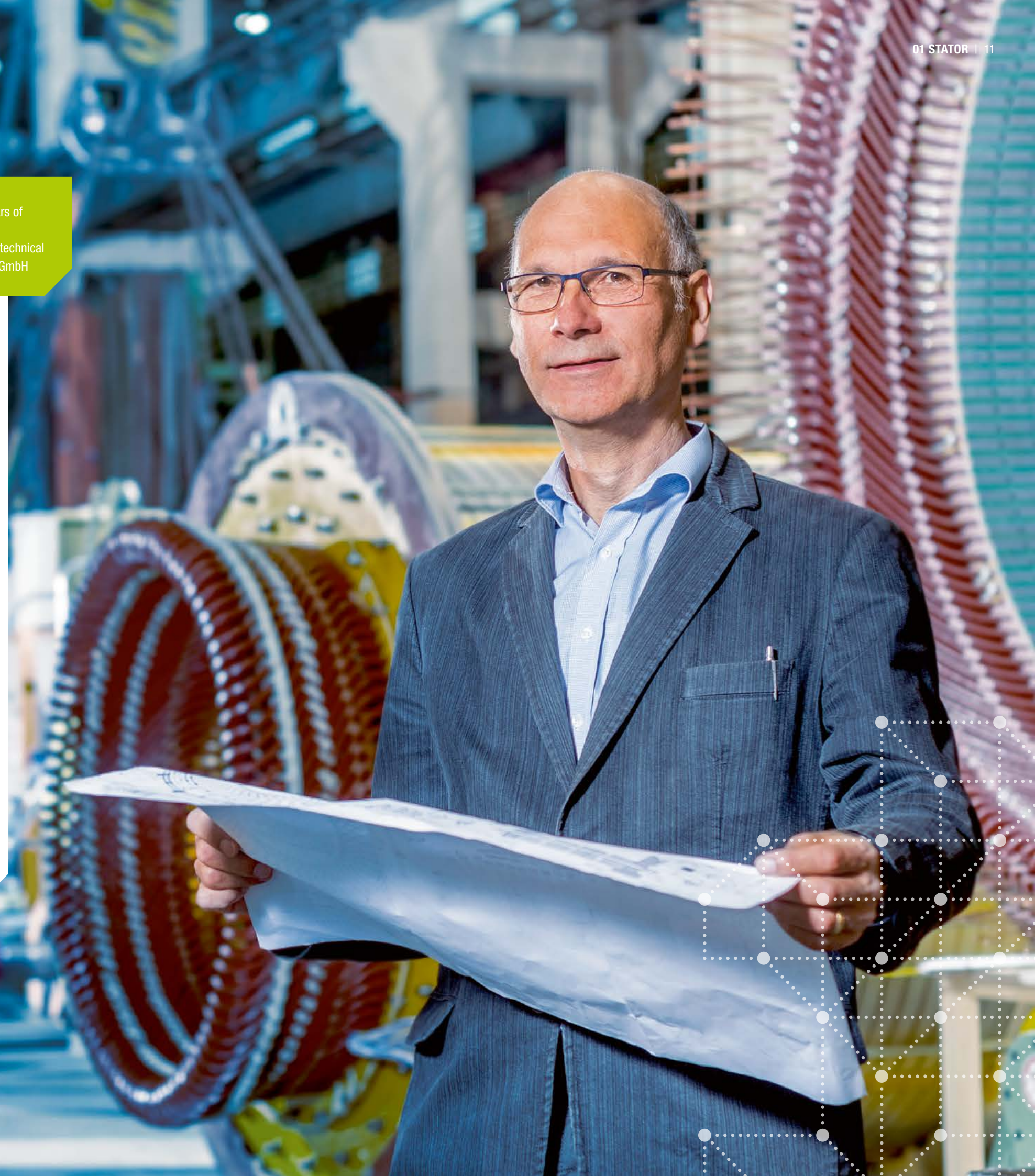


Andreas Boeltzig (58), over 20 years of management experience in design, today head of electrical design and technical documentation, VEM Sachsenwerk GmbH

When quality counts, VEM is the right partner

» When I began my design career in 1985, everyone still worked with ink and transparent paper on a drawing board. It was only after all the drawings for a motor were complete that the project was passed on to production planning. That could easily take nine months. In those days, it was not at all unusual for two to three years to pass between an order and the actual delivery. Today, we can reckon with about six to nine months. In the meantime, the first components are already being manufactured before the last parts even leave the design office. Powerful 3D CAD software naturally plays an important role. The first packages arrived in the late 1990s, and it was an unexpected challenge to adapt our accustomed way of thinking from 2D to 3D. Just a few years earlier, we had already introduced a new group structure in design – customer orientation instead of component orientation. Previously, each design group had concentrated on a particular component, for example shafts. Today, we have separate design teams for industrial motors, marine motors, traction motors and wind turbine generators.

That pays off in terms of bundled expertise. Take the example where a customer asks for last-minute modifications to a motor. The speed and output are fixed, but there could be changes to the foundation, the positions of the feet or the connections for measuring devices. The growing trend since as far back as 2000 is that we no longer simply design a motor for the customer, but instead offer much broader support to overall plant and system planning. That calls for a special kind of design engineer. They need to be at home in mechanical engineering, but must also know their way around in electrical engineering – I would say 70 per cent mechanical and 30 per cent electrical engineering. It may well be five years before a new colleague is in a position to design his or her first whole machine. We are constantly on the look-out for such talents. They are invaluable. After all, the special quality of VEM high-voltage motors is widely appreciated. We are a dependable partner for high quality, long service lifetimes and unequivocal customer orientation. And that is to remain so in the future. «



02

ROTOR

The rotor stands for the very essence of an electric motor, for its quality. The rotor delivers the torque, the running speed and the load capabilities.

A state of constant motion is also characteristic for our company. From the first motors and generators to the present day. In a branch which is characterised by ever shorter innovation cycles, we have always adopted the most progressive technologies and solutions, ready to set new standards ourselves.

The secret of our great traditions: Unwavering commitment to progress.

Already in the 19th century, when the triumphal march of the electric motor first set off, VEM was one of the key players. It all began with drives for trams and railways, with generators for hydropower plants. Rapid electrification opened up many new fields of application for electric drives. In industry and agriculture, in the craft trades and private households.

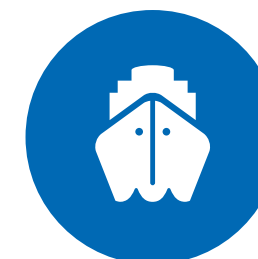
VEM's determination to be involved in all the latest developments, or even to trigger these developments itself, is what has made the company strong. In the 1950s, electric motor factories came together under the common roof

of VEM. Developments fostered by this process were paramount in the emergence of a larger unified enterprise and became indicative of the innovative spirit which still reigns today.

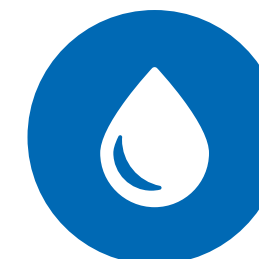
The innovation strength of VEM covers the full spectrum from small motors with outputs of just 0.06 kW to some of the largest electric machines in use, motors delivering up to 60 MW. But for all the diversity in the challenges to be met, VEM never fails to convince. Motors and generators from VEM are firmly established in practically all branches as efficient high-class solutions.



Largest reciprocating compressor drive (30 MW), installed in Jamnagar in India



Drive output of 46,000 hp for luxury cruise liners

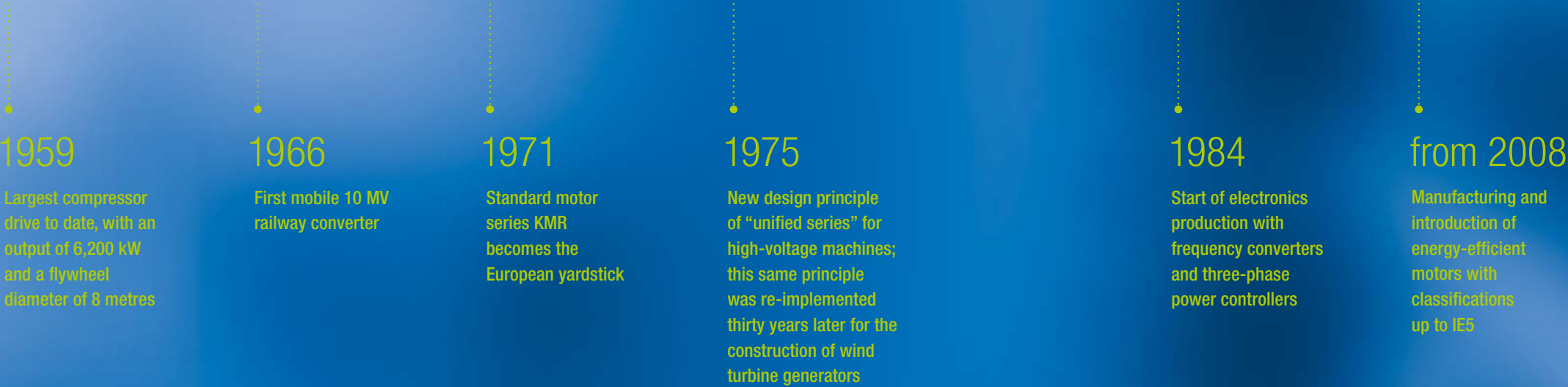


Largest slipring machine (312 MVA) in Europe, a motor-generator combination for the Goldisthal pumped-storage power station

VEM – from the origins to the present day



Masterpieces of engineering and efficiency





Transportation



Machine and plant engineering



Steel and rolling mills



Cement and mining industry



Shipbuilding



Chemical, oil and gas industry



Water management



Renewable energies



Power plant technology



In the front row for the electric motor's triumphal march

The technical principles of the electric motor were already discovered in the early 19th century. But the real triumphal march only began after the motor had provided proof of its practical reliability and its use could thus be deemed profitable. The first fields of application around the turn of the 20th century were electrically driven trams and railways. Here, too, VEM was able to set new standards, for example with the legendary "Hechtwagen" tram delivered to the Dresden public transport corporation in 1929. At the same time, the expansion of wide-scale power supply networks paved the way for the electric motor to spread into many new fields:

Power generation, the steel and chemical industries, machine and plant engineering, construction materials and shipbuilding, later also the craft trades and finally private households. And VEM motors were to be found in the front row of each new advance. The most recent field of development has been generators for wind turbines. Over the 20 years since 1997, VEM has already supplied over 8,000 such generators, and their individual outputs have risen from 1 MVA to 7.5 MVA. In offshore business, VEM is one of the world technology leaders. The electric motor would be inconceivable without VEM. And vice versa.

Ronny Frieß (34), machinist,
VEM motors Thurm

VEM for me stands for Versatility, Efficiency, Mastery

»I joined VEM motors Thurm as an apprentice machinist in 1999. Today, I am shift supervisor in a department with 28 employees. We manufacture rotors and rotor shafts. For me personally, this is a very exciting job, because each day brings new tasks and challenges. Our product range is constantly expanding, new machines arrive, materials and tools change, and programs need to be rewritten.

One brief example illustrates the transformation of our manufacturing processes: In 1999, we had just five CNC machines, and one person needed two shifts to prepare the machining of 20 drive shafts, including steps such as cutting to length and centering. In the meantime, we have 15 CNC machines and those 16 hours have been reduced to just two. Most of us here can operate several different machines. In the past, when customers still ordered quantities

of 500 and more, that was not really necessary. But there are today many customers who order just one, two or three motors. That is not enough to keep an operator busy, and so it has become imperative that we are able to move around.

We are a strong team and our motors are first-class products. That is regularly confirmed by our customers.

An increasing trend is for customers to need a particular motor at very short notice. But even that is no longer a problem for us, because we have gradually reorganised our production to cater for such circumstances. The customer often already receives a sample for inspection while our office is still gathering the last documents, papers and certificates.

We are flexible, deliver reliable quality, and are ideally prepared for the future. For me, that means: Versatility, efficiency, mastery.«



03

WINDING

The construction and laying of a winding are among the most demanding tasks when designing and manufacturing an electric motor. Here, especially, human skills and experience are absolutely imperative.

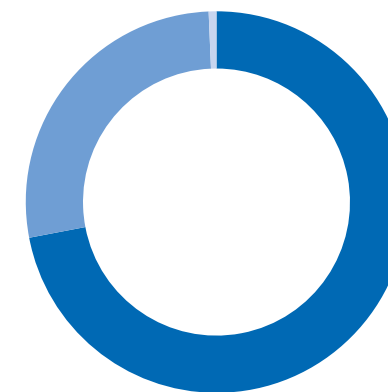
Our innovation strength has many sources. The strongest is our workforce.

As a company with headquarters in Dresden, we like to quote one of the most famous sons of our city, Erich Kästner: "Nothing good arises except through doing." The quality of VEM as a company group is likewise founded on actions, driven by the skills and experience of highly qualified machine operators, engineers and designers. Some 80 per cent of our employees have obtained career qualifications – from vocational training certificates to university degrees. They keep their knowledge up to date through extensive further training measures, seminars and courses. That could mean seminars on strategic development of the company, introductions to new materials and

familiarisation with new machine tools, the use of new programming software, or even English language courses.

Typical for our employees is their fundamental inquisitiveness regarding developments which affect their work environment or the company as a whole. That is paired with the courage to tread new paths and a readiness to break with acquired habits.

We call that innovative spirit. It has characterised our company since the earliest days. And traditions stretching back over more 100 years are at the same time proof of how doing things better always pays off.



Of 1368 employees:

- 985 have undergone vocational training up to the level of a skilled worker
- 374 have obtained a university degree, college engineering certificate or equivalent
- 9 have obtained a doctorate



VEM Sachsenwerk GmbH

Milestones in the new millennium

1998 – 2001

Start of production of wind turbine generators; sales activities in plant engineering, transportation, wind energy and shipbuilding; development of strategic alliances

2002 – 2010

Market leadership for double-fed asynchronous generators for wind turbines (1.5 to 6.5 MW); main roll stand drives up to 12 MW; reciprocating compressor drives up to 25 MW

2011

Commissioning of a 6 MW test stand for large machines; core business focussed on special drives and drive solutions for industrial applications; wind turbine generators up to 7 MW

2015

Introduction of a machine series with water-jacket cooling

Excellent motors and efficient system solutions



Synchronous motor, up to 60 MW
Chemical, oil and gas industry



Asynchronous/synchronous motor
up to 15 MW
Power plant technology



Synchronous or asynchronous motor
for a propeller drive up to 30 MW
Shipbuilding

VEM Sachsenwerk GmbH in Dresden-Niedersedlitz belongs to the exclusive circle of manufacturers able to supply electric motors with outputs up to 60 MW. Almost every one of these high-voltage machines is a custom product requiring a correspondingly high design input. Motors and generators from Dresden are characterised by their electromagnetic optimisation, high efficiency and reduced installation space. The high proportion of in-house manufacturing permits fast reactions to changing market demands. Modern test systems, with four test stands for outputs up to 6 MW (0–80 Hz), subject every motor to a stringent test regime prior to delivery.

As a manufacturer of high-quality custom machines, VEM Sachsenwerk GmbH has at the same time cemented its reputation as a competent partner for the planning, configuration and commissioning of complex drive projects in the most varied branches of industry. VEM Sachsenwerk GmbH maintains close cooperation with universities and scientific institutes. As an example, managers from VEM are long-term contributors to the Chair of Electrical Machines at the Dresden University of Technology. The majority of our engineers studied at the universities in Dresden, Chemnitz and Freiberg.



VEM motors Thurm GmbH



Milestones in the new millennium

2000

Start of production of compact drives

2001

Introduction of a special die-cast aluminium series

2004 – 2005

Extension of two production halls by a total of 3,500 sq.m

2010

Introduction of permanent-magnet synchronous motors

2015

Special compact drives as auxiliary traction drives for use in extreme environments

2017

IE5 series of permanent-magnet synchronous motors

Our trademark is innovation



Compact drive for railways



Explosion-protected motor in a marine version



Permanent-magnet motor

VEM motors Thurm GmbH in Zwickau distinguishes itself not least through its innovation strength. The company chronicles contain ample proof of that. Over the course of more than a century, VEM motors Thurm has mastered the transformation from a manufacturer of standard motors to a supplier of special drive solutions. The factory in Zwickau today specialises in motors for outputs ranging from 0.06 to 7.5 kW with shaft heights from 56 to 132 mm. In the production halls, the attention to new materials and new machining technologies is daily routine. Organisational structures permit response to customer wishes at extremely short notice.

In summer 2017, the company was able to point to its latest masterstroke. As the only one of 700 contenders, it received a “Bosch Global Supplier Award 2017” in the category “Innovation”. This award honoured VEM’s contribution to development of the new hydraulic power unit CytoPac. The entire motor, the flange for the pump, the end shield for the heat pipes and a matching compact housing were developed within an unusually short timeframe. According to Bosch Rexroth, the new unit has the potential to revolutionise the whole hydraulics market.



VEM motors GmbH



Milestones in the new millennium

1999 – 2006

Investments totalling € 16.5 million in modern production facilities

2008

Development of capacities for aluminium die-casting; modernisation of the test stand to accommodate energy-saving motors

2010

Manufacturing and deliveries of permanent-magnet synchronous motors

2014 – 2017

Development of the Transnorm motor series in sizes up to 450 for voltages up to 11 kV

Pioneer for energy-saving motors



IEC standard motor, 250 kW,
IE4-W61R 315 LX4



Slipring motor, Transnorm series, 30 kW,
S11R 250 MX8




Explosion-protected motor, protection type
'flameproof enclosure "d"', 70 kW,
IE3-K11R 280 M4 Ex e IIC T3

VEM motors GmbH in Wernigerode supplies standard and special motors for the output range from 7.5 to 1 000 kW. Energy-saving motors with efficiency classifications up to IE5 here play an important role. Highly qualified and experienced employees, with cutting-edge production facilities at their disposal, are guarantees for low-voltage machines and compact drive solutions which meet all the pressing demands of today's customers. That includes a long service life, effectiveness, eco-friendly operation and high motor efficiency. Flexible organisation

facilitates the efficient manufacturing of both larger batches and single motors.

One example which demonstrates our profound knowledge of the market is the slipring motor. Most competitors had already dismissed this motor type as an obsolete design. In the meantime, it is in demand once more as a drive for lifts and cranes, and VEM motors in Wernigerode is able to profit from this development. That just goes to show that experience makes all the difference.



Lucas Lehmann (20), 4th-year trainee,
VEM motors, Wernigerode

Our motors will also be needed for future technologies

» I will soon be completing my apprenticeship training as a machinist. With a grade average of 2.4 or better, I am promised a permanent job. And I am quite optimistic about that.

The work with automatic CNC machines, turning, milling – that's my world. If you show willing and a reasonable talent for the job, you are immediately accepted in the team. I feel at home here. Our motors are also good, very good in fact. They just keep running and

running. A friend of mine was recently at an open-cast mine and they had a VEM motor which had been in operation since 1982. After I finish my training, my next goal will be to obtain also a master craftsman's certificate. My career future lies with VEM. One day, I will perhaps be qualified as a supervisor, and e-mobility will presumably be a dominating topic. But I am certain that our motors will still be in great demand.«

04

DRIVE

Drive is a prerequisite for future progress. Whether in Europe or Asia, in America or Africa. Wherever you may be – a world in motion depends on high-quality drives. Everywhere. And that is precisely where you can find VEM.

VEM drives are found all over the world. And we are on your doorstep.

For VEM, as a German-based manufacturer with a worldwide market, local expertise is a factor which co-determines competitiveness and future prospects. For that reason, we have invested generously in technical equipment and personnel for our regional centres and offer dependable 24/7 customer service. Already before deliveries leave our factories for the long journey to distant customers, every motor is subjected to a strict inspection and extensive tests.

Motors and generators are exported to 86 countries. In eight countries, VEM possesses production facilities and sales offices. In Western Europe alone, we have supplied well over 12 million machines since 1960. The main sales markets were France, the Netherlands, Denmark and Sweden.

But the world continues to develop. New large markets are gaining significance, especially in Asia. As a company with an international orientation and globally acclaimed products, VEM has naturally reacted by expanding and strengthening its sales network in such regions. Further important impetus stems from the new owner of VEM, and we can look forward to broad access to one of the most dynamic markets in the world.

Justine Mehlhorn (23), order centre clerk, VEM motors Thurm

Our motors are ambassadors. All over the world, they stand for VEM.

» I started my training as a forwarding clerk at VEM motors Thurm in 2010. In the meantime, I work in the order centre. We accompany incoming customer orders from initial receipt, via actual manufacturing through to shipping of the final products.

Our work has changed significantly in recent years. In the past, customers ordered motors in large numbers, but there are today many cases where they are asking for just one custom-designed motor. We are today processing many more orders compared to previously.

Information exchanges are today faster, both internally and with the customer, and we attach great importance to good, close communication with our customers. We are helped in our work by the courses on international communication which VEM organises. Technical seminars also ensure that we stay abreast of the latest developments. We know the road which VEM plans to follow in the coming years.

And that is good for all of us. After all, our motors are ambassadors. All over the world, they stand for VEM. «





VEM worldwide

Manufacturing locations

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Sales and technical support

Austria	Finland	Indonesia	Portugal	Switzerland
Belgium	France	Iran	Romania	Thailand
Brazil	Germany	Iraq	Russia	Turkey
Canada	Great Britain	Italy	Saudi Arabia	Ukraine
Chile	Greece	Japan	Singapore	United Arab Emirates
China	Hong Kong	Morocco	Slovakia	USA
Czech Republic	Hungary	Netherlands	South Africa	Yemen
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