

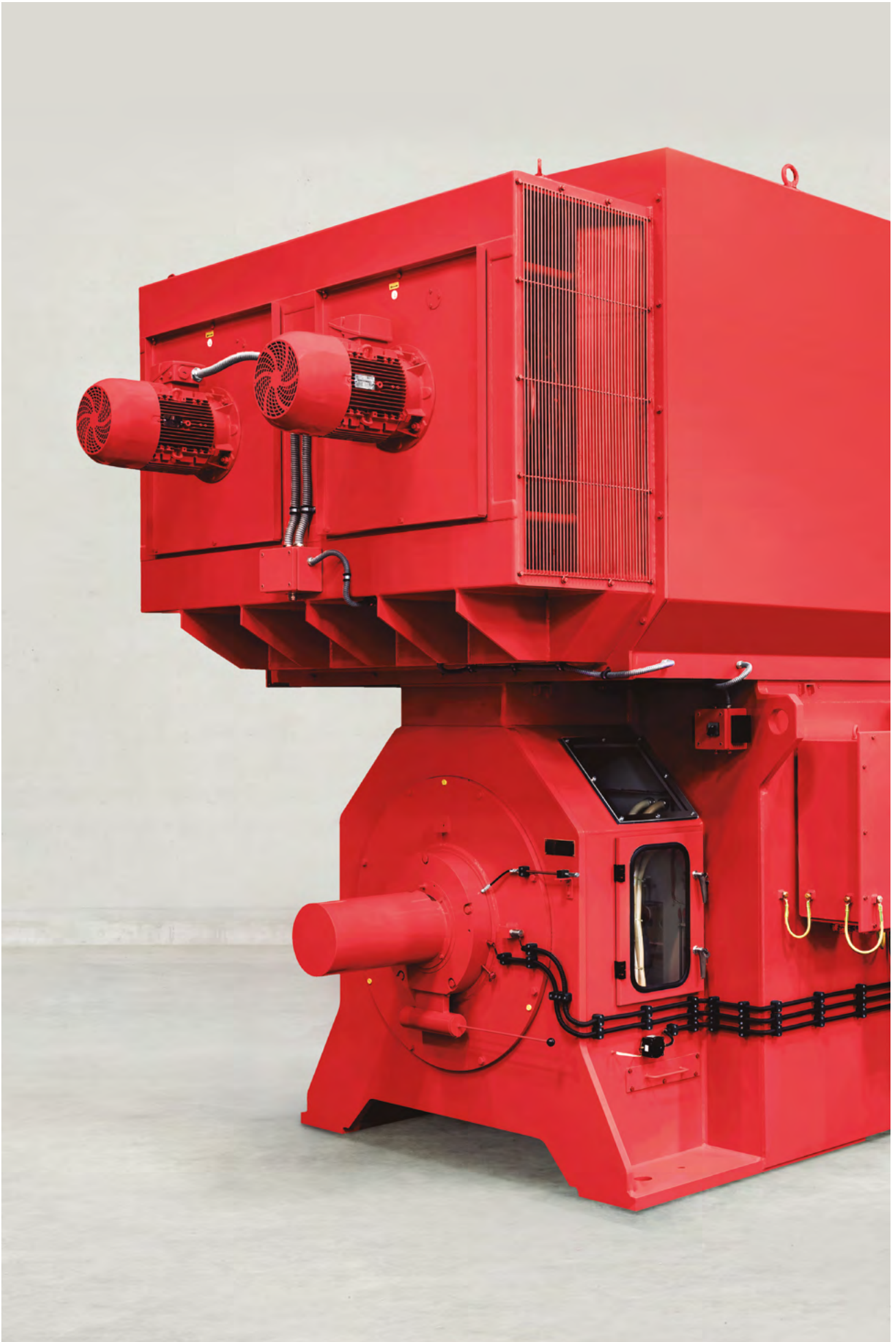


# HELMKE

## Slipring Motors

Robust, efficient, innovative





# Introduction HELMKE

## A wide range of products and services

**HELMKE is a leading supplier of slipping motors from own manufacturing or ex stock for following applications:**

- Ball mills
- Shredders
- Cement mills
- Variable speed for pump application

Headquartered in Germany, HELMKE has been a reputable manufacturer and supplier of electrical motors and variable speed drives since 1922. Today HELMKE offers tailored solutions for most industrial applications. We provide diversity and remain specialists.

We have the resources to handle almost any size project while still providing the personal attention customers appreciate.

### Certifications:

- J. HELMKE & Co.:  
ISO 9001, ISO 14001,  
RL 94/9/EG (ATEX),  
IECEX, AEO
- HELMKE Orbis GmbH:  
ISO 9001, AEO
- HELMKE S.à.r.l.:  
ISO 9001, Saqr-ATEX
- HELMKE Orbis S.à.r.l.:  
ISO 9001, Saqr-ATEX

### Experience and innovation

HELMKE records a long and successful partnership with the heavy industry. We are suppliers of motors up to 25 MW, for the cement, petrochemical, paper, pulp & wood, air separation, mining and power generation industries, with a successful record of multiple motor deliveries over the years.

Today we introduce our modular and compact drives into the above markets, aiming at maximum product reliability, availability and cost competitiveness.

Voltage (V)	Maximum output power (MW)
0–1000	2
1000–13800	25



**Slipring motors or also called wound rotor motors are the heart in a lot of drive applications in the high power range. They are most commonly used in the raw material industry like mining of ore and minerals or in the binders industry like cement, limestone and gypsum in diverse technologies of crushers, roller presses and mills but also in large fans, pumps and conveyors.**

Unfortunately, the more robust and more economic squirrel cage induction motor has such a specific characteristic that makes the motor start direct on the mains difficult or under various circumstances impossible. Especially during stand-still and at low speed during the starting process they generate only a low torque, while also requiring the same time a very high current, which is a multiple of the rated motor current. So the driven working machine, the technological process or the upstream mains limit the use of this simple drive concept.

A filled mill for example, needs a very high torque at start-up, or even a special initial break-away torque, with a value possibly much higher than the nominal torque of the installed motor. The high inertia of a filled mill leads additionally to a long ramp-up time, so that the high torque demand is required for a long duration even at low speed. If the process requires several starts a day, then the thermal load on the drive components is quite high and may limit the number of start-ups.

In case of a high ratio of nominal motor power to the ability of the upstream mains a high overcurrent during motor starting leads to a strong voltage dip, which may affect parallel consumers in their undisturbed operation. This is notably the case when single motors of relatively high power are installed in a weak network.

The design of induction motors with wound rotor and sliprings allows in combination with an appropriate designed starter a starting torque in the magnitude of the breakdown torque of the motor, which is commonly between two and three times the corresponding nominal motor torque at a starting current equal or slightly higher than the nominal motor current.

Under these circumstances the use of slipring motors is often useful or mandatory. In contrast to drive applications with squirrel cage motors and frequency converters slipring motors must be oversized for a high starting torque and consequently do not produce unnecessary losses during the whole operating time. By changing the motor characteristic curve with the help of external resistors in the rotor circuit the motor (oil cooled or liquid starter) the losses during start-up of the motor are generated in the starter, so that the frequency of starts is not limited anymore from motor side.

# HELMKE product overview

## Types of slipring motors and the designation

- Very high starting torque, two to three times nominal torque
- Low starting current at start, no or marginal higher than nominal current
- No limited acceleration time and number of starts
- No or very low torque impulses during start depending on starter technology
- High efficiency during continuous operation (no converter losses)
- No special environmental conditions required
- No harmonic distortions
- No EMI measures necessary, no need of shielded connection cable

Type Code Examples	
DOR	Three phase motor with squirrel cage rotor, surface cooled, round frame (e. g. IC411)
DKK	Three phase motor with squirrel cage rotor, air to air heat exchanger, round frame, box format frame
DSKK	Three phase motor with wounded rotor and sliprings, air to air heat exchanger and box format frame (e. g. IC611)
DSWK	Three phase motor with wounded rotor and sliprings, air to water heat exchanger and box format frame (e. g. IC81W)
FDOR	Three phase motor with squirrel cage rotor, surface cooled, round frame (e. g. IC411) with reinforced isolation for frequency converter operation
DSOR	Three phase motor with wounded rotor and sliprings, surface cooled, round frame
CDEDOR	Flame proof three phase motor with squirrel cage rotor, surface cooled, round frame (e.g. IC411) in combination with terminal boxes with increased safety Ex d e IIC

## HELMKE product overview

### Brush lifting device as an option

**Most of all installed slipring motors in the world are operated with continuous contact of the brushes to the sliprings. The advantage of a slipring motor during the starting period due to high starting torque and low starting current turns into a disadvantage during normal motor operation. The motor performs like a squirrel cage motor but there is a constant wear of the brushes and sliprings. This results in reduced maintenance intervals to avoid critical failures and downtime of the plant. Furthermore the costs for new brushes can easily reach thousands of dollars during the lifetime of the motor.**

An effective provision to keep the advantages of a slipring motor but to avoid the described disadvantages is a slipring motor with an automatic brush lifting device. This innovative system lifts the brushes from the sliprings after the motor has reached its nominal speed and executes the short circuit of the rotor phases in the slipring compartment.

HELMKE has successfully installed several slipring motors with a brush lifting device to customers world wide. The better performance and maintenance free operation of the motors convinced our customers to invest in this optional feature.

#### **Advantages of an automatic brush lifting device:**

- No wear of brushes and sliprings
- No risk of flash overs in the slipring compartment due to excessive carbon dust
- No regular cleaning of slipring compartment and brush change
- No follow-up costs for carbon brushes
- Extended maintenance intervals and motor life time

HELMKE slipring motors with a brush lifting device are ideal for all constant speed applications like e.g. ball mills, vertical mills, fans, crushers, compressors etc.

The brush lifting device is available for motor powers up to 10 MW (for higher powers on request), all voltages from 380 V to 13.8 kV and for all speeds.



## HELMKE locations

Offices and factories in the heart of Europe

For the support of its product development program, HELMKE has invested in the enhancement of its engineering taskforce, as well as in new testing and manufacturing infrastructure.



1. Establishment of 6 MW load test field at HELMKE France from 2013
2. New production and testing facility at HELMKE headquarters in Germany (3000m<sup>2</sup>, 100 t crane capacity)

## Research and development of HELMKE products

### Compact and modular architecture for high performance squirrel cage and slipring motors in frame size 630 and 710

**HELMKE is a renowned supplier and manufacturer of Megawatt motors for the heavy industry. Today HELMKE is expanding its product portfolio up to the power of 10 MW, through its technology development program for high performance, compact and modular motor architectures in Frame Sizes (FSs) 630 and 710. This paper gives an insight to our latest product offerings, coming as a result of our strategic planning and R&D, in line to the latest market trends and demands.**

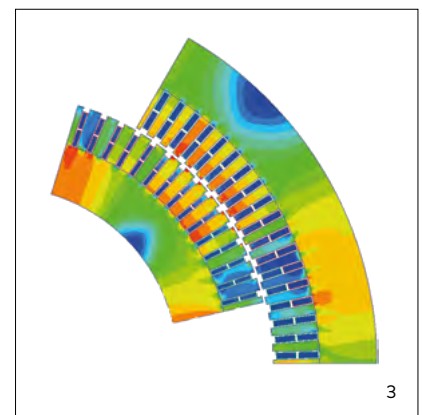
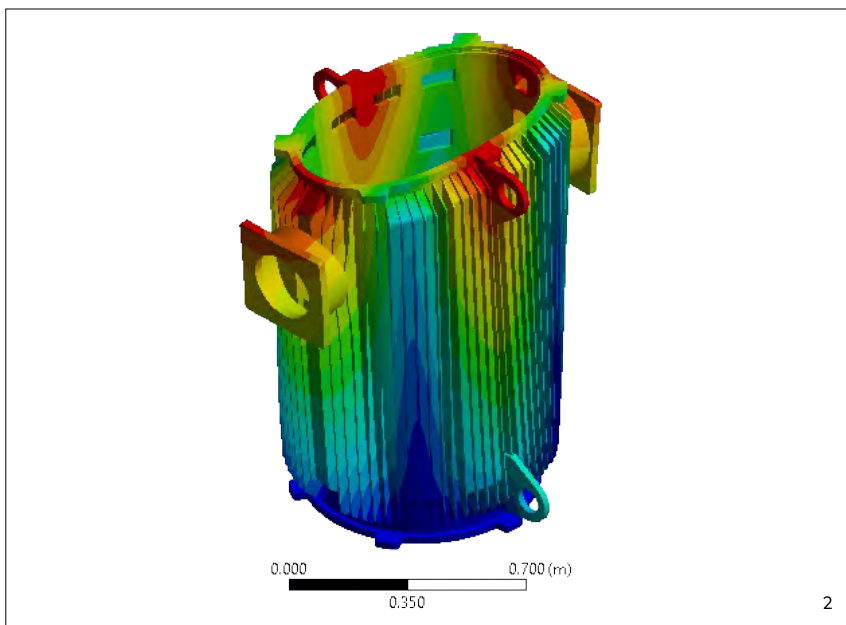
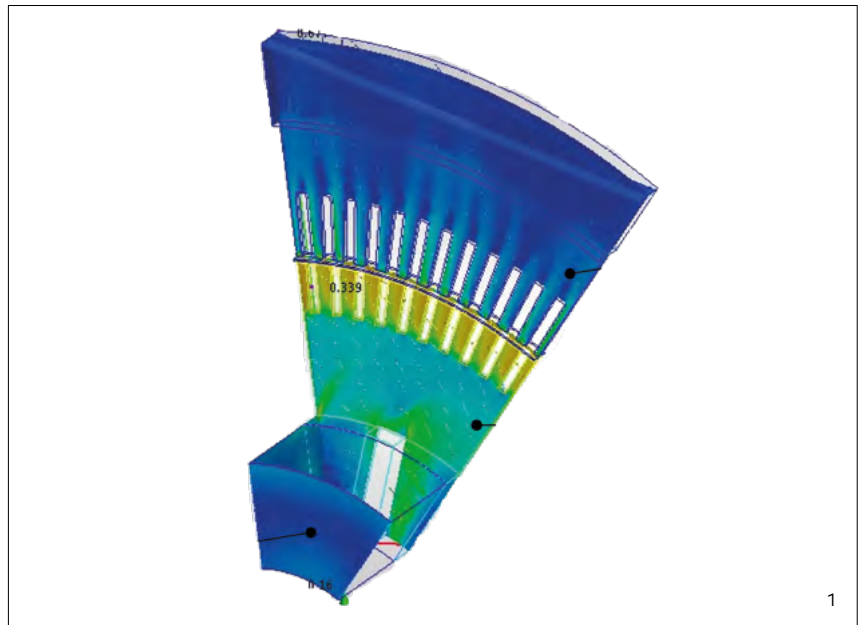
The increasing price-pressure as well as the increasing penetration of energy cost in the Total Cost of Operation for Induction Motors (IMs) in the power range from 5 to 10 MW, has further increased requirements both in terms of quality and competitiveness of the European market. The latter sets in front of the design engineers opposing specifications: on the one hand motor performance and efficiency versus production cost and product availability on the other. To confront with the latest market demands HELMKE has realized and successfully completed a technology development program aiming at the development of state of the art active components embedded in

fully configurable and compact, housing and cooling modules. The 3-step road-map, undergone and successfully completed by HELMKE:

- Use of cutting edge electromagnetic (3) and fluid dynamics (1) simulation calculation to enable optimum utilization of high-end and novel magnetic lamination, winding insulation and carbon brush materials: refine and re-apply 9 decades of HELMKE knowledge and experience to the latest generation of electro-technical materials, nowadays redefining the design rules for electric motors.
- Optimize for high power density at the maximum possible efficiency, without jeopardizing the longevity of critical motor components, as the winding insulation system or the slipring system: a novel design-goal prioritization, based on the concurrent market demands and technology trends, to be put in service through a new series of HELMKE motor products.

- Embed all motor components in a maximum configurable, flexible and modular architecture. Furthermore, plan for minimum number of components and strict/clear definitions of their functions and functional interactions for optimum reliability, manufacturing cost and product availability, involving short delivery time and easy integration to OEM and end-customer applications.

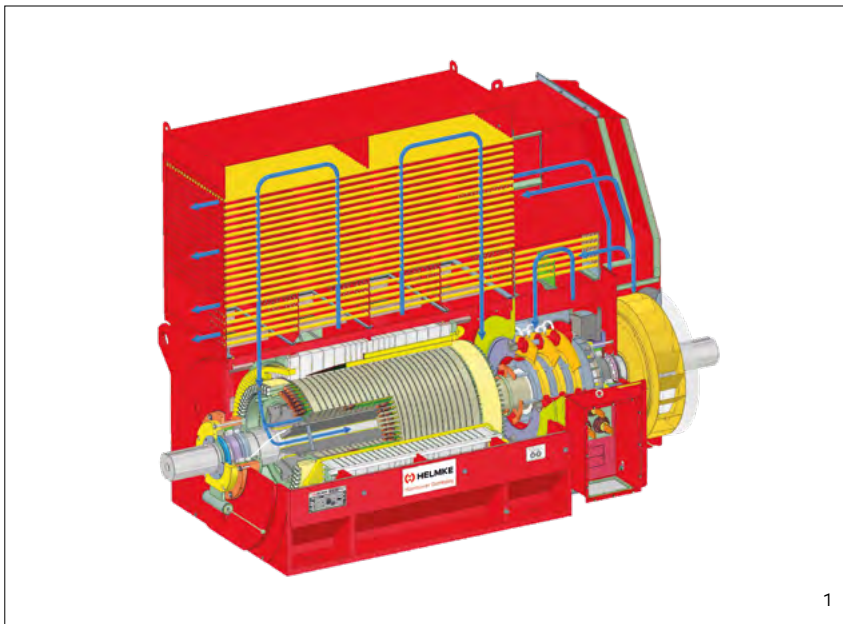




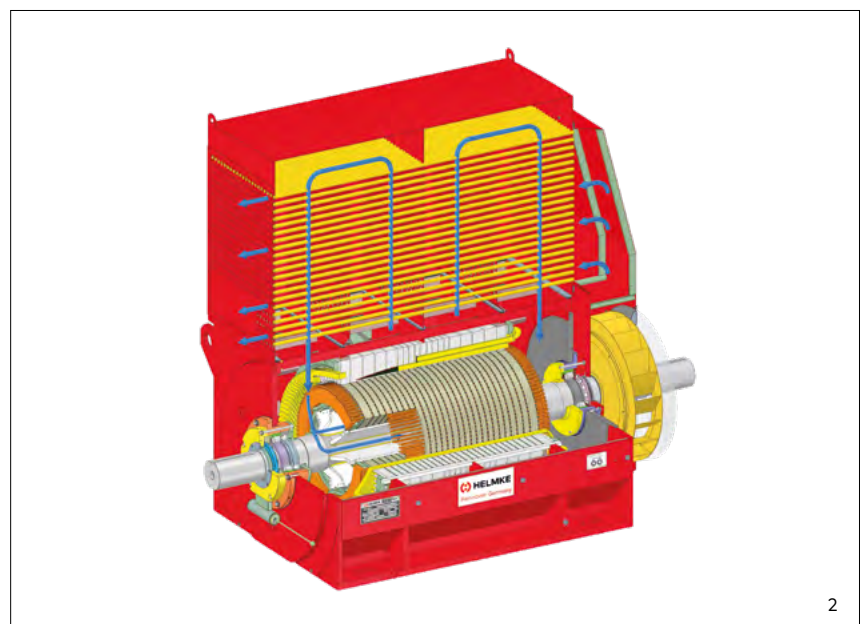
1. HELMKE engineering: simulation of dynamic fluids of the internal ventilation of a motor
2. HELMKE engineering: simulation of vibration effect in a cast iron housing
3. HELMKE engineering: electromagnetic simulation between stator and rotor lamination

## HELMKE compact and modular architecture

As a result of the above technology venture, HELMKE is launching today a brand-new motor series in FS 630/710, offering a unique combination of quality and cost competitiveness to the market



HELMKE compact and modular architecture:  
(1) slipring, (2) squirrel cage execution  
@ FS 630, (1 + 2) motor 3D CAD model highlighting principle structural blocks





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### Active components – Stator/Rotor assemblies

Traditionally, the initial and most important optimization item for Megawatt Induction Motors is the rotor assembly. Its design involves a fine balance between opposing structural, thermal and electromagnetic requirements. HELMKE offers with its rotors the welded spider-shaft construction (1a), a well known and proven design for its mechanical robustness as well as predictable and long-lasting mechanical performance. The cross sectional area of the various rotor components (and the resulting ventilation ducts/gaps) has been calculated for the optimum combination of cooling (ventilation) and rotor iron loss.

Stator design is incorporating similar engineering values: detailed stator slot geometry optimization, accounting both for functional (noise, iron loss) and manufacturing (winding manufacturing and assembly) costs. Bottom-up approach in the design of the coil insulation system in conjunction with the electromagnetic and thermal design of the magnetic core. Finally, detailed calculation of clearances between the winding heads (winding overhang) and metallic structures of

the frame, for well-controlled and predictable power factor and motor efficiency (1b).

The above developments along with our Failure Mode and Effects Analysis performed on the optimized components enable HELMKE to guarantee the reliable motor operation for the long-run, at the minimum total cost of operation for its customers.

### Motor frame and cooling system

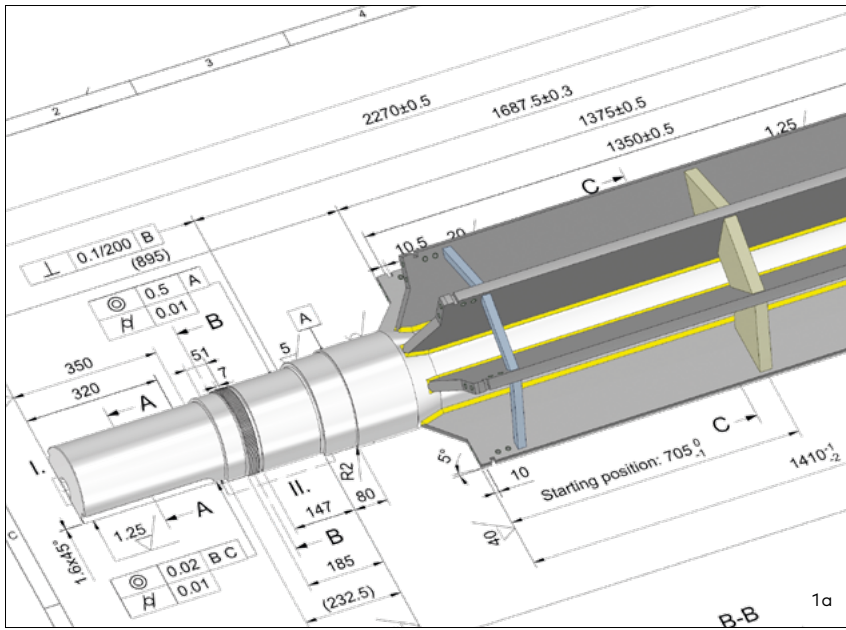
The motor frame and cooling system is separated to carefully selected and designed modules (building blocks), which house and cool key components of the motor system.

Our stator house and main cooler structure feature a fully symmetrical design, which allows for the free positioning of the slipring room and slipring cooler, thus a free selection of the motor Drive End (DE) orientation (2).

Furthermore, positioning of stator and rotor TBs is also free of limitations, as all frame components feature modular and interchangeable cable entries and cable paths. This architecture utilizes the well known benefits of structural symmetry on motor noise and vibration, while enables all different cable routes and load arrangements in the field. Additionally, the separation of the main motor cooler from the slipring cooler enables new possibilities to HELMKE field engineers for the individual fine tuning of the motor and slipring-brush system cooling performances, even under the most extreme climatic conditions.

Based on the above, our customers can benefit from a highly customized product, designed, built, configured and fine-tuned around their specific application needs. Not vice versa.

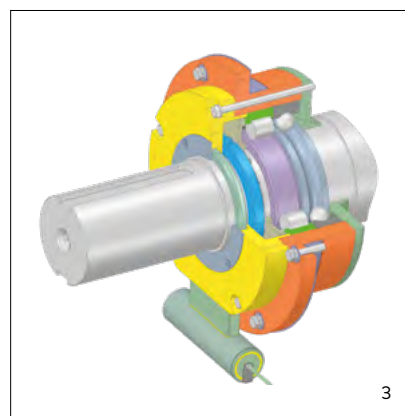
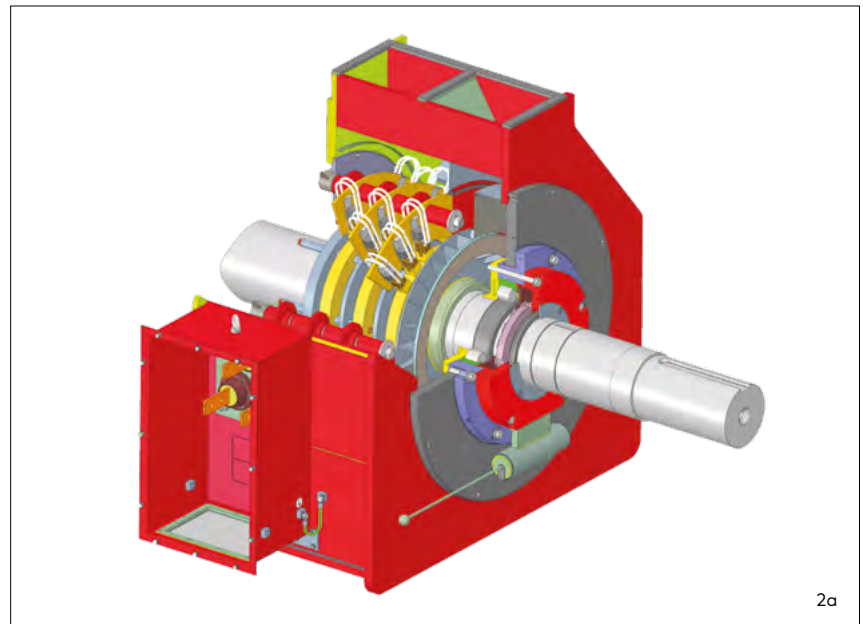
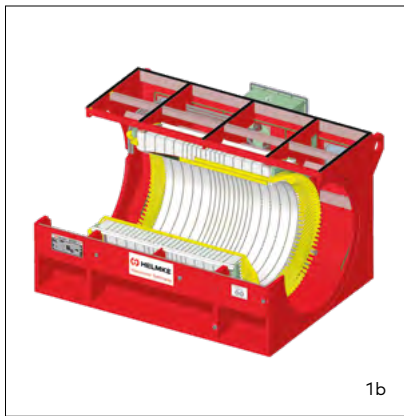




1. Optimized active components in the core of our products: (a) rotor CAD illustrating the spider-shaft structure, (b) stator core embedded in the modular frame module

2. Motor (a) slipring & slipring-frame, (b) slipring cooler modules; can be freely positioned around the fully symmetrical main frame and cooler

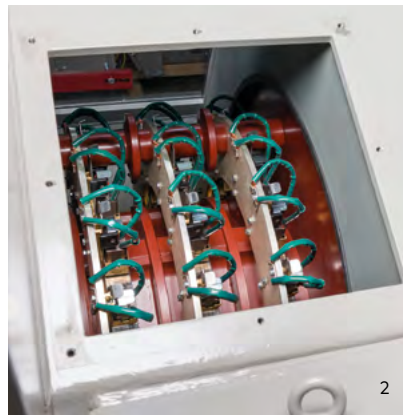
3. Antifriction bearing assembly: locating bearing at motor DE





## Motor bearing system

We have put in comparison all the known antifriction bearing arrangements and configurations. Long experience and detailed calculation have rendered a bearing assembly design which uses the minimum possible number of parts, the same for motor DE and NDE bearings. Design of these parts is driven by functional safety and reliability requirements. Our design offers safe, fast and fail-safe assembly and disassembly, a requirement of paramount importance for our customers expecting from HELMKE motors nothing less than the minimum downtime, repair and service costs.



A produced HELMKE prototype: the result of our product development program already put in customer service

Modular and compact 4800 kW, 4160 V, 60 Hz, 1200 rpm slipring motor: (1) main frame with assembled stator and rotor, (2) slipring and slipring-bridge assembly, (3) machine assembly





**Ball mill drive for a cement plant in Ukraine:**

- Type: DSKK630-06
- 4600 kW, 6000 V, 50 Hz, 6-pole
- IMB3, IP55, IC611

**Special execution:**

- Modification and delivery within a very short time due to a break-down situation
- Shaft end adapted as per customer's requirement
- Terminal boxes adapted according to customer's requirements
- Commissioning by HELMKE technician at site



**Slipring motor for a ball mill in Russia:**

- Type: DSKK1000-06
- 7000 kW, 10000 V, 50 Hz, 6-pole
- IMB3, IP55, IC616

**Special execution:**

- Adaptation to existing conditions
- Delivery ex stock incl. liquid starter and oil supply system for sleeve bearings
- Commissioning by HELMKE technician



**Slipring motor for a conveyor belt in Canada:**

- Type: DSOR800-06
- 1625 kW, 4160 V, 60 Hz, 6 pole
- IC511, IP55, IMB3

**Special execution:**

- Thermal windows in both slipring compartment inspection covers
- Special grease for low temperature in bearings
- Increased power of electric heating
- Special brushes for dry environment

## Headquarters

- Germany

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## Subsidiaries

- Pulversheim (Mulhouse), France
- Vaassen, The Netherlands
- Milan, Italy
- San Sebastián, Spain
- Moscow, Russland
- Singapore, City
- Huai'an, China

This paper presents an activities and result summary, concerning our product development program for compact and modular motor architectures in FS 630/710. Throughout this program, HELMKE has realized extensive investment in infrastructure and product R&D, aiming at an optimum combination of quality, reliability and cost competitiveness in the final motor product. As a result of this technology venture, we place today in the heavy industry market state-of-the-art technologies in motor principle

design and engineering to offer the minimum Total Cost of Operation to our customers. Our prototype modular and compact designs serve already critical industrial applications, further expanding our success record in this market sector.

Benefit now from our technology and meet our products through our sales offices.