

BROCHURE

# Synchronous motors

## High performance in all applications

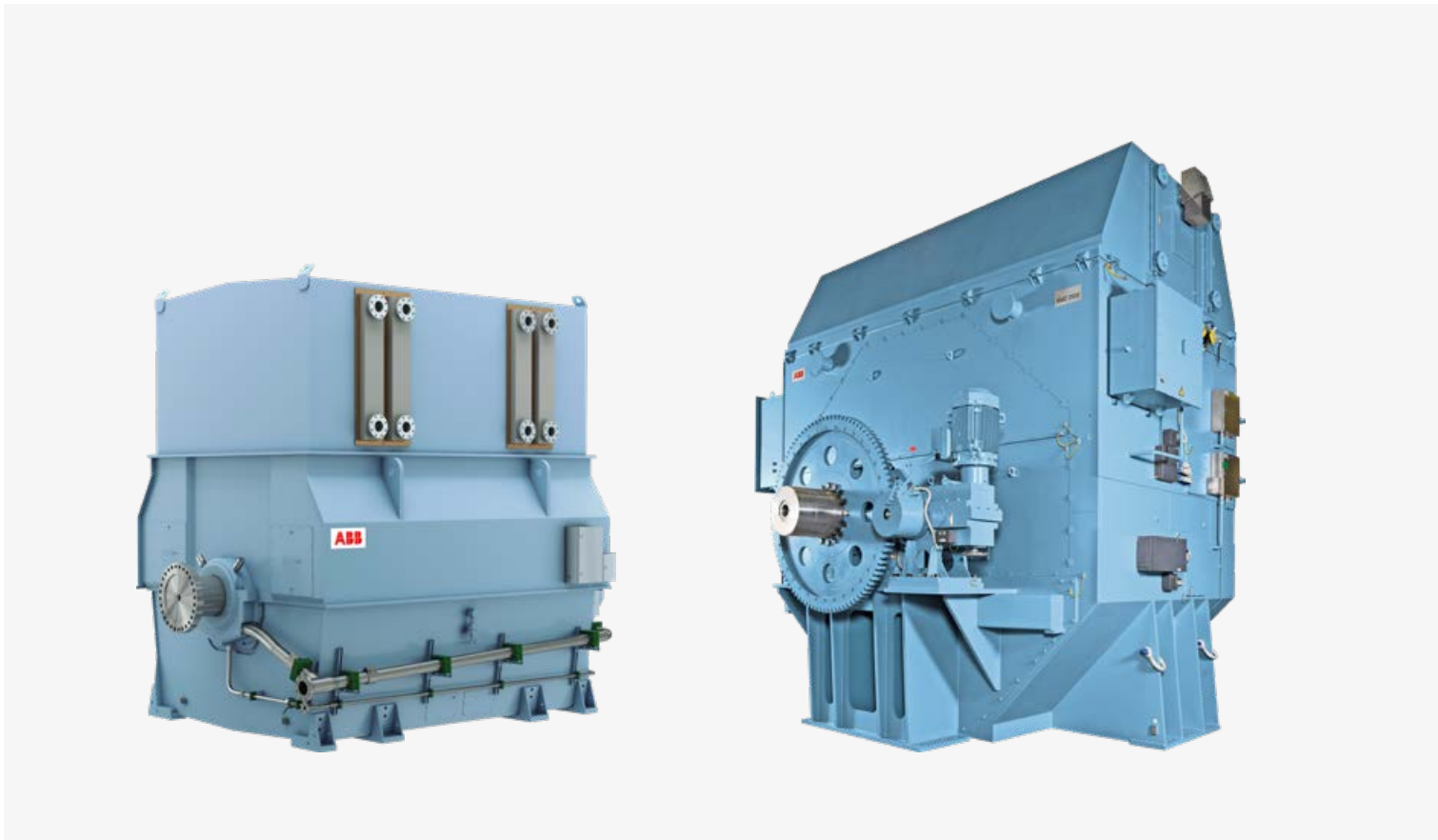


ABB synchronous motors help our customers to cut operating, maintenance and energy costs while lowering environmental impact.

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**We provide motors and generators, services and expertise to save energy and improve customers' processes over the total life cycle of our products, and beyond.**

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# Table of contents

<b>004</b>	<b>Synchronous motors from the world's leading supplier</b>
<b>005</b>	<b>Efficiency and reliability for a wide range of applications</b>
<b>006</b>	<b>Fixed and variable speed motors</b>
<b>008</b>	<b>Proven reliability</b>
<b>010</b>	<b>Effective cooling</b>
<b>011</b>	<b>Bearings and accessories</b>
<b>012</b>	<b>Robust frame</b>
<b>013</b>	<b>Excitation</b>
<b>014</b>	<b>Proven insulation system</b>
<b>015</b>	<b>Testing</b>
<b>016</b>	<b>Life cycle services and support</b>
<b>017</b>	<b>Total product offering</b>

# Synchronous motors from the world's leading supplier

## High performance in all applications

Designed to provide outstanding reliability and efficiency, ABB synchronous motors help our customers to cut operating, maintenance and energy costs while lowering environmental impact.



ABB is the market's leading supplier of synchronous motors and generators. All over the world our synchronous motors are delivering superior performance in industrial processes, the marine and offshore industries, utilities, and specialized applications.

We have been designing and manufacturing AC motors for mission-critical applications for more than 130 years, and our experience and application knowledge have made us the preferred supplier in many different industries.

ABB synchronous motors are based on modular and standardized platforms. Working together with customers, we use our know-how of

different applications to tailor cost-effective solutions. The flexible design concept enables us to adapt motors for almost every kind of application.

We offer predefined maintenance programs for all lifetime phases of all ABB motors, and preventive diagnosis and updates can help to further boost your competitiveness when needed.

The global ABB network ensures local service delivery whenever and wherever you need it. Around the world we have over 60 service centers and more than 150 authorized service providers ready to support you.

# Efficiency and reliability for a wide range of applications

## Motors that match your needs

ABB synchronous motors deliver efficient and reliable operation in a wide range of applications. We have a strong track record in tailoring motors to match customer needs across different industries.

### Examples of industries and applications where our motors are operating include:

- Oil, gas and petrochemical: compressors, pumps, fans and extruders
- Marine and offshore: variable speed motors in azimuthing propulsors and shaft line applications
- Metals and minerals: rolling mills, hoists, processing lines, semi-autogenous grinding (SAG) mills, ball mills and blowers
- Power utilities: pumps, fans and condensers
- Pulp and paper: chippers, refiners and grinders
- Water and wastewater: pumps
- Air separation: compressors
- Specialized applications: wind tunnel motors and motor-generator sets



Air separation



Cement



Oil, gas and petrochemical



Marine



Metals and minerals



Mining



Power generation



Pulp and paper



Water and wastewater

# Fixed and variable speed motors

## Tailored to application requirements

ABB motor designs are always optimized for the specific application, ensuring the correct starting method is used. The starting method is selected primarily on the basis of customer requirements, network capability and process demands.

### **Fixed speed motors**

Fixed speed synchronous motors are typically used in applications like compressors, fans, pumps, wood grinders and refiners.

The most commonly used starting methods for fixed speed synchronous motors are direct-on-line (DOL), reactor, autotransformer, load commutated inverter (LCI, 'soft starter'), capacitor and reactor capacitor.

### **Variable speed motors**

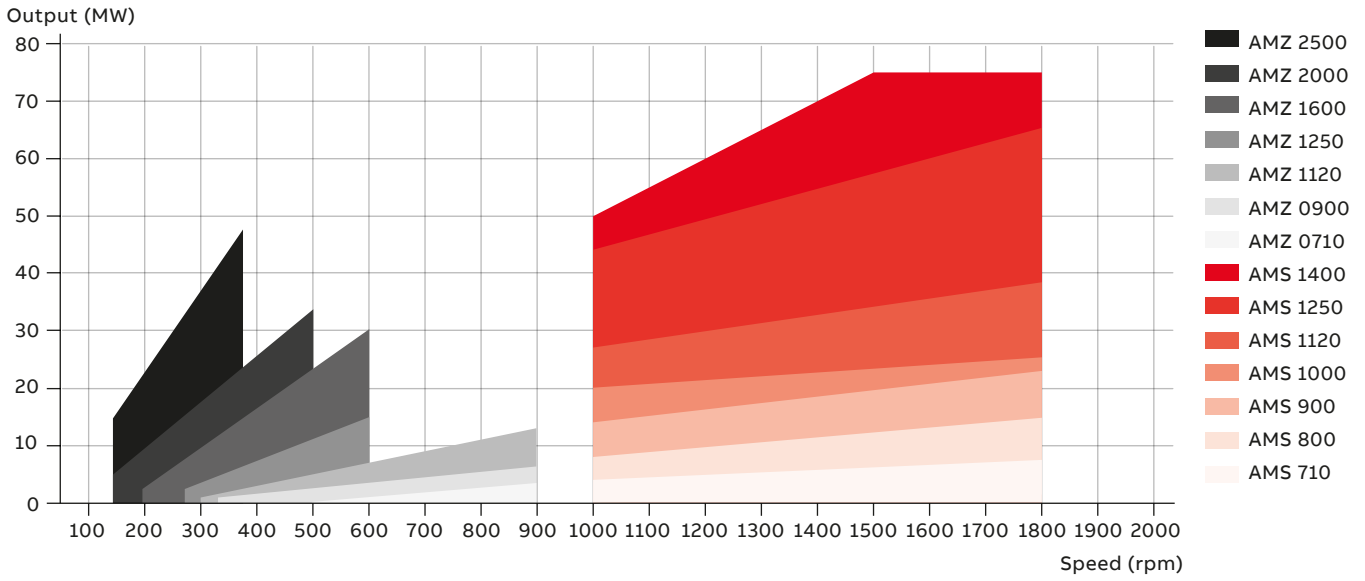
Variable speed synchronous motors are often used in demanding applications in process industries and in applications where variable speed delivers clear benefits. Rolling mills, mine hoists, pumps and compressors are typical examples of variable speed applications. Synchronous motors with variable speed drives (VSDs) are also commonly used in the main propulsion system in ships. Optimized electrical drive systems with variable speed motors can also provide considerable energy savings in applications like extruders, compressors and pumps.

We supply motors and drives that meet torque requirements over the entire operating range, from zero to maximum process speed. This ensures smooth starting, acceleration and operation. We offer optimized ABB motor-drive packages for the best possible variable speed solution. These consist of an ABB synchronous motor combined with an ABB load commutated inverter or ABB voltage source inverter.

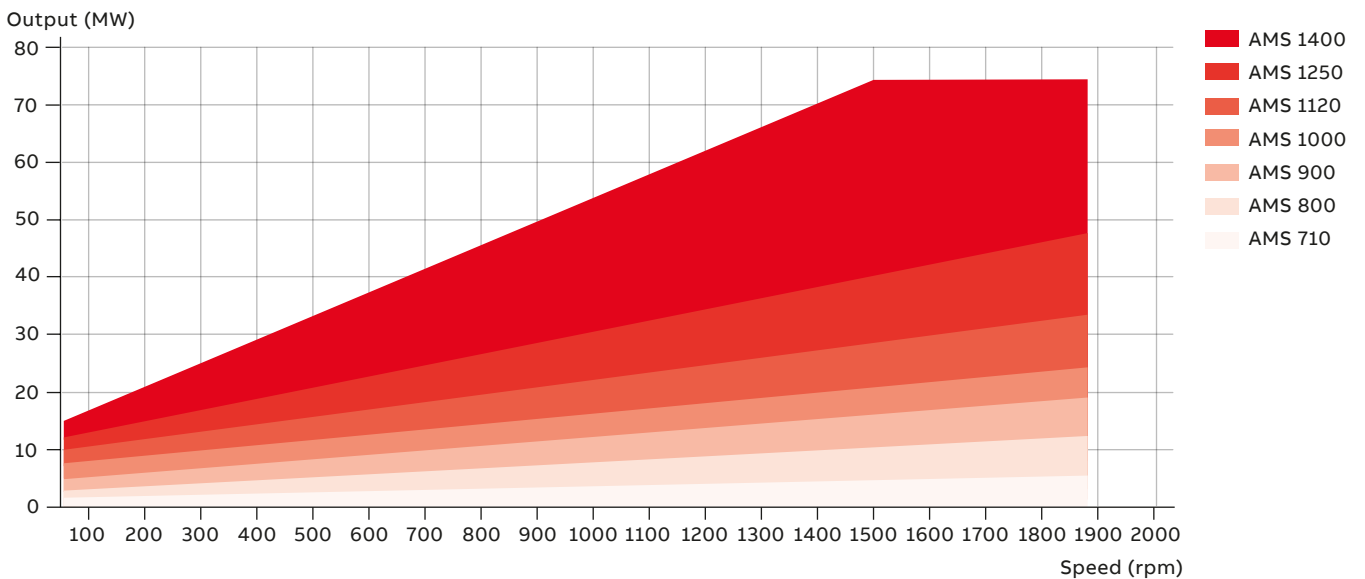
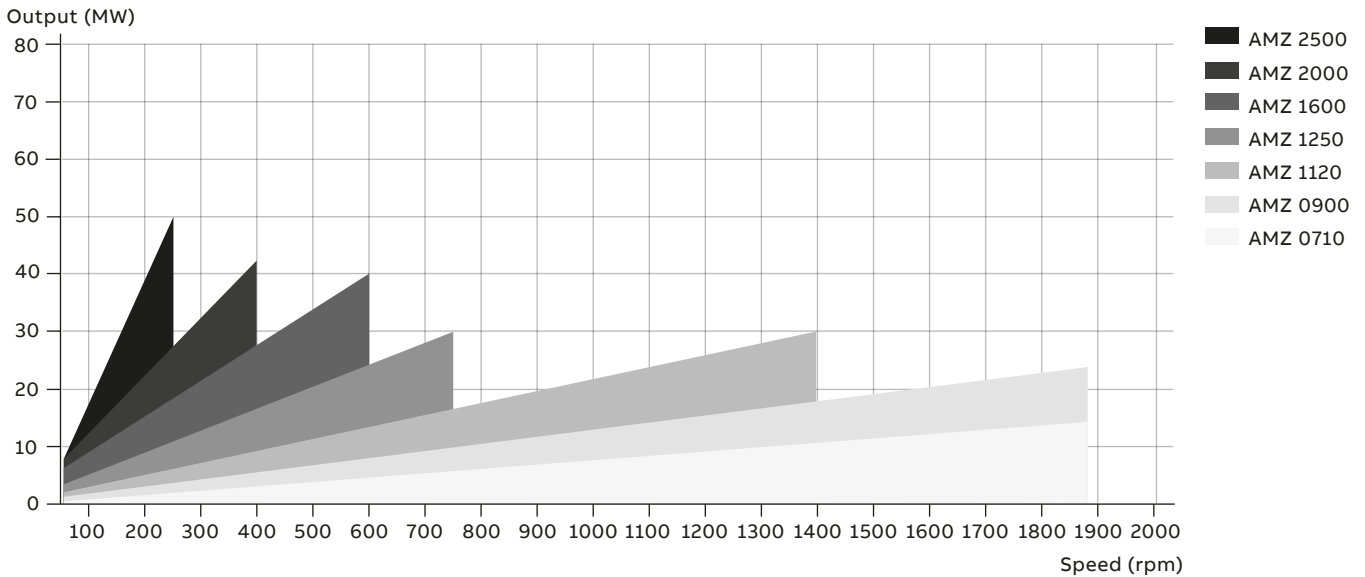
We use our engineering and application know-how to ensure that all the components in electrical drive packages, particularly the converter-motor interface, are optimally integrated to match the process. Benefits include special converter-fed motor designs, increased efficiency and improved torque production capabilities.

ABB motor designs are always optimized for the type of converter that is most suitable for the application. Our motors can be combined with all common converter types: load commutated inverter (LCI), cycloconverter (C) and voltage source inverter (VSI).

**Fixed speed motors**



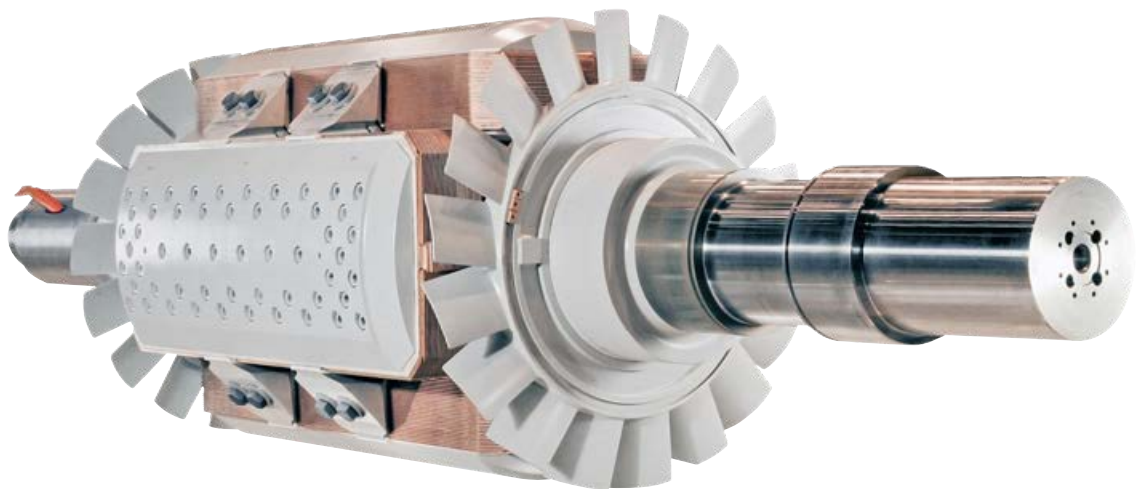
**Variable speed motors**



## Proven reliability

# Increased productivity for your operations

ABB synchronous motors are renowned for their proven quality and reliability. Robust design ensures reliability through cool operating temperatures and low vibration.



### Rotor

The rotor plays a crucial part in achieving the best possible electrical and mechanical performance.

Higher speed motors (four and six poles) have solid rotors with integrated poles made from a one-piece steel forging. A solid pole plate is attached to the pole, a design that has good overload capability and low harmonics. At the same time this rotor configuration contributes to excellent starting characteristics, high starting torque and low starting current.

The large cooling surfaces and effective flow of cooling air keep the rotor temperature low and uniform, helping to ensure reliability and a long operating life.

The coils are class H insulated for extra thermal margins. The rigid rotor construction and

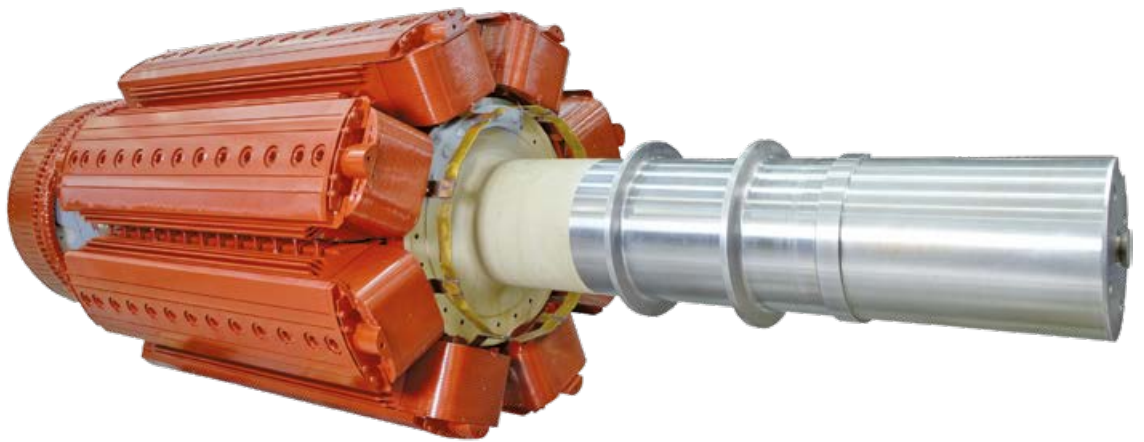
minimum distance between bearings ensure that the motor operates below the first critical speed, keeping vibration levels low.

Lower speed motors (eight or more poles) typically have rotors with the poles manufactured from 2 mm laminated steel sheet. The sheets are pressed together with inserted steel bars which are welded to the end plates.

For lower speed motors the technically preferred option is to vacuum pressure impregnate (VPI) the rotor assembly after it is wound to achieve excellent insulation and mechanical strength. After impregnation, the complete rotor assembly is dynamically checked for balance.

Permanent magnet poles are used in certain variable speed applications. Permanent magnet rotors are straightforward constructions and do





not need an excitation system. When necessary, high pole numbers can be used in low speed applications.

#### **Shaft**

The shaft is manufactured from forged or rolled steel and machined to exact specifications. The shaft ends can be cylindrical, conical or flanged. Also two shaft ends can be provided (double end drive).

#### **Rotor windings**

The rotor windings consist of either preformed enameled rectangular copper wire or flat copper. Proper supports between adjacent windings ensure stability up to the rated overspeed. The rotor windings are made to match (at the minimum) the insulation class of the stator. This ensures outstanding reliability and a long service life, even with asymmetric loads or under exceptional conditions.

#### **Modular stator design**

Each application has its own specific requirements in terms of motor performance. Our modular stator design allows us to precisely match the performance of every ABB synchronous motor to the needs of its application.

The use of high grade core material increases efficiency and reduces operating costs. Radial cooling ducts ensure uniform and effective cooling.

The rigid stator construction transmits all forces via the frame to the foundation to minimize vibrations. The windings are insulated with mica-based tape. When the windings are in place, the complete stator undergoes vacuum pressure impregnation (VPI). The windings are class F insulated, which gives good thermal margins.

# Effective cooling

The wide range of available cooling methods ensures that you can select the optimum system to match the motor's operating and environmental conditions.

The three most commonly used cooling methods are air-to-water, air-to-air and open air. Whichever method is chosen, it will provide effective cooling of the complete motor.

### **Air-to-water closed circuit cooling**

The cooling air circulates in a closed circuit through the active parts of the motor and then through an air-to-water heat exchanger. This method is especially recommended if cooling water is available nearby. It is an ideal solution for situations where closed circuit cooling is required due to installation outdoors or in a hazardous area, or whenever the quality of the surrounding air is not suitable for direct cooling. It is also a good choice for motors installed in machine rooms with limited ventilation, such as on board ships or in pumping stations that are fully enclosed.

### **Air-to-air closed circuit cooling**

The cooling air circulates in a closed circuit through the active parts of the motor and through an air-to-air heat exchanger. This solution is generally used when a closed circuit cooling system – such as air-to-water cooling – is required but water is not readily available. An additional shaft-mounted or separate electric fan is needed to ensure sufficient air flow through the cooler.

### **Open air cooling**

Open air cooling can be used where the air in the immediate environment is relatively clean and there is adequate air circulation. The cooling air is typically drawn in through filters, passed through the active parts of the motor, and then exhausted back to the environment. If the machine room ventilation system cannot compensate for the temperature gradient, the motor air outlet can be ducted to exhaust the air outdoors.



### **Enclosure protection classes**

Available protection classes are IP23, IP44, IP54, IP55 or IP66, or NEMA equivalents. Motors can also be supplied for hazardous areas in accordance with IEC/ATEX or NEC regulations (increased safety or pressurized construction).

# Bearings and accessories

## High quality bearings

Selection of the optimal bearing makes a significant difference to reliability.



The choice of optimal bearing arrangement and type is influenced by a number of factors. These include customer requirements and operating conditions like ambient temperature, air cleanliness, vibration levels and possible shocks affecting the bearings. Also radial and axial loads, rotation speed, coupling type and the type of driven equipment should be taken into account.

ABB synchronous motors use quality sleeve bearings that withstand high levels of vibration and offer great performance. The bearings provide the same outstanding reliability under static and dynamic (radial and axial) loads. Their excellent heat transfer capability makes them equally suitable for low and high speed applications.

End-shield mounted bearings are always used in higher speed (four and six pole) motors. Pedestal mounted bearings are generally used for the largest frame sizes of lower speed motors. Motors with pedestal bearings are as easy to mount and align as those with end-shield mounted bearings. The motors are normally delivered ready assembled and require no further assembly on site. Separate pedestal bearing motors are often mounted on a common base frame.

Sleeve bearings last as long as the expected lifetime of the motor, provided that the operating conditions and maintenance intervals are as specified. The bearing housing is designed to permit easy access for inspection and maintenance. The bearings are insulated from the motor frame to eliminate circulating currents in the shaft, and the shaft can be earthed. The bearings are sealed against oil leakage with labyrinth seals. Sleeve bearings are designed to be insensitive to misalignment and to permit large axial play.

### Lubrication

In some cases the bearings are self-lubricated by means of an oil ring, which picks up the lubricating oil and transfers it directly to the shaft, forming an independent and highly reliable lubrication system.

In applications involving large loads, high speeds, high ambient temperature or where the motor is mounted in an inclined position, an external oil cooling and circulation system may be necessary, unless the oil is supplied directly from the lubrication system of the driven equipment. In certain applications which run at slow speeds, a jack-up system may be required for starting and slow turning.

Hydrostatic jacking oil systems are available for low-speed applications and, in specific situations, for use during motor start-up and shut down.

### Accessories

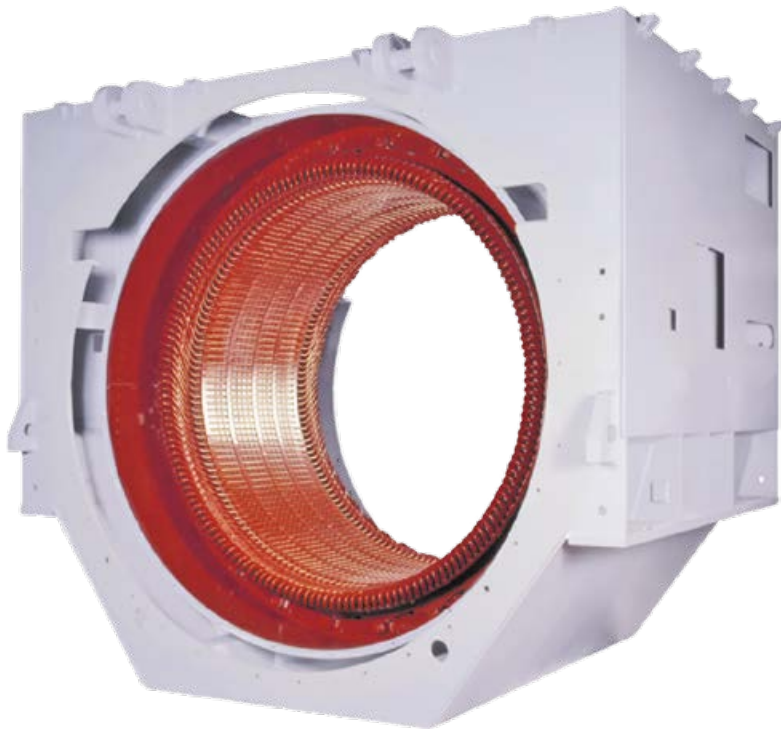
We offer a broad selection of accessories, including devices and equipment for measuring, protection, termination, lubrication and mounting of the motor. Typical examples are PT-100 sensors, earth fault protection relays, surge arrestors, current transformers, rotor telemetrics, sole plates and anchor bolts.

A separate main terminal box is mounted on the side of the motor, featuring bus bars outside the motor frame and allowing connections from any direction.

# Robust frame

## Low vibration

Robust frame ensures great stability and optimum dynamic behavior.



For maximum flexibility, ABB synchronous motors are designed for horizontal, inclined or vertical mounting. Vertical mounting is available for motors with eight or more poles.

The robust frame transfers dynamic and static stresses directly to the foundation, reducing vibration and contributing to the overall excellent performance of the motor.

We can supply motors – even up to the largest sizes and outputs – as complete, ready-to-install units. This means that no further on-site assembly is needed, which substantially reduces installation times and cuts the risk that something could go wrong during installation.

Our R&D team works closely with manufacturers of driven equipment, using finite element method (FEM) and dynamic animation techniques, to analyze vibration models, test critical parts and verify that harmful mechanical resonances will not occur in the motor.

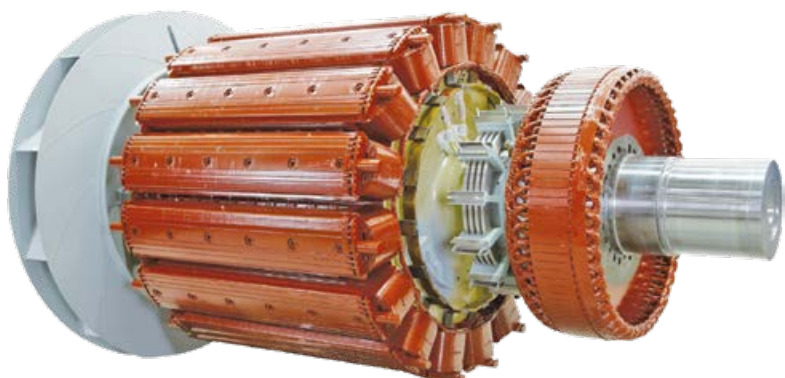
### **Corrosion protection**

Our motors are designed and built to withstand the relevant environmental conditions. All surfaces made of steel, aluminum alloy or cast iron are treated in accordance with the chosen paint system. Selection of a suitable paint system gives reliable anti-corrosion protection even under the most severe environmental conditions. For moderate indoor conditions the standard finish is moisture-proof in accordance with the relevant standards.

# Excitation

## The right excitation method for every application

We ensure that the excitation system matches the outstanding reliability of our motors.



For fixed speed applications and variable speed applications with less demanding dynamic control requirements, a brushless exciter and automatic voltage regulator are typical options. For AMS motors, PLC-based regulator is typically used. The brushless system has no wearing parts, and the external excitation power requirement is low.

The advanced and yet straightforward design has a low component count and effective protection functions, offering high reliability and easy access for maintenance.

For variable speed applications where very fast and accurate speed or torque control are required, the motor is typically equipped with brushes and a slip-ring unit to allow excitation and control of the motor from the frequency converter.

Higher speed motors (four and six poles) use a compact, brushless exciter unit mounted on the rotor shaft outboard of the bearings. No independent support or alignment is required. The high level of field forcing delivers improved system performance, which increases the production of reactive power and is beneficial when faults arise in the supply network.

Lower speed motors (eight or more poles) typically have a brushless exciter unit mounted inside the motor enclosure.

### Excitation control

The motor excitation control panel is supplied in a variety of basic formats. It houses the excitation equipment, protection system and logic functions for starting. We offer a wide range of instrumentation and control equipment to protect synchronous motors and ensure excellent reliability, availability and extended product lifetime.



# Proven insulation system

## High reliability, long lifetime

Insulation is crucial for overall reliability.



ABB has used the Micadur® Compact Industry (MCI) insulation system for several decades, and it has gone into tens of thousands of large motors and generators. Over this time, there have been no known primary insulation failures due to thermal aging. Thermal lifetime tests confirm that the endurance of the MCI system comfortably exceeds the requirements of International Electrotechnical Commission (IEC) and Institute of Electrical and Electronics Engineers (IEEE) standards.

The MCI insulation system is based on vacuum pressure impregnation (VPI) of mica materials. A specially formulated epoxy resin is used to produce a sealed and homogenous insulation system with good performance in terms of dielectric strength, heat transfer and elimination of partial discharge - factors that promote great reliability. Testing of the insulation system includes close monitoring of the impregnation process, curing times and pressure levels.

The systematic VPI process is highly effective. After VPI is completed, stators and rotors are cured in an oven at high temperature, producing very strong and stable insulation with high mechanical and electrical strength. This is especially important in order to resist inadvertent high stresses from out-of-phase synchronization, transients and short circuits.

Even the largest wound stators are impregnated as complete units, ensuring that both the insulation and the mechanical properties of the windings are excellent. This means that they can withstand vibrations induced by the driven equipment and the mechanical stresses caused by transients such as short circuits.

Medium and high voltage windings up to 15,000 V are made of form wound rectangular copper wire insulated with multiple layers of glass-fiber reinforced mica-tape. All the materials used, including the VPI resin, exceed the requirements of thermal class F.

# Testing

## Three levels of testing

Each motor is thoroughly tested before it leaves the factory.

During manufacturing, our motors typically pass through more than 50 separate quality control points comprising hundreds of individual inspections. In addition, components and assemblies constantly undergo quality monitoring, inspections, reliability evaluations and other tests as they progress through the manufacturing process.

Factory Acceptance Testing (FAT) is the final, comprehensive set of tests that every motor must pass before it leaves the plant. FAT verifies that the motor meets the customer's specifications and application requirements. The results are compiled in a report that is supplied together with the motor. Customers can attend the tests in person. For tests at the Helsinki factory we also offer the option of attending the tests via our online FAT system.

Our test field is fully equipped to perform three separate levels of testing, and we can also run combined tests with the customer's own variable speed drive (VSD) and transformer.



The insulation system is tested at full-voltage levels. Unless otherwise specified, testing is performed according to the IEC 60034 standard. Testing according to classification society requirements can also be done.

### Three levels of testing

#### 1. Routine tests

- performed on all motors

#### 2. Type tests

- done in addition to routine tests
- normally performed on one motor in a series that has not been previously manufactured
- can also be undertaken at the customer's request

#### 3. Special tests

- may be conducted to verify performance in special conditions, eg, to verify compliance with customer specifications regarding noise or vibration
- could also be done with regard to hazardous area or marine classification society requirements

# Life cycle services and support

## From pre-purchase to migration and upgrades

ABB offers a complete portfolio of services to ensure trouble-free operation and long product lifetimes. These services cover the entire life cycle. Local support is provided through a global network of ABB service centers and certified partners.



### Pre-purchase



ABB's front-end sales organization can help customers to quickly and efficiently select, configure and optimize the right motor for their application.

### Installation and commissioning



Professional installation and commissioning by ABB's certified engineers represent an investment in availability and reliability over the entire life cycle.

### Engineering and consulting



ABB's experts provide energy efficiency and reliability appraisals, advanced condition and performance assessments and technical studies.

### Condition Monitoring and Diagnosis



ABB's unique services deliver early warnings of developing problems before failures occur. The required data can be collected by an engineer during a site visit or by means of remote monitoring solutions. Integration into the ABB Ability™ platform means the data can be transmitted to the cloud and accessed and analyzed remotely, allowing even greater insight into the health of the equipment. The services focus on critical areas like the bearings, rotor winding, stator winding insulation and overall mechanical condition.

### Maintenance and field services



ABB offers life cycle management plans and preventive maintenance products. The recommended four-level maintenance program covers the entire product lifetime.

### Spare parts



Spare parts and support are offered throughout the life cycle of ABB products. In addition to individual spares, tailored spare part packages are also available.

### Repair and refurbishment



Support for all ABB motors and other brands is provided by ABB's global service organization. Specialist teams can also deliver emergency support.

### Migration and upgrades



Life cycle audits determine the optimum upgrades and migration paths. Upgrades range from individual components to direct replacement motors.

### Training



Product and service training courses take a practical approach. The training ranges from standard courses to specially tailored programs to suit customer requirements.

### Specialized support



Specialized support is offered through ABB's global service organization. Local units provide major and minor repairs as well as overhauls and reconditioning.

### Service contracts



Service contracts are tailored to the customer's needs. The contracts combine ABB's entire service portfolio and 130 years of experience to deploy the optimal service practices.



# Total product offering

ABB offers a wide range of motors, generators and mechanical power transmission products with a complete portfolio of services.

## IEC motors

- Low voltage motors
- High voltage induction and synchronous motors
- Marine motors
- Motors for explosive atmospheres
- Motors for food and beverage
- Motors for variable speed drives
- Permanent magnet motors
- Synchronous reluctance motors
- Traction motors

## NEMA motors

- Low voltage motors
- High voltage induction and synchronous motors
- Marine motors
- Motors for explosive atmospheres
- Motors for variable speed drives
- Permanent magnet motors
- Servomotors
- Washdown motors

## Generators

- Generators for wind turbines
- Generators for diesel and gas engine power plants
- Generators for steam and gas turbine power plants
- Generators for marine applications
- Generators for industrial applications
- Generators for traction applications
- Synchronous condensers for reactive power compensation

## Mechanical power transmission components, bearings, gearings

- Mounted bearings
- Enclosed gearing
- Mechanical drive components
- Couplings
- Sheaves and bushings
- Conveyor components
- Geared motor units

## Life cycle services









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For more information and contact details:

**[abb.com/motors&generators](http://abb.com/motors&generators)**