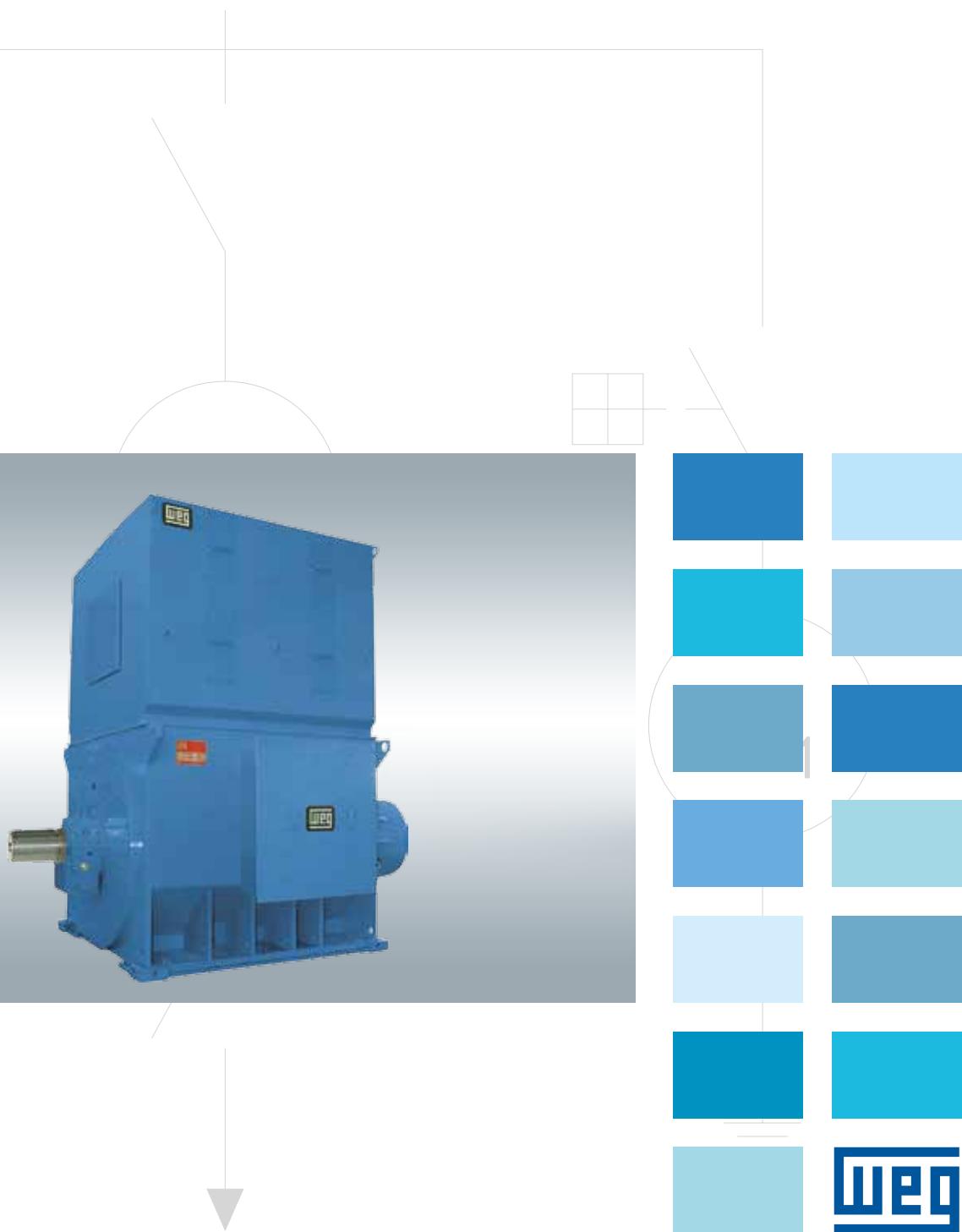


Synchronous Motors

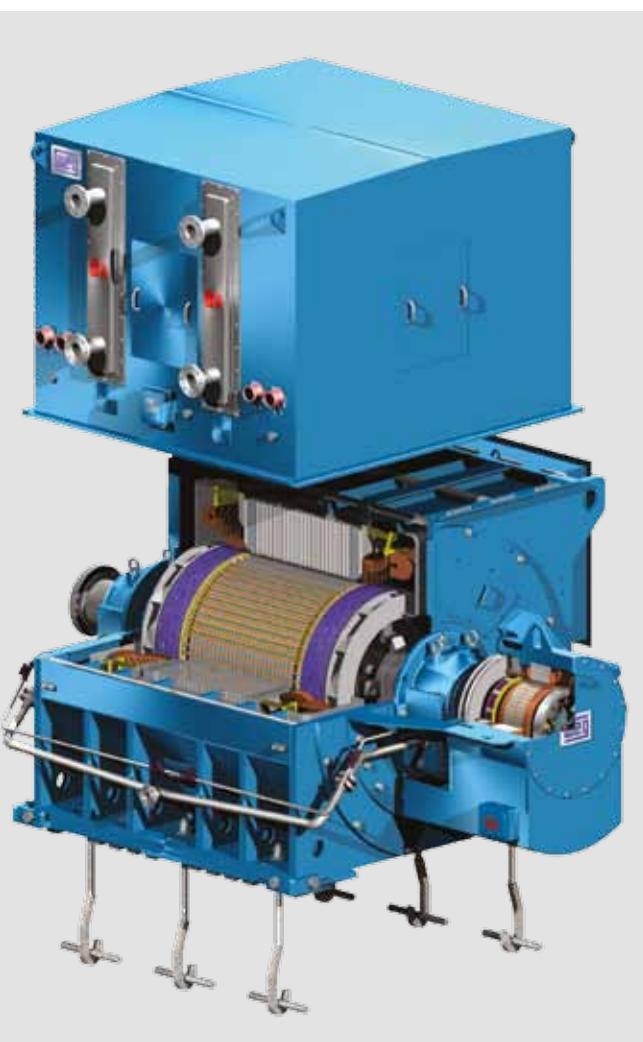


Synchronous Motors

WEG offers complete industrial solutions, providing the market with products developed together with specialized international consulting companies.

Among the products, the synchronous motors stand out for being increasingly more used in a variety of applications due to their special operating characteristics.

The efficiency, the power factor correction, high torques and low starting currents, constant speed under load variations, low operating and maintenance costs are the main reasons why synchronous motors are chosen to drive different types of loads.



Powers: up to 110,000 kW
Voltages: 220 to 13,800 V
Speeds: 3600 to 150 rpm

Projects

WEG products are designed with modern software applications developed in conjunction with universities from Europe, USA and Brazil, ensuring optimized projects and maximum efficiency of the products.

Certifications/standards

WEG quality system complies with the requirements of standards ISO 9001 and ISO 14001.

The quality system is audited and certified by the Bureau Veritas Quality Institute. In order to meet the requirements of the world's most demanding markets, WEG motors have important certifications from important certifying bodies, such as CSA, BVQI, NBR, ABS and DNV.

Why Use Synchronous Motors?

The application of the synchronous motor in industry most often results in considerable economic and operating advantages because of their operating characteristics. The main advantages are:

Power factor correction

Synchronous motors can help to reduce energy costs and improve the power system efficiency by correcting the power factor of the power line where they are installed. In a few years, the power savings can match the amount invested in the motor.

Constant speed

Synchronous motors maintain a constant speed under overload conditions and also during moments of voltage variations, observing the limits of maximum torque (pull-out).

High efficiency

Synchronous motors are more efficient in the conversion of electric into mechanical energy, resulting in greater energy savings. Synchronous motors are designed to operate with high efficiency over a wide speed range and provide a better use of energy for a wide variety of loads.

High torque capacity

Synchronous motors are designed with high torque on duty, keeping the speed constant even in applications with great load variations.

Greater stability in the operation with frequency inverters

It can operate in a wide speed range, while maintaining stability regardless load variation (e.g.: rolling mills, plastic extruders, etc.).



Applications

Synchronous motors are manufactured specifically to meet the needs of each application.

Due to their construction features, operation with high performance and adaptability to all types of environment, they are virtually used in all industry sectors, such as:

- Mining (crushers, grinding mills, belt conveyors and others)
- Iron and steel (rolling mills, fans, pumps and compressors)
- Paper and cellulose (extruders, chippers, shredders, compressors, peelers and refiners)
- Sanitation (pumps)
- Chemical and petrochemical industry (compressors, fans, exhausters and pumps)
- Cement (crushers, mills and belt conveyors)
- Rubber (extruders, mills and mixers)



Synchronous motors SEF900 (Ex-p), 3600 kW, 13,200 V
Application: Reciprocating compressors (petrochemicals)



Synchronous motors SDL800, 3000 kW, 3100 V
Application: Rolling mills (iron and steel)

Vertical synchronous motors

WEG also offers vertical synchronous motors, which can be supplied with ball bearing, roller bearing or angular contact bearing, lubricated with grease.

Depending on the application, especially when subject to high axial thrust loads, they can be manufactured with oil-lubricated ball bearings or sleeve bearings. The synchronous motors with vertical construction are designed and manufactured in order to meet applications in pumps, crushers, mixers and others.

Synchronous motors for hazardous atmospheres

For applications in hazardous atmospheres, WEG manufactures motors with specific safety features, able to operate in locations where flammable product are continuously handled, processed or stored.

They are provided with Ex-n (non-sparking), Ex-p (pressurized) protection type, meeting the requirements of national and international standards, and tested and approved by certifying bodies recognized worldwide.

Fixed speed

The application of synchronous motors with fixed speed is justified by the low operating costs, since they present high efficiency and can be used as synchronous compensators for power factor correction.

Variable speed

The application of synchronous motors with variable speed is justified in applications with high-torque at low speed and wide range of speed adjustment.

The construction of motors for these applications can be with or without brushes, depending on the load and environment characteristics. Due to the higher efficiency, smaller size and greater power capacity, they can replace direct-current motors in high-performance applications.

Synchronous motors can be specified with low starting currents, which provide a lower disturbance in the electrical system during the start and reduction in mechanical stresses resulting on the motor windings.

For the correct dimensioning and specification of a synchronous motor, WEG recommends that its customers provide all necessary information about the application.

Construction Features

Frame

Its main function is to support and protect the motor, also housing the lamination core and the stator windings.

They can be built for horizontal and vertical mounting and with protection degree according to the needs of the environment. The frame is built in welded steel profiles and sheets, forming a solid and robust set, which is the structural base of the machine. All the assembly of the frame receives a normalizing heat treatment to relieve the stress caused by the welds.

This kind of construction provides excellent structural strength so as to withstand mechanical stresses arising from potential short-circuits and vibration, enabling the motor to meet the severest requirements.



Frame

Stator

It is formed by a core of high-quality silicon steel laminations with slots to fit the stator winding, which operates with power supply in alternating current to generate the rotating magnetic field.



Stator

Rotor

The rotor can be constructed with salient poles or non-salient poles, depending on the construction characteristics of the motor and its application. The complete rotor is formed by the structure that composes or supports the poles, the field windings and the squirrel cage, which are the active rotating parts of the synchronous motor. The field poles are magnetized through the DC current of the exciter or directly by slip rings and brushes. In operation, the poles are aligned magnetically by the air gap and spin in synchronism with the stator rotating field. The shafts are made of forged steel and machined according to specifications. The shaft end is normally cylindrical or flanged.



Rotor

Bearings

Depending on the application, the synchronous motors can be supplied with rolling bearings or sleeve bearings.

Rolling bearings

These bearings are normally composed of ball roller bearings or cylindrical roller bearings, depending on the speed and axial and radial loads which they are subject to, seeing that in some applications special rolling bearings can be used. The rolling bearings can be lubricated with oil or grease.

Sleeve bearings

The sleeve bearings can have natural lubrication (self-lubrication) or forced lubrication (external lubrication).



Type of Excitation

Synchronous motors require a direct current source in order to supply the field winding (rotor winding), which is usually provided by a rotating brushless exciter or by slip rings and brushes (static exciter).

Brushless exciter

Synchronous motors with brushless excitation system have a rotating exciter, normally located in a compartment in the rear of the motor. Depending of the motor operation, the exciter is made by:

- Exciter with direct current supply on the stator
- Exciter with alternating current supply on the stator

The exciter rotor supplies the motor excitation winding through a rotating, three-phase rectifier bridge.



Brushless exciter

Static exciter (with brushes)

Synchronous motors with static exciter are composed of slip rings and brushes that allow the current supply of the rotor poles by means of sliding contact.

The direct current for the power supply of the poles must come from an AC/DC static controller and converter.

Synchronous motors with static exciter are more often used in applications with variable speed by means of frequency inverters.



Static exciter

Types of Cooling and Degrees of Protection

The most widely used types of cooling / protection in synchronous motors are:

- IC01 - self-ventilated, degree of protection IP23
- IC611 - air-air heat exchanger, degree of protection IP54 to IP65W
- IC81W - air-water heat exchanger, degree of protection IP54 to IP65W

Besides the types of cooling aforementioned, the motors can be supplied with forced ventilation, air inlet and outlet by ducts, and other means of cooling, meeting the requirements of the application and environment where they are installed in the most efficient way.



Accessories

The synchronous motors are supplied with the standard accessories required for their correct operation and monitoring. When specifying a motor, it is important to indicate the desired special accessories so that they will be included in the project and manufacture of the motor.

Standard accessories

- Pt-100 type temperature sensors on the stator windings
- Pt-100 type temperature sensors on the bearings
- Space heater
- Brush to ground the shaft on motors driven by frequency inverters.

Special accessories

- Capacitors for protection against surges
- Lightning arrester for protection against surges
- Current transformers (CT) for differential protection
- Vibration sensors
- Indicator of the shaft position (encoder)
- Device to lift the motor
- Temperature sensors for the air input and output
- Water leak detector
- Flow switch for water
- Flow switch for oil
- Sight glass of oil flow
- Sight glass of water flow
- Hydraulic unit for bearing lubrication
- System for injecting oil under pressure to start and stop the motor (hydrostatic jacking)
- Oil thermometer (bearings)
- Water thermometer (heat exchanger)
- Air thermometer (ventilation)
- Anchor plate
- Pressurization device (Ex-p motors)
- Capacitors for the reading of partial discharges
- Magnetic center indicator



Pt-100



Pressurization device



Manufacturing Processes

Winding

The winding process adopted by WEG is especially developed and specified for the voltage and application the generator is intended for. The coils of the high-voltage motors are manufactured with rectangular, form wound copper wire completely insulated with porous mica tape. In the winding process, conductor and semiconductor tapes are also used, enveloping the coils and ensuring the suitable characteristics for the required insulating level.

Insulation system

WEG MICATHERM insulation system is based on the "Vacuum Pressure Impregnation" process (VPI), which was developed together with the world's most renowned suppliers of insulating materials.

Using special epoxy resins, this system ensures perfect insulation of the motor winding, in a process totally free from emission of gases harmful to the environment.

For many years the VPI process has shown its efficiency and reliability in rotating electrical machines in many different applications. The insulation system is used in low and high voltage machines that use form wound coils from 380 to 15,000 V.

Balancing

WEG uses equipment that allows performing balancing at up to 3600 rpm. Computerized balancing equipment allows the accurate balancing of the rotors. Therefore, WEG motors present very low vibration levels. The standard balancing is done in two planes, but WEG can perform the balancing in three planes when required or when specified by the customer.



Calender



Laser cutting



Plasma cutting



Vertical lathe



Winding



VPI impregnation



Testing laboratory

Tests

The synchronous motors are tested according to NBR, IEC, NEMA, IEEE and API standards in a modern laboratories capable of testing medium and high-voltage motors with power up to 20,000 kVA and voltages up to 15,000 V, with fully computerized monitoring and highly accurate controls.

The tests are divided into three categories: routine, type and special tests.

Routine tests

- Visual inspection
- Ohmic resistance of the windings
- Inspection on the temperature sensors and space heater
- Marking of the terminals and phase sequence
- Balance between phases
- Vibration level
- Saturation with no load
- Permanent three-phase short circuit
- Blocked rotor
- High voltage
- Insulating resistance

Type tests

- Temperature rise
- Curve with no load (V curve)
- Overspeed
- Determination of losses and efficiency
- Determination of reactance
- Polarization index

Special tests

- Noise level
- Stress on the shaft



Laboratory of test



Control room

Technical Assistance

WEG provides its customers with technical assistance services responsible for all after sale support. These services include a 24/7 customer support, on site services such as machine's diagnosis, repair, start-up and commissioning and also assembly supervision. Our highly trained and experienced team is capable of handling complex issues in the field and provide remote support with state-of-the-art equipment, which produces reliable results. We also offer our worldwide repair shop network.



Services

WEG, market leader in motors and generators, also offers services of checkup, restoration and repowering on medium and large electrical machines performed in the factory or in the field, including other brands, as follows:

- DC generators and motors
- Three-phase induction motors (cage or rings of low, medium and high voltage)
- Synchronous motors (with or without brushes, low, medium and high voltage)
- Turbogenerators
- Hydrogenerators

When performing repair services, WEG uses the same technology and processes used in the manufacture of new machines.



Parts and Components

After years in operation, synchronous motors need restoration to continue working properly. For this restoration, it is advisable to use original parts supplied by the manufacturer.

WEG's team is available for immediate support and assistance with the proper identification of components.



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