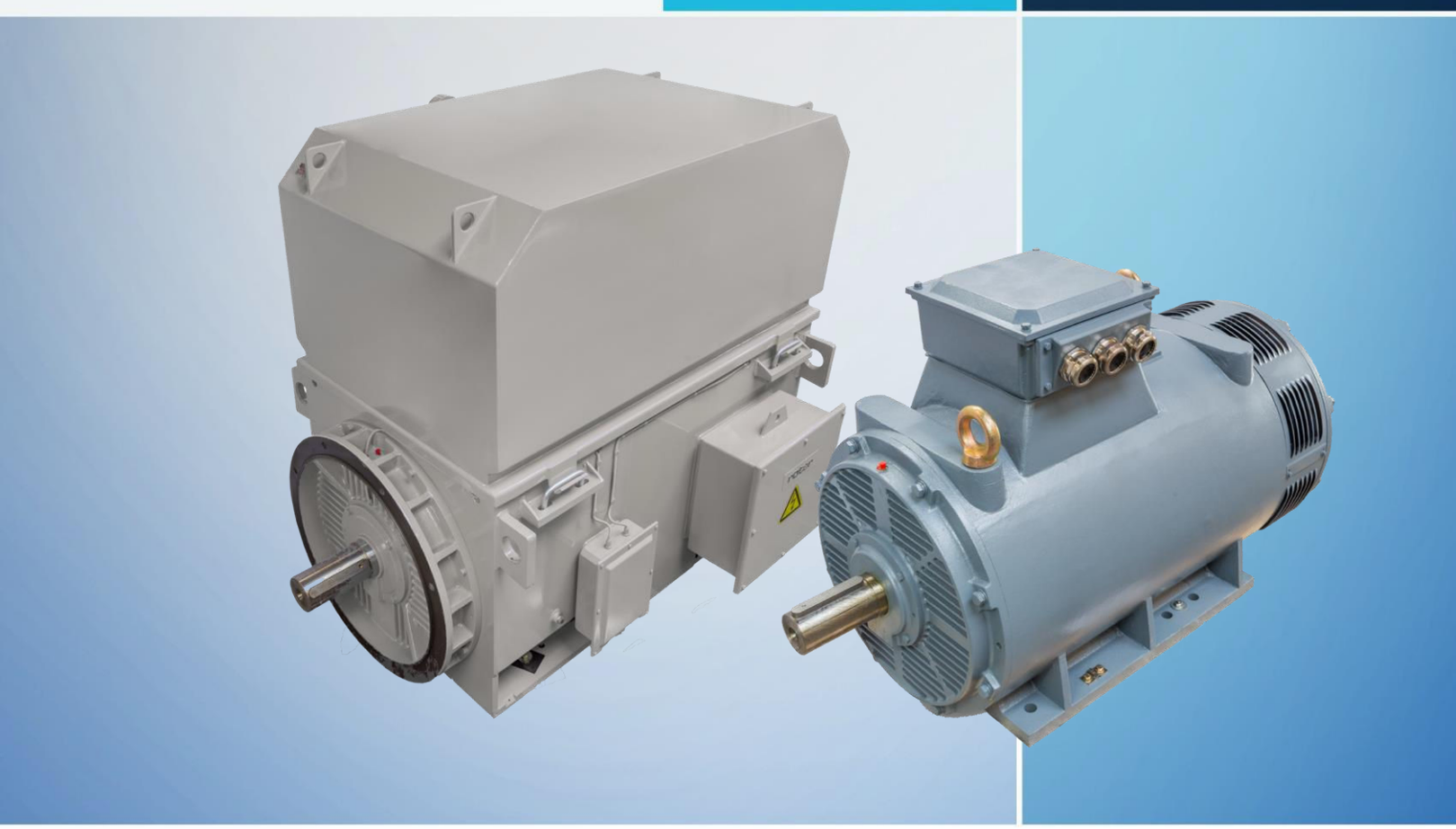
Industrial Motors
Commercial & Appliance Motors
Automation
Digital Solutions
Energy
Transmission & Distribution
Paints

# ROTOR PROPULSION AND THRUSTER

## Solutions for the **Marine** Industry



rotor WEG Group

Driving efficiency and sustainability

WEG



Rotor, part of WEG Group is a leading supplier of electric motors for some of the most demanding applications in the marine industry. For over 65 years, we have developed our expertise enabling us to engineer and deliver the best tailor made solutions at a world-class service level. We take pride in our ability to provide customized, flexible solutions with a quick turnaround time.

Located in Eibergen, the Netherlands, Rotor is able to draw on a broad network of production sales, engineering and as part of WEG Group, service facilities around the globe.

Together with WEG's electrical switchboards, variable frequency drives, soft starters, gearboxes and digital solutions, our propulsion and thruster motors provide an integrated motion drive solution for the marine industry.



## Characteristics

- Technical Assistance Available
- Smart Design
- Reduced Maintenance
- Certified By Shipping Classification Bureaus
- Optimum Performance

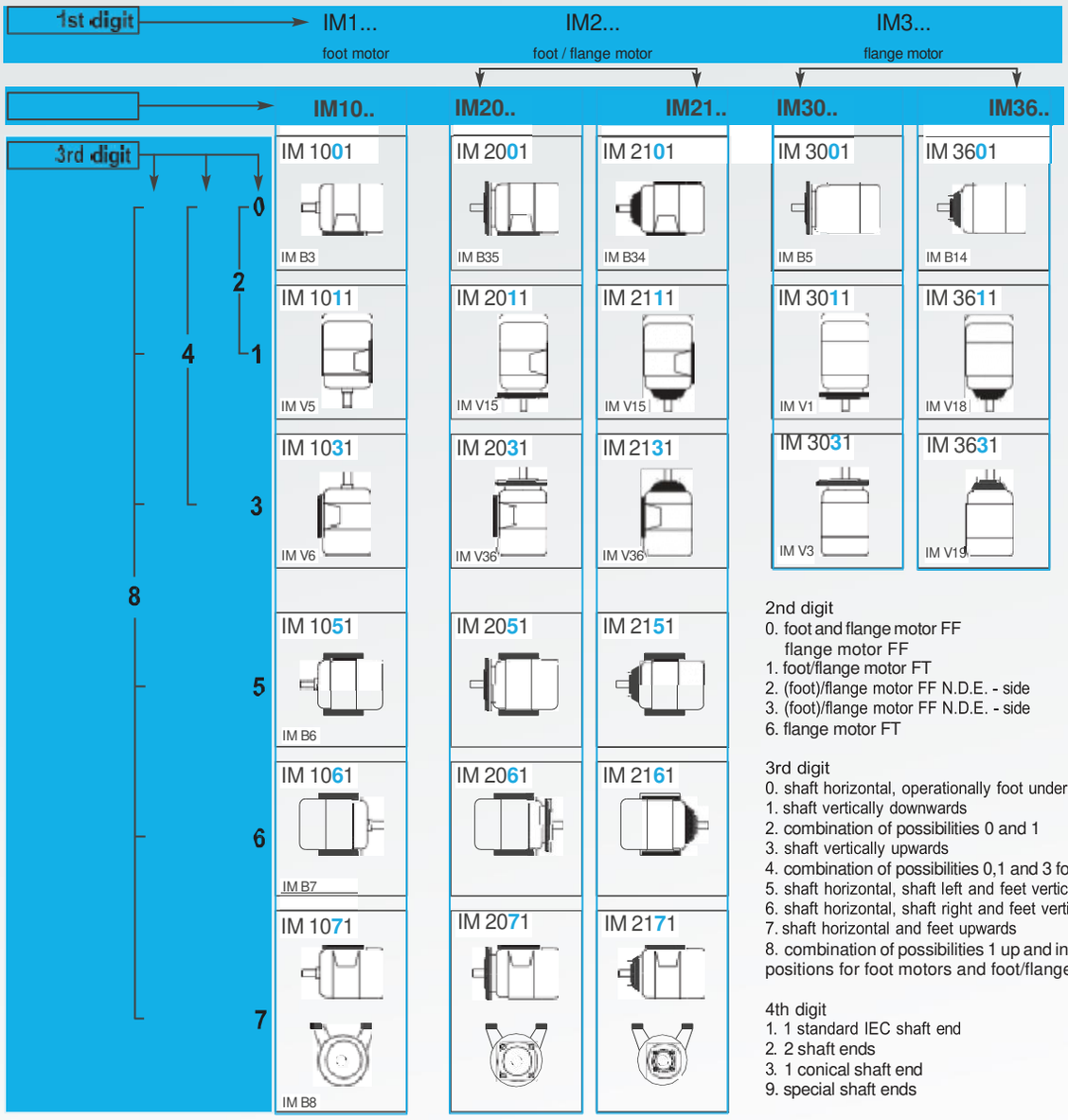
# MOUNTING POSITIONS & STANDARDIZATION

The mounting positions of electric motors are summarized in the table below.

## Remarks

The specified mounting must always be mentioned when ordering an electric motor. The actual motor mounting may influence the protection class and bearing design. Flange mounted motors need further specification of the required pitch circle diameter of the fixing holes in the flange (FF or FT type of flange).
FF (Flange Free Holes) = free holes are in B5 flanges
FT (Flange Tapped Holes) = tapped holes are in B14 flanges.

The pitch circle diameter (dimension M) is specified in the EN 50347 standard in relation to the frame size for the FF (B5) flange and the FT (B14A) flange (up to 160 frame). The pitch circle diameter (dimension M) is not specified for FT (B14B) flanges in the EB 50347 standard, they are however specified in IEC 60072-1 standard.
The motor mountings and the positions are summarized in the IM code as per the table below. For detailed information please consult the IEC 34-7 (NEN 10034-7) standard.




2nd digit
0. foot and flange motor FF
flange motor FF
1. foot/flange motor FT
2. (foot)/flange motor FF N.D.E. - side
3. (foot)/flange motor FF N.D.E. - side
6. flange motor FT

3rd digit
0. shaft horizontal, operationally foot under
1. shaft vertically downwards
2. combination of possibilities 0 and 1
3. shaft vertically upwards
4. combination of possibilities 0,1 and 3 for flange motors
5. shaft horizontal, shaft left and feet vertical
6. shaft horizontal, shaft right and feet vertical
7. shaft horizontal and feet upwards
8. combination of possibilities 1 up and including 7 (all positions for foot motors and foot/flange motors

4th digit
1. 1 standard IEC shaft end
2. 2 shaft ends
3. 1 conical shaft end
9. special shaft ends

# DEGREE OF PROTECTION IP

The Degree of Protection of rotating electric machines is defined as protection against the penetration of mechanical particles, dust and water. The Degree of Protection is defined in the following standard: IEC 34-5 (NEN-EN 60034-5)

## Indicators

The Degree of Protection is indicated by the 'IP' followed by two numbers, the first indicating the protection against mechanical particles and the second indicating the protection against water ingress.

## Example

The higher the digits, the greater the protection level against mechanical particles / water ingress (see the tables below). All Rotor three-phase electric motors are supplied in IP55 as standard enabling an outdoor installation. The higher level of protection may however cause a few issues.

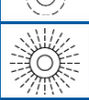
- 1. Tight shaft seals cause additional 'sliding friction' which generates heat and contributes to the friction losses which are more significant at fast running motors.
- 2. The condensation drain holes used for draining off the condensation water and equalization of atmospheric pressure ("breathing option") must be partially closed at IP55 and completely enclosed at IP56 protection.

A suitable solution can be implemented to overcome the firs problem by fitting an alternative shaft seal in the end shield / flange of the bearing cap but not on the bearing as this would cause excessive heat development. The second problem is less easy to resolve. The probability of condensation water accumulating inside the motor is higher at higher protection levels. A moisture-proof insulation system (tropical insulation is standard in all of our motors) is usually sufficient for IP55 protection.
At the protection class IP56 the problem is more difficult to overcome, especially for frame sizes greater than 100 frame as the air volume in large electric motors is larger and this increase the potential for condensation when changes in temperature occur. To minimize condensation accumulation a stable internal temperature must be maintained (5°C above the ambient temperature). This applies for motors when stationary as the internal temperature always rises significantly during the operation. The solution is the installation of anti-condensation (or "standstill") heaters.
The protection class selection is intended to reduce the probability of electric motor failures due to ingress of mechanical particles and water. This however is not a guarantee of trouble-free operation. Higher protection class should be implemented where necessary and for specific applications as it sometimes can achieve the opposite effect with regard to the reliability of operation.

*Protection degrees specified by the first indicator*

| 1ST | protection against solid particles and dust | |
|---|---|---|
| 0 | | No protection |
| 1 |  | Protection against the penetration of solid particles with a diameter larger than 50 mm |
| 2 |  | Protection against the penetration of solid particles with a diameter larger than 12 mm |
| 3 |  | Protection against the penetration of solid particles with a diameter larger than 2.5 mm |
| 4 |  | Protection against the penetration of solid particles with a diameter larger than 1 mm |
| 5 |  | Limited dustproof. The quantity of dust does not compromise electric motor performance |
| 6 |  | Protection against the penetration of dust (dustproof) |
| | | |
| | | |

*Protection degrees specified by the second indicator*

| 2ND | protection against water | |
|---|---|---|
| 0 | | No special protection |
| 1 |  | Protection against water that falls perpendicularly on to the electric motor |
| 2 |  | Protection against water that falls on the electric motor at an angle of no more than 15° |
| 3 |  | Protection against water that falls on the electric motor at an angle of no more than 60° |
| 4 |  | Protection against splashing water that falls on the electric motor from all sides |
| 5 |  | Protection against water jets (under a specific pressure) from a random direction |
| 6 |  | Protection against heavy seas or powerful water jets (for example, above deck set-up on vessels) |
| 7 |  | Protection against immersion |
| 8 |  | Protection against continuous submersion in water |

# INSULATION CLASS

Various insulation materials are used in electric motors and each has its own function.

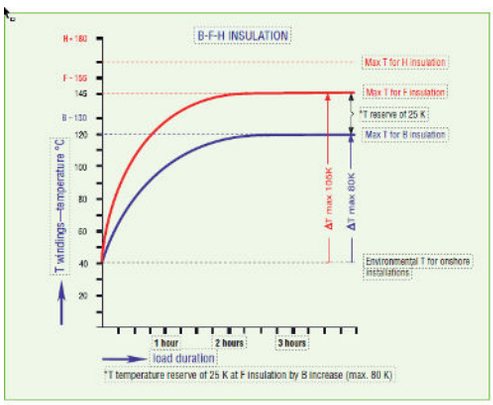
The most important materials are:
- Wire insulation
- Slot and phase insulation materials (insulation between the winding and the stator lamination pack and phase insulation between the winding heads).
- Winding impregnation
- Insulating sleeve used to cover wire / lead connections.
- Insulation of winding leads (between the winding and the terminal board).

All these insulation materials are specified in thermal classes that are referenced using a letter (Y - A - E - B - F - H - C). Every thermal class has its own temperature specified (see the table). An insulation material of a specific class need to retain its mechanical and electrical properties within the temperature limit and have a reasonably long service life.

The maximum permissible temperature rise (see the table) of the winding is determined based on the thermal class temperature limits. Continuous duty (S1) at the rated power output at an ambient of 40°C is specified for indoor / outdoor installations. The temperature of the winding increases as a result of the copper and iron losses in the electric motors during operation. The winding temperature rise is determined through measuring the resistance of the winding (winding resistance increases with increasing temperature). Hot spots in the windings cannot be determined using the winding resistance method. To allow for any hot spots in winding lower temperature limits are specified for the used insulation materials.

It is now common practice to produce motors with insulation class F with winding temperature rise in accordance with the class B (max. 80 K). This means that the motors have a temperature reserve of 25 K. This reserve can be utilized for short-term overload, a higher ambient temperature (above 40°C), for supply voltage / frequency fluctuation etc. Should you know that the thermal reserve would be utilized it is advisable to discuss the application requirements with the motor manufacturer.

Motors used with VSD's often require additional strength in the insulation system. Our standard insulation system works with VSD up to 480 V. For higher voltages additional insulation protection is used. This involves special wire, insulation system and impregnation.




**Remark:**
The allowable shaft load also decreases when the set-up height increases. The table below provides an overview of this

| Height (m) | 1,000 | 1,500 | 2,000 | 2,500 | 3,000 | 3,500 | 4,000 |
|---|---|---|---|---|---|---|---|
| Power (%) Tmax 40 °C | 100 | 98 | 95 | 91 | 87 | 83 | 78 |

| Insulation class | A | E | B | F | H | F* |
|---|---|---|---|---|---|---|
| Temperature limit | 105°C | 120°C | 130°C | 155°C | 180°C | 155°C |
| Max. temperature of the winding | 100°C | 115°C | 120°C | 145°C | 165°C | 145°C |
| Environmental temperature for offshore installations | 40°C | 40°C | 40°C | 40°C | 40°C | 40°C |
| Maximum T (K) of the stator winding | 60 K | 75 K | 80 K | 105 K | 125 K | 80 K + 25 K |
| Additional thermal reserve | | | | | | |

*Insulation class F (155°C) with winding temperature rise limited to class B (max. 80K)*
*This relates an additional thermal reserve of 25 K*

*Remark:*
*All of our motors are manufactured with class F insulation.*

# MOTOR THERMAL PROTECTION

All electric motors should be protected against overloading. Electric motors will develop a fault when overloaded as the temperature rises above the thermal limit of the insulation materials during the overload, which results in the loss of the mechanical and electrical properties.

## Service Life

The standard service life of the motor insulation material is 20,000 to 25,000 hours depending on the maximum limit temperature of the individual material. In real life this theoretical service life is exceeded many times. The insulation class B determines the maximum permissible winding temperature of 120°C (limit temperature 130°C) and class F determines the maximum permissible winding temperature of 145°C (limit temperature 155°C). The service life of the winding insulation is reduced by half every time the winding temperature exceeds the maximum permissible temperature by 10 K. Our motors have been wound in class F (155°C) as standard but the motors' temperature rise is withing the class B, well below the class F thermal limit. The service life is therefore expected to exceed the standard service life many times.

## Motor Protection Switch

The temperature of the winding is determined by the energy losses in the electric motor as well as other factors. The "copper losses" are the main contributor to the heat generation. The copper losses are in proportion to the square of the current ($P_{cu}=1^2xR$). It is often the case that the temperature does not rise immediately when a specific electric current starts to pass through the winding. The temperature will rise gradually. In order to prevent the damage of the motor winding a current protection switch is sometimes used. The electric motor current passes through bi-metal in the switch, which gets warmer.
Each metal has a different dilation property, which results in opening of the circuit when hot. In this case the electric motor does not need to be protected by fuses as they cannot be precisely adjusted for the electric motor current. Unlike bi-metal protection switches, the fuses do not heat up or cool down with the electric motor winding. It is recommended to set the fuses for a slightly higher current value to prevent tripping of one phase and running in two phases. In this case the thermal Protection Switch could trip off too late or not at all. The fuses should only serve as protection against short-circuits.

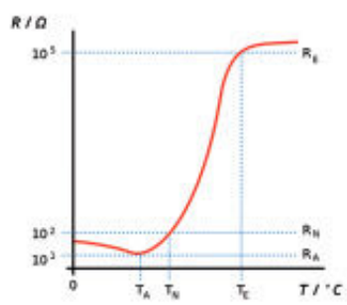
## Protection Tool For Your Driven Equipment

The thermal electric motor Protection Switch can also be used as a protection for the driven equipment. The current limit can set lower than the electric motor rated current. The Protection Switch will trip the motor off even when the motor rated current has not been exceeded. It is not unusual that electric motors run at 30% to 80% of the rated load. It is therefore advisable to adjust the thermal Protection Switch based on the driven equipment requirements.

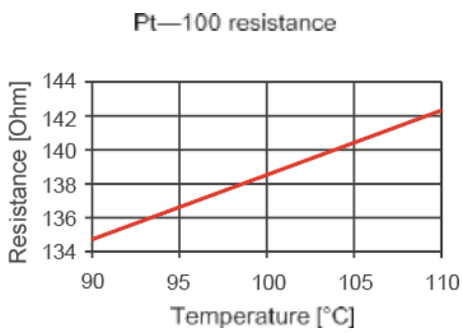
## PT100

PT100 is a commonly used sensor for temperature measurement. It is a resistance thermometer. Another name is the RTD (Resistance Temperature Detector). Although this expression also includes other types of temperature sensors 70% of all temperature measurements in electric motors are carried out by PT100. The advantages are wide measurement range, the (almost) linear characteristics, long service life, its accuracy and ease of use and connectivity. The linear relation between temperature and resistance values is a significant difference when compared with PTCs and their characteristics.

The acronym PT refers to platinum, this being the material from which the very fine resistance wires in PT100 are produced. The number of 100 refers to the electrical resistance of 100 Ohm (±0.1 Ohm) that the sensors have at 0°C.



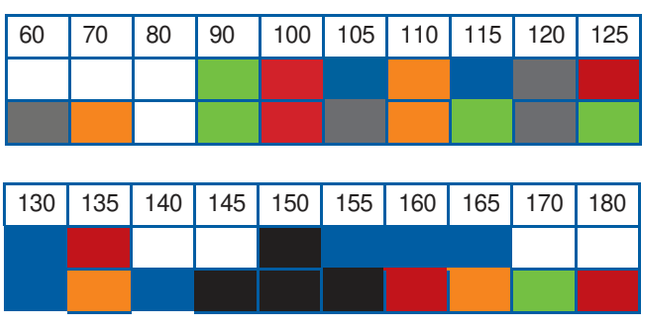

*Difference in resistance between a PTC (above) and a PT-100 (below*





## PTC Thermistors

PTC are used to protect the motor winding and trip when the maximum permissible winding temperature is reached. The PTC (Positive Temperature Coefficient) is a resistance sensor that has a small resistance value when cold and high resistance value when hot. The PTC has a thermistor effect. This means that the temperature characteristics on the resistance is not linear. The special resistance / temperature curve can be seen on page 6. PTC are used in combination with a PTC thermistor relay in the auxiliary current circuit of the electric motor. The electric motor will be switched off when the limit temperature is reached. This method is independent of the motor current and responds only to the temperature of the winding.




*Color code of temperature values of PTC*

## Klikson or Bi-metal Switch

The operation of this protection is similar to PTC thermistors, only no additional relay is required. The Bi-metal switch can operate up to 1.5 A enabling direct operation, avoiding the need for an additional relay.

## Anti-condensation (Standstill) Heaters

Electric motors that are not continuously running (S1 duty) are usually provided with a standstill or anti-condensation heaters coils (SHC). The heaters switch on when the electric motors are not running and ensure that a constant temperature inside the motor housing is maintained preventing water condensation during sudden differences in temperature inside the electric motors. Water condensation is harmful and can shorten the service life of electric motors. The heaters keep constant temperature in motors after they have been switched off and prevent forming condensation.

## Anti-condensation Heaters Power (Standard)

| Frame Size | Watt | Voltage |
|---|---|---|
| 63 | 16 W | 230 V |
| 71 | 16 W | 230 V |
| 80 | 16 W | 230 V |
| 90 | 25 W | 230 V (110 V optional) |
| 100 | 25 W | 230 V (110 V optional) |
| 112 | 25W | 230 V (110 V optional) |
| 132 | 25 W | 230 V (110 V optional) |
| 160 | 50 W | 230 V (110 V optional) |
| 180 | 50 W | 230 V (110 V optional) |
| 200 | 50 W | 230 V (110 V optional) |
| 225 | 80 W | 230 V (110 V optional) |
| 250 | 80 W | 230 V (110 V optional) |
| 280 | 100 W | 230 V (110 V optional) |
| 315 | 100 W | 230 V (110 V optional) |
| 355 | 200 W | 230 V (110 V optional ) |
| 400 | 400 W | 230 V (110 V optional) |
| 450 | 500 W | 230 V (110 V optional) |
| 500 | 500 W | 230 V |
| 560 | 500 W | 230 V |
| 630 | 800 W | 230 V |

# MOTOR COOLING

## IC 01 Open Drip Proof Air Cooled

IC 01

If the motor is located in a room where environmental conditions are clean, the type of cooling can be IC01.
An IC01 cooling means Open Drip Proof. The construction of an ODP motor allows air from outside of the motor to circulate through a metal enclosure with an internal fan to cool the rotor and the wirings. The internal fan is mounted on the shaft at the non-driven end side to pull air through to the motor to keep it cooled. The vents are designed to keep dripping water outside the motor.



Enclosure IP23
Self Circulated
Cooling air is blown through the motor by a fan mounted on the shaft

## IC 81 W TEWAC Air-Water Cooled

IC 81W

When environmental conditions do not allow open motors to be used, totally enclosed motors, cooled through air-water exchangers (IC81W) can be used.
With a fan placed in the shaft of the motor the interior air is made to circulate through the heat exchanger for cooling the motor.
In the standard execution it is a simple pipe although subject to client requirements, it can be double pipe.
Depending on the quality of the water, be it fresh or salt water, the pipe material changes. Also water ratio and temperatures are important.



Enclosure IP55
Self Circulated
Top mounted water heat exchanger

## IC 86W TEWAC Air-Water Cooled With Force Air Cooling

IC 86W

When the motors are supplied by frequency converters, and they have to work in a variable speed range, it often happens that the fan attached to the shaft is not capable of providing sufficient flow of air for the optimum cooling of the motors. In this event in these motors the shaft fan is eliminated, and an electro-fan is added to them.

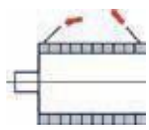


Enclosure IP55
Separate Ventilation
Top mounted water heat exchanger. Circulation by excited fan motor. This is an independent component.

## IC 71W Water-Jacket Cooled

IC 71W

Totally Enclosed Motors with integral heat exchanger around the motor - responsible for circulation of water keeping the motor cool with very low noise and high efficiency.
The quality and material of the heat exchanger depends on the type and quality of the water available.



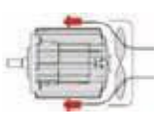
Enclosure IP55/56

Separate Circulated Water-Jacket Cooled Motor

## IC 411 Totally Enclosed Fan Cooled (TEFC)

IC 411

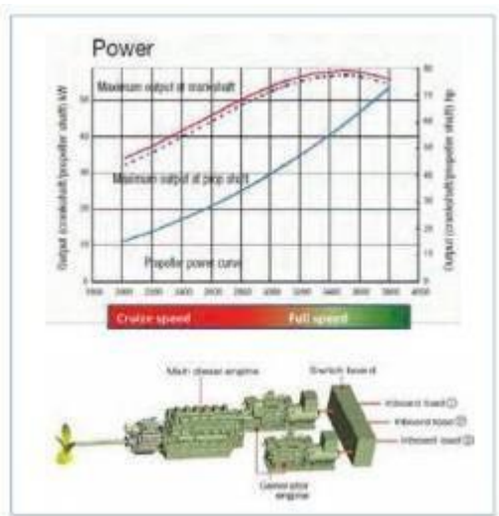
Self-ventilated surface-cooled motor (TEFC) in accordance with IEC 60034-6. Cooled by an external fan mounted on the motor shaft. This is by far the most common form of cooling for standard motors.



Enclosure IP55

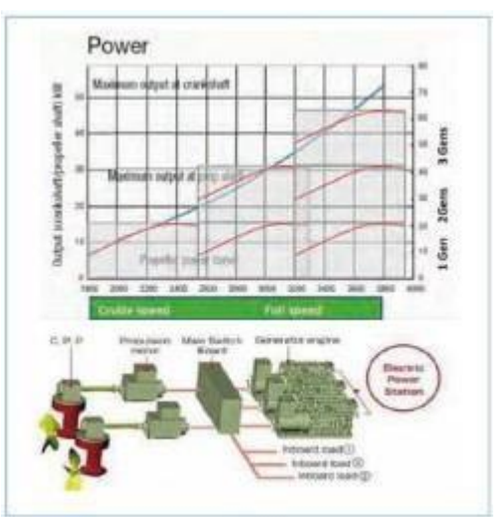
Cooling air is blown over the totally enclosed motor surface by an external fan mounted on the motor shaft

# DIESEL ELECTRIC PROPULSION




## Conventional propulsion system

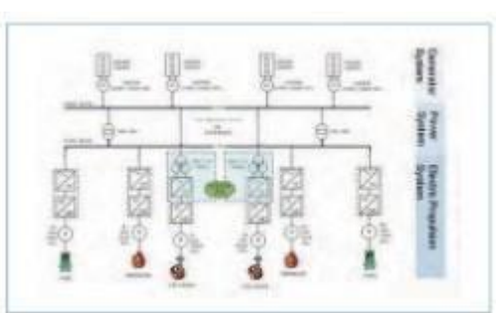
- At the maximum speed the crankshaft and propeller meet.
- At half speed, the crankshaft is at 33 kW, but the propeller is only at 10 kW
- Inefficient use of the diesel engine. 23 kW loss




## DEP (Diesel Electric Propulsion) System

Diesel electrical propulsion, multiple generators

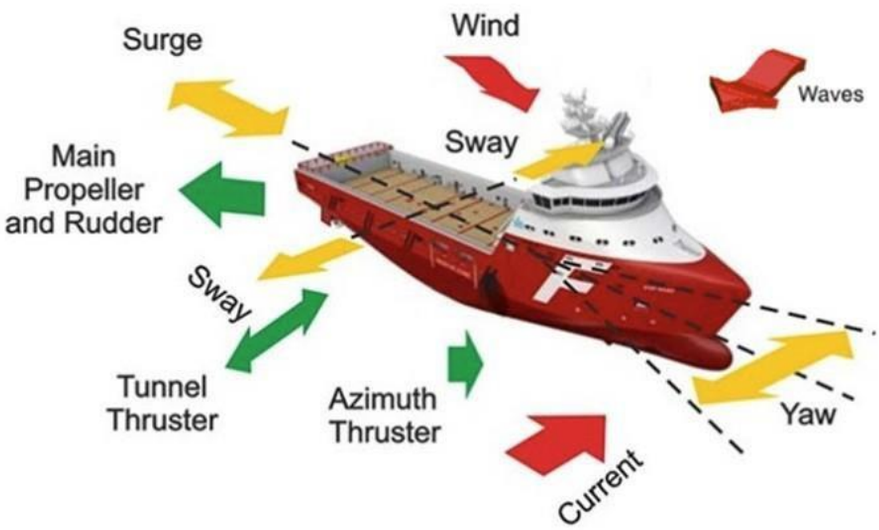
- The speed for the propellor is independent
- The electric motor power will meet the propellor at all speeds.
- The electric power needed is delivered by multiple generator sets.
- Total Crankshaft power is optimized to the power needed.
- Better control of the propulsion to meet dynamic position demands.



## Redundancy and power sharing

- By using a large generator system the power can be used by the propulsion system, but also as inboard power or process equipment.
- With multiple generators the redundancy is higher and automatic positioning and control is possible.

# DYNAMIC POSITIONING




Dynamic positioning (DP) is a computer controlled system to automatically maintain a vessel's position and heading by using its own propellers, rudders and thrusters. As minimum position reference sensors (DGPS), wind sensors, motion sensors and a gyro compass are needed to provide the computer with information about the vessel's position and magnitude and direction of environmental forces affecting its position.

USBL systems and other positions systems can be added to the computer to obtain a more precise positioning. Dynamic positioning may be either used to hold the vessel locked to a fixed point over the sea bottom, a fixed point on the sea bottom or relative to a moving object like another ship or an underwater vehicle. It would also be possible to position the vessel at a favorable angle towards wind, waves and current.

| Description | IMO | LR | DNV | GL | ABS | NK | BV |
|---|---|---|---|---|---|---|---|
| | Equipment Class | Equipment Class | Equipment Class | Equipment Class | Equipment Class | Equipment Class | Equipment Class |
| Manual position control and automatic heading control under specified maximum environmental conditions | - | DP(CM) | DYNPOS-AUTS | - | DPS-0 | - | |
| Automatic and manual position and heading control under specified maximum environmental conditions | Class 1 | DP(AM) | DYNPOS-AUT & DPS1 | DP 1 | DPS-1 | DPS A | DYNAPOS AM/AT |
| Automatic and manual position and heading control under specified maximum environmental conditions, during and following any single fault excluding loss of a compartment. (Two independent computer systems). | Class 2 | DP(AA) | DYNPOS-AUTR & DPS2 | DP 2 | DPS-2 | DPS B | DYNAPOS AM/AT R |
| Automatic and manual position and heading control under specified maximum environmental conditions, during and following any single fault including loss of a compartment due to fire or flood. (At least two independent computer systems with a separate backup system separated by A60 class division). | Class 3 | DP(AAA) | DYNPOS-AUTRO & DPS3 | DP 3 | DPS-3 | DPS C | DYNAPOS AM/AT RS |

# TESTING & CERTIFICATION

The mechanical and electrical performance of the basic Rotor electric motors is adapted for marine and offshore application. Due to the often aggressive “salty” environment, almost all sizes of the RN series can be supplied in cast iron motor housing and end shields (except very small sizes, which are aluminum housing with cast iron end shields). We produce electric motors for below deck as well as above deck applications and they can be equipped with disc brakes, encoders, force ventilation units etc. The electric motor windings are based on ambient temperatures of up to 50°C and are moisture and mold resistant suitable for relative air humidity up to 96%. These electric motors meet various criteria set out by a number of Marine Classification Societies and are suitable for “essential service” when supplied with a marine certificate.

***How can a Rotor electric motor be identified as a marine motor?***

All of our marine motors are equipped with a stainless steel rating plate that specifies the following:

- the nominal electric motor data and the marine classification marking.
- any additional rating plates with supplementary/ customer data.

The rating plate specifies the Marine Classification Society and the ambient temperature specified by the Society’s regulations (usual IEC 92.301.C). The date of purchase as well as the Marine Certificate number are also marked on the rating plate. The rating plate and a fixed component of the electric motor would have been certified and stamped by the Marine Classification Society surveyor when marine approval testing is required. Should no marine approval testing be required, only the Society’s logo and the date of production would be specified on the plate. No additional rating plate would be fitted. Electric motors that do not have the marine classification marking on their rating plate are not marine motors even though it is very likely that they would operate satisfactorily in the marine environment (on-board of a vessel or offshore), a factory marine motor declaration cannot be issued afterwards. A 2.1 or 2.2 class certificate can, in most cases, be issued for marine motors that are not older than one year upon request and the necessary data submission. The temperature rise of the winding must be determined by the resistance method. There are certain specific regulations applicable on marine motors relate to the mechanical execution.

## Certificates

All Rotor motors are tested after assembly to guarantee their correct operation and are subject to a high-voltage insulation test and a no-load run test. Additional tests can be performed in the factory test laboratory. Multiple electric motors can be tested there under continuous or intermittent load at the same time and their electrical and mechanical properties measured and identified. This is the same procedure as when new motor designs are tested and Type Test Reports are issued. Our electric motors can be supplied with a factory Declaration of Compliance or with a Test Certificate that confirms that the test data measured on a specific electric motor comply with the customer’s specification. Our motors are tested to the EN 10204 standard and 4 different certificates can be selected.

### EN10204-2.1

The declaration of Compliance 2.1 (factory declaration) is issued based on the electric motor serial number, invoice number and the customer order number. No testing is involved when issuing this document.

### EN10204-2.2

Test Certificate 2.2 (factory issued certificate) is issued based on the electric motor data set out in the Type Test Report (when the motor prototype has been tested) amended with certain other data (historical test data). The invoice number and the customer order number are also marked in the Test Certificate. A number of motor serial numbers of the same type can be included in one Test Certificate.

### EN10204-3.1

The relevant no-load and full-load tests are carried out on specific electric motors when the Inspection Certificate 3.1 (inspection report) is issued. A request for Inspection Certificate 3.1 must be made at the point of order placement. This test is also referred to as the “routine test” and provides a reasonable guarantee of the correct performance of the electric motor when the tested data complies with the Type Test data. The invoice number and the customer order number are also marked on the Inspection Certificate. One Inspection Certificate is issued for each electric motor.

## EN 10204-3.2

Inspection Certificate 3.2 is issued based on the test witnessed by an independent inspector (classified inspection report). The inspector (surveyor) can be appointed by the customer or by ourselves. In the majority of cases the surveyor would attend the testing in our approved test laboratory. External testing by certified laboratories have to be carried out in certain cases.

## Type Approval Certificate

Rotor is authorized and approved to independently test and certify electric motors up to 300 kW (without the actual presence of a surveyor). The tests are carried out in our approved test laboratory. This enables us to supply electric motors for essential service quickly and with the relevant certificate. The independent testing has been arranged with a number of Classification Societies. Rotor can currently issue Type Approval Certificate for DNV, BV, CCS, Lloyd's, ABS, RINA and KRS



# SHIPPING CLASSIFICATION BUREAUS























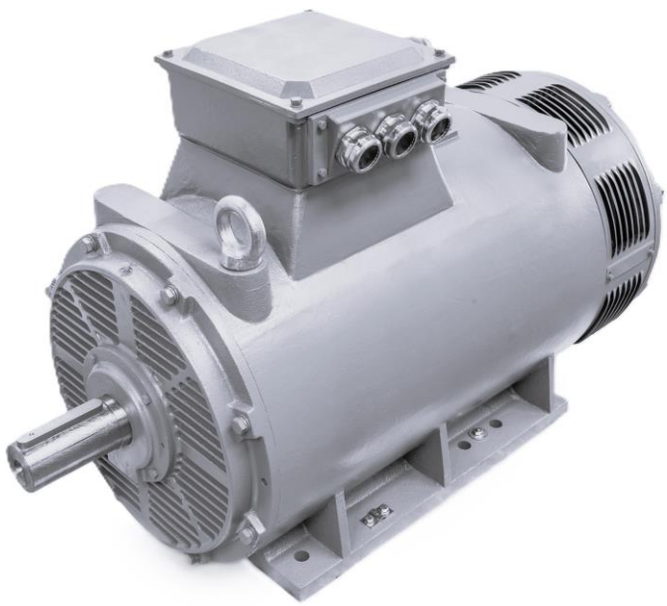





| Environmental temperatures for marine motors and maximum temperature increase of the winding | | | |
|---|---|---|---|
| **Marine Classification** | **Environmental temperature ºC** | **Maximum DT winding ºK at insulation class** | |
| | | **F** | **H** |
| **IEC34-1** | 40 | 105 | 135 |
| **IEC 92.301 (IEC 60092-301)** | 50 | 90 | 115 |
| **American Bureau of Shipping** | 45 | 100 | 120 |
| **Bureau Veritas** | 45 | 100 | 120 |
| **China Classification Society** | 45 | 100 | 120 |
| **China Corporation Register** | 45 | 95 | 110 |
| **DNV** | 45 | 100 | 120 |
| **Indian Register of Shipping** | 45 | 90 | 110 |
| **Korean Register of Shipping** | 45 | 100 | 120 |
| **Lloyd's Register of Shipping** | 45 | 95 | 110 |
| **Nippon Kaiji Kyokai** | 45 | 100 | 120 |
| **Registro Italiano Navale** | 45 | 100 | 120 |
| The temperature increase of the winding is determined by the resistance method. Specific regulations apply to marine motors with regard to the mechanical model. | | | |

| Standard | Dutch | English |
|---|---|---|
| EN 10204-2.1 | Factory declaration | Declaration of compliance with the order 2.1 |
| EN 10204-2.2 | Factory inspection certificate | Test report 2.2. |
| EN 10204-3.1 | Inspection report | Inspection certificate 3.1 |
| EN 10204-3.2 | Classified inspection report | Inspection certificate 3.2 |

# 23 RN (IP23) Low Voltage Open Drip Proof Motors

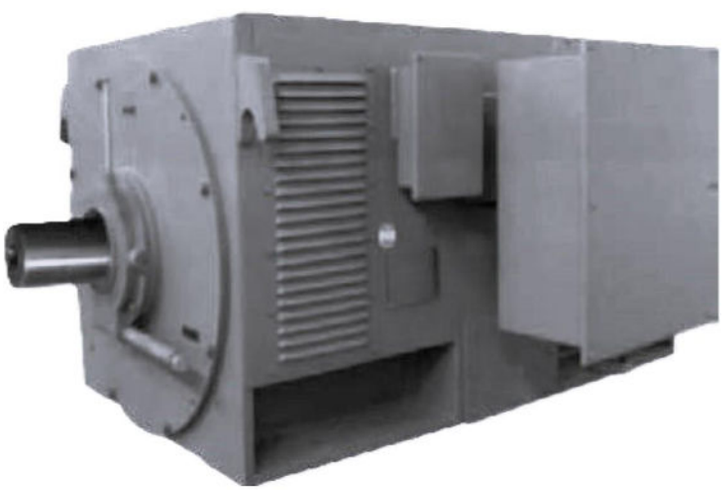


| | |
|---|---|
| Power Output | Up to 800 kW |
| Frame Size | 160 - 355 |
| Pole | 2 - 8 |
| Mounting | B3, B35, V1 |
| Voltage | Low Voltage |
| Marine | ABS, BV, DNV, LR - type approved |
| | KR, NKK, Rina - compatible |
| Bearings | SKF / FAG or equivalent |
| Cooling | IC01 |

Options Available:

- Heating
- PTC tripping
- PTC alarm
- PT100 winding
- PT100 bearing
- Bi-metal tripping
- Bi-metal alarm
- Insulated bearing
- SPM nipples
- External cooling
- C3 coating
- C5 coating
- Holding brake
- Speed sensor

# LOD (IP23) Large Low Voltage Open Drip Proof Motors



| | |
|---|---|
| Power Output | Up to 2500 kW - 50 Hz - S1 |
| Frame Size | 400 - 710 |
| Pole | 4 - 12 |
| Mounting | B3, B35, V1 (V1 Default) |
| Voltage | Low Voltage |
| Marine | DNV, LR - type approved |
| | KR, NKK, Rina, ABS, BV - compatible |
| Bearings | SKF / FAG or equivalent |
| Cooling | IC01 |

Options Available:

- Heating
- PTC tripping
- PTC alarm
- PT100 winding
- PT100 bearing
- Bi-metal tripping
- Bi-metal alarm
- Insulated bearing
- SPM nipples
- C3 coating
- C5 coating
- Holding brake
- Speed sensor

*Note: Medium Voltage options available up to 5000 kW*

# LAW (IP55) Low Voltage Air-Water Cooled Motors



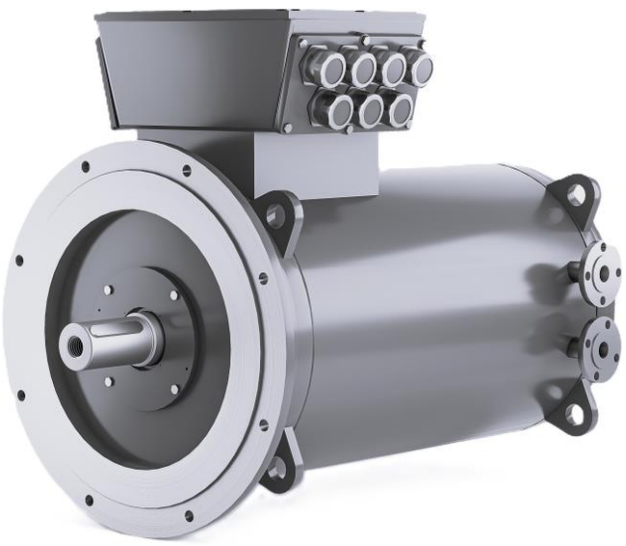
| | |
|---|---|
| Power Output | Up to 2500 kW - 50 Hz - S1 |
| Frame Size | 355 - 710 |
| Pole | 4 - 12 |
| Mounting | B3, B35, V1 |
| Voltage | Low / Medium Voltage |
| Marine | ABS, BV, DNV |
| | KR, NKK, Rina, ABS, LR - compatible |
| Bearings | SKF / FAG or equivalent |
| Cooling | IC81W |

Options Available:

- Heating
- PTC tripping
- PTC alarm
- PT100 winding
- PT100 bearing
- Bi-metal tripping
- Bi-metal alarm
- Insulated bearing
- SPM nipples
- C3 coating
- C5 coating
- Holding brake
- Speed sensor
- External Cooling (IC86W)
- Water Leakage Detectors

*Note: Medium Voltage options available up to 5000 kW*

# LWJ (IP55) Low Voltage Water-Jacked Cooled Motors



| | |
|---|---|
| Power Output | Up to 2000 kW - 50 Hz - S1 |
| Frame Size | 280 - 560 |
| Pole | 4 - 12 |
| Mounting | B3, B35, V1 |
| Voltage | Low Voltage (other voltages available on request) |
| Marine | Compatible |
| Bearings | SKF / FAG or equivalent |
| Cooling | IC71W |

Options Available:

- Heating
- PTC tripping
- PTC alarm
- PT100 winding
- PT100 bearing
- Bi-metal tripping
- Bi-metal alarm
- Insulated bearing
- SPM nipples
- C3 coating
- C5 coating
- Holding brake
- Speed sensor
- Water Leakage Detectors

*Note: Medium Voltage options available*

# LVX (IP55) Low Voltage Large TEFC Motors



| | |
|---|---|
| Power Output | Up to 1500 kW - 50 Hz |
| Frame Size | 400 - 560 |
| Pole | 4 - 12 |
| Mounting | B3, B35, V1 |
| Voltage | Low Voltage (other voltages available on request) |
| Marine | DNV, LR - type approved |
| | Other certifications possible |
| Bearings | SKF / FAG or equivalent |
| Cooling | IC411 |

Options Available:

- Heating
- PTC tripping
- PTC alarm
- PT100 winding
- PT100 bearing
- Bi-metal tripping
- Bi-metal alarm
- Insulated bearing
- SPM nipples
- C3 coating
- C5 coating
- Holding brake
- Speed sensor
- External Cooling

*Note: Medium Voltage options available*

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