



B&P Elektromotoren

Industrial Motors

Commercial &
Appliance Motors

Automation

Digital &
Systems

Energy

Transmission &
Distribution

Coatings

W22

Three-Phase Electric Motor

Technical Catalogue European Market



Driving efficiency and sustainability



W22 Line

The increasing demand for electrical energy to sustain global development requires consistent heavy investments in power supply generation. However, in addition to complex medium and long term planning, these investments rely on natural resources, which are becoming depleted due to constant pressures upon the environment. The best strategy, therefore, to maintain energy supply in the short term is to avoid wastage and increase energy efficiency. Electric motors play a major role in this strategy, since around 40% of global energy demand is estimated to be related to electric motor applications. Consequently, any initiatives to increase energy efficiency, by using high efficiency electric motors and frequency inverters, are to be welcomed, as they can make a real contribution to reductions in global energy demand.

At the same time as efficiency initiatives make an impact in traditional market sectors, the application of new technologies in emerging sectors is resulting in profound changes in the way that electric motors are applied and controlled. By integrating these changes together with the demands for increased energy efficiency, WEG has taken up the challenge and produced a new design of high efficiency motor, one that exceeds the performance of the previous WEG's W21 motor line, which is recognised worldwide for its quality, reliability and efficiency.

Using the latest generation of computerised tools, such as structural analysis software (finite element analysis) and computer fluid dynamics, as well as electrical design optimization software, an innovative - next generation - product has been developed: the W22 motor.

Several key objectives have been achieved in the design of the W22 motor:

- Reduction of noise and vibration levels;
- Increased energy efficiency and reduced thermal footprint;
- Easy maintenance;
- Compatibility with present & future generations of frequency inverters;
- Flexible and modular design.



Sustainability and Carbon Emission Reduction Through Super Premium Efficiency Motors

The Super Premium Efficiency (IE4) level established in IEC 60034-30-1: 2014 is considered the highest efficiency class which a squirrel cage induction motor can achieve whilst remaining economically viable.

It is also the optimum solution to increase the efficiency of an existing application through direct replacement.

It may be argued that super premium efficiency motors are also super premium in price when comparing against standard efficiency (IE1), high efficiency (IE2) and premium efficiency (IE3) motors.

Whilst this is not strictly untrue, it should be appreciated when considering their lifetime that the cost of acquisition of an induction motor typically represents only 2% of the total cost of ownership. In contrast, the associated energy savings provided by Super Premium and Premium efficiency motors far outweigh this additional investment in purchase price.

The reduction in CO₂ emissions is one of the direct consequences, and therefore benefits, of increasing efficiency in industry. Using IE4 rated motors today will show that a company is serious about saving energy, reducing carbon and saving money.

Visit our website at www.weg.net to check the potential energy savings, CO₂ emissions reduction and return on investment with W22 Premium and Super Premium motors.

The W22 Super Premium Efficiency line from WEG is the most complete range of IE4 motors available to Industry today, designed to offer not only a significant reduction in energy consumption, but improved noise and vibration levels, higher reliability, easier maintenance and lower overall total cost of ownership.



Minimum Energy Performance Standards - Europe

Increasingly, the World seeks a path of sustainability and new ways to reduce energy consumption.

A significant percentage of the electrical energy utilized in facilities around the World is consumed by electric motors. Consequently, Governments around the World are implementing Energy Efficiency Programs in order to enforce the use of high efficiency motors.

Up until 2009, Europe did not have any specific regulations relating to the energy efficiency levels of electric motors. There existed only a voluntary agreement between Manufacturers from 1998 that determined the efficiency bands EFF1, EFF2 and EFF3.

However, in July 2009 Commission Regulation 640/2009 (implementing EuP Directive 2005/32/EC of July 2005) was adopted, which determined the ecodesign requirements relating to the scope, implementation dates and efficiency levels for electric motors and their use with variable speed drives. Also referred to as EU MEPS (European Minimum Energy Performance Standards), the efficiency levels for electric motors are determined in two IEC standards:

IEC/EN 60034-30-1, which details the efficiency classes in the form of 'IE' codes, and IEC/EN 60034-2-1 which defines the methods to be used to measure the efficiency. The EU Regulation is mandatory within the European Economic Area, EEA (EU countries plus Norway, Iceland and Liechtenstein), from 16th of June 2011. EU MEPS does not apply outside Europe.

Manufacturers can continue to supply IE1 non-CE marked motors to customers located in Europe for further shipment to non-European markets, but these must of course respect any applicable energy efficiency legislation for the destination country of use.

EU Regulations referred are implemented into UK law through the Statutory Instrument 2021 No 745

A new version of the EuP Directive (2009/125/EC) became effective on 21st October 2009 to expand the ecodesign requirements for Energy Related Products, whilst January 2014 saw the adoption of the Commission Regulation 4/2014 (amending the scope of 640/2009) which came into force with effect from 27th July 2014.

Scope

Regulation	EU 1781/2019 and UK Statutory Instrument 2021 No. 745				
Standard	IEC 60034-30-1				
Power supply system	Three - phase				Single - phase
Minimum energy performance	IE3	IE2	IE4	IE2	IE2
Minimum energy performance when is able to operate with inverter frequency	IE3	IE2	IE4	IE2	Not applicable
Output (kW)	0,75 up to 1000 kW	0,12 up to <0,75kW	75 up to 200 kW	0,12 up to 1000 kW	
Number of poles	2,4,6 and 8		2,4 and 6	2,4,6 and 8	
Voltage (V)	up to 1000 V				
Frequency (Hz)	50Hz or 60 Hz				
Service Duty	S1, S3 ≥ 80% or S6 ≥ 80%				
Cooling method	TEFC, TEBC, ODP, TEO				
Degree of protection	IP 00 up to IP 66				
Area classification	Safety and hazardous area (Ex ec, Ex tc, Ex tb, Ex db, Ex dc, Ex db.eb)		Safety area	Hazardous area (Ex.eb)	Safety are
Altitude	Up to 4000 m				
Ambient temperature	-30 up to 60 °C				
Required documentation	Self declaration				

However, the Regulation does not apply to:

- a) Motors designed to operate wholly immersed in liquid.
- b) Motors completely integrated into a product where its energy efficiency cannot be measured independently.
- c) Motors designed to operate exclusively:
 - at altitudes greater than 4,000 metres above sea level
 - in ambient+ air temperatures exceeding 60 °C
 - in maximum operating temperature above 400 °C

- where ambient air temperatures are below -30 °C (or 0 °C for water cooled motors)
- where water coolant temperatures are below 0 °C or above 32 °C at the inlet to the product
- in potentially explosive atmospheres defined in the Directive 94/9/EC

d) Brake motors

50Hz					
Output	IE1				
	Poles				
kW	2	4	6	8	
0,12	45,0	50,0	38,3	31,0	
0,18	52,8	57,0	45,5	38,0	
0,20	54,6	58,5	47,6	39,7	
0,25	58,2	61,5	52,1	43,4	
0,37	63,9	66,0	59,7	49,7	
0,40	64,9	66,8	61,1	50,9	
0,55	69,0	70,0	65,8	56,1	
0,75	72,1	72,1	70,0	61,2	
1,1	75,0	75,0	72,9	66,5	
1,5	77,2	77,2	75,2	70,2	
2,2	79,7	79,7	77,7	74,2	
3	81,5	81,5	79,7	77,0	
4	83,1	83,1	81,4	79,2	
5,5	84,7	84,7	83,1	81,4	
7,5	86,0	86,0	84,7	83,1	
11	87,6	87,6	86,4	85,0	
15	88,7	88,7	87,7	86,2	
18,5	89,3	89,3	88,6	86,9	
22	89,9	89,9	89,2	87,4	
30	90,7	90,7	90,2	88,3	
37	91,2	91,2	90,8	88,8	
45	91,7	91,7	91,4	89,2	
55	92,1	92,1	91,9	89,7	
75	92,7	92,7	92,6	90,3	
90	93,0	93,0	92,9	90,7	
110	93,3	93,3	93,3	91,1	
132	93,5	93,5	93,5	91,5	
160	93,8	93,8	93,8	91,9	
200 up to 1000	94,0	94,0	94,0	92,5	

50Hz					
Output	IE2				
	Poles				
kW	2	4	6	8	
0,12	53,6	59,1	50,6	39,8	
0,18	60,4	64,7	56,6	45,9	
0,20	61,9	65,9	58,2	47,4	
0,25	64,8	68,5	61,6	50,6	
0,37	69,5	72,7	67,6	56,1	
0,40	70,4	73,5	68,8	57,2	
0,55	74,1	77,1	73,1	61,7	
0,75	77,4	79,6	75,9	66,2	
1,1	79,6	81,4	78,1	70,8	
1,5	81,3	82,8	79,8	74,1	
2,2	83,2	84,3	81,8	77,6	
3	84,6	85,5	83,3	80,0	
4	85,8	86,6	84,6	81,9	
5,5	87,0	87,7	86,0	83,8	
7,5	88,1	88,7	87,2	85,3	
11	89,4	89,8	88,7	86,9	
15	90,3	90,6	89,7	88,0	
18,5	90,9	91,2	90,4	88,6	
22	91,3	91,6	90,9	89,1	
30	92,0	92,3	91,7	89,8	
37	92,5	92,7	92,2	90,3	
45	92,9	93,1	92,7	90,7	
55	93,2	93,5	93,1	91,0	
75	93,8	94,0	93,7	91,6	
90	94,1	94,2	94,0	91,9	
110	94,3	94,5	94,3	92,3	
132	94,6	94,7	94,6	92,6	
160	94,8	94,9	94,8	93,0	
200 up to 1000	95,0	95,1	95,0	93,5	

50Hz					
Output	IE3				
	Poles				
kW	2	4	6	8	
0,12	60,8	64,8	57,7	50,7	
0,18	65,9	69,9	63,9	58,7	
0,20	67,2	71,1	65,4	60,6	
0,25	69,7	73,5	68,6	64,1	
0,37	73,8	77,3	73,5	69,3	
0,40	74,6	78,0	74,4	70,1	
0,55	77,8	80,8	77,2	73,0	
0,75	80,7	82,5	78,9	75,0	
1,1	82,7	84,1	81,0	77,7	
1,5	84,2	85,3	82,5	79,7	
2,2	85,9	86,7	84,3	81,9	
3	87,1	87,7	85,6	83,5	
4	88,1	88,6	86,8	84,8	
5,5	89,2	89,6	88,0	86,2	
7,5	90,1	90,4	89,1	87,3	
11	91,2	91,4	90,3	88,6	
15	91,9	92,1	91,2	89,6	
18,5	92,4	92,6	91,7	90,1	
22	92,7	93,0	92,2	90,6	
30	93,3	93,6	92,9	91,3	
37	93,7	93,9	93,3	91,8	
45	94,0	94,2	93,7	92,2	
55	94,3	94,6	94,1	92,5	
75	94,7	95,0	94,6	93,1	
90	95,0	95,2	94,9	93,4	
110	95,2	95,4	95,1	93,7	
132	95,4	95,6	95,4	94,0	
160	95,6	95,8	95,6	94,3	
200 up to 1000	95,8	96,0	95,8	94,6	

50Hz					
Output	IE4				
	Poles				
kW	2	4	6	8	
0,12	66,5	69,8	64,9	62,3	
0,18	70,8	74,7	70,1	67,2	
0,2	71,9	75,8	71,4	68,4	
0,25	74,3	77,9	74,1	70,8	
0,37	78,1	81,1	78,0	74,3	
0,4	78,9	81,7	78,7	74,9	
0,55	81,5	83,9	80,9	77,0	
0,75	83,5	85,7	82,7	78,4	
1,1	85,2	87,2	84,5	80,8	
1,5	86,5	88,2	85,9	82,6	
2,2	88,0	89,5	87,4	84,5	
3	89,1	90,4	88,6	85,9	
4	90,0	91,1	89,5	87,1	
5,5	90,9	91,9	90,5	88,3	
7,5	91,7	92,6	91,3	89,3	
11	92,6	93,3	92,3	90,4	
15	93,3	93,9	92,9	91,2	
18,5	93,7	94,2	93,4	91,7	
22	94,0	94,5	93,7	92,1	
30	94,5	94,9	94,2	92,7	
37	94,8	95,2	94,5	93,1	
45	95,0	95,4	94,8	93,4	
55	95,3	95,7	95,1	93,7	
75	95,6	96,0	95,4	94,2	
90	95,8	96,1	95,6	94,4	
110	96,0	96,3	95,8	94,7	
132	96,2	96,4	96,0	94,9	
160	96,3	96,6	96,2	95,1	
200	96,5	96,7	96,3	95,4	
250	96,5	96,7	96,5	95,4	
315 up to 1000	96,5	96,7	96,6	95,4	

60Hz					
Output	IE1				
	Poles				
kW	2	4	6	8	
0,12	57,5	62,0	48,0	36,0	
0,18	62,0	66,0	52,5	40,0	
0,25	64,0	68,0	57,5	50,5	
0,37	70,0	70,0	62,0	57,5	
0,55	72,0	74,0	66,0	59,5	
0,75	74,0	77,0	72,0	64,0	
1,1	78,5	79,0	75,0	73,5	
1,5	81,0	81,5	77,0	77,0	
2,2	81,5	83,0	78,5	78,0	
3,7	84,5	85,0	83,5	80,0	
5,5	86,0	87,0	85,0	84,0	
7,5	87,5	87,5	86,0	85,0	
11	87,5	88,5	89,0	87,5	
15	88,5	89,5	89,5	88,5	
18,5	89,5	90,5	90,2	88,5	
22	89,5	91,0	91,0	90,2	
30	90,2	91,7	91,7	90,2	
37	91,5	92,4	91,7	91,0	
45	91,7	93,0	91,7	91,0	
55	92,4	93,0	92,1	91,5	
75	93,0	93,2	93,0	92,0	
90	93,0	93,2	93,0	92,5	
110	93,0	93,5	94,1	92,5	
150 up to 1 000	94,1	94,5	94,1	92,5	

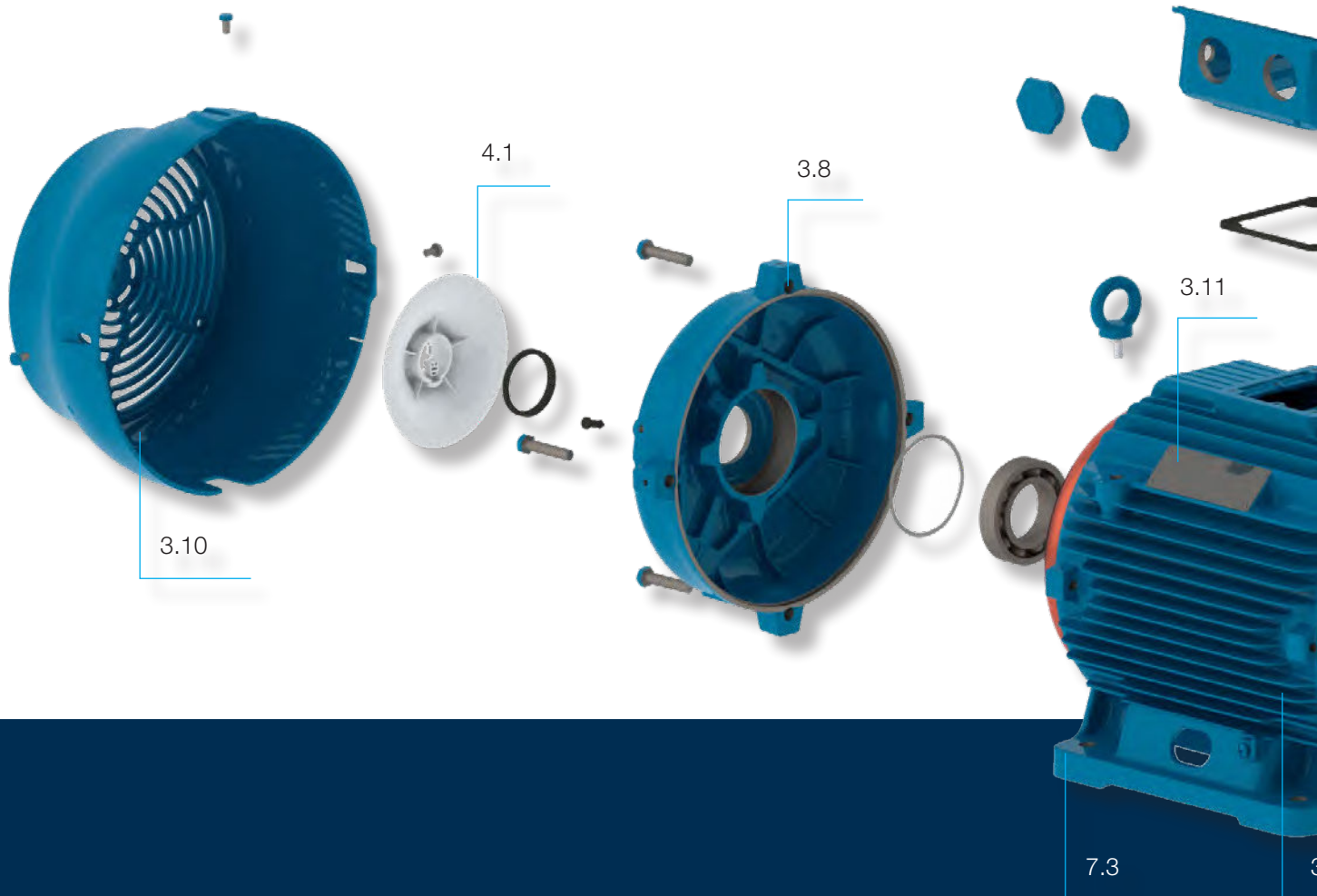
60Hz					
Output	IE2				
	Poles				
kW	2	4	6	8	
0,12	59,5	64,0	50,5	40,0	
0,18	64,0	68,0	55,0	46,0	
0,25	68,0	70,0	59,5	52,0	
0,37	72,0	72,0	64,0	58,0	
0,55	74,0	75,5	68,0	62,0	
0,75	75,5	78,0	73,0	66,0	
1,1	82,5	84,0	85,5	75,5	
1,5	84,0	84,0	86,5	82,5	
2,2	85,5	87,5	87,5	84,0	
3,7	87,5	87,5	87,5	85,5	
5,5	88,5	89,5	89,5	85,5	
7,5	89,5	89,5	89,5	88,5	
11	90,2	91,0	90,2	88,5	
15	90,2	91,0	90,2	89,5	
18,5	91,0	92,4	91,7	89,5	
22	91,0	92,4	91,7	91,0	
30	91,7	93,0	93,0	91,0	
37	92,4	93,0	93,0	91,7	
45	93,0	93,6	93,6	91,7	
55	93,0	94,1	93,6	93,0	
75	93,6	94,5	94,1	93,0	
90	94,5	94,5	94,1	93,6	
110	94,5	95,0	95,0	93,6	
150	95,0	95,0	95,0	93,6	
185	95,4	95,0	95,0	93,6	
220 up to 335	95,4	95,4	95,0	93,6	
375 up to 1 000	95,4	95,8	95,0	94,1	

60Hz					
Output	IE3				
	Poles				
kW	2	4	6	8	
0,12	62,0	66,0	64,0	59,5	
0,18	65,6	69,5	67,5	64,0	
0,25	69,5	73,4	71,4	68,0	
0,37	73,4	78,2	75,3	72,0	
0,55	76,8	81,1	81,7	74,0	
0,75	77,0	83,5	82,5	75,5	
1,1	84,0	86,5	87,5	78,5	
1,5	85,5	86,5	88,5	84,0	
2,2	86,5	89,5	89,5	85,5	
3,7	88,5	89,5	89,5	86,5	
5,5	89,5	91,7	91,0	86,5	
7,5	90,2	91,7	91,0	89,5	
11	91,0	92,4	91,7	89,5	
15	91,0	93,0	91,7	90,2	
18,5	91,7	93,6	93,0	90,2	
22	91,7	93,6	93,0	91,7	
30	92,4	94,1	94,1	91,7	
37	93,0	94,5	94,1	92,4	
45	93,6	95,0	94,5	92,4	
55	93,6	95,4	94,5	93,6	
75	94,1	95,4	95,0	93,6	
90	95,0	95,4	95,0	94,1	
110	95,0	95,8	95,8	94,1	
150	95,4	96,2	95,8	94,5	
185 up to 1 000	95,8	96,2	95,8	95,0	

60Hz					
Output	IE4				
	Poles				
kW	2	4	6	8	
0,12	66,0	70,0	68,0	64,0	
0,18	70,0	74,0	72,0	68,0	
0,25	74,0	77,0	75,5	72,0	
0,37	77,0	81,5	78,5	75,5	
0,55	80,0	84,0	82,5	77,0	
0,75	82,5	85,5	84,0	78,5	
1,1	85,5	87,5	88,5	81,5	
1,5	86,5	88,5	89,5	85,5	
2,2	88,5	91,0	90,2	87,5	
3,7	89,5	91,0	90,2	88,5	
5,5	90,2	92,4	91,7	88,5	
7,5	91,7	92,4	92,4	91,0	
11	92,4	93,6	93		

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3.4

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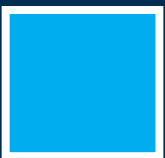
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3.1



Driving efficiency and sustainability



1. Versions Available

Meeting the legislative requirements of the European Market, W22 motors are available in three versions in accordance with IEC 60034-30-1:2014: Premium (IE3), Super Premium (IE4) or Ultra Premium (IE5) motors.

Efficiency values for W22 motors are prepared in accordance with the test standard IEC 60034-2-1:2014, with stray load losses determined directly by the summation of losses.

The output versus frame ratio for all W22 motors follows the EN 50347 standard, thus allowing direct replacement of existing lower efficiency motors with Premium (IE3), Super Premium (IE4) or Ultra Premium (IE5) motors.

A further characteristic of the W22 electrical design is that it was conceived in such way that its efficiency remains practically constant in the 75% to 100% load range. Therefore, even when the motor is not running at full load its efficiency is not affected (see figure 1).

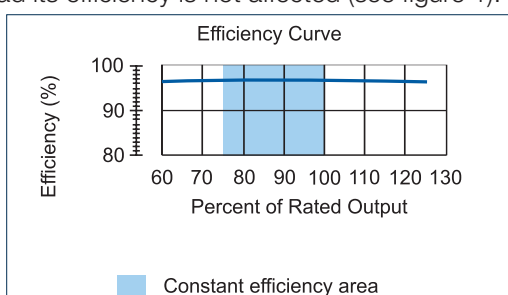


Figure 1 - Typical efficiency curve of W22 line

2. Standards

W22 motors meet the requirements and regulations of the latest versions of the following International Standards: IEC 60034-1 Rotating electrical machines - Part 1: Rating and performance.

IEC 60034-2-1 Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles).

IEC 60034-5 Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - classification.

IEC 60034-6 Rotating electrical machines - Part 6: Methods of cooling (IC code).

IEC 60034-7 Rotating electrical machines - Part 7: Classification of types of enclosures and mounting arrangements (IM code).

IEC 60034-8 Rotating electrical machines - Part 8: Terminal markings and direction of rotation.

IEC 60034-9 Rotating electrical machines - Part 9: Noise limits.

IEC 60034-11-1 Rotating electrical machines - Part 11-1: Thermal protection.

IEC 60034-12 Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors.

IEC 60034-14 Rotating electrical machines - Part 14: Mechanical vibration of certain machines - Limits of vibration.

IEC 60034-30-1 Rotating electrical machines - Part 30: Efficiency classes for single-speed three-phase cage induction motors.

IEC 60072-1 Dimensions and output series for rotating electrical machines - Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080.

EN 50347 General purpose three-phase induction motors having standard dimensions and outputs - frame numbers 56 to 315 and flange numbers 65 to 740.

3. Construction Details

The information included in this technical catalogue refers to the standard construction features and most common variations for W22 Low Voltage General Purpose Motors in frame sizes from IEC 63 to 355A/B.

W22 motors for special and/or customized applications are available on request. For more information, please, contact your WEG office or distributor.

3.1. Frame

The W22 frame (figure 2) is manufactured in FC-200 (EN GJL 200) cast iron providing high levels of mechanical strength to cater for the most demanding applications. The cooling fins are designed to minimize the accumulation of liquids and dust on the motor.



Figure 2 - W22 Frame

The motor feet are completely solid for optimal mechanical strength (figure 3), allowing easier alignment and installation.

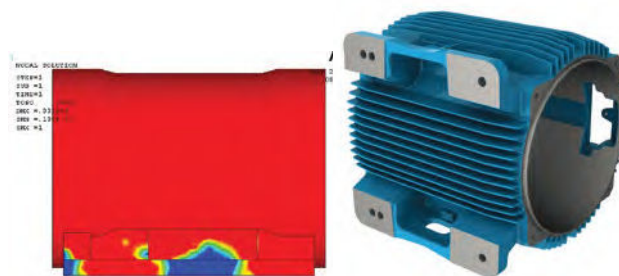


Figure 3 - Solid feet

3.2. Eyebolts

Eyebolts are provided as standard from frame size 100L. The positions of the eyebolts are shown in the table 2:

Number of eyebolts	Description
1	Frames 100L to 200L Motors with feet and with side mounted terminal box
2	Frames 100L to 200L Motors with feet and with top mounted terminal box
2	Frames 100L to 200L - Motors without feet and with C or FF flange
2	Frames 225S/M to 355A/B - Motors with feet and side or top mounted terminal box. These motors have four threaded holes in the upper part of the frame for fastening of the eyebolts (figure 5)
2	Frames 225S/M to 355A/B - Motors without feet and with C or FF flange. These motors have four threaded holes in the upper part of the frame for fastening of the eyebolts and two more threaded holes in the bottom part

Table 2 - Eyebolts



Figure 4 - Motor with four threaded holes for fastening of the eyebolts

3.3. Points for Vibration Monitoring

To allow easy maintenance, specifically vibration testing, the 160 to 355 frames are designed with flat areas on both ends for better placement of accelerometers. These flat areas are provided in both vertical and horizontal planes. As an option M8 threads for SPM accelerometers can be supplied. (Figure 5)



Figure 5 -Flat surfaces for vibration monitoring on the top, front and side.

3.4. Earth Terminals

All frames from 63 to 355A/B are provided with an earth terminal located inside the terminal box (see figure 6). Motors in frames 225S/M to 355A/B are also fitted with an earth terminal on the frame. It is located on the same side of the main terminal box cable entry and is responsible to equalize electrical potential and provide greater safety for operators. Capable of terminating cables from 25 mm² to 185 mm².

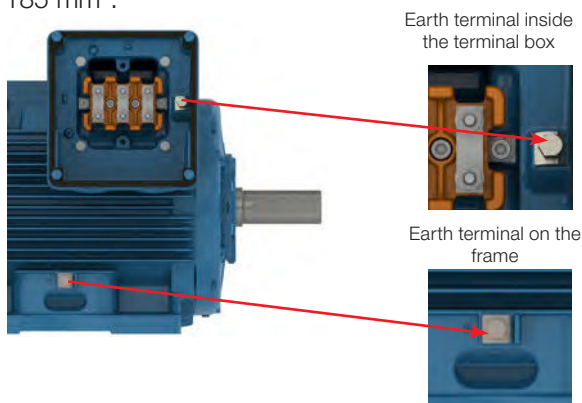


Figure 6 -Earth terminal inside the terminal box and on the frame

Optionally, an external earth terminal can be provided for motors in frame sizes 63 to 200, and, for frame sizes 80 to 355A/B a second external earth terminal as indicated in figure 7.

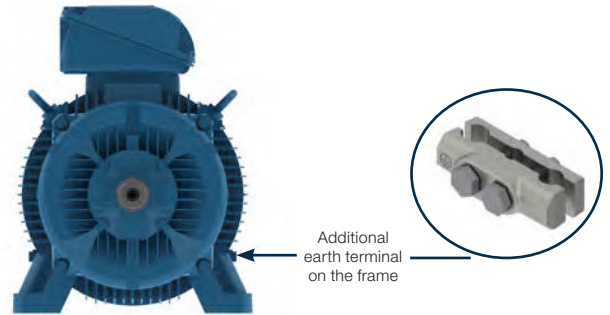


Figure 7 -Additional earth terminal position on the frame

3.5. Terminal Box

The terminal box of W22 motors is produced in FC-200 (EN GJL 200) cast iron, which is the same material used for the frame and endshields. It is diagonally split for easier handling of leads and connections.

For the frame size range 63 to 200 the terminal box position is centralized on the motor frame and can be supplied in two configurations - top (standard) or left / right side (optional). A motor with a side mounted terminal box (B3R or B3L) can have the terminal box position located on the opposite side through modification.

For frame sizes 225S/M to 355A/B the terminal box is positioned towards the drive end of the motor and on top as standard. This arrangement allows improvement of the airflow over the cooling fins, thus reducing motor operating temperatures.

Terminal box position on either the left or right hand side of the motor is possible through the use of an adaptor (see figure 8).



Figure 8 - Terminal box mounted on the left side viewing from drive end shaft

When supplied from the factory with a side mounted terminal box arrangement, this can be positioned on the opposite side simply by rotating the adaptor.

Similarly, by removing the adaptor and adjusting the length of the motor leads, the terminal box can be positioned on top of the motor.

The flexibility of terminal box positions on the W22 motor offered by the adaptor can be seen in figure 9.



Figure 9 -Terminal box mounted on both sides and on top (versatility)

Conversely, factory supplied motors with the terminal box position on top can be modified to side mounting by fitting the adaptor and extending the motor leads.

Note: For all terminal box position modifications please contact WEG or your local WEG service centre.

For all frames, the terminal box can be rotated in 90° increments. Motors in IEC frame sizes 315L, 355M/L and 355A/B are supplied as standard with removable cast iron cable gland plates. As an option, the gland plates can be supplied undrilled.

Motors are supplied with plastic threaded plugs in the cable entries for protection against ingress of solid objects during transport.

In order to guarantee the degree of protection, cable glands must comply with at least the same degree of protection as that indicated on the motor nameplate. Lack of compliance with such detail can invalidate the motor warranty. If required, please contact the WEG Service Area for further advice.

3.6. Power Supply Connection Leads

Motor power supply leads are marked in accordance with IEC 60034-8 and are connected to a terminal block made from a polyester based resin BMC (Bulk Moulding Compound), duly reinforced with fibre glass (see figure 10).



Figure 10 -BMC terminal block

Motors in frame size 355A/B are provided with a staggered terminal block arrangement, as indicated in figure 11.



Figure 11 -355A/B staggered terminal block

3.7. Accessory Connection Leads

Accessory terminals are assembled onto connectors whenever the motor is supplied with a terminal block. They may be assembled inside the main power terminal box or in a separate accessory terminal box (figure 12). Whether the accessory terminals are assembled inside the main power or a separate terminal box, an M20x1,5 threaded hole is provided for fitting of cable glands for the incoming connection leads.

In the Terminal Box Drawings Section of this technical catalogue it is possible to check the permissible number of connectors which may be assembled inside the main power and accessory terminal boxes.



Figure 12 -Accessory terminal box attached to power terminal box

For all frame sizes, there is also the option of providing a dedicated terminal box for the connection of space heaters, or two separate accessory terminal boxes, as shown in figure 13.



Figure 13 -Two accessory terminal boxes attached to power terminal box

3.8. Endshields

The drive end shield (figure 14) is designed with fins for improved thermal heat dissipation, to ensure lower bearing operating temperatures, resulting in extended lubrication intervals.

For the frames 225S/M to 355A/B, where ventilation is critical for thermal performance of the motor, the endshield fastening screws are located in such a way so as not to obstruct the airflow across any cooling fin, thus contributing to better thermal exchange.



Figure 14 - Drive and non-drive endshields

3.9. Drains

W22 has automatic drain plugs with degree of protection IP66 (see figure 15) which do not require human intervention to open the plug and avoid accumulation of condensed liquids into the motor.

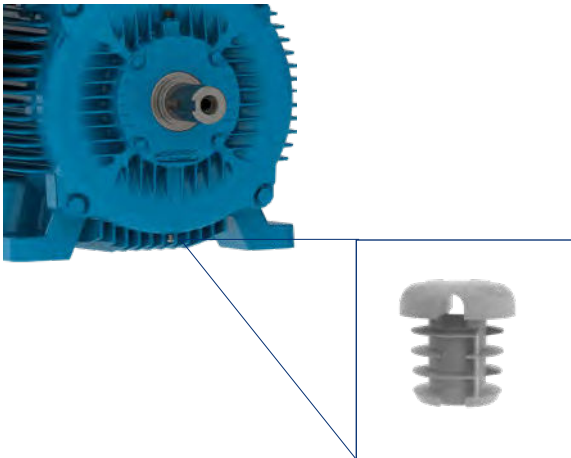


Figure 15 - Detail of the drain plug position on drive endshield.

3.10. Fan Cover

The fan cover is made of steel for frames 63 to 132 and FC-200 (EN GJL 200) cast iron for frames 160 to 355. The cast iron fan covers have an aerodynamic design, which results in a significant reduction in noise level and optimized airflow between frame fins for heat exchange improvement. Figure 16 shows the aerodynamic design of the cast iron fan cover.



Figure 16 - Fan cover

3.11. Nameplate

The nameplate details information relating to the construction and performance characteristics of the motor. It is also necessary to indicate on the nameplate the IE code and nominal efficiency of the motor at full load (and 3/4 and 1/2 load where space permits), as required by IEC 60034-30-1.

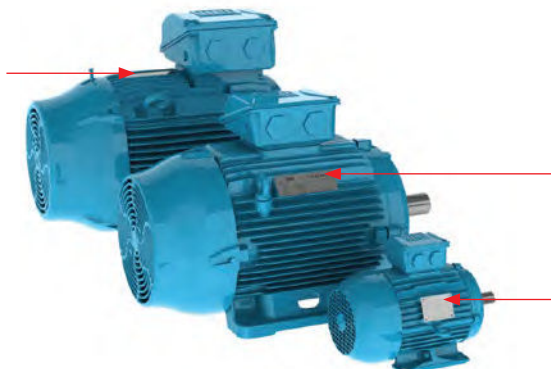


Figure 17 - Nameplate position of W22 motors

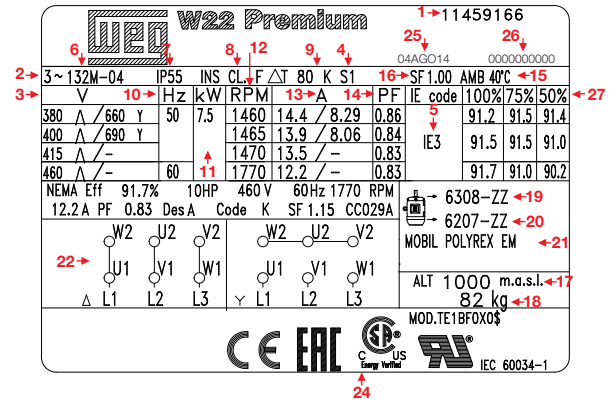


Figure 18 - Nameplate layout for frames 63 to 132

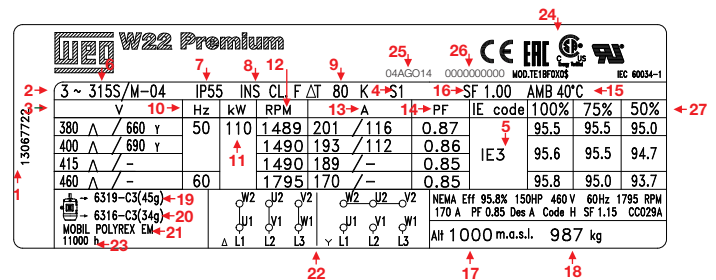


Figure 19 - Nameplate layout for frames 160 to 355

- 1 - Motor code
- 2 - Number of phases
- 3 - Rated operating voltage
- 4 - Service duty
- 5 - Efficiency Code - IE
- 6 - Frame size
- 7 - Degree of protection
- 8 - Insulation class
- 9 - Temperature rise
- 10 - Frequency
- 11 - Motor rated power
- 12 - Full load speed (rpm)
- 13 - Rated operating current
- 14 - Power factor
- 15 - Ambient temperature
- 16 - Service factor
- 17 - Altitude
- 18 - Motor weight
- 19 - Drive end bearing type and amount of grease (where applicable)
- 20 - Non-drive end bearing type and amount of grease (where applicable)
- 21 - Type of grease for bearings
- 22 - Connection diagram
- 23 - Relubrication intervals in hours
- 24 - Certification labels
- 25 - Manufacturing date
- 26 - Serial number
- 27 - Partial load efficiencies

4. Cooling System and Noise Level / Vibration Level / Impact Resistance

4.1. Cooling System

The W22 standard motors are totally enclosed fan cooled (TEFC - IC 411), as per IEC 60034-6 (figure 20).

Non-ventilated versions (TENV - IC 410), air over (TEAO - IC 418) and motors with forced ventilation (TEBC - IC416) are available on request. Further information regarding the TEBC - IC 416 option can be found in Section 13 - Variable speed drive application.



Figure 20 -Cooling system

The cooling system (fan, non drive endshield and fan cover) is designed to minimize the noise level and improve thermal efficiency (figure 21).

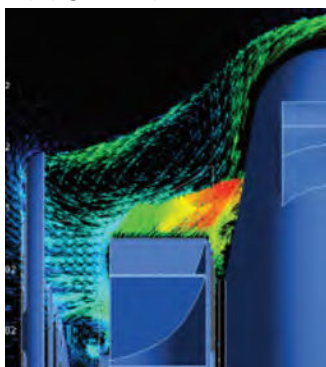


Figure 21 -Cooling system operation

4.2. Noise Level

W22 motors comply with IEC 60034-9 Standard and the corresponding sound pressure levels. Tables 3 and 4 show sound pressure levels in dB(A) which are obtained upon tests at 50 Hz and 60 Hz.

Frame	IEC 50 Hz Sound pressure level - dB(A) at 1 meter			
	2 poles	4 poles	6 poles	8 poles
63	52	44	43	-
71	56	43	43	41
80	59	44	43	42
90	64/ 62(*)	49	45	43
100	67	53	44	50
112	64	56	48	46
132	68/ 67(*)	60/ 56(*)	52	48
160	67	61	56	51
180	67	61	56	51
200	72/ 69(*)	65/ 63(*)	60	53
225	75/ 74(*)	66/ 63(*)	61	56
250	75/ 74(*)	66/ 64(*)	61	56
280	77	69	65	59
315S/M	77	71	67	61
315 L	78	74/ 73(*)	68	61
355M/L	80	76/ 74(*)	73	70
355A/B	83	76	73	70

Table 3 - Sound pressure levels for 50 Hz motors

(*) Values for IE3 and IE4 motors.

Frame	IEC 60 Hz Sound pressure level - dB(A) at 1 meter			
	2 poles	4 poles	6 poles	8 poles
63	56	48	47	-
71	60	47	47	45
80	62	48	47	46
90	68	51	49	47
100	71	54	48	54
112	69	58	52	50
132	72	61	55	52
160	72	64	59	54
180	72	64	59	54
200	76/ 74(*)	68/ 66(*)	62	56
225	80/ 79(*)	70/ 67(*)	64	60
250	80/ 79(*)	70/ 68(*)	64	60
280	81	73	69	63
315S/M	81	75	70	64
315L	82	79/ 77(*)	71	64
355M/L	84	81/ 78(*)	77	75
355A/B	89	81	77	75

Table 4 -Sound pressure levels for 60 Hz motors

(*) Values for IE3 and IE4 motors.

The noise level values shown in tables 3 and 4 are taken at 1 metre at no load. Under load the IEC 60034-9 Standard foresees an increase of the sound pressure levels as shown in table 5.

Frame (mm)	2 poles	4 poles	6 poles	8 poles
90 ≤ H ≤ 160	2	5	7	8
180 ≤ H ≤ 200	2	4	6	7
225 ≤ H ≤ 280	2	3	6	7
H = 315	2	3	5	6
355 ≤ H	2	2	4	5

Table 5 -Maximum expected increase of sound pressure level for loaded motors.

Note: These values refer to operating frequencies of 50 Hz and 60 Hz.

The overall noise level can be reduced by up to 2 dB (A) with the installation of a drip cover.

4.3. Vibration Level

Vibration of an electrical machine is closely related to its assembly on the application and, thus, it is generally desirable to perform vibration measurements under installation and operational conditions. However, to allow evaluation of the vibration generated by the electrical machine itself in a way to allow reproducibility of the tests and the obtaining of comparative measurements, it is necessary to perform such measurements with the machine uncoupled, under controlled test conditions. The test conditions and vibration limits described here are those found in IEC 60034-14.

The severity of vibration is the maximum value of vibration found among all the recommended measurement points and directions. Table below, indicates the recommended admissible values of vibration severity under IEC standard 60034-14 for the frames IEC 56 to 400, for degrees of vibration A and B.

W22 motors (> frame 80, 2P and > frame 71, 4P and up) are dynamically balanced with half key and the standard version meets the vibration levels of Grade A (without special vibration requirements) described in IEC 60034-14 Standard. As an option, motors can be supplied in conformance with vibration of Grade B. The RMS speed and vibration levels in mm/s of Grades A and B are shown in table 6.

Vibration	Frame	56 ≤ H ≤ 132	132 < H ≤ 280	H > 280
	Assembly	Vibration speed RMS (mm/s)	Vibration speed RMS (mm/s)	Vibration speed RMS (mm/s)
Grade A	Free suspension	1,6	2,2	2,8
Grade B	Free suspension	0,7	1,1	1,8

Table 6 - Speed and vibration levels

4.4. Impact Resistance

The W22 motor complies with impact level IK08 (mechanical impact of 5J) as defined in EN 62262:2002 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) - therefore ensuring superior mechanical strength for the most demanding applications.

5. Shaft / Bearings

5.1. Shaft

The shaft steel material for W22 standard motors is AISI 1040/45, in frames IEC 63 to 315S/M, and AISI 4140 for frames 315L, 355M/L and 355A/B. When supplied with roller bearings, the shaft material must be AISI 4140. Information regarding the maximum allowable radial and axial loads on shaft ends is given in tables 8, 9 and 10. Important: when equipped with a roller bearing, it is necessary to lock the non-drive end bearing which obliges replacement of the non-drive end bearing cap.

Shafts of W22 motors are supplied with an open profile keyway, with a threaded centre hole, and can optionally be provided with a second shaft end. Dimensions of motor shafts can be found in Section 18 - Mechanical Data. For highly corrosive environments, W22 motors may also be supplied with AISI 316 or AISI 420 stainless steel shafts.

Note: 2 pole motors will have as an option only the shaft end in stainless steel AISI 316.

5.2. Bearings

W22 motors are supplied with deep groove ball bearings as standard (figure 22). Optionally, for frame sizes 132 and above, NU series roller bearings can be fitted to motors intended for heavy duty applications where high radial loads may occur e.g. pulley and belt drives.



Figure 22 -Ball bearing view

The nominal bearing life L10h is 20.000 or 40.000 hours in conformance with maximum radial and axial loads as described in tables 8, 9 and 10. When direct coupled to the load (without axial or radial thrusts), the L10h bearing life can be extended to 50.000* hours.

** For regreasable motors. Other configurations contact WEG.*

In standard configuration, with ball bearings, the drive end bearing is locked axially from frame 160. To compensate for any axial movement the motors are fitted with pre-load washers for frames 63 to 200 and with pre-load springs for frames 225 to 355. When provided with roller bearings, the non-drive end bearing is locked and the axial movement is compensated by the axial play of the front roller bearing. Minimum and maximum admissible radial loads for roller bearings are shown in table 10 on page 14.

The lifetime of the bearing is dependent on its type and size, the radial and axial mechanical loads it is submitted to, operating conditions (environment, temperature, mounting orientation), rotational speed and grease life. Therefore, bearing lifetime is closely related to its correct use, maintenance and lubrication. Respecting the quantity of grease and lubrication intervals allows bearings to reach the indicated lifetime. W22 motors in IEC frames 225S/M and above are provided as standard with grease fittings in each endshield to permit the relubrication of the bearings (optional for frames 90 to 200). The quantity of grease and lubrication intervals are stamped on the motor nameplate. The lubrication intervals are shown in tables 13 and 14 on page 16. It must be emphasized that excessive lubrication, i.e. a quantity of grease greater than that recommended on the motor nameplate, can result in the increase of bearing temperatures leading to reduced operating hours.

Note:

1. L10h lifetime means that at least 90% of the bearings submitted to the maximum indicated loads will reach the number of hours indicated. The maximum admissible radial and axial loads for the standard configuration are shown in tables 8,9,10,11 and 12. The values of the maximum radial load consider axial load as nil. The values of the maximum axial load consider radial load as nil. For bearing lifetimes with combined axial and radial loads condition contact WEG.
2. The radial force value Fr usually results from information recommended in the catalogues of pulley / belt manufacturers. When this information is not available, the force Fr, under operation, can be calculated based on the output power, on coupling design characteristics with pulleys and belts and on the type of application. So we have:

$$Fr = \frac{19,1 \times 10^6 \times P_n}{n_n \times dp} \times ka \text{ (N)}$$

Where:

Fr is the radial force caused by pulley and belt coupling [N];

Pn is the motor rated power [kW];

nn is the motor rated speed per minute [rpm];

dp is the pitch diameter of the drive pulley [mm];

ka is a factor that depends on belt tension and type of application (table 7).

Groups and basic types of application		ka factor of the application	
		V belts	Plane belts
1	Fans and blowers, centrifugal pumps, winding machines, compressors, machine tools with outputs up to 22 kW (30 HP)	2,0	3,1
2	Fans and blowers, centrifugal pumps, winding machines, compressors, machine tools with outputs higher than 22 kW (30 HP)	2,4	3,3
3	Presses, vibrating screens, piston and screw compressors, pulverisers, helicoidal conveyors, woodworking machines, textile machines, kneading machines, ceramic machines, pulp and paper industrial grinders (for all power range).	2,7	3,4
4	Overhead cranes, hammer mills, metal laminators, conveyors, gyratory crushers, jaw crushers, cone crushers, cage mills, ball mills, rubber mixers, mining machines, shredders (for all power range).	3,0	3,7

Table 7 - ka factor

Important:

1 - Special applications

Motor operation under adverse operating conditions, such as higher ambient temperatures and altitudes or abnormal axial / radial loads, may require specific lubrication measures and alternative relubrication intervals to those indicated in the tables provided within this technical catalogue.

2 - Roller bearings

Roller bearings require a minimum radial load so as to ensure correct operation. They are not recommended for direct coupling arrangements, or for use on 2 pole motors.

3 - Frequency inverter driven motors

Bearing life may be reduced when a motor is driven by a frequency drive at speeds above nominal. Speed itself is one of the factors taken into consideration when determining motor bearing life.

4 - Motors with modified mounting configurations

For motors supplied with horizontal mounting but working vertically, lubrication intervals must be reduced by half.

5 - Figures for radial thrusts

The figures given in the tables below for radial thrusts take into consideration the point upon which the load is applied, either at the centre of the shaft (L/2) or at the end of the shaft (L), figure 23.

Note: On motors with second shaft end, refer to WEG for details of the maximum permissible axial and radial loads.

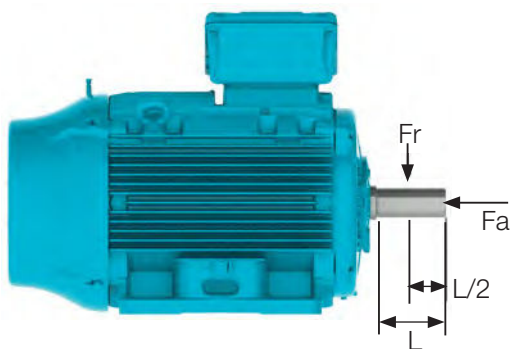


Figure 23 -Radial and axial thrust on motor shaft

5.2.1. PermissibleLoads

Radial Thrust - Ball Bearings

Frame	Maximum permissible radial thrust - 50 Hz - Fr in (kN) 20.000 hours							
	2 poles		4 poles		6 poles		8 poles	
	L	L/2	L	L/2	L	L/2	L	L/2
63	0,3	0,4	0,3	0,4	0,3	0,4	0,3	0,4
71	0,5	0,5	0,5	0,6	0,5	0,6	0,6	0,7
80	0,6	0,6	0,7	0,7	0,7	0,8	0,8	1,0
90	0,6	0,7	0,7	0,8	0,8	0,9	0,9	1,0
100	0,9	1,0	1,0	1,1	1,2	1,3	1,3	1,4
112	1,2	1,3	1,4	1,5	1,6	1,8	1,7	1,9
132	1,8	2,0	2,2	2,4	2,4	2,7	2,6	2,9
160	2,3	2,6	2,6	2,9	2,7	3,3	2,7	3,7
180	3,1	3,5	3,6	4,0	4,2	4,7	4,2	5,2
200	3,7	4,0	4,2	4,7	4,9	5,4	5,7	6,2
225	5,1	5,5	5,2	6,3	5,3	7,0	5,7	8,1
250	4,9	5,3	5,2	5,7	6,5	7,1	6,0	8,2
280	5,0	5,4	6,7	7,2	7,8	8,4	8,7	9,4
315S/M	4,3	4,7	7,0	7,7	8,1	8,8	9,0	9,8
315L	4,6	5,0	4,0	7,3	6,2	8,2	9,1	9,8
355M/L	4,8	5,1	8,5	9,3	9,6	10,4	11,6	12,6
355A/B	4,5	4,7	5,1	7,4	7,4	8,0	6,9	10,6

Table 8 -Maximum permissible radial thrusts for ball bearings (horizontal mounting)

Radial Thrust - Ball Bearings

Frame	Maximum permissible radial thrust - 50 Hz - Fr in (kN) 40.000 hours							
	2 poles		4 poles		6 poles		8 poles	
	L	L/2	L	L/2	L	L/2	L	L/2
63	0,2	0,2	0,3	0,3	0,3	0,4	0,3	0,4
71	0,3	0,3	0,4	0,4	0,5	0,5	0,5	0,6
80	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,7
90	0,5	0,5	0,5	0,6	0,6	0,7	0,7	0,8
100	0,7	0,7	0,7	0,8	0,9	1,0	1,0	1,1
112	0,9	1,0	1,0	1,1	1,2	1,4	1,3	1,4
132	1,4	1,6	1,6	1,8	1,8	2,0	2,0	2,2
160	1,8	2,0	1,9	2,1	2,2	2,4	2,5	2,7
180	2,4	2,7	2,7	3,0	3,2	3,5	3,6	3,9
200	2,8	3,0	3,2	3,5	3,7	4,0	4,3	4,7
225	3,9	4,3	4,3	4,7	4,7	5,2	5,6	6,2
250	3,7	4,1	3,8	4,2	4,9	5,4	5,7	6,3
280	3,8	4,1	4,9	5,4	5,8	6,3	6,5	7,0
315S/M	3,1	3,4	4,9	5,4	5,7	6,2	6,3	6,9
315L	3,4	3,6	4,0	4,9	5,1	5,5	6,4	6,9
355M/L	3,3	3,6	5,8	6,3	6,5	7,1	8,2	8,9
355A/B	3,0	3,2	4,1	4,4	4,2	4,5	5,3	6,8

Table 9 - Maximum permissible radial thrusts for ball bearings (horizontal mounting).

Radial Thrust - Roller Bearings

Frame	Maximum permissible radial thrust - 50 Hz - Fr in (kN) 40.000 hours					
	4 poles		6 poles		8 poles	
	L/2	L	L/2	L	L/2	L
160	5,0	3,2	5,1	3,3	5,1	3,3
180	8,8	5,5	8,8	5,6	8,8	5,6
200	11,2	7,3	11,2	7,4	11,3	7,4
225S/M	12,9	7,6	12,9	7,6	13,0	7,8
250S/M	13,7	8,9	13,8	8,9	13,7	8,9
280S/M	19,3	12,6	19,4	12,8	19,6	12,9
315S/M	25,8	12,9	27,4	13,0	27,4	13,2
315L	21,5	10,1	20,1	9,4	26,1	12,2
355M/L	34,0	17,3	33,5	16,4	33,5	16,1
355A/B	31,4	14,9	25,4	12,0	28,4	13,5

Table 10 -Maximum permissible radial thrusts for roller bearings (horizontal mounting)

Note: the values given for roller bearings consider AISI 4140 steel shafts.

Axial Thrust - Ball Bearings

Maximum permissible axial thrust - 50 Hz - Fa in (kN) - 20.000 hours							
Frame	Poles	Horizontal		Vertical with shaft upwards		Vertical with shaft downwards	
		Pushing	Pulling	Pushing	Pulling	Pushing	Pulling
63	2	0,2	0,2	0,2	0,2	0,2	0,2
	4	0,3	0,3	0,3	0,3	0,3	0,3
	6	0,3	0,4	0,3	0,4	0,4	0,3
	8	0,3	0,4	0,3	0,4	0,4	0,3
71	2	0,2	0,3	0,2	0,3	0,2	0,3
	4	0,3	0,4	0,3	0,4	0,3	0,4
	6	0,4	0,5	0,4	0,5	0,4	0,5
	8	0,5	0,6	0,4	0,6	0,5	0,6
80	2	0,3	0,4	0,3	0,4	0,3	0,4
	4	0,4	0,6	0,3	0,6	0,4	0,5
	6	0,5	0,7	0,4	0,7	0,5	0,7
	8	0,6	0,8	0,5	0,9	0,6	0,8
90	2	0,4	0,4	0,3	0,5	0,4	0,4
	4	0,5	0,6	0,5	0,7	0,5	0,6
	6	0,6	0,7	0,6	0,8	0,6	0,7
	8	0,8	0,9	0,7	0,9	0,8	0,8
100	2	0,4	0,6	0,3	0,7	0,4	0,6
	4	0,5	0,8	0,4	0,9	0,5	0,8
	6	0,7	1	0,6	1,1	0,7	1
	8	0,8	1,2	0,7	1,3	0,8	1,1
112	2	0,5	0,8	0,5	0,9	0,6	0,7
	4	0,7	1,1	0,7	1,2	0,8	1
	6	1	1,4	0,9	1,5	1	1,3
	8	1,1	1,5	1	1,7	1,1	1,4
132	2	0,7	1,3	0,6	1,5	0,8	1,2
	4	1	1,8	0,8	2,1	1	1,7
	6	1,2	2,2	1,1	2,5	1,3	2,1
	8	1,4	2,5	1,2	2,8	1,4	2,3
160	2	2,4	1,7	0,2	2,1	2,8	1,5
	4	3	2,3	2,7	2,7	3,4	2
	6	3,4	2,7	3,1	3,3	4	2,4
	8	3,9	3,2	3,6	3,7	4,4	2,9
180	2	3,2	2,3	2,9	2,8	3,7	2
	4	3,9	3	3,6	3,7	4,6	2,7
	6	4,7	3,8	4,2	4,5	5,3	3,3
	8	5,2	4,4	4,8	5,1	6	3,9
200	2	3,6	2,6	3,1	3,3	4,3	2,1
	4	4,5	3,5	4	4,3	5,3	3
	6	5,2	4,2	4,7	5,1	6,1	3,7
	8	6	5	5,5	5,9	6,9	4,5
225	2	4,6	3,8	3,8	4,9	5,7	3,1
	4	5,8	5	5	6,3	7,1	4,2
	6	6,7	5,9	5,7	7,6	8,4	4,9
	8	7,8	7	6,9	8,5	9,3	6,1
250	2	4,5	3,7	3,7	4,9	5,6	3
	4	5,4	4,7	4,2	6,6	7,4	3,4
	6	6,8	6	5,4	8	8,8	4,6
	8	7,8	7,1	6,6	8,9	9,7	5,9
280	2	4,4	3,7	3,2	5,4	6,2	2,4
	4	6,3	5,5	4,6	8	8,8	3,9
	6	7,6	6,8	5,8	9,4	10,2	5
	8	8,5	7,8	6,6	10,6	11,4	5,8
315S/M	2	4,1	3,3	2,4	5,9	6,7	1,6
	4	6,8	6	4,3	10	10,7	3,5
	6	8	7,2	5,2	11,9	12,7	4,5
	8	9,1	8,3	6,2	13,2	14	5,5
315L	2	3	2,2	1,1	5	5,7	0,4
	4	4,5	3,7	1,4	8,2	8,9	0,6
	6	5,2	4,4	1,9	9,5	10,3	1,2
	8	6,3	5,5	3,4	10	10,8	2,6
355M/L	2	4,4	3,7	1,1	8,8	9,5	0,3
	4	7,7	7	3,2	13,9	14,7	2,5
	6	9,1	8,4	4,7	15,3	16	3,9
	8	10,9	10,2	6,4	17,2	17,9	5,7
355A/B	2	4,1	3,3	On request			
	4	6,8	6				
	6	7,8	7				
	8	9,8	9				

Table 11 -Maximum permissible axial thrusts for ball bearings (horizontal mounting).

Axial Thrust - Ball Bearings

Maximum permissible axial thrust - 50 Hz - Fa in (kN) - 40.000 hours							
Frame	Poles	Horizontal		Vertical with shaft upwards		Vertical with shaft downwards	
		Pushing	Pulling	Pushing	Pulling	Pushing	Pulling
63	2	0,1	0,1	0,1	0,1	0,1	0,1
	4	0,2	0,2	0,2	0,2	0,2	0,2
	6	0,2	0,2	0,2	0,2	0,2	0,2
	8	0,2	0,2	0,2	0,2	0,2	0,2
71	2	0,1	0,2	0,1	0,2	0,1	0,2
	4	0,2	0,3	0,2	0,3	0,2	0,2
	6	0,2	0,3	0,2	0,3	0,2	0,3
	8	0,3	0,4	0,3	0,4	0,3	0,4
80	2	0,2	0,3	0,1	0,3	0,2	0,3
	4	0,2	0,4	0,2	0,4	0,2	0,3
	6	0,3	0,5	0,3	0,5	0,3	0,4
	8	0,4	0,6	0,3	0,6	0,4	0,5
90	2	0,2	0,3	0,2	0,3	0,2	0,2
	4	0,3	0,4	0,3	0,4	0,3	0,3
	6	0,4	0,5	0,4	0,5	0,4	0,4
	8	0,5	0,6	0,5	0,6	0,5	0,5
100	2	0,2	0,4	0,2	0,4	0,2	0,3
	4	0,3	0,5	0,2	0,6	0,3	0,5
	6	0,4	0,7	0,3	0,8	0,4	0,6
	8	0,5	0,8	0,4	0,9	0,5	0,7
112	2	0,3	0,5	0,3	0,6	0,3	0,4
	4	0,4	0,7	0,4	0,8	0,5	0,6
	6	0,6	0,9	0,5	1,1	0,6	0,8
	8	0,7	1	0,6	1,2	0,7	0,9
132	2	0,4	0,9	0,3	1,1	0,5	0,8
	4	0,6	1,2	0,5	1,4	0,6	1,1
	6	0,8	1,5	0,6	1,8	0,8	1,3
	8	0,9	1,7	0,7	2	0,9	1,5
160	2	1,8	1,1	1,6	1,5	2,2	0,9
	4	2,2	1,5	1,9	1,9	2,6	1,2
	6	2,5	1,8	2,2	2,3	3,1	1,5
	8	2,9	2,2	2,5	2,7	3,4	1,8
180	2	2,4	1,5	2,1	2	2,9	1,2
	4	2,9	2	2,5	2,6	3,5	1,6
	6	3,4	2,5	3	3,2	4,1	2,1
	8	3,9	3	3,5	3,7	4,6	2,6
200	2	2,7	1,7	2,2	2,4	3,4	1,2
	4	3,3	2,3	2,8	3,1	4,1	1,8
	6	3,8	2,8	3,3	3,8	4,8	2,3
	8	4,4	3,4	3,9	4,3	5,3	2,9
225	2	3,4	2,6	2,7	3,7	4,5	1,9
	4	4,2	3,5	3,4	4,7	5,5	2,6
	6	4,8	4	3,8	5,7	6,5	3
	8	5,7	4,9	4,8	6,4	7,1	4,1
250	2	3,4	2,5	2,5	3,7	4,5	1,8
	4	3,9	3,1	2,6	5	5,9	1,8
	6	4,9	4,1	3,6	6,2	7	2,8
	8	5,8	4,9	4,5	6,8	7,6	3,8
280	2	3,3	2,5	2	4,3	5,1	1,2
	4	4,6	3,8	2,9	6,2	7	2,1
	6	5,4	4,7	3,6	7,3	8	2,8
	8	6,1	5,4	4,2	8,2	9	3,4
315	2	2,9	2,2	1,2	4,8	5,5	0,4
	4	4,7	4	2,2	7,9	8,6	1,4
	6	5,6	4,8	2,8	9,4	10,2	2
	8	6,4	5,6	3,4	10,4	11,2	2,6
315L	2	3	2,2	1,1	5	5,7	0,4
	4	4,5	3,7	1,4	8,2	8,9	0,6
	6	5,2	4,4	1,9	9,5	10,3	1,2
	8	6,3	5,5	3,4	10	10,8	2,6
355M/L	2	3,1	2,4	0,6	6,7	7,5	0,2
	4	5,5	4,7	1,9	1,1	11,6	1,2
	6	6,3	5,6	2,8	11,8	12,7	2
	8	7,6	6,8	3,8	13,2	13,7	2,9
355A/B	2	2,9	2,2	On request			
	4	4,6	3,9				
	6	5,2	4,5				
	8	6,5	5,8				

Table 12 -Maximum permissible axial thrusts for ball bearings (horizontal mounting)

Lubrication Intervals (Ambient ≤ 40°C at Rated Speed)

Lubrication intervals (hours)			
Frame	Poles	50 Hz	60 Hz
160	2	25000	25000
	4		
	6		
	8		
180	2	25000	25000
	4		
	6		
	8		
200	2	25000	25000
	4		
	6		
	8		
225	2	5000	4000
	4	14000	12000
	6	20000	17000
	8	24000	20000
250	2	5000	4000
	4	14000	12000
	6	20000	17000
	8	24000	20000
280	2	5000	4000
	4	13000	10000
	6	18000	16000
	8	20000	20000
315	2	5000	4000
	4	11000	8000
	6	16000	13000
	8	20000	17000
355	2	5000	4000
	4	4000	On request
	6	9000	6000
	8	13000	11000
	8	19000	14000

Table 13 -Lubrication intervals for ball bearings (horizontal mounting).
Note: the amount of grease is indicated on the nameplate.

Lubrication intervals (hours)			
Frame	Poles	50 Hz	60 Hz
160	4	25000	25000
	6		
	8		
180	4	25000	25000
	6		
	8		
200	4	25000	21000
	6		25000
	8		
225	4	11000	9000
	6	16000	13000
	8	20000	19000
250	4	11000	9000
	6	16000	13000
	8	20000	19000
280	4	9000	7000
	6	14000	12000
	8	19000	17000
315	4	7000	5000
	6	12000	9000
	8	17000	15000
355	4	5000	4000
	6	9000	7000
	8	14000	13000

Table 14 -Lubrication intervals for roller bearings (horizontal mounting).

Note: the amount of grease is indicated on the nameplate.

5.2.2. Bearing Monitoring

W22 motors can, on request, be equipped with bearing temperature detectors to provide continuous monitoring of bearing operating conditions, most commonly used is the Pt-100 temperature detector.

This type of monitoring is extremely important considering that it directly affects the grease and bearing lives particularly on motors equipped with regreasing facilities.

6. Mounting Forms

Motors are supplied, as standard, in the B3T foot configuration, with the terminal box on top.



Figure 24 -B3T mounting

The mounting configuration for the W22 motor lines comply with IEC 60034-7 standard. Standard mounting forms and their variations are shown in table 15. After the designation, a characteristic letter is used to define the terminal box position. So, the mounting code IM B3 can be seen in WEG documents as detailed below (without IM code).

- B3L - terminal box on left hand side of the motor frame
- B3T - terminal box on top of the motor frame
- B3R - terminal box on right hand side of the motor frame

Note: The terminal box position is defined viewing the motor from the shaft end. Mounting forms and their variations are indicated in table 15.

Basic mountings	Other type of mounting				
IM B3	IM V5	IM V6	IM B6	IM B7	IM B8
IM 1001	IM 1011	IM 1031	IM 1051	IM 1061	IM 1071
IM B35	IM V15	IM V36	- *)	- *)	- *)
IM 2001	IM 2011	IM 2031	IM 2051	IM 2061	IM 2071
IM B34	IM V17	IM V37	- *)	- *)	- *)
IM 2101	IM 2111	IM 2131	IM 2151	IM 2161	IM 2171
IM B5	IM V1	IM V3	IM B30		
IM 3001	IM 3011	IM 3031			
IM B14	IM V18	IM V19			
IM 3601	IM 3611	IM 3631			

Table 15 - Mountings configurations

* Non-defined mountings by IEC 60034-7.

Important:

1. The mountings IM B34 and IM B14 with C-DIN flange, in accordance with standard EN 50347, are limited to frame size 132. As an option, C Flanges in accordance with NEMAMG 1 Part 4 standard are available for frames 63 to 355M/L.
2. For motors mounted vertically shaft down fitting of a drip cover / impact canopy is recommended to prevent ingress of small objects into the fan cover. The increase in total length of the motor with drip cover / impact canopy is shown in the Section 20.
3. For motors mounted vertically with shaft up and installed in environments containing liquids, the use of a rubber slinger is recommended to prevent the ingress of liquid into the motor through the shaft.

7. Degree of Protection / Sealing System / Painting

7.1. Degree of Protection

As per IEC 60034-5, the degree of protection of a rotating electrical machine consists of the letters IP (ingress protection), followed by two characteristic numerals, with the following definitions:

- a) First characteristic numeral: refers to protection of persons against or approach to live parts and against contacts with moving parts (other than smooth rotating shafts and the like) inside the enclosure and protection of the machine against ingress of solid and foreign objects.
- b) Second characteristic numeral: protection of machines against harmful effects due to ingress of water.

As standard, W22 motors have the degree of protection IP55. According to IEC 60034-5, this defines the degree of protection as follows:

- a) First characteristic numeral 5: machine protected against dust. The enclosure is protected against contact with moving parts. Ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with satisfactory operation of the machine.
- b) Second characteristic numeral 5: Machine protected against water jets. Water projected by a nozzle against the machine from any direction shall have no harmful effect.

7.2. Sealing System

V-Ring seals are utilized on the shafts of W22 foot mounted motors in frame sizes 63 to 200. For frames 225S/M to 355A/B shaft sealing is provided using the exclusive WSeal®, which consists of a double lipped V-Ring with a metallic cap (see figure 25). This configuration operates like a labyrinth preventing ingress of water and dust into the motor.



Figure 25 - WSeal®

Alternatively, W22 motors are available with other sealing arrangements, for example, oilseal, taconite labyrinth and the WEG exclusive W3 Seal® (see Section 16 - Optional features).

When fitted with a flange, the recommended seal is either a lip seal (no contact with liquid) or oilseal (direct contact with liquid).

7.3. Painting



Figure 26 -WEG internal painting plan

The standard painting plans utilized on W22 motors meet the atmospheric corrosive category “C3” as indicated in the DIN EN ISO 12944-2 standard. They are designed for use on motors installed in normal environments, slightly severe, sheltered or non-sheltered, for industrial use, with low relative humidity, normal temperature variations and the presence of SO₂.

Motor frame sizes 63 to 132 utilize WEG internal painting plan 207A (semi-matt), which consists of:

Primer: One coat of red oxide, alkyd based primer, with minimum thickness of 20 mm.

Finishing: One coat of alkyd based synthetic enamel paint, with minimum thickness of 60 mm.

And, motors in frame sizes 160-355 utilise the WEG internal paint plan 203A (semi-gloss):

Primer: One coat of red oxide, alkyd based primer, with minimum dry coat thickness of 20 mm.

Finishing: One coat of alkyd based synthetic enamel paint, with minimum dry coat thickness of 60mm.

Note: These painting plans are not recommended for direct exposure to acid steam, alkalis, solvents and salty environments.

Alternative painting plans are available on request, which are suitable to guarantee additional protection in aggressive environments, either protected or unprotected (see section 16 - Optional features).

For painting over the WEG original painting, please make sure with your paint supplier that the new painting system is compatible with the base paint used in WEG motors and that the surfaces are prepared accordingly, otherwise it can affect the performance of the paint plan and void the product warranty.

7.3.1. Tropicalized Painting

The integrity of the insulation system is the primary consideration when determining the lifetime of an electric motor. High humidity can result in premature deterioration of the insulation system, therefore for any ambient temperature with relative humidity above 95%, it is recommended to coat all internal components of the motor with an epoxy painting, also known as tropicalization.

8. Voltage / Frequency

As defined in IEC 60034-1 the combination of voltage and frequency variations are classified as Zone A or Zone B, as per figure 27.

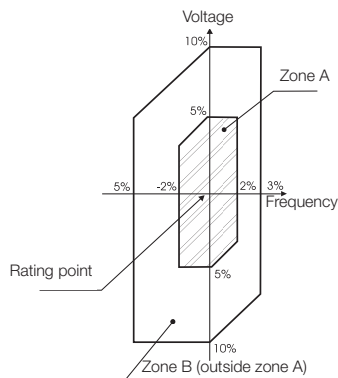


Figure 27 -Rated voltage and frequency limits for electric motors

IEC 60034-1 states that the motor must be suitable to perform its main function (supply torque) continuously within Zone A. However, this motor may not fully meet its performance characteristics due to power supply voltage and frequency variation, which can result in temperature rise above the rated value.

The motor must also be suitable to perform its main function (supply torque) at Zone B. However, the performance characteristic changes will be greater than those operating in Zone A. The temperature rise will also be higher than that at rated voltage and frequency and when operating within Zone A. Prolonged operation near the boundaries of Zone B is not recommended.

9. Overload Capacity

As per IEC 60034-1, motors having rated output not exceeding 315 kW and rated voltages not exceeding 1 kV shall be capable of withstanding a current equal to 1,5 times the rated current for not less than 2 minutes.

10. Ambient and Altitude

Unless otherwise specified, the rated outputs shown in the electrical data tables within this catalogue refer to continuous duty operation S1, as per IEC 60034-1 and under the following conditions:

- ambient temperature range -20 °C to +40 °C
- altitudes up to 1000 metres above sea level

For operating temperatures and altitudes differing from those above, the factors indicated in table 16 must be applied to the nominal motor power rating in order to determine the derated output (Pmax).

Pmax = Pnom x correction factor

T (°C)	Altitude (m)								
	1000	1500	2000	2500	3000	3500	4000	4500	5000
10							0,97	0,92	0,88
15						0,98	0,94	0,90	0,86
20					1,00	0,95	0,91	0,87	0,83
25				1,00	0,95	0,93	0,89	0,85	0,81
30			1,00	0,96	0,92	0,90	0,86	0,82	0,78
35		1,00	0,95	0,93	0,90	0,88	0,84	0,80	0,75
40	1,00	0,97	0,94	0,90	0,86	0,82	0,80	0,76	0,71
45	0,95	0,92	0,90	0,88	0,85	0,81	0,78	0,74	0,69
50	0,92	0,90	0,87	0,85	0,82	0,80	0,77	0,72	0,67
55	0,88	0,85	0,83	0,81	0,78	0,76	0,73	0,70	0,65
60	0,83	0,82	0,80	0,77	0,75	0,73	0,70	0,67	0,62
65	0,79	0,76	0,74	0,72	0,70	0,68	0,66	0,62	0,58
70	0,74	0,71	0,69	0,67	0,66	0,64	0,62	0,58	0,53
75	0,70	0,68	0,66	0,64	0,62	0,60	0,58	0,53	0,49
80	0,65	0,64	0,62	0,60	0,58	0,56	0,55	0,48	0,44

Table 16 -Correction factors for altitude and ambient temperature

11. Insulation & Temperature Rise

W22 motors are supplied with class F insulation and Class B (80 K) temperature rise at normal operating conditions (unless otherwise specified).

The difference between the temperature of the class F insulation (105 K) and the temperature rise of the design (80 K) means that, in practice, W22 motors are suitable to deliver outputs above the rated values up to a limit where the temperature rise reaches the temperature rise value of the insulation class.

The ratio between temperature rise and service factor is given by the equation below:

$$\Delta T_{FINAL} (S.F.)^2 \times \Delta T_{INITIAL}$$

From the above calculation, we can conclude that the service factor is approximately 1.15. This reserve of temperature permits W22 motors with class B temperature rise (80 K) to operate continuously under the following conditions:

- Up to 15% above their rated output, considering 40 °C ambient temperature and 1000 m.a.s.l. or;
- At ambient temperatures up to 55°C or altitudes up to 3000 m.a.s.l. maintaining their nominal rated output.

Important: Please note that under these conditions the combined ambient and temperature rise may reach class F limits.

Table 16 shows the safety margins per thermal class.

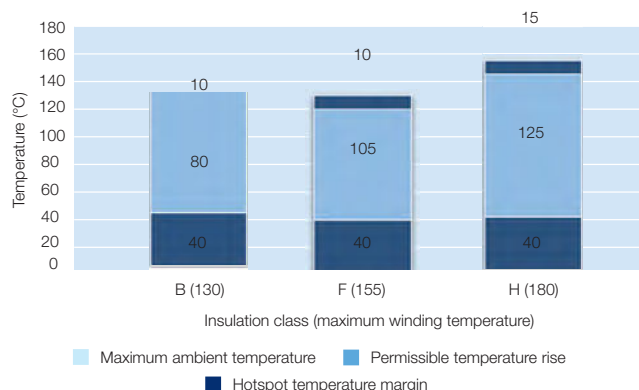


Figure 28 -Safety margins per thermal class.

Bearing lubrication intervals will change under operating conditions other than 40 °C maximum ambient temperature and 1000 metres above sea level. Contact WEG for further information.

All W22 motors are wound with the WISE® insulation system which consists of enamelled wire impregnated with solvent free resin which protects motors at temperatures up to 200 °C. The WISE® system also permits motor operation with variable speed drives (see section 13).

11.1. Space Heaters

The use of space heaters is recommended in two situations:

- Motors installed in environments with relative air humidity up to 95%, in which the motor may remain idle for periods greater than 24 hours;
- Motors installed in environments with relative air humidity greater than 95%, regardless of the operating schedule. It should be highlighted that in this situation it is strongly recommended that an epoxy painting, more commonly known as tropicalization, is applied to the internal components of the motor. More information can be found in section 7.3.

The supply voltage for space heaters must be defined by the Customer. For all frame sizes, W22 motors can be provided with space heaters suitable for 110-127 V, 220-240 V and 380-480 V. As an option, dual voltage heaters of 110-127 / 220-240 V can be supplied for motor frame sizes 112 to 355A/B, through reconnection of the heater cables inside the terminal box.

The power rating and number of space heaters fitted depends on the size of the motor as indicated in table 17 below:

Frame	Quantities	Total power rated (W)
63 to 80	1	7,5
90 and 100	1	11
112	2	22
132 and 160	2	30
180 and 200	2	38
225 and 250	2	56
280 and 315	2	140
355	2	174

Table 17 -Power and quantity of space heaters

12. Motor Protections

Protections available for the W22 motor line can be classified as follows:

- Based on operating temperature
- Based on operating current

Refer to section 15 for further details of the standard and optional protection types available for W22 motors.

12.1. Protection Based on Operating Temperature

Continuous duty motors must be protected from overload either by a device integrated into the motor or via an independent protection system, usually a thermal relay with rated or setting current, equal to or below the value obtained when multiplying the power supply rated current (In), as per table 18.

Service factor	Relay setting current
1,0 up to 1,15	In x S.F.
≥ 1,15	(In x S.F.) - 5%

Table 18 -Relay setting current referred to service factor

12.1.1. Pt-100



Figure 29 - Pt-100

These are temperature detectors with operating principle based on the properties that some materials vary the electric resistance with the variation in temperature (usually platinum, nickel or copper). They are also fitted with calibrated resistances that vary linearly with temperature, allowing continuous reading of motor operating temperature through a monitoring display, with high precision rate and response sensitivity.

The same detector can serve as alarm (with operation above the regular operating temperature) and trip (usually set up for the maximum temperature of the insulation class).

12.1.2. Thermistor (PTC)



Figure 30 - Thermistor (PTC)

A thermistor is a non-linear resistance temperature detector, made from semi-conductor material. Each specific thermistor has its own unique resistance vs. temperature characteristic i.e. they have one pre-set, non-adjustable tripping point.

PTC (positive temperature coefficient) thermistors have a resistance that increases dramatically at its defined tripping temperature. This sudden variation in resistance blocks the PTC current which causes the output relay to operate and the main circuit to switch off.

Thermistors are compact, do not wear, and feature faster response times when compared to other types of thermal protectors, although they do not allow continuous monitoring of motor operating temperature.

Together with their electronic circuits, these thermistors provide full protection against overheating caused by overload, under or overvoltage or frequent reversing operations.

Where thermistor protection is required to provide both alarm and trip operation, it is necessary for each phase of the motor winding to be equipped with two sets of appropriately rated thermistors.

WEG Automation offers a range of electronic relays 'RPW' intended specifically to read the PTC signal and operate its output relay. For further information please visit the website www.weg.net.

12.1.3. Bimetallic Thermal Protectors

These are silver-contact thermal sensors, normally closed, that operate at certain temperature rise. When their operating temperature decreases, they return to their original position instantaneously, allowing the silver contact to close again.

The bimetallic thermal protectors are series-connected with the contactor coil, and can be used either as alarm or trip.

There are also other types of thermal protectors such as Pt-1000, KTY and thermocouples. Contact your local WEG office for further information.

12.2. Protection Based on Operating Current

Overloads are processes which usually see the temperature increase gradually. To overcome this problem, the thermal protectors described in item 12.1 are quite suitable. However, the only way to protect motors against short-circuit currents is the application of fuses. This type of protection depends directly on the motor current and is highly effective in cases of locked rotor.

WEG Automation supplies a range of fuses in versions D and NH. Visit the website www.weg.net for further information.

13. Variable Speed Drive Application

13.1. Considerations Regarding Voltage Spikes and the Insulation System

The stator windings of W22 motors are wound with class F insulation (class H optional) and are suitable for either DOL starting or via a variable speed drive. They incorporate the WEG exclusive insulation system - WISE® (WEG Insulation System Evolution) - which ensures superior electrical insulation characteristics. The stator winding is suitable for variable speed drive application, taking into account the limits shown in table 19.

Motor rated voltage	Voltage Spikes ¹⁾		dV/dt ²⁾		Rise time ²⁾	Time between pulses
	At motor terminals (phase-phase)	At motor terminals (phase-phase)	At motor terminals (phase-phase)	At motor terminals (phase-phase)		
$V_{rated} < 460\text{ V}$	$\leq 1600\text{ V}$	$\leq 5200\text{ V}/\mu\text{s}$	$\geq 0,1\ \mu\text{s}$	$\geq 6\ \mu\text{s}$		
$460\text{ V} \leq V_{rated} < 575\text{ V}$	$\leq 1800\text{ V}$	$\leq 6500\text{ V}/\mu\text{s}$				
$575\text{ V} \leq V_{rated} \leq 1000\text{ V}$	$\leq 2200\text{ V}$	$\leq 7800\text{ V}/\mu\text{s}$				

Table 19 - Supportability of random wound motors' insulation system.

1) Peak voltage in the case of unipolar pulses. Peak-to-peak voltage in the case of bipolar pulses.

2) dV/dt and Rise time definition according to Nema Std. MG1 - Part 30.

Notes:

- If one or more of the above conditions is not respected, a filter (load reactor or dV/dt filter) must be installed in the output of the VSD.
- W22 motors with rated voltage greater than 575 V, which at the time of purchase did not have any indication of operation with VSD, are able to withstand the electrical limits set in the table above for rated voltage up to 575 V. If such conditions are not fully satisfied, output filters must be used.
- W22 motors of the dual voltage type, for example 400/690 V or 380/660 V, which at the time of purchase were not specified for VSD operation, are permitted to be operated with the VSD at the higher voltage provided that the limits defined in the table above for rated voltage up to 460 V are fully respected. Otherwise, a load reactor or a dV/dt filter must be installed in the VSD output.

13.2. Influence of the VSD on the Motor Temperature

Motors operating with frequency inverters may present a higher temperature rise than when operating under sinusoidal supply. This occurs due to the combined effects of the loss increase resulting from the PWM harmonics and the reduction in ventilation experienced by self-ventilated motors when operating at low frequencies. There are basically three solutions to avoid excessive overheating of the motor in VSD applications:

- Torque derating (oversizing of the self-ventilated motor frame size);
- Forced ventilation (use of an independent cooling system);
- Optimal Flux Solution (exclusive to applications where both motor and drive are WEG).

13.2.1. Torque Derating Criteria

In order to maintain the temperature rise of WEG motors within acceptable levels, when supplied by VSD, the speed range-related loadability limits established in figures 31 (for operation under constant flux condition) or 32 (for operation under optimal flux condition) must be observed.

Notes:

- These derating curves relate to the motor thermal capability only and do not concern the insulation class. Speed regulation will depend on VSD mode of operation and proper adjustment.
- Torque derating is usually necessary when the motor is required to drive constant torque loads (e.g. screw compressors, conveyors, extruders, etc.). For squared torque loads, such as pumps and fans, no torque derating is normally required.
- W22 motors in frame sizes 90S and above can be blower cooled (independently ventilated) under request. In such cases, the motor will be suitable for VSD operation without torque derating regardless the load type.
- For operation above base (nameplate) speed, mechanical issues must be also observed. Please refer to table 20 for the maximum limits for safe operation.

13.2.2. Constant Flux Condition

Applicable when the motor is supplied by any commercial drive operating with any control scheme other than the Optimal Flux available in WEG drives.

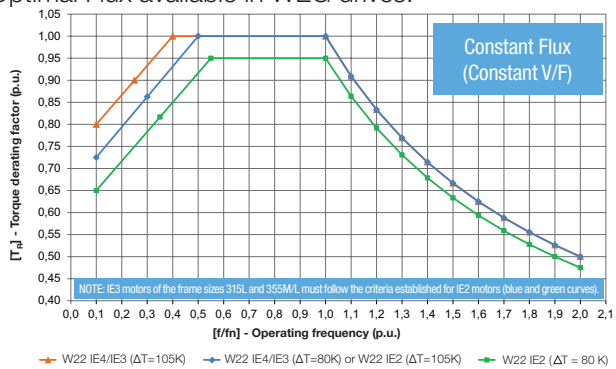


Figure 31 - Derating curves for constant flux condition

13.2.3. Optimal Flux Condition

The study of the composition of the overall motor losses and its relation to operation parameters such as the frequency, the magnetic flux, the current, and the speed variation led to the determination of an optimal flux value for each operating frequency. The implementation of this solution within the CFW-11 and CFW-700 control algorithms mean that the motor optimal flux condition can be automatically applied by the drive throughout the speed range, resulting in a continuous minimization of losses. As a consequence of this loss minimization, the use of the optimal flux control provides higher efficiency and lower temperature rise. Therefore, the torque derating factors for this operating condition are lower than for constant V/f, as shown in figure 32.

The optimal flux solution was developed for low frequency applications with constant torque loads. It should not be used for variable torque loads nor when the operating speed range includes points above the base (rated) frequency. The Optimal Flux Solution may be only applied under the following conditions:

- The motor has an efficiency class IE2 or above;
- The motor is controlled by a WEG drive (CFW-11 or CFW-700);
- Sensorless vector control is used.

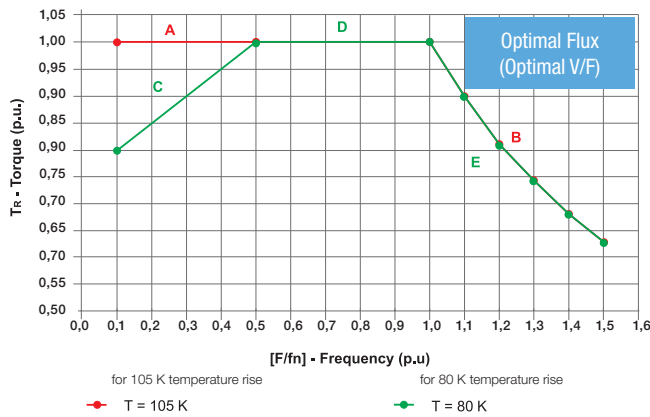


Figure 32 -Derating curves for Optimal Flux condition

Output (kW)	Maximum safe operating speeds (rpm)		
	TEFC Motors		
	2 poles	4 poles	6 poles
0,18	7200	3600	2400
0,25	7200	3600	2400
0,37	7200	3600	2400
0,55	7200	3600	2400
0,75	7200	3600	2400
1,1	7200	3600	2400
1,5	7200	3600	2400
2,2	7200	3600	2400
4,0	7200	3600	2400
5,5	5400	3600	2400
7,5	5400	3600	2400
11	5400	3600	2400
15	5400	3600	2400
18,5	5400	2700	2400
22	5400	2700	2400
30	4500	2700	2400
37	4500	2700	2400
45	3600	2700	2400
55	3600	2700	2400
75	3600	2700	1800
90	3600	2700	1800
110	3600	2700	1800
150	3600	2250	1800
185	3600	2250	1800
220	3600	2250	1800
260	3600	1800	1800
300	3600	1800	-
330	3600	1800	-
370	3600	1800	-

Table 20 -Maximum safe operating speeds (rpm) for W22 motors driven by VSD

Notes:

- The values in table 20 are related to mechanical limitations. For operation above nameplate speed, the electrical limitations (motor torque capability) must be also observed.
- The limits established in table 20 are in accordance with the IEC 60034-1 Table 17.
- The permissible overspeed value is 10% above the limits given in Table 20 (not to exceed 2 minutes in duration) except where the maximum safe operating speed is the same as the synchronous speed at 60 Hz - in such case, please contact WEG.
- Operation above nameplate speed may require specially refined motor balancing. In such case, vibration and noise limits per IEC 60034-14 and IEC 60034-9, respectively, are not applicable.
- Bearing life will be affected by the length of time the motor is operated at various speeds.
- For speeds and ratings not covered by the table above, please contact WEG.

13.3. Considerations Regarding Bearing Currents

Motors for variable speed drive applications up to frame size 280S/M, do not generally require any special considerations with respects to the bearings. However, for frame sizes 315S/M upwards additional measures should be taken in order to avoid detrimental bearing currents.

This can be accomplished by utilisation of an insulated bearing or insulated hub endshield and a shaft grounding brush mounted on the opposite side. W22 motors will normally be supplied duly protected per such recommendations when operation with VSD is specified at the time of purchase. Otherwise, WEG can modify motors that were not originally supplied with such protection under request.

13.4. Forced Ventilation

For those cases where an independent cooling system is required, W22 motors can be supplied with forced ventilation, as shown in figure 33.

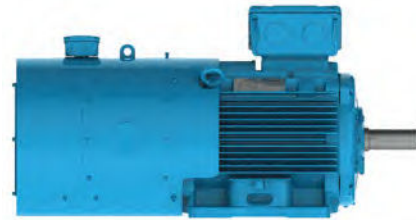


Figure 33 -Forced ventilation for W22 motors

When forced ventilation is assembled on the motor in the factory, the overall motor length will be increased, see Section 21. External Motor Dimensions with Forced Ventilation.

As a local stock modification option, an alternative forced ventilation kit can be fitted. Please contact your local WEG office for details of these dimensions.

13.5. Encoders

W22 motors may be supplied with encoders for speed control in closed loop. Encoders can be fitted to motors with either forced ventilation(TEBC) or with shaft mounted cooling fan (TEFC). When encoders are fitted, TEFC motors may not have a second shaft end or be fitted with drip cover.

The following models of encoder are available for supply:

- Dynapar - B58N - 1024ppr (hollow shaft)- frames 90 to 355
- Leine & Linde - XH861 - 1024ppr (hollow shaft)- frames 160 to 355
- Hengstler - RI58 - 1024ppr (hollow shaft) *
- Hubner Berlin - HOG 10 - 1024ppr (hollow shaft)*

*These models can be supplied on request.

Note: The encoders described above have 1024 pulses per revolution. Optionally, models with 2048 pulses per revolution are available.

For more information on VSD motor applications, visit our website (www.weg.net) and download the Technical Guide - Induction motors Fed by PWM (code 50029350).

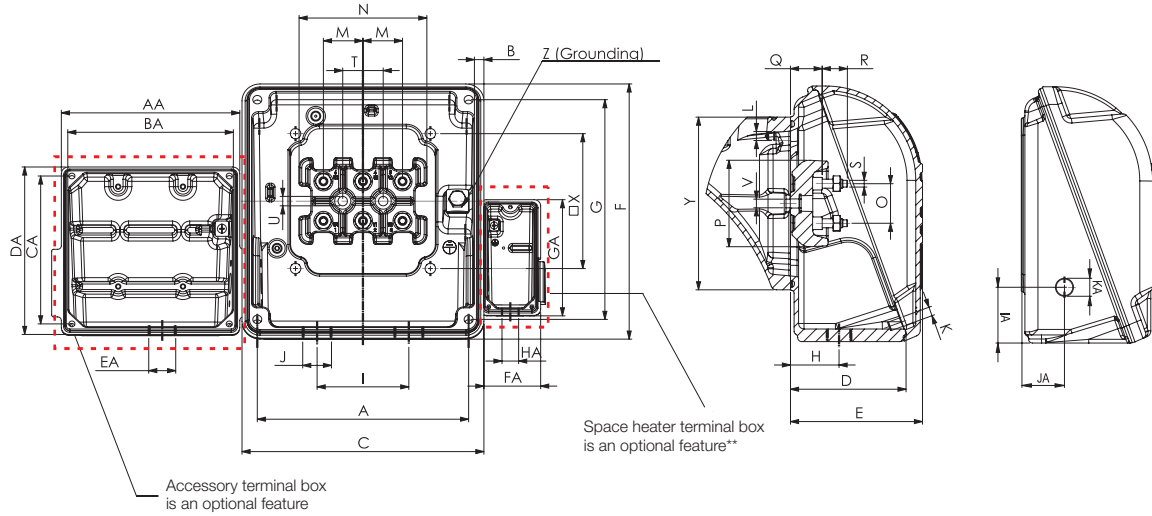
14. Tolerances for Electrical Data

The following tolerances are permissible in accordance with IEC 60034-1:

Efficiency (η)	-0,15 (1- η) for $P_{nom} \leq 150$ kW / -0,1 (1- η) for $P_{nom} > 150$ kW Where η is a decimal number
Power factor	$\frac{1 - \cos \phi}{6}$ Minimum 0,02 and Maximum 0,07
Slip	$\pm 20\%$ for $P_{nom} \geq 1$ kW and $\pm 30\%$ for $P_{nom} < 1$ kW
Starting current	20% (without lower limit)
Starting torque	- 15% + 25%
Breakdown torque	- 10 %
Moment of inertia	± 10 %

Table 21 -Tolerances for electrical data

19. Terminal Box Drawings



Frame	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
63	90	3,5	108	51,5	59	98	85	27	42	2xM20x1,5	M5x0,8	M5x0,8	16	75	16	35	13,5	12	M4x0,7	20	5,8
71																					
80																					
90																					
100	2xM25x1,5																				
112	117	2,5	140	71	80	133	117	36,5	54	2xM32x1,5	M6x1,0	M6x1,0	23	23	52	17	16	M5x0,8	23	6,5	
132																					
160	175	4	198,5	90	101	190	175	46	84	2xM40x1,5	M8x1,25	M8x1,25	28	90	28	60	21,5	20,5	M6x1	28	6,6
180																					
200	204	4,5	230	107	119,5	220	204	59	94	2xM50x1,5	M10x1,5	M10x1,5	35	112	35	74	24	24	M8x1,25	35	9,5
225S/M	235	12,5	269	133	153	285	260	71	110	2xM63x1,5											
250S/M																					
280S/M																					
315S/M																					
315L	340	14,5	379	162	176	382	345	78	160	M12x1,75	M12x1,75	45	153	45	108	34	40	M12x1,75	65		
355M/L																					
355A/B	415	-	460	267 232*	328	544	678	187 152(*)	140	M10x1,5	M12x1,75	80	-	105	-	-	-	-	M16x2,5	-	-

Frame	V	X	Y	Z	AA	BA	CA	DA	EA	FA	GA	HA	IA	JA	KA	Max number of connectors																		
																Main	Accessories	Space heater																
63	M5x0,8	56	77	0,5-6 mm ²	109	90	85	98	M20x1,5	68	101,4	M20x1,5	23	17,5	M20x1,5	4	16	4																
71			78																															
80			81																															
90			77																															
100			81																															
112			70																107	2-10 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	25	22,5	M20x1,5	6	16	4
132	103																																	
160	M6x1,0	110	140	5,2-25 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	47	40	M20x1,5	15	26	4																
180			155																5,2-35 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	47	45	M20x1,5	15	26	4	
200	M10x1,5	150	192	25-50 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	62	48	M20x1,5	15	26	4																
225S/M			204																															
250S/M			260																35-70 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	77	56	M20x1,5	15	26	4	
280S/M			200																															
315S/M			260																300	85-120 mm ²	139	117	117	133	M20x1,5	68	101,4	M20x1,5	82	69	M20x1,5	15	26	4
355M/L																																		
355A/B	-	290										57	95																					

Notes:

- (*) Dimension is applicable to top, right or left terminal box mounting
- (**) Space heater terminal box is a special feature for frame sizes 63 to 112.
- (***) Dimensions are in mm.

20. Drip Cover Data

Utilization of a drip cover / impact canopy increases the total length of the motor. The additional land length can be seen at table 22.

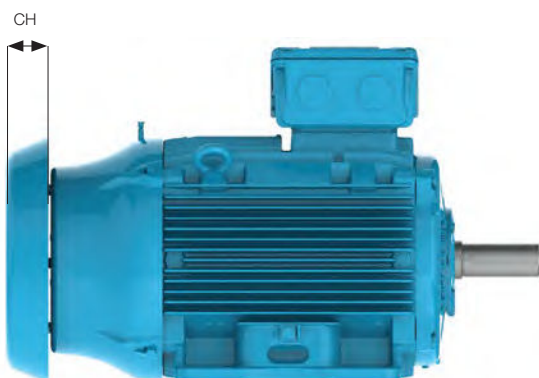


Figure 34 -Motor with drip cover

Frame	Dimension CH (increase motor length (mm))
63	18
71	
80	
90	
100	
112	28
132	
160	47
180	
200	67
225S/M	
250S/M	81
280S/M	
315S/M	91
315L	
355M/L	
355A/B	

Table 22 -Drip cover dimensions

21. External Motor Dimensions with Forced Ventilation

The use of forced ventilation increases the overall motor length, according to the table below.

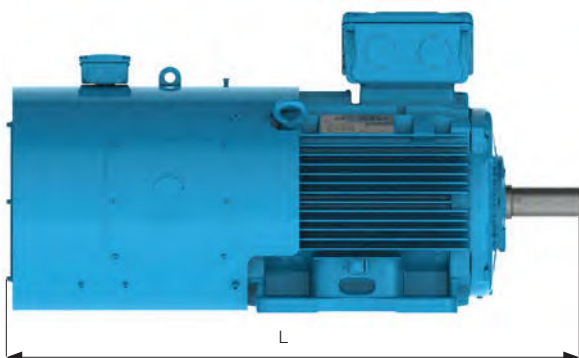


Figure 35 -Motor with forced ventilation

Frame size	Poles	Total motor length in mm (L)	
		Without forced ventilation	With forced ventilation
90S	All	304	548
L90S	All	335	579
90L	All	329	573
L90L	All	360	604
100L	All	376	646
L100L	All	418	690
112M	All	394	660
L112M	All	423	690
132S	All	452	715
132M	All	489	753
132M/L	All	515	778
160M	All	598	855
160L	All	642	899
180M	All	664	908
180L	All	702	946
200M	All	729	976
200L	All	767	1014
225S/M	2	856	1140
	4/8	886	1170
250S/M	2	965	1217
	4/8	965	1217
280S/M	2	1071	1348
	4/8	1071	1348
315S/M	2	1244	1459
	4/8	1274	1489
315L	2	1353	1568
	4/8	1389	1598
355M/L	2	1412	1786
	4/8	1482	1856
355A/B	2	1607	1981
	4/8	1677	2051

Table 23 -Forced ventilation dimensions

22. Silencer

The silencer for W22 motors reduces the noise level up to 5 dB(A), and it is available on 225 to 355 frames for foot-mounted and flange-mounted motors.

It is made of 2 mm steel or stainless steel plate and is internally covered by a sound absorbing material.

For foot-mounted the silencer fits loosely over the motor, and has a rubber strip to seal against the floor.

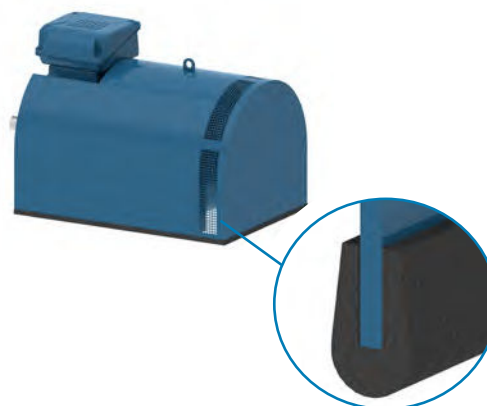
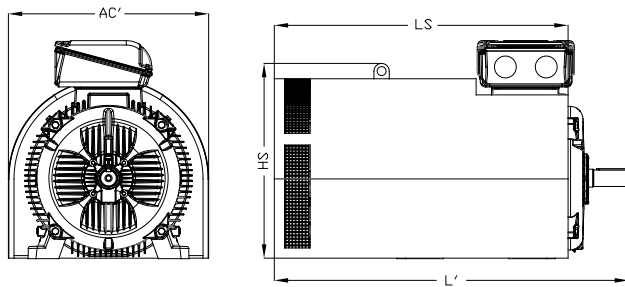


Figure 36 -Silencer for W22 motors.

Silencer dimensional



Frame	AC'	L'	LS	HS
225S/M	564	955* 985	760	567
250S/M	604	1065	830	612
280S/M	704	1205	950	687
315S/M	784	1387* 1417	1150	762
355M/L	854	1587* 1657	1305	834
355A/B	854	1782* 1852	1500	834

Table 24 -Silencer dimensional

* Dimension for 2-pole motors.

** Dimensions are in mm.

23. Leveling screws and dowel pins

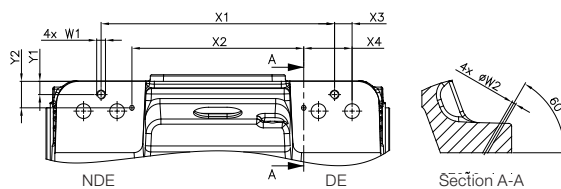


Figure 37 -Dimensions for motors with dowel pins and leveling screws

Frame	Threaded hole W1	Ø W2	X1	X2	X3	X4	Y1	Y2
160 M	M10x1,5	5	160	126	25	42	10	25
160 L	M10x1,5	5	204	170	25	42	10	25
180 M	M10x1,5	5	201	171	20	35	15	30
180 L	M10x1,5	5	239	209	20	35	15	30
200 M	M10x1,5	5	227	197	20	35	15	30
200 L	M10x1,5	5	265	235	20	35	15	30
225 S/M	M12x1,75	5	311	201	25	65	20	35
250 S/M	M12x1,75	5	349	219	25	65	20	35
280 S/M	M16x2,0	5	369	259	25	85	20	35
315 S/M	M16x2,0	5	457	281	50	100	30	50
315L	M16x2,0	5	508	361	50	115	30	50
355 M/L	M16x2,0	5	530	350	50	140	30	50
355 A/B	M16x2,0	5	710	545	50	140	30	50

Table 25 -Dimensions for motors with dowel pins and leveling screws

* Dimensions are in mm.

24. Packaging

24.1. Frames 63 to 132

W22 motors in frames 63 to 132 are packaged in cardboard boxes (see figure 38), following the dimensions, weights and volumes of the tables 26 and 27.



Figure 38 -Cardboard box

Frame	External height (m)	External width (m)	External length (m)	Weight (kg)	Volume (m ³)
63	0,26	0,21	0,30	0,2	0,02
71					
80					
L80	0,32	0,27	0,43	0,9	0,04
90S					
90L					
L90S					
L90L	0,33	0,27	0,46	1,4	0,04
100L					
L100L					
112M	0,36	0,30	0,46	1,5	0,05
L112M	0,42	0,33	0,60	1,5	0,08
132S	0,42	0,33	0,60	1,7	0,08
132M					
132M/L					

Table 26 -Cardboard box dimensions, weights and volumes for top mounting.

Frame	External height (m)	External width (m)	External length (m)	Weight (kg)	Volume (m ³)
63	0,20	0,24	0,28	0,2	0,01
71	0,20	0,28	0,30	0,2	0,01
80	0,21	0,28	0,36	0,7	0,02
L80	0,24	0,32	0,40	0,8	0,03
90S					
L90S					
90L					
L90L	0,26	0,34	0,43	1,0	0,04
100L	0,27	0,35	0,46	1,6	0,04
L100L	0,32	0,37	0,50	1,4	0,06
112M	0,31	0,38	0,46	1,7	0,05
L112M	0,31	0,38	0,53	1,5	0,06
132S	0,35	0,48	0,60	2,1	0,10
132M					
132M/L					

Table 27 -Cardboard box dimensions, weights and volumes for side mounting.

Note: Values to be added to the net motor weight.

25. Frames 160 to 355A/B

For frames 160 to 355A/B, the motors are packaged in wooden crates (figure 39). Dimensions, weights and volumes are in tables 28 and 29.



Figure 39 -Wooden crates

Note: Values to be added to the net motor weight.

Frame	External height (m)	External width (m)	External length (m)	Weight (kg)	Volume (m ³)
160	0,50	0,40	0,74	9,2	0,15
180	0,53	0,43	0,82	12,3	0,19
200	0,59	0,51	0,88	13,5	0,27
225S/M	0,90	0,85	1,15	51,9	0,88
250S/M	0,90	0,85	1,25	54,6	0,96
280S/M	1,13	0,85	1,40	67,9	1,34
315S/M	1,13	0,85	1,55	69,9	1,49
315L	1,20	0,90	1,70	111	1,84
355M/L	1,32	1,05	1,73	127	2,40
355A/B	1,32	1,05	1,90	141	2,63

Table 28 -Wooden crates dimensions, weights and volumes for top mounting.

Frame	External height (m)	External width (m)	External length (m)	Weight (kg)	Volume (m ³)
160	0,40	0,51	0,74	9,85	0,15
180	0,45	0,57	0,82	13,42	0,21
200	0,49	0,63	0,88	14,58	0,27
225S/M	0,78	0,85	1,15	47,70	0,76
250S/M	0,90	0,85	1,25	52,20	0,96
280S/M	0,95	0,95	1,40	71,60	1,26
315S/M	1,13	1,10	1,75	88,40	2,18
315L	1,10	1,12	1,70	138,37	2,10
355M/L	1,20	1,19	1,72	146,00	2,46
355A/B	1,20	1,19	1,90	163,00	2,71

Table 29 -Wooden crates dimensions, weights and volumes for side mounting.

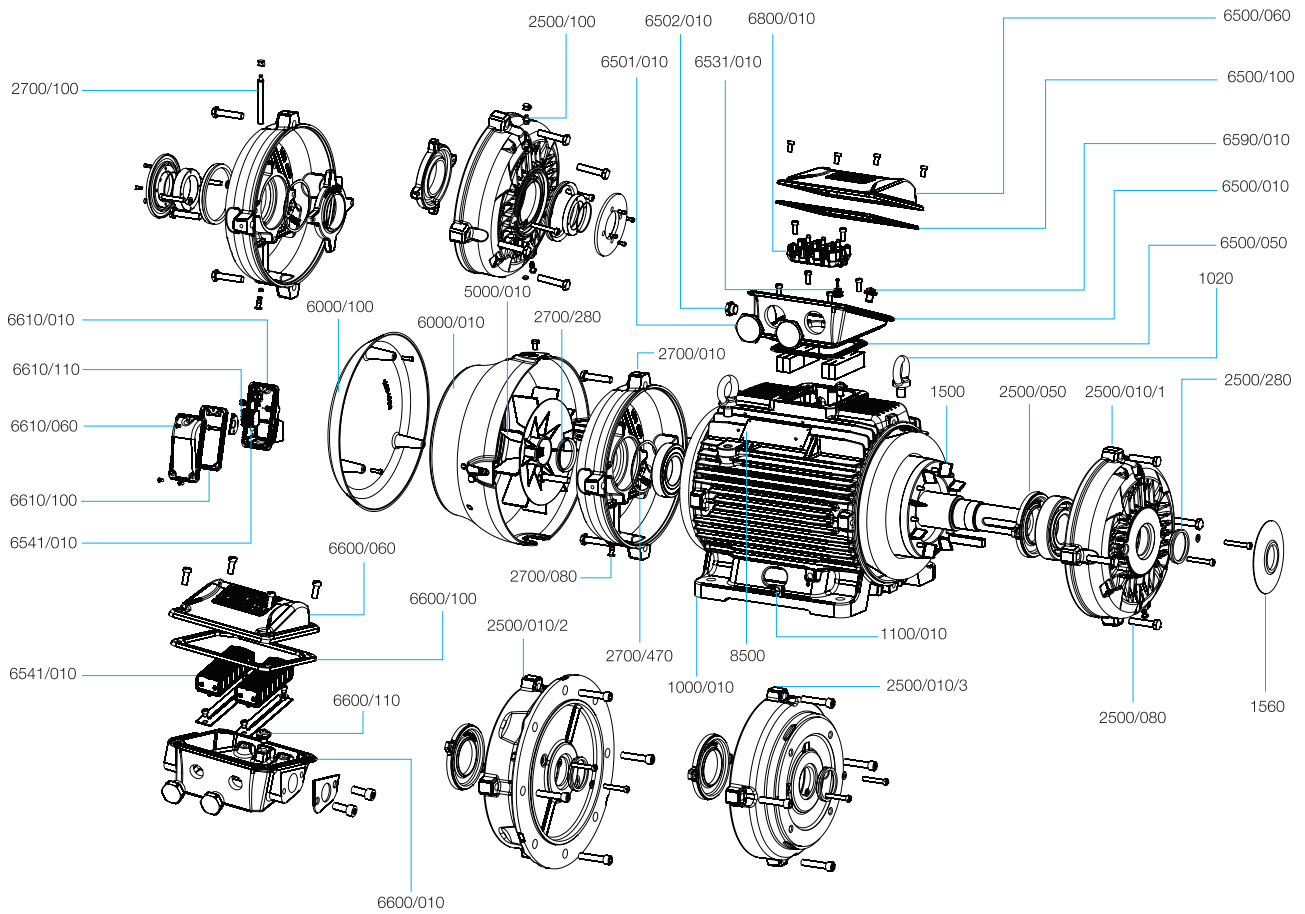
Note: Values to be added to the net motor weight.

Component		Spare part	
Item	Description	Item	Composition
1000/010	Frame with wound stator	1000	Frame with wound stator
1020	Lifting eyebolt	1020	Lifting eyebolt
1100/010	Earthing terminal	1100	Earthing terminal
1500	Rotor, complete with shaft and key	1500	Rotor, complete with shaft and key
1560	Slinger	1560	Slinger (recommended for vertical shaft up applications, non-flange mounted)
2500/010/1	Endshield, drive end	2500/1	Endshield, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end (2)		
2500/280	Shaft seal, drive end (1)		
2500/010/2	FF Flange	2500/2	FF Flange, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end (2)		
2500/280	Shaft seal, drive end (1)		
2500/010/3	C Flange (5)	2500/3	C Flange, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end (2)		
2500/280	Shaft seal, drive end (1)		
2500/010/4	C-DIN Flange (5)	2500/4	C-DIN Flange, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end (2)		
2500/280	Shaft seal, drive end (1)		
2700/010	Endshield, non-drive end	2700	Endshield, drain plug, shaft seal, bolts and washers
2700/080	Drain plug, non-drive end		
2700/100	Grease nipple, non-drive end (2)		
2700/280	Shaft seal, non-drive end (1)		
2700/470	Wave washer for axial displacement		
5000/010	Cooling Fan	5000	Fan (3)
6000/010	Fan cover (4)	6000	Fan cover, bolts
		6050	Fan cover, drip cover and bolts
6000/100	Drip cover	6100	Drip cover, bolts
6500/010	Terminal box	6500	Terminal box complete with lid, gaskets (for lid and terminal box), plugs (for mains and accessories), earthing terminal, bolts and washers
6500/050	Terminal box gasket		
6500/060	Terminal box lid		
6500/100	Terminal box lid gasket		
6501/010	Terminal box plug for main leads		
6502/010	Terminal box plug for accessory leads		
6590/010	Terminal box earthing terminal		
6531/010	Accessory connector		
6541/010	Accessory connector	6541	Accessory connector, mounting rail, bolts and washers
6600/010	Accessory terminal box	6600	Accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6600/060	Accessory terminal box lid		
6600/100	Accessory terminal box lid gasket		
6600/110	Accessory terminal box earthing terminal		
6610/010	Space heater accessory terminal box	6610	Space heater accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6610/060	Space heater accessory terminal box lid		
6610/100	Space heater accessory terminal box lid gasket		
6610/110	Space heater accessory terminal box earthing terminal		
6800/010	Terminal block	6800	Terminal block, bolts and washers
8500	Main nameplate	8500	Main nameplate

Notes:

- (1) The shaft sealing may vary with product line. As a spare part, the shaft sealing in the 63-112 range will be supplied as an integral part of the endshield kit. If fitted with labyrinth seal, taconite or W3 Seal®, these are available available from 90 frame upwards.
- (2) When fitted with grease nipple, the endshield spare part kit will also have grease relief, internal bearing cap and labyrinth seal (taconite or W3 Seal®).
- (3) When non-plastic fan is fitted, the spare part kit is also supplied with key and circlip for fan assembly onto the shaft.
- (4) The fan cover material may vary with product line. Considering general purpose, it is fabricated steel in the 63-112 frame range.
- (5) C flange dimensions according to standards NEMA MG1 Part 4 or DIN.

26.2. Spare Parts Available 132-200

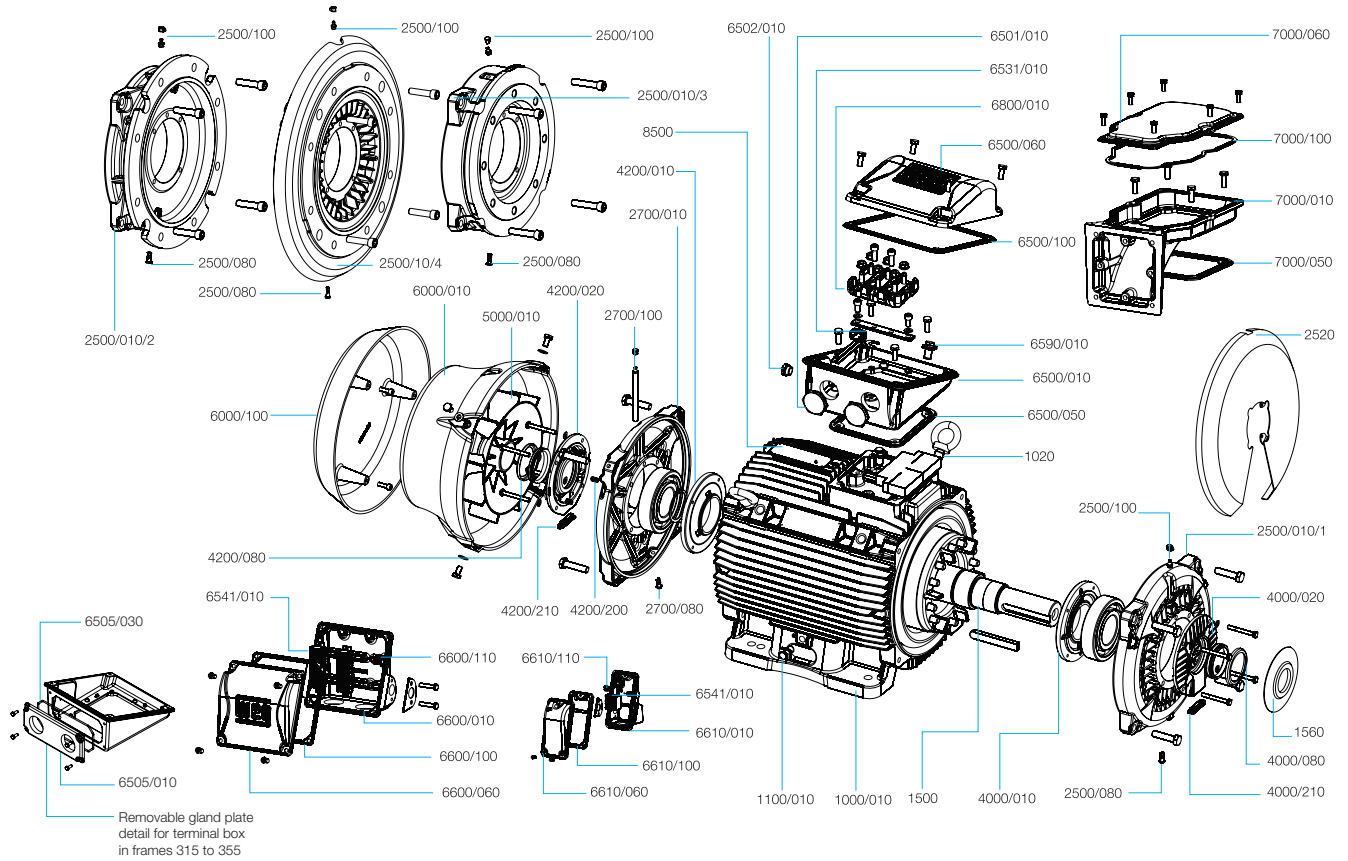


Motor component		Spare part	
Item	Description	Item	Composition
1000/010	Frame with wound stator	1000	Frame with wound stator
1020	Lifting eyebolt	1020	Lifting eyebolt
1100/010	Earthing terminal	1100	Earthing terminal
1500	Rotor, complete with shaft and key	1500	Rotor, complete with shaft and key
1560	Slinger	1560	Slinger (recommended for vertical shaft up applications, non-flange mounted)
2500/010/1	Endshield, drive end	2500/1	Endshield, bearing cap, drain plug, shaft seal, bolts and washers
2500/050	Bearing cap, internal, drive end		
2500/080	Drain plug, drive end		
2500/280	Shaft seal, drive end (1)		
2500/100	Grease nipple, drive end (2)		
2500/010/2	FF Flange	2500/2	FF Flange, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end (2)		
2500/280	Shaft seal, drive end (1)		
2500/010/3	C Flange (7)	2500/3	C Flange, drain plug, shaft seal, bolts and washers
2500/080	Drain plug, drive end		
2500/280	Shaft seal, drive end (1)		
2500/100	Grease nipple, drive end (2)		
2700/010	Endshield, non-drive end	2700	Endshield, drain plug, shaft seal, bolts and washers
2700/080	Drain plug, non-drive end		
2700/100	Grease nipple (with extensor pipe), non-drive end (4)		
2700/280	Shaft seal, non-drive end (1)		
2700/470	Wave washer for axial displacement (3)		
5000/010	Fan	5000	Fan (5)
6000/010	Fan cover (6)	6000	Fan cover, bolts
		6050	Fan cover, drip cover and bolts
6000/100	Drip cover	6100	Drip cover and bolts
6500/010	Terminal box	6500	Terminal box, complete with lid, gaskets (for lid and terminal box), plugs (for mains and accessories), earthing terminal, bolts and washers
6500/050	Terminal box gasket		
6500/060	Terminal box lid		
6500/100	Terminal box lid gasket		
6501/010	Terminal box plug for main leads		
6502/010	Terminal box plug for accessory leads		
6590/010	Terminal box earthing terminal		
6531/010	Accessory connector		
6541/010	Accessory connector	6541	Accessory connector, mounting rail, bolts and washers
6600/010	Accessory terminal box	6600	Accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6600/060	Accessory terminal box lid		
6600/100	Accessory terminal box lid gasket		
6600/110	Accessory terminal box earthing terminal		
6610/010	Space heater accessory terminal box	6610	Space heater accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6610/060	Space heater accessory terminal box lid		
6610/100	Space heater accessory terminal box lid gasket		
6610/110	Space heater accessory terminal box earthing terminal		
6800/010	Terminal block	6800	Terminal block, bolts and washers
8500	Main nameplate	8500	Main nameplate

Notes:

- (1) The shaft seal may vary with product line. As a spare part, the shaft seal in the 132-200 range will be supplied as an integral part of the endshield kit. If fitted with labyrinth seal (taconite or W3 Seal) internal bearing cap is mandatory from frame 160.
- (2) When fitted with grease nipple, the endshield spare part kit will also have grease relief.
- (3) Valid when ball bearing is fitted in drive end. When the drive end is fitted with roller bearings, the wave washer is not supplied (non-drive end bearing locked with internal bearing cap).
- (4) When fitted with grease nipple in the non-drive end, the endshield spare part kit will also have grease relief and internal bearing cap.
- (5) When non-plastic fan is fitted, the spare part kit is also supplied with key and circlip for fan assembly onto the shaft.
- (6) The fan cover material may vary with product line. Considering general purpose, it is cast iron in the 160-200 range and fabricated steel in 132 frame.
- (7) C flange dimensions according to NEMA MG1 Part 4 standard (frames 132-200) or DIN standard (frame 132)..

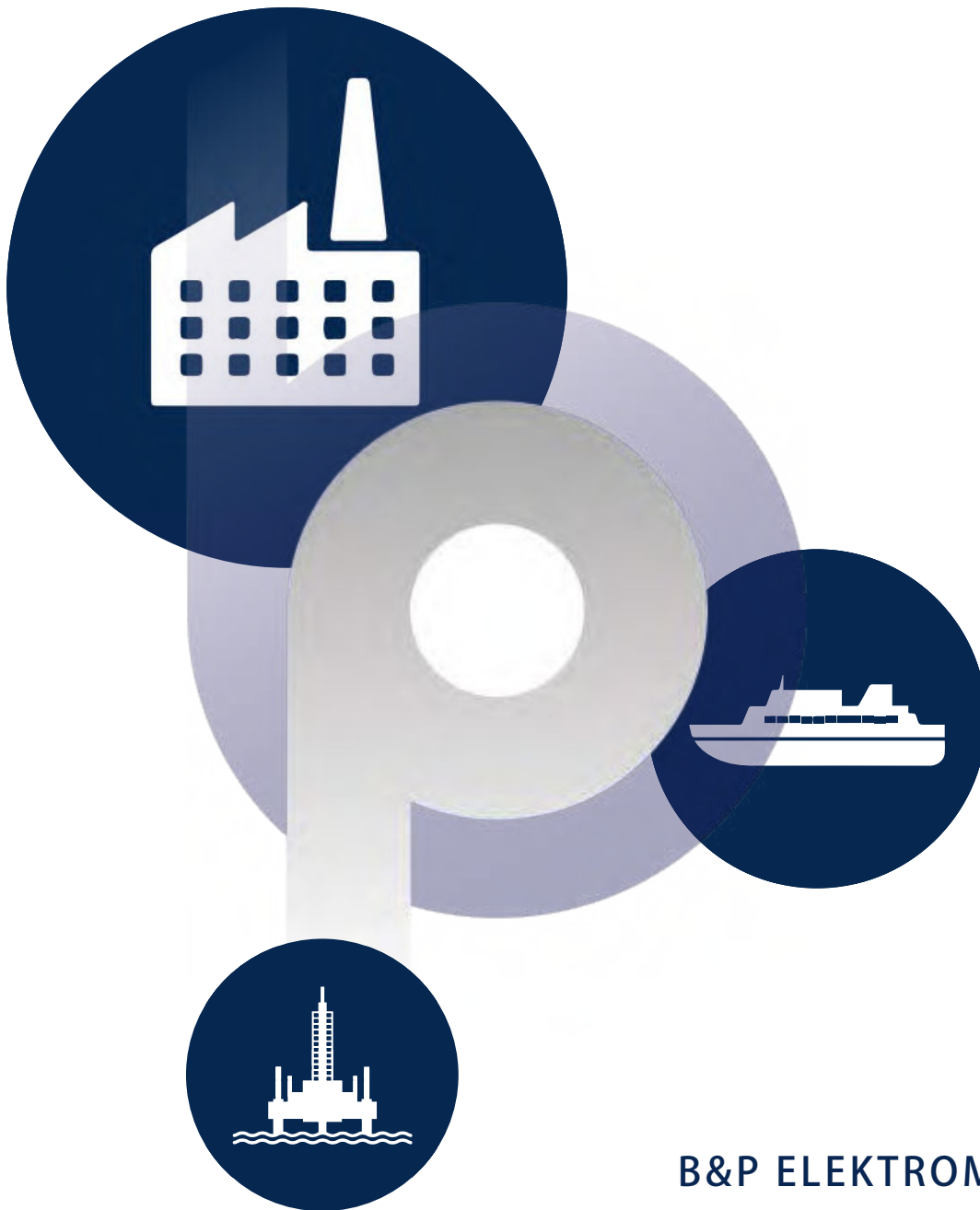
26.3. Spare Parts Available 225 - 355



Motor component		Spare part	
Item	Description	Item	Composition
1000/010	Frame with wound stator	1000	Frame with wound stator
1020	Lifting eyebolt	1020	Lifting eyebolt
1100/010	Earthing terminal	1100	Earthing terminal
1500	Rotor, complete with shaft and key	1500	Rotor, complete with shaft and key
1560	Slinger	1560	Slinger
2500/010/1	Endshield, drive end	2500/1	Endshield, grease nipple, drain plug, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end		
2500/010/2	FF Flange	2500/2	FF Flange, grease nipple, drain plug, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end		
2500/0010/3	C Flange (5)	2500/3	C Flange, grease nipple, drain plug, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end		
2500/010/4	FF Flange with air deflector	2500/4	FF Flange with air deflector, grease nipple, drain plug, bolts and washers
2500/080	Drain plug, drive end		
2500/100	Grease nipple, drive end		
2520	Air Deflector	2520	Air Deflector
2700/010	Endshield, non-drive end	2700	Endshield, grease nipple with extensor pipe, drain plug, bolts and washers
2700/080	Drain plug, non-drive end		
2700/100	Grease nipple (with extensor pipe), non-drive end		
4000/010	Bearing cap, internal, drive end	4000	Bearing cap (external and internal), shaft seal, grease relief, bolts and washers
4000/020	Bearing cap, external, drive end		
4000/080	Shaft seal, drive end (1)		
4000/210	Grease relief		
4200/010	Bearing cap, internal, non-drive end	4200	Bearing cap (external and internal), shaft seal, grease relief with extensor pipe, pre-load springs, bolts and washers
4200/020	Bearing cap, external, non-drive end		
4200/080	Shaft seal, non-drive end (1)		
4200/200	Pre-load springs for axial displacement (2)		
4200/210	Grease relief		
5000/010	Fan	5000	Fan (3)
6000/010	Fan cover, cast iron	6000	Fan cover
		6050	Fan cover and canopy
		6100	Canopy
6500/010	Terminal box	6500	Terminal box, complete with lid, gaskets (for lid and terminal box), plugs (for mains and accessories), earthing terminal, bolts and washers
6500/050	Terminal box gasket		
6500/060	Terminal box lid		
6500/100	Terminal box lid gasket		
6501/010	Terminal box plug for main leads		
6502/010	Terminal box plug for accessory leads		
6505/010	Terminal box removable cable gland		
6505/030	Lid gasket of the terminal box removable cable gland		
6531/010	Accessory connector	6531	Accessory connector, mounting rail, bolts and washers
6541/010	Accessory connector	6541	Accessory connector, mounting rail, bolts and washers
6590/010	Terminal box earthing terminal	6800	Terminal block, mounting rail, bolts and washers
6800/010	Terminal block		
6600/010	Accessory terminal box	6600	Accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6600/060	Accessory terminal box lid		
6600/100	Accessory terminal box lid gasket		
6600/110	Accessory terminal box earthing terminal		
6610/010	Space heater accessory terminal box	6610	Space heater accessory terminal box, complete with lid, gasket, plugs, earthing terminal, bolts and washers
6610/060	Space heater accessory terminal box lid		
6610/100	Space heater accessory terminal box lid gasket		
6610/110	Space heater accessory terminal box earthing terminal		
7000/010	Terminal box adaptor base	7000	Terminal box adaptor for side mounted position, complete with lid, gaskets, bolts and washers
7000/050	Terminal box adaptor base gasket		
7000/060	Terminal box adaptor lid		
7000/100	Terminal box adaptor lid gasket		
8500	Main nameplate (4)	8500	Main nameplate

Notes:

- (1) The shaft sealing may vary with product line. As a spare part. the shaft sealing in the 225-355 range will be supplied as an integral part of the bearing cap kit.
- (2) Valid when ball bearing is fitted in drive end. When the drive end is fitted with roller bearings. pre-load springs are not supplied (non-drive end bearing locked).
- (3) When non-plastic fan is fitted. the spare part kit is also supplied with key and circlip for fan assembly onto the shaft.
- (4) Main nameplate position will vary with terminal box configuration (top and side mounting)
- (5) C flange dimensions according to NEMA MG1 Part 4 standard.



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