Smoke Extraction Motors

Applicable to Low Voltage Motors in Frame Sizes 80 to 500
Application: Fan for Smoke Extraction

Installation, Operation and Maintenance Manual

Smoke Extraction Motors Manual

Series: Smoke Extraction Motor

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Dear Customer,

The electric motor is an item of equipment widely used by man in industrial development, considering that most of the machines he has been inventing depend upon it.
Taking into consideration the prominent role the electric motor plays in people's lives', it must be regarded as a prime power unit embodying features that require special care including its installation and maintenance in order to ensure perfect operation and extended lifetime of the unit.
This INSTALLATION, OPERATION AND MAINTENANCE MANUAL intends to assist those who deal with electric machines facilitating their task to preserve the most important item of the unit:

The ELECTRIC MOTOR.

ATTENTION!
READ CAREFULLY THE INSTRUCTIONS INCLUDED IN THIS MANUAL IN ORDER TO ENSURE A SAFE AND RELIABLE OPERATION TO THE EQUIPMENT.

WEG Equipamentos Elétricos. S.A - MOTORES

1. INTRODUCTION

NOTE!
These instructions must be followed to ensure safe and proper storage, installation, operation and maintenance of the motor.
The Fan OEM's and End Users should bring these instructions to the attention of anyone who installs, operates or maintains this equipment.
Ignoring the instruction may invalidate the warranty. In case you still have further doubts, please contact WEG.

IMPORTANT:
All standard and procedures included in this manual must be followed accordingly to ensure proper and reliable operation or storage to the equipment as well as to ensure safety conditions to the personnel involved in the motor operation.
Following these procedures is also important for the warranty policy as explained at the end of this manual.

1.1 SAFETY INFORMATION

Additional information about installation, operation, and maintenance of electrical equipment:

ATTENTION!
During operation, such equipment has energized or rotating parts that may present high temperature. So open terminal boxes, unprotected couplings, incorrect handling may cause serious injuries to people and/or material damage.
The people responsible for installation safety should ascertain that:
- Only qualified personnel perform installation and operation services on the equipment;
- These personnel must carry this Manual along with other documents supplied with the motor, and the works should be performed in accordance with specific standards and documentation for this product;
- Unqualified personnel should never perform any work on electric equipment;
- If installation and safety instructions are not followed accordingly, the warranty may be void

ATTENTION!
We recommend that all services related to the installation plan as well as all transportation activities, storage, assembly, installation, start-up, maintenance, and repairs should be carried out only by qualified personnel.
The qualified personnel should be pay attention to:
- Technical data referred to allowed applications (assembly, storage, connection, installation and operation conditions), included in this Manual, Purchase Order documentation, operation instructions, manuals, and other documents;
- Instructions and specific conditions for installation on site;
- Use of proper tools and equipment;
- During handling and transportation;
- That all protection devices of each component were removed before installation;
- Do not remove components without WEG permission;

Additionally, all motors must be stored in vibration-free rooms to avoid bearings damages.
For practical reasons, it is not possible to include in this Manual detailed information that covers all construction variables, nor covering all possible assembly, operation or maintenance alternatives.
For this reason, the present Manual only includes required information that qualified and trained personnel to carry out the required work.

QUALIFIED PERSONNEL is those people (OEM and end user) who based on their education, experience, knowledge of standards and service conditions required are properly authorized to perform any service on the motor. The qualified personnel must read and have this document in mind and they need to know all cares and procedures mentioned here. Furthermore, these people should know and how to carry out first aid procedures. If you still have further doubts about this, especially in reference to specific product information, WEG is willing to provide such information.

ATTENTION!
If this Installation, Operation and Maintenance Manual is lost, a replacement copy can be provided upon request, alternatively this can be downloaded online from the WEG website www.weg.net If required, WEG is prepared to assist you with any further doubts you may have; in this case, the motor serial number should also be advised.

In order to allow WEG to provide prompt service within technical standards, the motor serial number detailed on the motor nameplate should be advised.
Aiming at a satisfactory motor performance, we suggest making the storage, installation, commissioning, start-up and maintenance plan before receiving the equipment.

ATTENTION!
To prevent eventual motor operating problems, we recommend that all maintenance and revision services described in this Installation, Operation and Maintenance Manual be carried out by duly trained personnel. Changes of rated operating characteristics, such as excess demand for energy, temperature, and noise level increase, abnormal smell and tripping of protections are the first signs of any abnormal occurrence. In this case, to avoid material damage or injury to people, maintenance people should be immediately informed about such circumstances.

ATTENTION!
In case of doubt, switch off the motor immediately!

NOTE!
This document is supplementary to Installation and Maintenance Instructions for Electric Motors provided with the motor. When the same issues are addressed in both documents, instructions given in this document will prevail.

2. VALIDITY

These instructions are valid for the following WEG Motors class:
200 °C – 2 hours; 250 °C – 1 hour; 250 °C – 2 hours; 300 °C – 1 hour; 300 °C – 2 hours; 400 °C – 2 hours.

ATTENTION!
The Warranty Terms will be presented at the end of this manual, but these terms will be valid only if the criteria and recommendations informed in this manual have been followed in their entirety as well as the motor design has not been changed, otherwise, the terms will invalid.

3. CONFORMITY

WEG Smoke Extraction Motors comply mechanically and electrically with the requirements laid down European Standard – EN12101-3 (Specification for powered smoke and heat exhaust ventilators).
Motors in conformity with this standard are able to provide daily ventilation, as well as for driving smoke extraction fans in a fire/emergency condition.
In fire emergency condition, they must be effective in creating a smoke-free area near the floor allowing possible evacuation and rescue of people and animals, as well as ensuring property protection and allowing that fires could be fought in their initial stages. These systems also help to eliminate hot gases produced by combustion in the first stages of the fire.

ATTENTION!
Since their operation will be vital in the event of an accident, WEG recommend performing additional surveillance and maintenance operation as mentioned in this manual. In order to ensure their perfect operation, a safety function is required.

ATTENTION!
When a motor at normal ambient conditions (normally ≤ 40ºC) is driven by an inverter (VSD/VFD), in case of emergency it is highly recommended that the motor is connected to a sinusoidal (direct online) supply.
Where the building control system is such that the motor will necessarily be fed via a VFD/VSD during emergency conditions, it is imperative that the motor is run at its rated speed and voltage/frequency as it will be this speed at which the motor has normally been certified as a component of the ventilator.

ATTENTION!
In the emergency condition, any overheating protection device must be switched off.

4. RECEIVING, HANDLING, AND STORAGE

4.1 RECEIVING

Upon receipt, we recommend checking the package to see if any damage has occurred during transportation. If you check some abnormality or damage, please contact WEG immediately without using the motor, and make a record on the receipt. The lack of notice will void the warranty.
Check all rating plate data, especially voltage and winding connection (star or delta). The type of bearing is specified on the nameplate of motors.
The adjusting and sliding surfaces are protected with corrosion inhibitors. WEG does not recommend removing these protections until the motors have been installed.
The motors with cylindrical roller bearings or angular contact bearings are shipped with a shaft-locking device to avoid damage on the bearings. Remove it when receiving, to check the free rotation.

ATTENTION!
Machines fitted with cylindrical-roller or angular contact bearings must be fitted with locking devices during transportation.

ATTENTION!
Make a visual inspection after the unpacking has been done. Do not remove the protecting grease from the shaft end neither the stoppers from the terminal boxes. These protection devices must be kept in place until the final installation has been concluded

4.2 HANDLING

When lifting the package, it is important to observe the appropriate local for this purpose as well as to check the weight of the package and the hoist capacity.
The motors shipped in wooden boxes must be always lifted by the eyebolts or by forklift and never by the shaft.
Lifting and lowering the packages must be done gently in order to avoid damage to the bearings.
Use the forklift to handling the motors on pallets, or use the existing eyebolts to lift the motor.

Check that the eyebolts or the lifting lugs integrated with the motors are undamaged and fully tightened before lifting. Damaged lifting lugs must not be used.

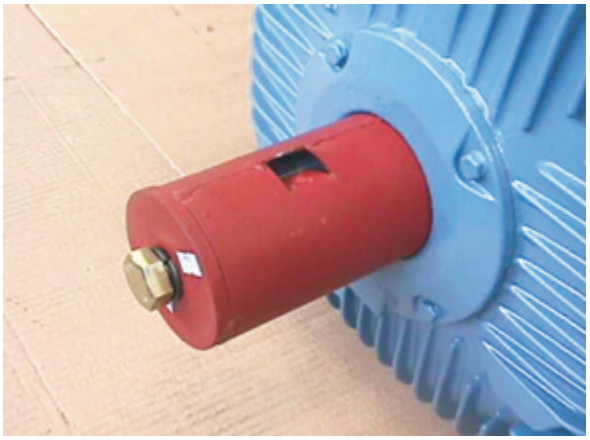
NOTE!
- Never lift the motor by the shaft;
- Check the motor weight to lift;

4.3 STORAGE

If the motor is not installed immediately, it must be stored in horizontal position, without placing objects on it, in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 ºC and 40 ºC, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. Do not remove the protective grease from shaft end to prevent rust.

If the painting has been damaged, WEG recommend repainting the damaged area to avoid rusting. Use protective oil (anti-rust) when oil has been removed from machined surfaces.

We recommend to remove the shaft locking device, when existing, and rotate it manually (once a month, 10 turns) in order to avoid contact corrosion and ensure again uniform grease distribution.
During transportation, the shaft-locking device must be installed again.
If the drain plugs are inserted and closed, remove them (every three months) to eliminate the condensing water, if motors are not fitted with space heater.

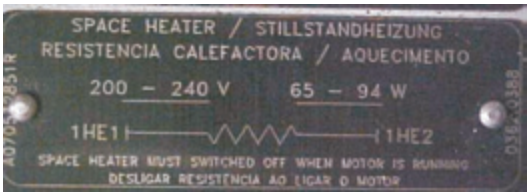


ATTENTION!
It is recommended to rotate the shaft manually once a month (10 turns at least) to prevent grease migration and to avoid corrosion. It is also recommended to place the shaft in another position after the 10 turns.

Space heaters - some motors are equipped with space heaters in order to avoid condensation of water.

WEG recommends using space heaters when the motors are installed in moist (areas where high levels of humidity like above 95%) and the drain plug is closed. The space heater can be used in spare motor or in motors that do not run every day.

The voltage and power of the space heaters are indicated on an additional nameplate. This nameplate also shows the wiring diagram of the power supply. The picture below shows an example:



ATTENTION!
During the storage or when the motor is a turn-off, the space heaters must be kept switched-on to avoid condensation and reduction of the insulation resistance. The space heater never must be energized when the motor is in operation.

Special Internal Painting-Tropicalisation - WEG recommends use special internal painting in the following situations:

HUMIDITY <=95% and with temperatures between –16 °C up to 40 °C and between 40 °C up to 65 °C (in this case with power reduction if it was designed for 40 °C as environment temperature);
>95% it is recommended use special painting and space heaters.

Bearings
Motors equipped with roller bearings: WEG recommends to run these motors with a minimum radial force in order to avoid bearings damage (consult WEG in case of doubts).
Motors equipped with angular contact bearings: WEG recommends to run these motors with the appropriate axial force in the correct direction in order to avoid bearings damage.

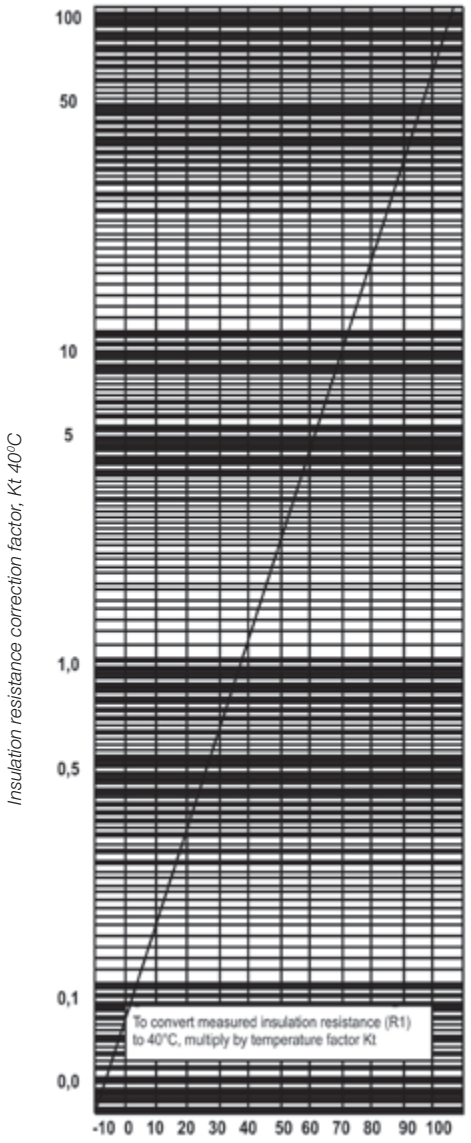
5. INSULATION RESISTANCE

When the motor is not installed immediately, it should be protected against moisture, heat, and dirt in order to avoid insulation resistance reduction.

ATTENTION!
Measure the insulation resistance before the motor starting.

- Disconnect motor from the power supply before making any insulation measurement.
- To avoid electric discharge risks, discharge the terminals right after performing the measurement.

If the motor is stored in rooms with moisture, insulation resistance must be measured at periodical intervals.
It is difficult for determining rules for the current insulation resistance value of a motor since its resistance may change from type to type, size, rated voltage, condition of the used insulating material and motor construction method. A lot of experience is required to decide when the motor is ready for operation. Periodical records will be helpful to take the correct decision.
The minimum recommended insulation resistance value is 100 MOhms.
If the test is performed at a different temperature than 40 °C, it is necessary to correct the reading to 40 °C (as shown on the graphic 1) by using an insulation resistance variation curve in relation to temperature, given by the motor itself.
If this curve is not available, it is possible to use an approximate correction given by the characteristic curve. (Graphic 1).
On new motors, lower resistance values are sometimes obtained, since solvents are present in the insulating varnishes, which become volatile in a later stage during normal operation. This does not necessarily mean that the motor is not suitable for operation considering that the insulation resistance will increase after a period of operation.
On old motors, still in operation, higher resistance values are normally obtained. The comparison with values obtained from previous tests on the same motor under identical voltage, temperature and moisture conditions will be a good indicator of the insulation conditions in comparison to the value obtained from a single test. Any sudden or high reduction of the resistance requires careful evaluation



***Graphic 1**. Variation of insulation resistance with the temperature.*
Winding temperature (°C) R 40°C=Rt x Kt 40°C

6. ABSORPTION AND POLARIZATION INDEX

In addition to the insulation resistance measurement, WEG also recommends the absorption and polarization index test.
The polarization index is the ratio of the 10 min insulation resistance to the 1 min insulation resistance.
The absorption index is the ratio between the 1 min insulation resistance to the 0,5 min insulation resistance.

To avoid electric discharge risks, discharge the terminals right after performing the measurement.

IR	IP (only for motors >11kW)	IA	Recommendations	Conditions
> 500M	IP >2	IA > 1,2	The motor can run. As the current lack levels are very low at these insulation resistance values, the index turns very inaccurate.	Released
	1 < IP < 2	1 < IA < 1,2		
	IP < 1	IA < 1		
500M > IR > 100M	IP >2	IA > 1,2	The motor can run.	Released
	1 < IP < 2	1 < IA < 1,2	Evaluate why the index is very low. If external causes are identified, the motor can run. Otherwise, it is required to run another test and check the index tendency.	Released with reservation
	IP < 1	IA < 1	It is necessary to wash and dry the motor in an oven and evaluate the index again. If the index remains low, it is necessary to repeat the process. If it still is not good, see the notes.	Evaluate the using
100M > IR > 5M	IP >2	IA > 1,2	The motor can run.	Released
	1 < IP < 2	1 < IA < 1,2	It is necessary to wash and dry the motor in an oven (100ºC/2h) and evaluate the index again. If the index is better than before, this process must be repeated until a good value is obtained. If this is not achieved, see notes.	Evaluate the using
	IP < 1	IA < 1	To wash and dry the motor winding and evaluate the index. If the values are still low, see notes.	It is necessary to repair
< 5 M	IP >2	IA > 1,2	To wash and dry and evaluate the index. If the values are still low, see notes.	It is necessary to repair
	1 < IP < 2	1 < IA < 1,2		
	IP < 1	IA < 1		

***Table 1**. Guideline for the motor winding evaluation*
Legend:
IR: Insulation Resistance;
IP: Polarization Index;
IA: Absorption Index.

NOTE!
- Never lift the motor by the shaft;
- Check the motor weight to lift;

The combination of the insulation resistance, polarization index, and absorption index results will give a better answer than only the insulation resistance evaluation.
Table 1, shows this combination and the conditions/results. If the index results are in conflicting, it must be chosen the worst case.
The tests must be realized in controlled temperature and moisture or in known conditions. This table shall be used as a guide and is based on site experience.

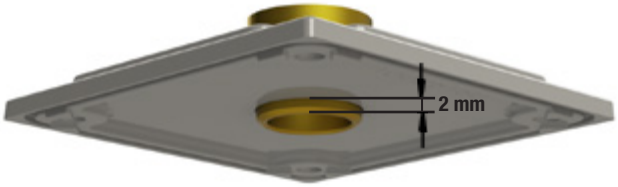
7. INSTALLATION

Smoke Extraction Motors were not designed to operate in hazardous location, like explosive atmosphere.

ATTENTION!
The locations where the motors are installed should allow easy access for inspection and maintenance services. WEG is not liable for removing motors from the site.

ATTENTION!
Install cable glands to protect the main and accessories lead wires. Handle these leads carefully in order to avoid insulation damages on leads and cable in general.

In case of replacement of the original cable gland, it shall be guaranteed the complete protection of the cables, avoiding contact with the machining of the thread. WEG recommends using a cable gland with a thread 2 mm longer the base plate thickness.

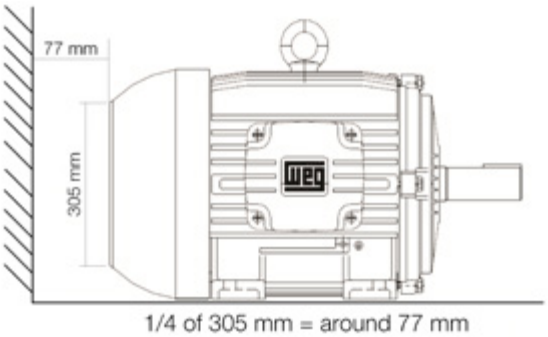


ATTENTION!
Bearings are sensitive to standstill vibration or impacts caused during handling.

7.1 COOLING

Smoke Extraction Motors are designed to operate in a maximum ambient temperature of 40 °C and a maximum altitude of 1000 m above sea level (unless otherwise specified as part of the Contract).
Ensure that no nearby equipment, surfaces or direct sunshine, radiate additional heat on to the motor. To ensure free air circulation around the motor, TEFC (Totally Enclosed Fan Cooled) machines must not be mounted nearer than 1/4 of the air inlet diameter to walls or other obstructions. See below example of a 200 frame motor.

ATTENTION!
Under no circumstance, motors can be enclosed in boxes or covered with materials which may obstruct or reduce the free cooling air circulation.



1/4 of 305 mm = around 77 mm

ATTENTION!
Some smoke extraction motors used inside axial follow fans or similar are supplied without any self ventilation as they receive their cooling from the driven fan. There are designated TEAO (Totally Enclosed Air Over – IC 418).

Find below an illustration of TEAO motor.

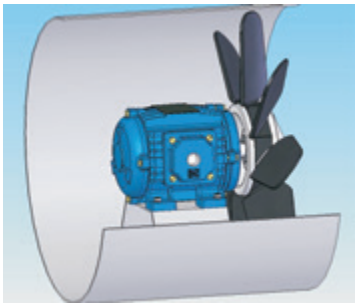


Table 2 shows the minimum air velocities required to cool TEAO fan and exhaust/smoke extraction motors considering IEC outputs only (ratings according to the main nameplate).

Minimum Air Speeds Required to Cool Three-Phase - TEAO motors W21 & W22 Standard Fan & Exhaust / Smoke Extraction Lines IEC Ratings (Standard Outputs)								
Frame	II Poles		IV Poles		VI Poles		VIII Poles	
	3000 rpm	3600 rpm	1500 rpm	1800 rpm	1000 rpm	1200 rpm	750 rpm	900 rpm
	Speed	Speed	Speed	Speed	Speed	Speed	Speed	Speed
	m/s	m/s	m/s	m/s	m/s	m/s	m/s	m/s
63	7,9	9,5	4,0	4,8	2,6	3,1	2,0	2,4
71	10,4	12,5	5,2	6,2	3,5	4,2	2,6	3,1
80	8,8	10,6	4,6	5,5	3,1	3,7	2,3	2,8
90	10,1	12,1	5,0	6,0	3,7	4,4	2,7	3,2
100	15,7	18,8	7,9	9,5	5,3	6,4	3,9	4,7
112	14,0	16,8	9,2	11,0	6,1	7,3	4,6	5,5
132	16,8	20,1	9,9	11,9	6,8	8,2	5,1	6,1
160	11,3	13,6	8,4	10,1	5,6	6,7	4,2	5,0
180	10,6	12,7	10,1	12,1	6,7	8,0	5,0	6,0
200	12,8	15,4	11,3	13,6	7,5	9,0	5,6	6,7
225	24,9	29,9	15,4	18,5	13,6	16,3	10,2	12,2
250	24,4	29,3	15,5	18,6	13,6	16,3	10,2	12,2
280	17,5	21,0	15,5	18,6	15,1	18,1	11,3	13,6
315S/M	19,1	22,9	15,2	18,2	16,3	19,6	12,2	14,6
315L	19,1	22,9	20,8	25,0	16,3	19,6	12,2	14,6
355S/M	17,8	21,4	21,0	25,2	19,6	23,5	14,7	17,6
355A/B	20,5	24,6	21,0	25,2	19,6	23,5	14,7	17,6

Table 2: Minimum required air velocities passing across motor cooling fins to achieve IEC ratings.

Table 3 shows the minimum air velocities required to cool TEAO fan and exhaust/smoke extraction motors considering AOM 'air over motor' outputs (higher ratings according to the separate tag nameplate).

Minimum Air Speeds Required to Cool Three-Phase - TEAO motors W21 & W22 Standard Fan & Exhaust / Smoke Extraction Lines AOM Ratings (High Outputs)								
Frame	II Poles		IV Poles		VI Poles		VIII Poles	
	3000 rpm	3600 rpm	1500 rpm	1800 rpm	1000 rpm	1200 rpm	750 rpm	900 rpm
	Speed	Speed	Speed	Speed	Speed	Speed	Speed	Speed
	m/s	m/s	m/s	m/s	m/s	m/s	m/s	m/s
63	11,9	14,3	6,0	7,2	3,9	4,7	3,0	3,6
71	15,6	18,7	7,8	9,4	5,3	6,4	3,9	4,7
80	13,2	15,8	6,9	8,3	4,7	5,6	3,5	4,2
90	15,2	18,2	7,5	9,0	5,6	6,7	4,1	4,9
100	23,6	28,3	11,9	14,3	8,0	9,6	8,0	9,6
112	21,0	25,2	13,8	16,6	9,2	11,0	9,0	10,8
132	25,2	30,2	14,9	17,9	10,2	12,2	10,2	12,2
160	17,0	20,4	12,6	15,1	8,4	10,1	6,3	7,6
180	20,0	24,0	16,0	19,2	10,0	12,0	7,5	9,0
200	23,0	27,6	17,0	20,4	11,3	13,6	8,4	10,1
225	30,0	36,0	23,1	27,7	20,4	24,5	15,3	18,4
250	30,0	36,0	23,3	28,0	20,4	24,5	15,3	18,4
280	26,3	31,6	23,3	28,0	22,7	27,2	17,0	20,3
315S/M	28,7	34,4	22,8	27,4	24,5	29,4	18,3	22,0
315L	28,7	34,4	31,2	37,4	24,5	29,4	18,3	22,0
355S/M	26,7	32,0	31,2	37,4	29,4	35,3	22,1	26,5
355A/B	30,7	36,8	31,2	37,4	29,4	35,3	22,1	26,5

Table 3: Minimum required air velocities passing across motor cooling fins to achieve AOM ratings

ATTENTION!

Failure to provide the minimum air velocities indicated in tables 2 and 3 (above) and for the required directions(s) of rotation, can result in an increased temperature rise or overheating, leading to premature failure of the insulation system.

8. MECHANICAL ASPECTS

8.1 ALIGNMENT/LEVELING

The electric motor must be accurately aligned with the driven machine, particularly in cases of direct coupling. Incorrect alignment can cause bearing damages, vibrations and even shaft breaking.
The best way to ensure correct alignment is to use laser alignment or dial indicator, placed on each half coupling, one reading radially and the other axially.
In this way, simultaneous readings can be informed and one can check any parallel (Figure 1a) or concentricity deviations (Figure 1b) by rotating the shaft. The dial indicator should not exceed 0.03 mm. If the operator is sufficiently skilled, he can obtain alignment with clearance gauge and a steel ruler, providing that the couplings be perfect and centered (Figure 1c).

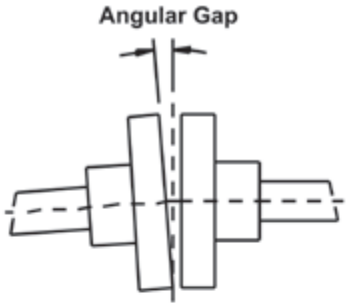


***Figure 1a**- Angular alignment (parallelism).*

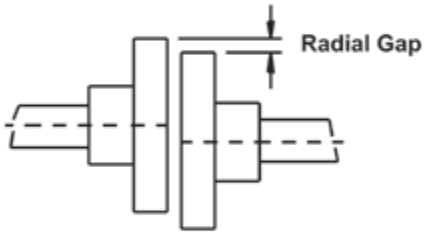


***Figure 1b** - Radial alignment (concentricity).*

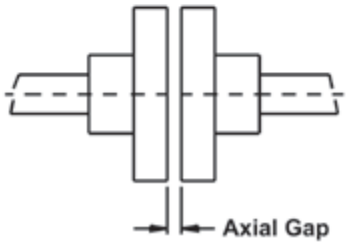


***Figure 1c** - Radial alignment (concentricity).*

On the alignment/leveling, it is important to take into consideration the effect of the temperature over the motor and driven machine. The different expansion levels of the coupled machines can modify the alignment/leveling during motor operation.
It is a good practice to check the alignment after motor first operation when it is still hot.

8.2 COUPLING

Whenever possible, it is recommended to use direct coupling due to lower cost, less space required, no belt slippage and lower accident risk.
IMPORTANT: Align carefully the shaft ends using, whenever possible, flexible coupling. The maximum recommended value is 0.04 mm (angular or radial).

8.3 VIBRATIONS LEVELS

WEG produces the motors in agreement with IEC60034-14 (ROTATING ELECTRICAL MACHINES - PART 14: MECHANICAL VIBRATION OF CERTAIN MACHINES WITH SHAFT HEIGHTS 56 MM AND HIGHER - MEASUREMENT, EVALUATION, AND LIMITS OF VIBRATION).
This standard (IEC60034-14) is related to motor no-load vibration. As a reference for motor vibration with load, WEG recommends following ISO10816-1 (MECHANICAL VIBRATION - EVALUATION OF MACHINE VIBRATION BY MEASUREMENTS ON NON-ROTATING PARTS - PART 1: GENERAL GUIDELINES).

8.4 BALANCING

The motor rotor is dynamically balanced. WEG balances its motor with half key as standard.

ATTENTION!
To avoid vibration, the fan impeller/driven equipment shaft must be balanced with a half key.

9. ELECTRICAL ASPECTS

9.1 SUPPLY SYSTEM

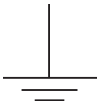
A table electric power supply is very important. All the wires and protection system must ensure an excellent quality of electric power supply to the motor terminals, following the IEC60034-1:

9.2 CABLES CONNECTION

ATTENTION!
WEG recommends checking the specific lead connection diagram indicated on the main motor nameplate by noting the correct lead identification. If the motor is fitted with accessories (like temperature sensors, space heaters, etc…), check to please the motor auxiliary nameplate which contains the required information and cable identification.

For supply cable connection, remove terminal box cover.
Insert the cables into the terminal box. Cut the supply cables to the desired length, and crimp the terminals on them and make the connection on motor.
Connect the cable shielding (if any) to the common grounding system.
Cut the grounding cable to size crimp terminal on it and connect it to the existing grounding terminal inside the terminal box and/or frame. Fasten all connections firmly.

NOTE!
For terminal connection use only material that ensures excellent electrical conductivity.



ATTENTION!
The motor must be ground to a good grounding system.

10. STARTING

The starting method is defined during the design step.

10.1 NUMBER OF STARTS

The motors are designed according to the predefined duty cycle. The motor duty indicates how many starts are allowed per hour, without damage the motor winding.

ATTENTION!
These overheating protection devices (temperature sensor) must be connected to an appropriate panel for signaling or motor switching off during abnormal motor operation. If not used, the warranty may be void.

10.2 DIRECTION OF ROTATION

Motors are usually designed for both directions of rotation. However, sometimes there may be additional nameplate indicating the direction of rotation that the motor must run.
Special attention must be given to the mechanical design, since components, like bearings (for example angular contact) may be designed according to the direction of rotation.

ATTENTION!
- Direction of rotation must be indicated on fan equipment and there can be noted also when equipment is designed for only one direction of rotation.
- Motor cooling must be according to table 2 (page 13) regardless of the direction of rotation.

11. PROTECTION

11.1 ELECTRICAL PROTECTION

Thermal protection is not fitted as standard to Smoke Extraction Motors. In this way, this section must be used just when thermal protection is fitted.
Motors usually use two types of protection: protection against overload/locked rotor, and short circuits (protection of the installation).
When the motor is designed for factor different than 1.0 (SF), the current of thermal relay protection must be set accordingly.

11.2 OVERHEATING PROTECTION

In case of a drop of voltage, overvoltage, inadequate motor ventilation, etc, the temperature sensors may switch off the motor due overheating.

ATTENTION!
These overheating protection devices (temperature sensor) must be connected to an appropriate panel for signaling or motor switching off during abnormal motor operation. If not used, the warranty may be void.

When the motor is fitted with temperature sensors, they will be indicated on the motor auxiliary nameplate. These nameplates contain the respective cable identification.

11.3 WINDING TEMPERATURE LIMITS

The temperature of the hottest winding point must be kept below the maximum insulation class temperature.
The total temperature corresponds to the sum of ambient temperature plus temperature rise (ΔT) plus the difference between the average temperature of the winding and the hottest point.
The temperature values and the permissible total temperature at the hottest point are given in the Table 3 below:

Insulation class		F	H
Ambient temperature	°C	40	40
Difference between the hottest point and the average temperature of the winding	°C	10	10
Maximum running temperature	°C	130	155
Maximum temperature material support	°C	155	180

***Table 3**. Material insulation class and temperature.*

The Smoke Extraction Motors must be operated at temperature rise one class below than motor insulation system. For instance, if the motor is designed with class H insulation system (180 °C), the maximum allowed temperature rise of this motor will be 105 K. So all temperature protection must be set accordingly.

Thermistors (PTC)

The thermistor is temperature sensing elements composed of semiconductor material (PTC) which exhibit a large change in resistance proportional to a small change in temperature (setpoint). They are serial connected or independent according to the connection diagram.

NOTE!
Thermistors must be connected to a control unit that cuts off the motor power supply or switches on an alarm system as a response of the thermistors reaction. WEG can provide proper relay for this function if requested.

RTD (PT100)
The Resistance Temperature Detectors is not set to only one temperature like thermistors since it has a range of resistance according to the temperature value.

NOTE!
PT100 is connected to a temperature control unit that monitors the temperature. The control switches off the motor power supply or switches on an alarm according to the set temperature.

PT100 have usually two leads, but sometimes they can be fitted with three leads to compensate for the distance (resistance effect) between the motors and control panel.
If the motor is fitted with thermistors, the sensor is already set to a specific temperature that depends on the material insulation class.
When PT100 is used to turn off the motor, we recommend using the same value of the maximum insulation temperature class according to Table 3. When used as an alarm, you can reduce the value by 15 °C, as the example below:
Using PT100 - In the windings (Class H – 180 °C):
Alarm temperature: 140 °C
Trip temperature: 155 °C

11.4 BEARING TEMPERATURE LIMITS

Find below the recommended temperature to alarm and motor turn-off, based on the bearings temperature. These temperatures do not depend on the winding insulation class.
Bearing temperature:
Alarm temperature: 110ºC
Trip temperature: 120ºC
The alarm and tripping temperatures can be set to different values based on experience. However, they cannot exceed the values indicated above.

ATTENTION!
The temperature sensors control must be turned-off under emergency conditions in order to ensure that the motors can operate under the specified time/temperature conditions for which it has been supplied.

12. COMMISSIONING

12.1 PRELIMINARY INSPECTION

Before starting the motor for the first time, check the following items:
1) Is the motor clean? Were all packing materials and cleaning materials removed?
2) Make sure the supply voltage and VFD match those indicated on the nameplate.
3) Make sure that all fixing bolts from the motor are firmly tightened.
4) Make sure the motor is correctly aligned.
5) Are the bearings lubricated correctly?
6) Are the thermal sensors, the grounding terminal, and the space heaters connected?
7) Is the measured stator insulation resistance according to the prescribed value (IR>=100MΩ)?
8) Are all objects such as tools, measuring instruments and alignment devices removed from the area of the motor?
9) Are all motor fixing bolts duly tightened?
10) When the motor is started without load, does it rotate freely without abnormal noise? Is the direction of rotation correct? (To reverse the rotation, invert any of two terminal leads of the power supply).
11) Is the air ventilation passing on the motor?
12) Are all required motor protection (like fuses, thermal relay, etc.) on?

WARNING!
The non-observation of the items described above can lead to serious problems to motor performance, overheating and possible motor winding damage. These problems are not covered under the warranty terms included in this manual.

In order to ensure good motor conditions during the running time, follow recommended start-up checklist below:
- Motors features: Tag, frame, serial number, rpm, mounting, power, voltage and current;
- Visual inspection: cleanliness, terminal box, terminal block, leads cables, space heaters and sensors leads, terminals, eye bolts, fan and fan cover, couplings, fittings and drain plug;
- Space heater value: measure the space heater resistance (use the power and voltage indicated on space heater auxiliary nameplate for measuring the expected resistance value);
- Type of alignment: what type was used (clock – radial/radial; clock – radial/axial; optical; rule to pulleys;
- Alignment values: radial (….mm) and axial (….mm);
- Type of start: DOL, Soft-Starter, frequency inverter, etc… (Model, capacity, etc.);
- Voltage: measure the voltages between phases and check to the tolerance according to IEC60034-1;
- Unbalance Voltage: calculate the voltage unbalance according to IEC60034-26 and check if it is OK;
- Current: check the current in each phase and compare it with nameplate one;
- Current Unbalance: calculate the current unbalance according to IEC60034-26 and check if it is OK;
- Speed: check the speed (rpm);
- Ambient Temperature: measure the ambient temperature at a distance of 1 m from the motor;
- Altitude: determine site altitude;
- Air flow speed: check if the TEAO motor is receiving the necessary air speed as recommended. If the motor is a TEFC, ensure that motor supplies the required cooling air over the motor fins;
- Bearings housing temperature: D.E and N.D.E temperature;
- Winding temperature: check if the winding temperature is according to its insulation class limit.
- Vibration values: check the vibration on all of 6 points (if possible), as recommended by standard, at the D.E and N.D.E bearing. Check also acceleration;
- Final condition: approved or not approved, and who is approving;
- General observation: all of the details that were verified during the start-up.

NOTE!
WEG recommends measuring the motor temperature (bearings, winding, if possible) within 6 hours (in intervals of 15 minutes). This time is required for motor reach the thermal equilibrium;

ATTENTION!
SHUTDOWN PROCEDURE
Before proceeding any task, switch-off the motor, since there are moving part and hot surfaces that may cause serious injurious.

13. MAINTENANCE

Well-Programmed maintenance of electric motors can be summed up as a periodical inspection (like 7 days, 15 days, 1 month, 1,5 month, 3 months, 6 months, etc…). These inspections must include checking procedures like:

- Cleanliness (fins, fan cover, etc…);
- Current and Voltage;
- Bearings and Windings temperature;
- Ambient temperature;
- Vibration levels;
- Seals conditions (V'ring, taconite, oil seal, etc…);
- Wears in general;
- Noisy;
- Lubrication conditions and useful life (listed on a specific topic);
- Connections conditions;
- Screw tightness in general;
- Winding life (listed in a specific topic);
- Insulation resistance;
- Etc…

In case one of the above items are not met accordingly, you might have unexpected stops of the equipment.
Inspection cycles depend upon conditions under which the motor operates (safety and production). These procedures ensure long motor life if followed correctly.
In order to ensure proper cooling, the motor frame must be kept clean, free of dust, dirt or oil.

Component	Daily	Weekly	Every 3 months	Yearly (partial maintenance)	Every 3 years (complete maintenance)
Complete motor	Check the noise level		Drain condensed water (it any). Check vibration levels	Retighten the bolts	Dismantle the motor. Check spare parts.
Stator Winding				Visual inspection. Measure insulation resistance.**	Cleanliness: check the fastenings and the slot wedges; measure the insulation resistance.**
Bearings		Check noise level	Check and relubricate for intervals see the data on the nameplate.		Clean the bearings. Replace them, if required
Terminal boxes and grounding lugs				Clean the inside area and retighten the bolts	Clean the inside area and retighten the bolts
Coupling: follow maintenance instructions specified in the coupling manufacturer manual		After the first week of operation: check the alignment and fastening		Check alignment and fastening	Check alignment and fastening
Monitoring devices	Record the measuring values				If possible, disassemble and check its operating condition

***Table 4**: Recommended Maintenance Schedule for a motor operating continuously.*
*** Minimum insulation resistance 100Mohm (500VDC)*

NOTE!
This maintenance schedule is recommended for a motor in continuous duty (S1) and not for a motor operating in emergency conditions only (S2);

Below some recommendation for motors that only will run in emergency conditions, i. e., motors that remain stopped during long times:
- Keep the space heaters energized (when fitted);
- Rotate the shaft at least once a month (10 turns);
- Measure the insulation resistance every 3 months;
- Replace the bearings after 2 years;
- If necessary, clean motor fins and fan cover.

ATTENTION!
Following the use of the motor under emergency conditions it must be replaced with a new motor. The motor will no longer be suitable to operate in its safety operation condition.

ATTENTION!
After each maintenance procedures when the motor is opened, it is advised to replace the seals and if the motor is fitted with labyrinth taconite or W3-Seal, apply new grease on the labyrinth as bearings grease indicated on the nameplate.

13.1 WINDING LIFE

The lifetime of winding is 10 years from the manufacturing date. Smoke extraction motors must be replaced after this period.

14. LUBRIFICATION

ATTENTION!
It is necessary to record the number of hours the motor is running in order to determine when bearing relubrication is required.
If the motor is not running continuously, the date of installation must be recorded, since relubrication is recommended every six months, even when the motor was never run during this time.

ATTENTION!
Beware of all rotation parts!
Grease can cause skin and eye irritation. Follow all safety precautions specified by the grease manufacturer.

14.1 SHIELDED/SEALED BEARINGS

Small motors (frame 80-132), when fitted with ZZ/2Z bearings, greased for life must be replaced after 20,000 running hours.
Check motor nameplate for determining the used bearing type.

14.2 MACHINES FITTED WITH GREASE NIPPLES

Grease nipples are usually used in motors frame above and included 160. The purpose of this maintenance is to extend bearing lifespan.
The bearings life depends essentially from the maintenance cares and regreasing procedures, otherwise, the bearings may have their life shortened drastically.

Maintenance includes:
a) Attention to the overall bearing status;
b) Cleaning and lubrication;
c) Detailed inspection of the bearings.

The motor noise should be checked at regular intervals as recommended before. A well-tuned ear is perfectly capable of distinguishing unusual noises, even with rudimentary tools (such as a screwdriver, etc). For more reliable and preventive bearing analysis, sophisticated equipment is required.
Bearings should be lubricated to avoid metallic contact of the moving parts, and also for protection against corrosion and wear. Lubricant properties deteriorate in the course of time and due to mechanical operation and, furthermore, all lubricants are subject to contamination under working conditions. For this reason, lubricants must be renewed or replenished from time to time.

NOTE!
Bearings with grease nipples facilities must be replaced after 40,000 running hours.

14.3 LUBRIFICATIONS INTERVALS

ATTENTION!
If Krytox GPL226 is the grease, it may cause higher noise levels particularly at low temperatures, or when intermittent duty does not allow a running temperature above 20 °C in the bearing. Please contact WEG if the service temperature is below -5 °C.

Type of grease, lubrication intervals, amount of grease and type of bearing and clearance are indicated on the motor nameplate.
Lubrication intervals depend on motor size, speed, working conditions, type of grease used and ambient temperature.

NOTE!
When the motor was designed for horizontal operation but is operated at a vertical position, the lubrication intervals should be reduced by half.

14.4 QUALITY AND AMOUNT OF GREASE

Correct lubrication is important for proper bearing operation, i. e., the grease must be applied correctly and in sufficient amount. On the other hand, insufficient or excessive greasing may cause bearing damage.

ATTENTION!
It is recommended to measure the weight of one shot of grease, in order to determine how many shots of grease are required to inject the amount of grease indicated on the motor nameplate.

Excessive greasing causes overheating due to high resistance caused by the rotating parts and, in particular, by the lubricant compacting and its eventual lubricating characteristic losses.
Excess of grease may cause leakage and motor winding contamination.
Lack of greasing causes overheating due to high friction between the rolling elements and the outer ring and inner race.

14.5 GREASE COMPATIBILITY

Incompatibility between different grease types can cause problems.

ATTENTION!
Never mix greases of different bases.
Example: lithium-based grease should never be mixed with sodium or calcium-based grease.

ATTENTION!
To avoid any eventual grease incompatibility, regrease bearings always with the grease type indicated on the motor nameplate.

As a general rule, greases with the same specification are compatible. However, depending on the mixture rate, they may not be compatible.
So before mixing different grease types, contact grease supplier firstly.
Some condensing and basic oils cannot be mixed since they do not produce a homogeneous mixture. In this case, either a grease hardening or a softening (or mixture melting point drop) can occur.

14.6 DRIVE END AND NON-DRIVE END BEARING RELUBRICATION STEPS

1. Before lubricating the bearing, clean the area around the grease nipples with a clean cotton cloth;
2. With the motor running, add with manual grease gun the amount of grease indicated on the bearing nameplate;
3. Leave the motor running enough time to spread the grease on the bearing;
4. Check bearing temperature to make sure there have not been significant variations.

NOTE!
During the first start or after a bearing relubrication it may appear a temporary temperature rise, approx. during 10-20 hours.

If the motor cannot be lubricated while it is running, lubrication can be carried out while the machine is at a standstill, proceeding as below:
1. Inject about half amount of required grease, and run the motor at full speed for a few minutes;
2. Switch off the motor and inject the remaining grease;
3. Start the motor again to spread the grease internally.

Be careful with the numbers of motor starts.

ATTENTION!
The bearing life is estimated through L10. Beyond the periodical maintenance, we recommend checking the conditions of the bearings (using special equipment) at least at each lubrication. Depending on the results, the bearing must be replaced by a new one.

ATTENTION!
The lubrication intervals are based on bearing operating temperature of 75 °C (frame 63 to 200) and 85 °C (frame 225 to 500). Some designs may present different references.
An increasing of the ambient temperature raises the bearing temperature correspondingly.
For each 15 °C of temperature rise, the relubrication should be reduced by half.

ATTENTION!
Motors mounted inside of fan ducts and with grease nipples must have external greasing nipples mounted on the external of the fan duct with a nameplate affixed advising the type, quantity and re-lubrication interval of the grease.

15. EXTERNAL/INTERNAL MAINTENANCE

ATTENTION!
TRANSPORTATION CARE:
Motors fitted with a roller or angular contact bearings must have their shaft locked during the transport in order to avoid bearing damage.
For locking the shaft, use the shaft locking device shipped with the motor.

15.1 CLEANLINESS

Motor
Motors should be kept clean, free of dust, dirt, and oil. Soft brushes or clean cotton rags should be used to clean the motors. Compressed air should be used to remove non-abrasive dust from the fan cover, fan and cooling fins. Oil or damp impregnated impurities can be removed with rags soaked in a suitable solvent.
Terminal boxes should also be cleaned; the terminals should be free of oxidation, in perfect mechanical condition, and all unused space must be dust free.

15.2 PARTIAL MAINTENANCE

- Drain the condensed water;
- If necessary, clean the inside of the terminal boxes;
- Inspect winding insulation visually;
- Verify if the all screws are well tightened.

ATTENTION!
The complete maintenance of Smoke Extraction Motors must be done only by WEG Authorized or Indicated Repair Shops. Contact our branch nearest you.

So the complete maintenance (dismantling, winding drying, bearing replacement, assembly, etc…) can be carried out only by WEG Authorized Repair Shops.

15.3 SPARE PARTS

How to order:
When ordering spare parts, motor type and serial number must be always given as indicated on the nameplate. Consult our repair shop or branch nearest you in case of doubts.

Keeping stock:
It is recommended to keep in stock the spare parts that, under normal use, can have some kind of wear such as:
- An set of bearings;
- Space heater;
- Temperature sensors.

16. ABNORMAL SITUATIONS DURING OPERATION

The most common abnormal operating conditions that affect the motor running during operation can be avoided by predictive maintenance.
Sufficient ventilation, cleanliness and careful maintenance are the main factors. The further essential factor is the prompt attention given to all abnormal situation such as vibrations, shaft knocks, insulation resistance decrease, smoke or fire, sudden changes of bearing temperature increase.
When failures of electric or mechanical nature arise, stop the motor immediately and inspect all mechanical and electrical parts of the installation.
In case of fire inside the motor, restrain and suffocate it by closing the ventilation openings. For extinguishing the fire, use dry chemical or CO_2 extinguishers. Never use water.

16.1 COMMON FAILURES ON SMOKE EXTRACTION MOTORS

Motors built by WEG are normally designed for class H insulation (overtemperature of 105K) and ambient temperatures up to 40ºC (as indicated on the motor nameplate). Most winding failures occur due to overheating (there are a lot of causes to generate overheating, as shown in the previous topic). These failures are identified by the darkening or carbonizing of the wire insulation.
This failure can be avoided using the correct protections like temperature sensors on winding and bearings, thermal relay, and others.

Short between turns
A short circuit between turns can occur due to two coincident insulation defects, or as a result of defects arising simultaneously on two adjacent wires.
In some cases, the three-phase current unbalance can be so insignificant that the motor protective device fails to act. A short circuit between turns and phases to the ground due to insulation fault is rare, and even so, it normally occurs during the early stages of operation.

Winding failures
a) One winding phase burned
This fault occurs when the motor is operating in delta connection and the current fails in one power supply cable. Current rises 2 to 2.5 times in the remaining winding with a simultaneous drop of motor
speed. If the motor stops, the current will increase 3.5 to 4 times relating to its rated value. In most cases, this fault is due to lack of a protection switch, or due to the fact that this switch has been set too high.

b) Two winding phases burned
This failure occurs when the current fails in one power supply cable and the motor winding is star connected. One of the winding phases remains current less while the other absorbs the voltage and carries an excessive current. The slip almost doubles.

c)Three winding phases burned

Probable cause 1:
- Motor protected by fuses only. An overload on the motor will be the cause of the trouble. As a consequence, progressive carbonizing of the wires and insulation will generate a short-circuit between turns, or a short-circuit against the frame. A protection switch installed before the motor can easily solve this problem.

Probable cause 2:
- Motor is not connected correctly.
- For example: a motor with windings designed for 220/380 V is connected through 380 V. The drawn current will be so high that the winding will burn out in few seconds if the fuses or the protection switch set incorrectly fails to react promptly.

Probable cause 3:

- The start delta switch is not commutated and the motor runs under overload conditions at star connection during a certain period. As it only develops 1/3 of its torque, the motor cannot reach the rated speed. The increase of slip results in higher ohmic losses arising from the Joule effect. As the stator current, consistent with the load, may not exceed the rated value for delta connection, the protection switch will not act. Due to the increased winding and motor losses, the motor will overheat and the winding will burn out.

Probable cause 4:

- These failures are caused by thermal overload, due to excessive starts under intermittent operation or due to long starting cycle.
- The perfect motors operation under these conditions is only ensured when the following values are taken into account (these must be informed during the design stage).

a) The number of starts per hour.
b) Starting with or without load.
c) Mechanical brake or current inversion.
d) Acceleration of load connected to the motor shaft.
e) Load torque related to speed during acceleration and braking.
f) Correct ambient temperature and altitude.

Rotor Failures

Motor running under load conditions generates noises of several intensities, decreasing the frequency while the load is increased. The reason for this will be, in most cases, an unsymmetrical rotor winding.
In squirrel cage motors, this will cause nearly always the break of one or more rotor bars; simultaneously, periodical stator current fluctuations may be recorded.
Failures due to spot heating in one or more rotor bars can be identified by the blue coloration at the affected spots. If there are failures in various adjacent bars, vibrations and lack of power can occur. When rotor core shows a blue or violet coloration, this will be a sign of overloading/overheating;
This can be caused by an overly high slip, by too many starts or overlong starting cycles. This failure can also be caused due to a insufficient power supply voltage.

Bearing failures

Bearing failure are the most frequent causes of delayed breakdowns.
The most common reasons for this failure are identified as excessive vibration, incorrect operation, bad alignment, unbalanced couplings, and excessive radial and/or axial loads and not followed lubrication procedures as indicated on the nameplate.

Shaft breaking

Although bearings generally constitute the weakest part of the motor, and the shafts are designed with a wide margin of safety, notwithstanding shaft may break due to fatigue from bending stress caused, for instance, by excessive belt tension. In most cases, shaft breakings occur right behind the drive end bearing.
As a consequence of alternating bending stresses, induced by a rotating shaft, breakings travel inwards from the outside of the shaft until the rupture point is reached when the remaining shaft cross-section resistance no more withstand to the stressed. Thus avoid additional drilling on shaft (fastening screw holes) since such machining operations tend to cause stress concentrations.
The replacement of only one or two belts of a belt drive system may cause frequently shaft breaking, besides being an incorrect practice.
Used and consequently stretched belts on a belt drive system, especially when mounted inner side of the pulley, while new and unscratched belts are mounted outer side on the same pulley and so farther from the bearing, can cause shaft stress.
Damage arising from poorly fitted transmission parts or improper motor alignment.
Bearing damage and shaft breaking are often caused by the unsuitable fitting of pulley, couplings or pinions on the shaft.
These parts “knock” when rotating. This defect can be recognized by the scratches that appear on the shaft or the eventual like scale flaking on the shaft end. Keyways with pitted edges caused by loosely fitted keys can also result in shaft failures.
Poorly aligned couplings cause beatings and excessive vibrations. Within a short time, this vibration will damage the bearing on the drive end side and can result in shaft breaking.

17. TROUBLESHOOTING CHART X SOLUTIONS

NOTE!
This troubleshooting chart provides a basic list of problems that may occur during motor operation, possible causes and recommended corrective actions. In case of doubts, please contact WEG Service Center.
In certain cases, the bearing manufacturer must be contacted to find out the cause of the failure.

Problem	Possible cause	Corrective action
Motor does not start, neither coupled nor decoupled	Power cables are interrupted	Check the control panel and the motor power supply cables
	Blown fuses	Replace blown fuses
	Wrong motor connection	Correct the motor connection according to connection diagram
	Locked rotor	Check motor shaft to ensure that it rotates freely
The motor starts at no-load, but fails when load is applied. It starts very slowly and does not reach the rated speed	Load toque is too high during start-up	Do not start the motor on load
	Too high voltage drop in the power cables	Check the installation dimensioning (transformer, cable cross section, relays, circuit breakers, etc.)
Abnormal/excessive noise	Defective transmission component or defective driven machine	Check the transmission force, the coupling and the alignment
	Misaligned / unleveled base	Align / level the motor with the driven machine
	Unbalanced components or unbalanced driven machine	Balance the machine set again
	Different balancing methods used for motor and coupling balancing (halve key, full key)	Balance the motor again
	Wrong motor direction of rotation	Reverse the direction of rotation
	Loose bolts	Retighten the bolts
	Foundation resonance	Check the foundation design
	Damaged bearings	Replace the bearings
Motor overheating	Insufficient cooling	Clean air inlet and outlet and cooling fins
		Check the minimum required distance between the fan cover and nearest walls. See item 7
		Check air temperature at inlet
	Overload	Measure motor current, evaluate motor application and if required, reduce the load
	Number of starts per hour is too high or the load inertia moment is too high	Reduce the number of starts per hour
	Power supply voltage too high	Check the motor power supply voltage. Power supply voltage must not exceed the tolerance specified in item 7.2
	Power supply voltage too low	Check the motor power supply voltage and the voltage drop. Power supply voltage must not exceed the tolerance specified in item 7.2
	Interrupted power supply	Check the connection of the power cables
	Voltage unbalance at the motor terminals	Check for blown fuses, wrong commands, voltage unbalance in the power line, phase fault or interrupted power cables
	Direction of rotation is not compatible with the unidirectional fan	Check if the direction of rotation matches the rotation arrow indicated on end shield
Bearing overheating	Excessive grease/oil	Clean the bearing and lubricate it according to the provided recommendations
	Grease/oil aging	
	The used grease/oil does not matches the specified one	
	Lack of grease/oil	Lubricate the bearing according to the provided recommendations
	Excessive axial or radial forces due to the belt tension	Reduce the belt tension
		Reduce the load applied to the motor

ATTENTION!
The motors listed in this manual are constantly updated. For this reason, the information herewith included may change without prior notice.

ARGENTINA
WEG EQUIPAMIENTOS ELECTRICOS S.A.
Sgo. Pampiglione 4849
Parque Industrial San Francisco,
2400 - San Francisco
Phone: +54 (3564) 421484
www.weg.net/ar

AUSTRALIA
WEG AUSTRALIA PTY. LTD.
14 Lakeview Drive, Scoresby 3179,
Victoria
Phone: +03 9765 4600
www.weg.net/au

AUSTRIA
WATT DRIVE ANTRIEBSTECHNIK GMBH*
Wöllersdorfer Straße 68
2753, Markt Piesting
Phone: + 43 2633 4040
www.wattdrive.com

LENZE ANTRIEBSTECHNIK GES.M.B.H*
Ipf - Landesstrasse 1
A-4481 Asten
Phone: +43 (0) 7224 / 210-0
www.lenze.at

BELGIUM
WEG BENELUX S.A.*
Rue de l'Industrie 30 D, 1400 Nivelles
Phone: +32 67 888420
www.weg.net/be

BRAZIL
WEG EQUIPAMENTOS ELÉTRICOS S.A.
Av. Pref. Waldemar Grubba, 3000,
CEP 89256-900
Jaraguá do Sul - SC
Phone: +55 47 3276-4000
www.weg.net/br

CHILE
WEG CHILE S.A.
Los Canteros 8600,
La Reina - Santiago
Phone: +56 2 2784 8900
www.weg.net/cl

CHINA
WEG (NANTONG) ELECTRIC MOTOR MANUFACTURING CO. LTD.
No. 128# - Xinkai South Road,
Nantong Economic &
Technical Development Zone,
Nantong, Jiangsu Province
Phone: +86 513 8598 9333
www.weg.net/cn

COLOMBIA
WEG COLOMBIA LTDA
Calle 46A N82 - 54
Portería II - Bodega 6 y 7
San Cayetano II - Bogotá
Phone: +57 1 416 0166
www.weg.net/co

DENMARK
WEG SCANDINAVIA DENMARK*
Sales Office of WEG Scandinavia AB
Verkstadgatan 9 - 434 22
Kumgsbacka, Sweden
Phone: +46 300 73400
www.weg.net/se

FRANCE
WEG FRANCE SAS *
ZI de Chenes - Le Loup13 / 38297
Saint Quentin Fallavier, Rue du Morel-lon - BP 738 / Rhône Alpes, 38 > Isère
Phone: + 33 47499 1135
www.weg.net/fr

GREECE
MANGRINOX*
14, Grevenon ST.
GR 11855 - Athens, Greece
Phone: + 30 210 3423201-3

GERMANY
WEG GERMANY GmbH*
Industriegebiet Türnich 3
Geigerstraße 7
50169 Kerpen-Türnich
Phone: + 49 2237 92910
www.weg.net/de

GHANA
ZEST ELECTRIC MOTORS (PTY) LTD.
15, Third Close Street Airport
Residential Area, Accra
Phone: +233 3027 66490
www.zestghana.com.gh

HUNGARY
AGISYS AGITATORS & TRANSMISSIONS LTD.*
Tó str. 2. Torokbalint, H-2045
Phone: + 36 (23) 501 150
www.agisys.hu

INDIA
WEG ELECTRIC (INDIA) PVT. LTD.
#38, Ground Floor, 1st Main Road,
Lower Palace, Orchards,
Bangalore, 560 003
Phone: +91 804128 2007
www.weg.net/in

ITALY
WEG ITALIA S.R.L.*
Via Viganò de Vizzi, 93/95
20092 Cinisello Balsamo, Milano
Phone: + 39 2 6129 3535
www.weg.net/it

JAPAN
WEG ELECTRIC MOTORS JAPAN CO., LTD.
Yokohama Sky Building 20F, 2-19-12
Takashima, Nishi-ku, Yokohama City,
Kanagawa, Japan 220-0011
Phone: + 81 45 5503030
www.weg.net/jp

MEXICO
WEG MEXICO, S.A. DE C.V.
Carretera Jorobas-Tula
Km. 3.5, Manzana 5, Lote 1
Fraccionamiento Parque
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Estado de México - C.P. 54680
Phone: +52 55 53214275
www.weg.net/mx

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Sales Office of WEG Benelux S.A.
Hanzepoort 23C, 7575 DB Oldenzaal
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Rua Eng. Frederico Ulrich,
Sector V, 4470-605 Maia, Apartado
6074, 4471-908 Maia, Porto
Phone: +351 229 477 705
www.weg.net/pt

RUSSIA
WEG ELECTRIC CIS LTD*
Russia, 194292, St. Petersburg, Pro-spekt Kultury 44, Office 419
Phone: +7 812 3632172
www.weg.net/ru

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47 Galaxy Avenue, Linbro Business
Park - Gauteng Private Bag X10011
Sandton, 2146, Johannesburg
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www.zest.co.za

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C/ Tierra de Barros, 5-7
28823 Coslada, Madrid
Phone: +34 91 6553008
www.weg.net/es

SINGAPORE
WEG SINGAPORE PTE LTD
159, Kampong Ampat, #06-02A KA
PLACE. 368328
Phone: +65 68581081
www.weg.net/sg

SWEDEN
WEG SCANDINAVIA AB*
Box 27, 435 21 Mölnlycke
Visit: Designvägen 5, 435 33
Mölnlycke, Göteborg
Phone: +46 31 888000
www.weg.net/se

SWITZERLAND
BIBUS AG*
Allmendstrasse 26
8320 – Fehraltorf
Phone: + 41 44 877 58 11
www.bibus-holding.ch

UNITED ARAB EMIRATES
The Galleries, Block No. 3, 8th Floor,
Office No. 801 - Downtown Jebel Ali
262508, Dubai
Phone: +971 (4) 8130800
www.weg.net/ae

UNITED KINGDOM
WEG (UK) Limited*
Broad Ground Road - Lakeside
Redditch, Worcestershire B98 8YP
Phone: + 44 1527 513800
www.weg.net/uk

ERIKS *
Amber Way, B62 8WG
Halesowen, West Midlands
Phone: + 44 (0)121 508 6000

BRAMMER GROUP *
PLC43-45 Broad St, Teddington
TW11 8QZ
Phone: + 44 20 8614 1040

USA
WEG ELECTRIC CORP.
6655 Sugarloaf Parkway,
Duluth, GA 30097
Phone: +1 678 2492000
www.weg.net/us

VENEZUELA
WEG INDUSTRIAS VENEZUELA C.A.
Centro corporativo La Viña
Plaza, Cruce de la Avenida
Carabobo con la calle Uzlar de la
Urbanización La Viña /
Jurisdicción de la Parroquia
San José - Valencia
Oficinas 06-16 y 6-17, de la planta
tipo 2, Nivel 5, Carabobo
Phone: (58) 241 8210582
www.weg.net/ve

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