B&P Elektromotoren

OPERATING INSTRUCTIONS

Reference MM “W” Rev 03 EN 02/2022

GENERAL SAFETY WARNINGS

Installation, operating and maintenance of electric motors can be potentially dangerous. All precautions and measures must therefore be taken to prevent the occurrence of such dangerous situations.

NOTICE

Electric motors are components with dangerous parts as they are live or have parts which move while in operation.

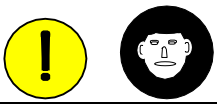
Therefore:

- **incorrect use,**
- **removal of protections without isolating the power supply,**
- **disconnection of protection devices,**
- **failure to perform inspections or maintenance,**

may cause serious injuries to people.

In particular, maintenance interventions must be carried out exclusively by qualified staff i.e. persons with specific knowledge, experience, appropriate professional training, knowledge of safety regulations, standards, accident prevention provisions and working conditions. Safety managers must authorize this staff to perform the necessary jobs and prevent any danger (also refer to IEC 364 Standard for the definition of qualified staff).
For jobs in plants with high electric currents, the access and work prohibition for unqualified staff is ruled by the IEC 364 Standard as well.

This manual contains some of the symbols used to warn about any danger which could arise during the various operations.
The symbols, together with relative wording “Danger”, “Caution” and “Warning” indicate the potential risk from not complying with the prescriptions which they are coupled up with.
The following table gives the meaning of the symbols:

	**DANGER - RISK OF ELECTRIC SHOCK** Warning that there is a risk of electric shock if this notice is ignored
	**DANGER** Warning that there is a risk of serious injury if this notice is ignored
	**CAUTION** Warning that there is a risk of damage to persons and/or objects if this notice is ignored
	**WARNING** Warning that there is a risk of damage to the motor or to the driving unit if this notice is ignored

DESCRIPTION OF THE MOTORS

GENERAL INFORMATION

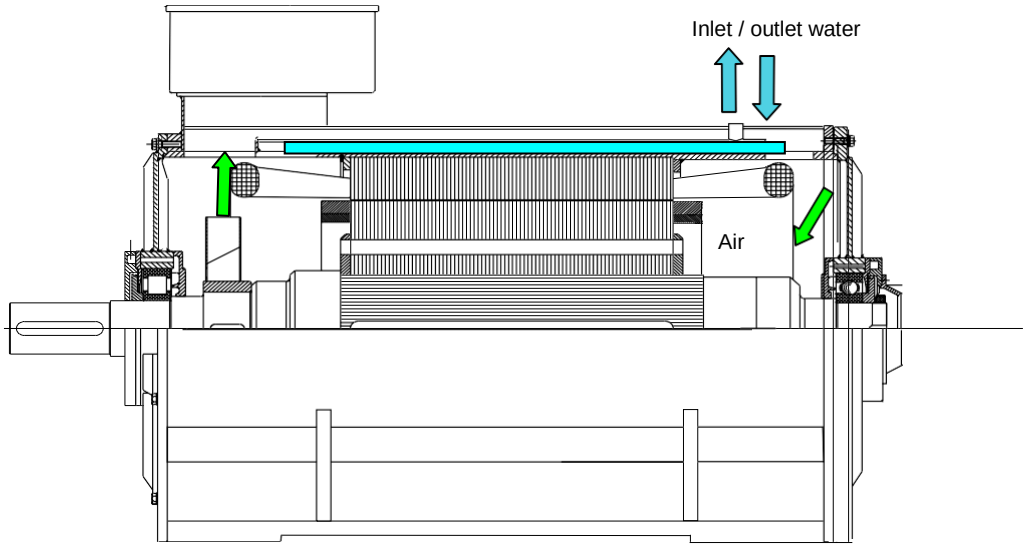
The W Line asynchronous three-phase motors frame size 160 ÷ 560 described in this manual are designed in order to consider the different requirements of industries in the field of low voltage applications, in the range of outputs included within 11 and 1800 kW.

The cooling system used (IC7 A1W7) consists of a primary cooling fluid (air) with a heat exchanger built in the motor frame, which uses fresh water coming from a remote circuit.

The water cooling is a very efficient system to remove the heat produced by the motor.
This system allows to reduce significantly the dimensions and the weight of the motor.
The efficiency of the water cooling system is independent of the motor rotation speed and therefore is particularly suitable for variable-speed drives operating with constant torque.

The water cooling also allows to:

- Reduce the heat transmitted to the installation room
- Reduce the noise transmitted
- Reduce the vibrations transmitted to the foundation
- Avoid to raise dust in the room
- Reduce the dimensions of the machines



All W Line motors are designed, manufactured, assembled and tested at our works in BEVERATE di BRIVIO - Lecco - ITALY

GENERAL FEATURES

REFERENCE STANDARDS

The W Line is in compliance with the following Standards:

- RATINGS AND PERFORMANCES IEC 60034-1 CEI EN 60034 - 1
- METHODS FOR DETERMINING LOSSES AND EFFICIENCY IEC 60034 - 2 CEI EN 60034–2
- CLASSIFICATION OF DEGREES OF PROTECTION (IP CODE) IEC 60034-5 CEI EN 60034–5
- METHODS OF COOLING (IC CODE) IEC 60034 - 6 CEI EN 60034–6
- CLASSIFICATION OF TYPE OF CONSTRUCTION AND MOUNTING ARRANGEMENTS (IM CODE) IEC 60034-7 CEI EN 60034–7
- TERMINAL MARKINGS AND DIRECTION OF ROTATION IEC 60034-8 CEI 2-8
- BUILT-IN THERMAL PROTECTIONS IEC 60034-11
- MECHANICAL VIBRATIONS IEC 60034-14 CEI EN 60034–14
- DIMENSIONS AND POWERS OF ELECTRIC MACHINES IEC 60072-1

MANUFACTURING DETAILS

The W Line motors described in this manual have been designed and are manufactured in order to assure the maximum operating reliability and safety.
All W Line motors have steel frame and shields are in steel or cast irons.

The terminal box for is made in steel or aluminum and is normally positioned on the side of the motor, the cable exit can be rotated in step of 90°. Upon request the terminal box can be positioned on the top of the frame.

Frame and stator

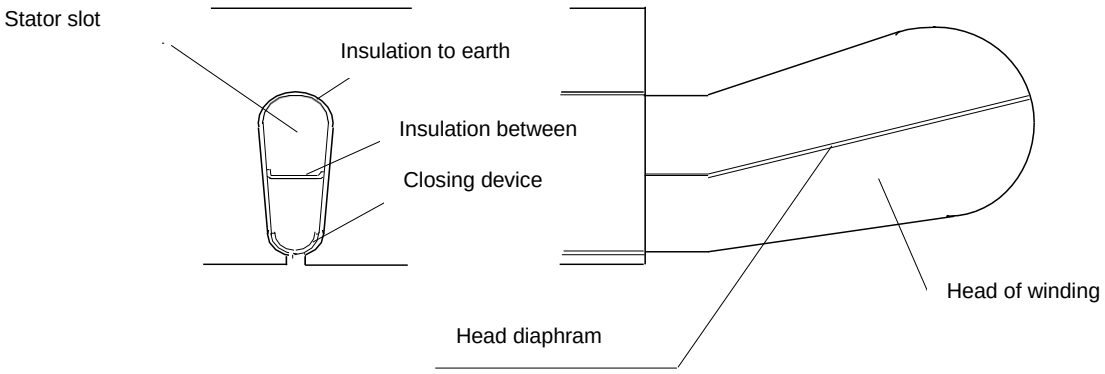
The frame is the external envelope of the motor and, besides the structural function, it also conveys the cooling water by means of a proper interspace obtained in the frame itself.
The frame is made in welded steel.
The stator core complete with the windings is placed inside the frame.
The stator lamination core consists of thin thickness (0,65 mm.) magnetic laminations. Longitudinal grooves are made in the part of the laminations nearest to the air gap, called slots, distributed evenly around the air gap with the winding housed inside them.
The stator slots are half-open to make it easier to insert the winding.
The laminations used are insulated, the ones from the others by insulating varnish. The insulation is in the order of hundredths of mm. to reduce losses from eddy currents.
The core stator laminations are made of low loss steel sheet alloyed with silicon, to reduce iron losses and consequently improve the general performance of the unit.
The production cycle includes forming of discs and punching of stator slots, cutting the rotor disc and then punching the same using quick automatic punching machines.
Laminations are then stacked in packages and packed by means of a press at a pressure of approx. 200 kg/cm^2 to avoid vibrations of the laminations and to reduce noise.
Proper flanges for pressing the package assure stiffness of the stator package and fasten the package to the frame.
Stator slots are tilted lengthwise to reduce troubles due to harmonic fields which occur like eddy torques.

Condensate drainage holes

The external envelope containing the cooling water, completely encloses the stator core in order to reduce condensate water. W Line motors are provided with condensate drainage holes in order to avoid that the water condensed inside the motor may damage the windings.
In W Line motors it is of essential importance that the drainage holes are in the correct position in order to allow the condensate drainage downwards.
Consequently it is necessary to verify that the motor is prepared for the required type of mounting.

Stator winding and insulation

Materials used to make the windings and the insulation system are in class H.
Stator winding is three-phase AC with coils manufactured with enamelled copper wire and positioned in bulk in the stator slots.
Winding is normally made with copper (Cu) for electrical use having a purity grade higher than 99,9% after electrolytic refining, specific gravity Ps=8900 kg/m^3 and resistivity at 20°C ρ = 0,0172 [*ohm*^{x}*mm*^{2}*7mm*]. After drawing, copper wire is annealed to increase ductility and consequently to facilitate the winding shaping.
The copper wire used for stator winding is insulated using enamel made with modified polyesterimide resins plus amide-imide resins, with 200°C heat class.
The type of wire used is particularly suitable for the application on motors supplied by inverter. This type of copper wire is in fact able to support high voltage gradients (dV/dt) and high voltage peaks.
Stator slots are insulated using "NOMEX" sheets
The figure highlights the parts insulating the stator winding and the materials used.



Component	Materials used
Enamel insulated wire	Grade 2 class 200
Insulation towards earth	Nomex
Diaphragm	Nomex
Insulation between layers	Nomex
Closing device	Nomex
Impregnation varnish	Polyester modified with Phenolic resin

Finally, the winding is exposed to a vacuum impregnation process in autoclave using hot polimerizing resins to guarantee further insulation and gathering the bundles of copper, which are subject to electro-dynamic stress, tightly.

Rotor
The rotor of the motor is made of a laminated core obtained with the same lamination types of the stator core.
Motors frame size 160÷280 normally have a rotor made with a die-cast aluminium double cage. This solution provides an excellent core stiffness.
Motors frame size 315÷560 have a rotor in short circuit made in copper, with double cage if they are supplied by the mains and with simple cage with rectangular section bars if supplied by inverter.
The bars of the cage are connected to each other by means of copper rings. These rings are welded to the bars using a welding process in an atmosphere of inert gas.
The realization of the rotor cage for motors supplied by inverter as indicated above, in addition to an optimization of the torque features (higher max. torque with less absorbed current) also allows to reduce the rotor losses (thanks to reduced resistivity) and additional losses due to harmonic currents determined by the non-sinusoidal power supply of the inverter and therefore allows to obtain a higher efficiency and lower general heating of the machine.

Non-drive end shield
The non-drive end shield is made in steel or cast iron and is fixed to the frame using high tensile strength screws.

Drive end shield
The drive end shield is made in steel or cast iron and is fixed to the frame using high tensile strength screws.

Flange
The flange is made in steel or cast iron and is fixed to the frame using high tensile strength screws.

Bearings
The motor is provided with grease-lubricated rolling bearings.
Motors frame size 160÷250 usually have sealed self-lubricated bearings while motors frame size 280÷560 require lubrication.
The shield supports have a Tecalemit-type greasing nipple to allow re-lubrication of the bearing and a plug for the drainage of the consumed grease.
Appropriate covers are also provided to prevent leakage of lubricant from the bearings.

Line terminal box
The line terminal box is situated on the frame, with which its lower part is integrated. It has cable-glands for the passage of the power supply cables and can be orientated in step of 90° to make cable entry possible from the various directions.
Inside the terminal box, line cable connections are provided. These cables have to be connected according to the wiring diagram which is normally available inside the terminal box itself.
The terminal for the earth connection is inside the terminal box. The earth connection must be realised using a copper wire with suitable section according to the regulations in force.

Accessory terminal box (if provided)
The auxiliary terminal boxes are fixed to the motor frame, depending on the accessories and the customer's requirements.
Their position is outlined in the overall dimensions drawing.

DOCUMENTATION

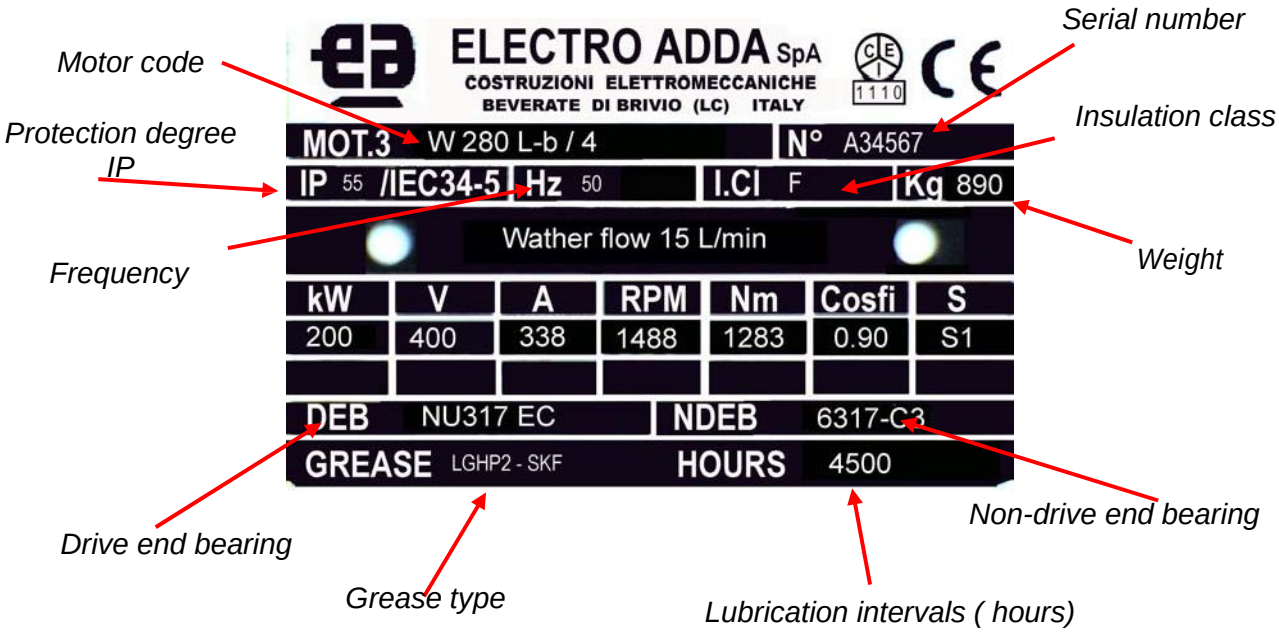
The documentation concerning the motor specifications and the operating and maintenance manuals are supplied to the customer who places the order.
You can contact Electro Adda SpA to obtain further copies of these documents.
In addition to this manual, each machine is provided with the following documents:

- Data sheet containing the electromechanical details
- Overall dimensions drawing
- Weight and loads of the motor on the foundation
- Electrical connection diagram
- Instruments and position of accessories

Upon customer request it is possible to issue an additional documentation containing items not included in this manual.
In case of conflict between this manual and the additional documentation of the machine, the additional documentation will prevail.

IDENTIFICATION OF THE MOTOR

A plate containing rating data as well as electro mechanical and magnetic data is fixed to the motor frame. This plate must never be removed from the motor.
This plate also contains the serial number assigned by Electro Adda SpA. This serial number enables the complete motor tracking.



Motor Code	**W**	**280**	**L**	**b**	**4**
Motor line					
Frame size					
Frame length code					
Core lenght code					
Polarity					

Upon customer's request special rating plates mentioning particular features can be added. For example: system item etc.

RECEIPT

The motor is delivered complete with all parts, ready for installation, after the prescribed quality controls during the production cycle and a final inspection to ascertain correspondence to the project specifications.
On receipt, it is advisable to examine the motor to verify that no damage during transport occurred.

Any damage that might be detected, must be immediately reported to the forwarder and to ELECTRO ADDA S.p.A.

Motor handling

To unload the motor and to handle it, it is necessary to pay particular attention to avoid injuries to the persons in charge and to avoid any damage to the motor.

Before lifting the machine, make sure that the lifting equipment is available and that the personnel is familiar with this type of operation. The weight of the machine is shown on the rating plate, on the dimensional drawing and on the delivery note.

Wooden case package
A wooden case package is usually provided for seafreight. Normally a wooden case, covered with lamina paper in the inside, is used. This case must be lifted using a fork lift from the bottom or a crane with lifting slings.
Lifting points are marked on the package.

Pallet package
To handle a machine placed on a pallet it is possible to use a crane that lifts the machine by means of proper eyebolts, or by means of a forklift from the bottom of the pallet.
The machine is fixed to the pallet with bolts.

Unpacked motor
Great care has to be taken in handling an unpacked motor.
The machine must *never* be lifted by a forklift from the bottom or the feet.
A proper lifting equipment has to be used!
The crane must always lift the machine using the proper eyebolts placed on the motor frame.

After unloading the motor and removing package, if available, it is necessary to carefully clean all parts protected by grease.

If the motor is not installed immediately, it must be stored in a covered, clean and dry place, free from any vibration. Of course, rust preventer has not to be removed.

STORAGE

If the motor must be stored for a long period of time, several precautions must be taken to prevent its deterioration.

If possible, the machine must be placed in a covered, clean and dry place.

The temperature of the rooms where motors are stored, should be included within 10°C and 50°C.
In case motors should be stored in heavier conditions, it is necessary to consult Electro Adda SpA Technical Department when placing the order.
The storage place should possibly have a low humidity level (Relative humidity below 75%).
If the motor is provided with anti-condensation heaters, it is convenient to connect them and to occasionally check their good operation.
If the machine has to be stored outdoors, it is advisable to protect the machine with proper covers which prevent water inlet but at the same time allow ventilation of the machine. If the motor is protected with plastic wrapping, it is advisable to make some holes in the wrapping to allow ventilation.

If the storage period is extended, the motor must be inspected frequently and the insulation resistance of the windings must be controlled at regular intervals. The procedure to check insulation resistance is described in enclosure 1 of this manual.
Whenever a significant reduction in the resistance value is detected, the cause must be investigated and a solution found for the problem.
The motor must be placed in an environment without excessive vibrations, which could damage the shaft and the bearings.
The bearings used are grease-lubricated rolling bearings. This is sufficient to maintain the bearings lubricated; therefore they do not require maintenance during storage.
To prevent deformation of the bearings and of the shaft, it is necessary to turn the shaft by some turns every month.
The above-mentioned provisions must also be carried out on machines that remain inactive for long periods of time after installation (e.g.: reserve machines).

INSTALLATION AND COMMISSIONING

The motor must be installed in a well ventilated place. Avoid the proximity of walls or other machinery as they might obstruct normal ventilation.
Normal motor performance is referred to a maximum temperature of 40°C.
Make sure that no equipment or surface next to the motor might radiate additional heat to the motor itself.

Installation

Before positioning the machine on the foundation, it is advisable to verify that the foundation is clean, even and horizontal with a tolerance of 0,2 mm (8,0 mil).
The foundation must be free from vibrations transferred by external equipment and must be rigid enough to withstand possible stresses coming from the normal operation and short circuit.
The foundation should be dimensioned in order to avoid arising of vibrations due to resonance.
Metal foundations should be painted to avoid corrosion.
The holes for the machine fixing screws are situated on the feet of the frame for motors with horizontal axis and on the flange for motors with vertical axis.
Insert the foundation bolts in the motor feet and insert a 1-2 mm shim (washer) between the bolt and the foot.
The following table shows the tightening torque of the foundation bolts.

Bolt dimensions	Nm		Pound foot	
	Lubricated	Dry [Nm]	Lubricated	Dry
M12	75	55	80	59
M13	120	88	130	96
M16	180	130	200	150
M 20	350	380	260	280
M 24	600	650	430	470
M 27	900	970	660	700
M 30	1200	1300	890	960
M 36	2100	2300	1500	1700

Tightening torque in Nm (pound foot) Bolts Class 8.8

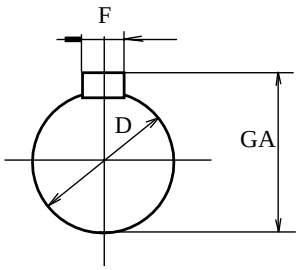
Assembly and disassembly of the transmission component

The use of a flexible coupling is advisable for the mechanical connection of the motor. This must be able to prevent the transmission of any axial or radial thrust to the bearings.
Normally the coupled machine must not transmit torsional vibrations to the motor shaft.

In the case of direct coupling it is necessary to pay particular attention to the motor alignment. Any vibrations and operation irregularities are a sign of imprecise alignment. In this case it is necessary to perform alignment with higher accuracy.

The motor rotor has been ***dynamically balanced with half key*** applied to the shaft extension. To prevent vibrations during operation it is also necessary that the transmission component (coupling

half) is accurately balanced, with half key in the corresponding keyway, before being fitted onto the shaft extension.
The transmission component must be shrink fitted according to the manufacturer's instructions.
For more common applications and normal couplings it is possible to establish the following tolerances for the execution of the hole in coupling half:



Tolerances

D : H7

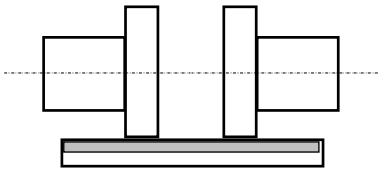
F : P9

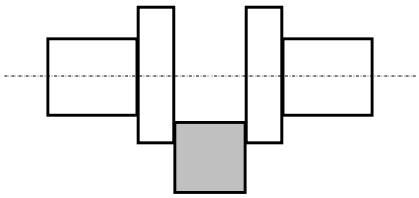
GA : +0.4 - +0.6 mm

Do not use hammers or mallets to fit the transmission component. Before heating the coupling half any non-metal parts must be disassembled as they might be damaged by the heat.
The coupling half must also only be removed after it has been heated using a flame or an electric induction appliance. It is advisable to use a proper extractor.
It is possible to find equipment on the market for the disassembly of coupling halves. These allow disassembly without heating the coupling half, using pressurised oil. In this case the coupling halves must be already prepared before assembly.

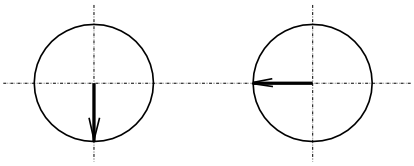
Alignment

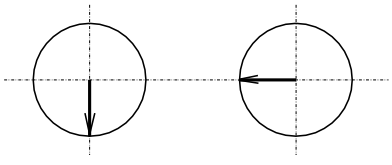
The motor must always be well-aligned, most of all if coupled directly to the load.
Incorrect alignment is a source of vibrations, which may lead to bearing, support and shaft damage.
To obtain precise alignment, it is necessary to use a metal ruler and a thickness gauge or alternatively one or two comparators.
After having mounted the two coupling halves onto the coupled machine and its motor and after having positioned the two machines, having taken the precaution to leave the distance indicated on the overall dimensions diagram, between the two coupling halves, it is necessary to slightly tighten the flange fixing screws and carry out a first rough alignment.
Rest the ruler on the two coupling halves and measure the radial alignment.



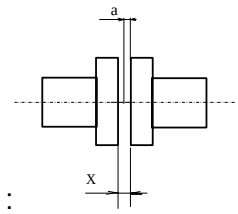


Repeat the measurement in the positions at 90°, 180° and 270° after having turned the two shafts together:



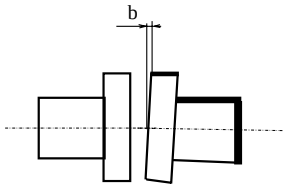


Insert a thickness gauge between the faces of the coupling halves and measure their axial distance.
Repeat the measurement in the various positions at 90°, 180° and 270° after having turned the two shafts together.
The difference between the measurements must be lower than 0.05 mm.
The maximum alignment errors must be within the values indicated below:
(x = distance defined for the type of coupling half used)

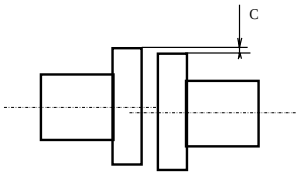


:

a = X/2 ± 5

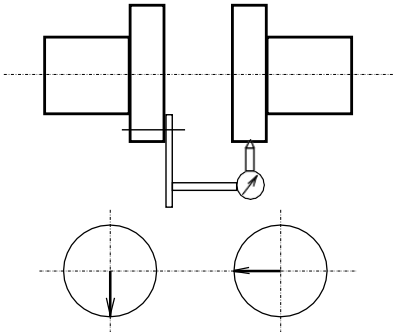


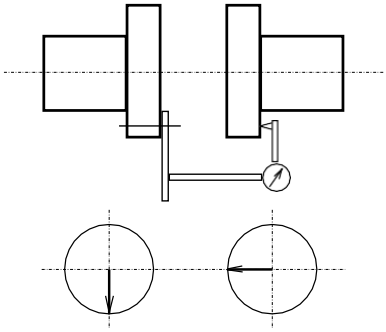
b = ± 0.05



c = ± 0.05

Whenever the alignment errors exceed the tolerated values, the appropriate corrections must be performed by means of shims inserted under the machine flange and, if necessary, with small lateral movement.
After having fully tightened the bolts, the measurement must be repeated and, if alignment is precise, the reference pins can be applied between the machine and the rest surface.
Further refinement of alignment can be obtained using two comparators, each joined to a coupling half, which measure axial and radial oscillations in the different positions.





If the coupled machine works at temperatures higher than those of the motor, in the alignment phase, it is necessary to compensate the differences that can be determined by the different expansions.
The suppliers of the coupled machines must supply the values of the vertical, lateral and axial deviations to normal operation temperatures.

Vertical deviation
The increase of the distance between the motor foot and the shaft center is given in the following table:

Frame size	Increase in mm
132 ÷ 160	0.07
180 ÷ 200	0.1
225 ÷ 250	0.12
280	0.15
315	0.16
355	0.18
400	0.2
450	0.23
500	0.25
560	0.28

NOTE: It is necessary to consider also the height variation due to the temperature increase of the driven machine in respect to the electric machine in order to establish the real thermal variation.

Axial displacement
The axial displacement needs to be considered when (as it usually occurs) the non-drive end bearing is locked.
The shaft expansion is proportional to the length of the shaft and can be obtained by the following table:

Frame size	Increase in mm
132	0.6
160 ÷180	0.7
200 ÷225	0.8
250 ÷280	1
315	1.2
355	1.3
400	1.3
450	1.5
500	1.6
560	1.8

NOTE: Make sure that between the coupling halves (excluding rigid couplings) the axial movement is free and continuous in order to permit expansion.

Hydraulic connections
The following table shows the cooling water flow rate values and the dimensions of the pipes normally used.

Frame size	Flow rate Litres/min	Pipe coupling thread
132	6	1/2 gas
160	8	1/2 gas
180	8	1/2 gas
200	8	3/4 gas
225	8	3/4 gas
250	10	3/4 gas
280	15	1 gas
315	20	1 1/4 gas
355	25	1 1/4 gas
400	30	1 1/4 gas
450	35	1 1/2 gas
500	40	1 1/2 gas
560	50	2 gas

Unless otherwise mentioned, the cooling water temperature is 32°C
Machines provided with air-water heat exchanger are normally equipped with threaded couplings for the connection to the cooling circuit.
Upon request, flanges for the connection to the cooling circuit can be provided.

Connect the pipes (or the flanges) and seal the joints using the proper gaskets.

Remember to open the cooling water circuit before starting the machine.

W Line motors must be used only with water circuit closed.
The water cooling circuit is made with carbon steel pipes which is prone to corrosion with saline or foul water.
The corrosion products and fouling deposits may cause a reduction in the thermal exchange or obstruct the cooling circuit; consequently it is extremely important to use purified and inhibited water.

Standard values for the cooling water to be used in the cooling system:

pH	6.0 - 8.0
Alkalinity (CaCO3)	> 1 mmol/kg
Chloride (Cl)	< 20 mg/kg
Sulphate	< 100 mg/kg
KMnO4 concentration	< 20 mg/kg
Al concentration	< 0,3 mg/kg
Mn concentration	< 0,05 mg/kg

The normal tap water fulfils the above values.
The cooling water must also be inhibited with an agent protecting the system against corrosion, fouling and when necessary, against freezing. All materials which may be in touch with the cooling water (pipes, heat exchanger, etc.) must be considered when selecting a suitable inhibitor.
It is recommended to use suitable and high-quality connection components to carry out the cooling circuit.
Before commissioning the motor check if there are any leaks after the pipes and joints have been connected.

Assembling of the vibration transducers (SPM) (if provided)
Vibration transducers are normally supplied disassembled in order to avoid to have them damaged during transport.
To install transducers it is necessary to refer to the instructions supplied by the transducer manufacturer.

Electric connections

CAUTION
It is important to verify that the supply voltage and the frequency correspond to the values indicated on the rating plate fixed on the machine.

Before starting the installation work, it is important to check that the incoming cables are separated from the supply mains, and that the cables are connected to the protective earth.

Check all rating plate data, especially the voltage and winding connection.

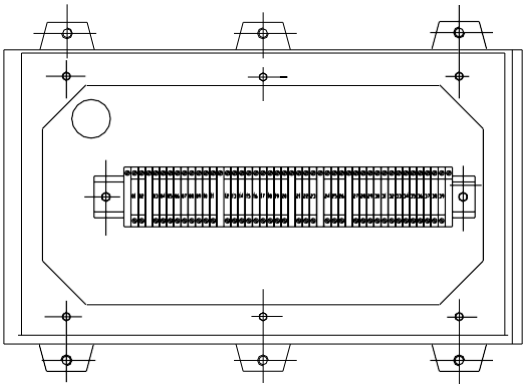
Any work on the electric installation must be carried out only by skilled personnel.

The following safety rules must be applied:
- De-energize all equipment, including auxiliary equipment
- Provide safety protections to avoid re-energizing of the equipment
- Verify that all components are isolated from their respective supply
- Connect all parts to protective earth and to short circuits
- Cover or provide barriers against live parts in the surrounding area

Main terminal box

The winding terminals are places inside the main terminal box.
Motors in standard execution are made with 3 terminals only. In some types with star connection, an accessible “star point” is provided.
Direction of rotation is clockwise seen from the drive end when the phase sequence L1, L2, L3 is connected to the terminals U1 V1 V2.
To reverse the direction of rotation, exchange the connection of two of the terminals.
Dimension of the incoming cables must be suitable for the maximum load current and in accordance with the applicable rules.
Cable terminals must be of the appropriate type and have the right dimensions.
In order to assure a reliable operation, power cable connections must be properly tightened.
Supply cables must be suitably held in order not to cause stresses on the terminal boards.
The inside of the main terminal box must be free from dirt, humidity and foreign residues. The box itself, the cable glands, and unused cable entrance holes must be hermetically sealed against dust and water.

Auxiliary terminal box (if provided)
Auxiliary terminal boxes are fixed to the frame of the motor according to the accessories and to the customer’s requirements.
Their position is shown on the overall dimensions drawing.
Auxiliary terminal boxes are provided with terminal blocks and cable glands, as shown in the undermentioned drawing. The maximum dimensions permitted for the conductors are normally limited to 2.5 mm² for signal conductors and 4 mm² for auxiliary power circuits and the voltage is limited to 750 V.
Cable glands are normally suitable for cables with 10 – 16 mm diameter.



Earth connection
The motor and all the installed instruments must be connected to earth according to the provisions of the rules in force.
The motor is provided with two earth terminals; one is positioned inside the terminal box and one is positioned on the frame.

Motors equipped with lubricators
At the first commissioning of the motor, apply at least the minimum grease quantity mentioned hereafter or until it comes out from the grease drain holes.

1) Remove the drain plug and extract the old and used grease.
2) With the motor running, insert new grease into the lubricators and by means of the specially provided grease gun actuated by hand. The grease quantity is indicated in motor nameplate.
3) Let the motor run for approximately twenty minutes to enable the excess grease to deposit in the drain pipe.
4) Check that the consumed grease is completely eliminated and reassemble the drain plug.
5) In case there is no grease at the outlet pipe, re-grease again and repeat steps 1 to 4 until grease is visible

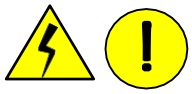
OPERATION

Running conditions

These motors are designed for industrial use.
Ambient temperature limits are -25°C +40°C.
Maximum altitude is 1000 m. asl.

Special conditions may be provided for, in this case they are mentioned on the sheets given for any single motor.

Safety notice



The motor must be installed and used by skilled personnel familiar with the safety requirements.
Accident-prevention devices necessary to prevent injuries during assembling and operation of the motor on the system, must be in accordance with the accident-prevention rules locally in force.

Checks during operation

Variations as regards normal operation (anomalous current input, high temperature or vibrations, unusual noise or smell, tripping of the protection devices) are indicative for wrong operation.

In this case, to avoid injuries to people or material damage, immediately stop the motor, perform the necessary checks and carry out maintenance.

If necessary, contact ELECTRO ADDA SpA

In order to run correctly, the electric motor must be submitted to proper care and maintenance.

Before starting the motor it is necessary to check the following

- Bearings are lubricated according the directions mentioned in the plate, data sheets or drawings
- The cooling system is efficient and in operation
- No maintenance works are in progress
- Personnel and equipment associated with the motor are ready for starting

NOTE: During full load operation, some motor parts might be hot.

Operating temperatures
W Line motors are designed to run under the operating conditions provided by the main European and international rules.
Operating conditions, such as maximum ambient temperature and maximum operating altitude, are specified in the data sheet related to each motor.
In case of ambient conditions as the ones mentioned in the data sheet and in operating conditions as mentioned in the data sheet, machine temperatures are fully included within the limits set forth by the reference standards.
If the machines are equipped with temperature sensors in the windings, check that the temperatures do not exceed the limits permitted by the standards for the relevant insulation class.
For standard motors, insulated in class F, the maximum temperature rise permitted is 155°C.
During operation it is necessary to make sure that the bearing temperature remains around the value of approx. 90°C.

Vibration check
The motor is dynamically balanced with half key, consequently no further balancing on site is necessary after assembling and alignment with the coupled machine.
However, if after having carefully checked that the alignment has been properly carried out observing the assembling instructions and that foundations did not suffer any damage, an anomalous vibration of the motor should occur, it is necessary to make the programmed vibration measuring and to correct the rotor balancing.
Moreover, before commissioning the unit, it is always necessary to measure the vibration amplitude and speed at the motor supports in three different directions to verify if any harmful vibration takes place.
In case in whatever measuring direction, vibration speeds higher than 7 mm/s effective value should be detected, it is absolutely necessary to inquire into the causes of this and take appropriate actions to limit the vibration.

Starting
Motors can be suitable for the following starting types:

Direct (DOL)
Direct on line starting is the starting normally provided for W Line motors.
In this case the motor is directly connected on the mains supply by proper contactors or switches. Starting current is normally mentioned on the data sheet of each motor.
Carefully check that the line is able to bear the starting current.
The number of consecutive starts permitted on machines with direct starting fundamentally depends on the features of the load (stall torque curve against the rotational speed, inertia) and on the features of the motor itself.
Too many starts or prolonged starts may lead to temperature rises in the windings and in the rotor cages reducing the motor life or causing a motor damage.
The maximum number of starts permitted, if not mentioned in the data sheet, can be given by Electro Adda SpA.
Of course it is necessary to know the features of the application load in order to have the possibility to establish the maximum number of starts permitted.

Star-delta starting

Star-delta starting is a type of starting with reduced voltage and is used to start the motor limiting currents during starting.
W Line motors may be star-delta started in the following cases:
1) If they are provided with terminal- board with 6 terminals
2) If the torque requested by the load is consistent with such starting
3) If the motor is delta connected referred to the line voltage

Star-delta starting should reduce the starting current and the starting torque to values equal to 33% (1/3) of the ones that can be found in a direct starting. As a matter of fact the starting torque is reduced to approx. 25% of the starting torque with full voltage while the current is reduced to approx. 30% of the current with full voltage.

By this type of starting it is extremely important to define the commutation time of the connection between star and delta.
Commutation should occur after that the motor exceeded the rpm corresponding to the motor maximum torque. In practice, in W Line motors characterized by a quite high maximum torque, commutation should occur when the motor has nearly reached the rated speed.
If commutation is made before the maximum torque, there could be voltage peaks that might make useless the purpose of star delta starting.
Moreover it is necessary to pay particular attention in order that the transition time (the passing from star to delta) is longer than 50ms to allow the extinction of the electric arc on the star contactor and avoid that, with the closing of the delta contactor, a short circuit may take place, even if reduced by the arc resistance. A longer time would cause the motor deceleration with consequent voltage peaks during commutation.
The number of consecutive starts permitted on machines with direct starting fundamentally depends on the features of the load (stall torque curve against the rotational speed, inertia) and on the features of the motor itself.
Too many starts or prolonged starts may lead to temperature rises in the windings and in the rotor cages causing a motor damage.
The maximum number of starts permitted, if not mentioned in the data sheet, can be given by Electro Adda SpA.
Of course it is necessary to know the features of the application load in order to have the possibility to establish the maximum number of starts permitted.

Starting by autotransformer

In the star-delta starting, motor supply voltage is reduced by a fixed value (Vnom / 1.73).
Very often this reduction does not allow a regular motor starting, consequently a proper autotransformer may be used, which allows to adapt voltage to the starting requirements during the starting phase.
Moreover it allows to make starting more gradual since for the three-phase autotransformer it is possible to adopt several intermediate outputs.
It is necessary to consider that the torque delivered and the current absorbed by the motors changes with the square of the of the supply voltage but the current before the autotransformer changes at the 4th power, therefore this type of starting, with the same line current, allows to start the motor with a very high torque.
In the undermentioned table are mentioned the real values of the torque delivered by the motor and of the current absorbed by the motor and of the current absorbed by the autotransformer from the line. All values are expressed in % for the motor rated values.

Motor supply voltage %	Motor starting current %	Line current %	Torque delivered by the motor %
100	100.0	100.0	100.0
95	89.8	85.3	89.8
90	80.2	72.1	80.2
85	71.1	60.4	71.1
80	62.6	50.1	62.6
75	54.7	41.0	54.7
70	47.3	33.1	47.3
65	40.5	26.3	40.5
60	34.2	20.5	34.2
55	28.5	15.7	28.5
50	23.3	11.7	23.3

(Note: Real values consider the motor de-saturation in case of a supply lower than the rated value).

Starting by static starter

Starting by soft starter consists in using an electronic static starter (precisely the Soft Starter), which allows to reduce the starting current, to establish the torque and to set out the starting time.
The motor supply is gradually increased during the whole procedure, in order to obtain a linear starting, avoiding stresses to the mechanical parts.
The static starter is installed between the mains supply and the motor, it directly controls the voltage and the current absorbed by the motor.
Its physical structure is much simpler than the one of the frequency converter (inverter); it is mainly made up of two parts, a power unit and a control unit.
Actually, in the soft starter there is not a variable frequency starting as in inverters, but a starting with an increasing starting with variable voltages.
The main components of the power unit are the heat dissipator and six thyristors (SCR), controlled by a logic implemented on a control card (precisely the control unit), usually with microprocessor.
Power losses are limited and the direct voltage drop is equal to approx. 1% of the rated voltage.
Consequently the line current may be suitably reduced, thus reducing electrical and mechanical stresses.
However it is necessary to consider that the wave form of the voltage coming out from the soft starter is rather distorted and therefore it generates remarkable stresses to the motor. Consequently in case of repeated starts it is appropriate to verify that the overheating due to the non-sinusoidal supply, is accepted by the motor.
For the same reason, even if theoretically it would be possible to have the soft starter always connected, it is advisable to cut out the starter once starting is performed and connect the motor directly to the line.
In case this is not possible, it is appropriate to properly strengthen motor windings to allow operation with non-sinusoidal supply voltages.

MAINTENANCE

Maximum motor reliability and minimum maintenance costs are the result of a planned maintenance and inspection program scrupulously followed during the whole machine life.
In case the motor needs to be repaired, please contact ELECTRO ADDA SpA.

CAUTION
BEFORE STARTING ANY MAINTENANCE OPERATION ALL ELECTRIC CONNECTIONS MUST BE DISCONNECTED.

BEFORE RE-STARTING THE MOTOR UNIT, RE-CHECK THE SYSTEM ACCORDING TO THE START-UP PROCEDURE.

THE FAILURE TO COMPLY WITH THESE PRECAUTIONS MAY LEAD TO INJURY.

PREVENTIVE MAINTENANCE

In addition to normal daily surveillance during normal operation, it is advised to carry out periodical inspections to verify if any maintenance is necessary.
Motors have been designed and manufactured in a way to require little maintenance during normal operation.
To guarantee long life of the motor, it is advisable to prepare an appropriate maintenance program that takes into consideration the real operation conditions and environmental conditions of the place where the motor is installed.
For normal conditions of use, the following maintenance program can be followed:

Component	Inspection or requested maintenance	Interval
Bearings	Grease the bearings	See motor data sheet and plate
Foundations	Check that all fixing bolts are fully tightened	12 months
Connections	Check all electric connections	6 months
Windings	Visually control the windings Clean the windings Measure insulation resistance	12 months
Terminal board	Control and clean the terminal board	12 months
Gaskets	Shaft seal rings (e.g. V-ring)	6 months

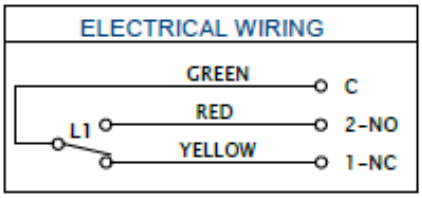
Checking the gaskets

Gaskets may not have any split or abrasion and must maintain their elasticity. The gasket compression must be approx. 25% of the thickness of the gasket.

With the time gaskets loose their elasticity and remain efficient only if they are not detached from their resting surfaces. Therefore check the elasticity level after every maintenance operation and, if necessary, replace the gaskets. For standard exchangers the type of gasket is N-SBR or NBR closed cell foam. It is allowed to use EPDM (Dutral).

Water leakage detector

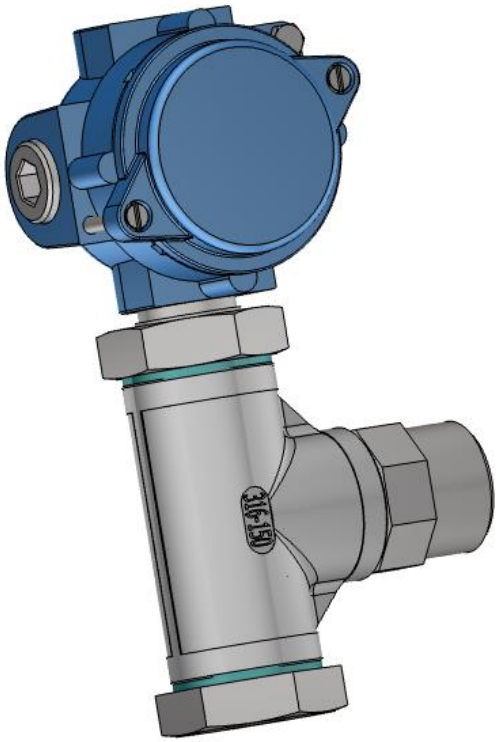
When required or requested by the customer, a water leakage detector can be installed. The instrument - connected hydraulically near the water-cooled casing, collects any leaks of the same.



Max working temperature	105°C
Max working pressure	20 bar

6D-7D SPDT REED CONTACT (ELECTRICAL AND MAGNETIC DATA)

PARAMETER		VALUE		UNITS
	MIN.	TYP.	MAX.	
CONTACT RESISTANCE			150	mΩ
BREAKDOWN VOLTAGE	200			V ac/dc
INSULATION RESISTANCE	1000			MΩ
CAPACITANCE			0.8	pF
MAX. AC/DC POWER			20	VA/W
MAX. AC/DC VOLTAGE			150	V ac/dc
MAX. AC/DC CURRENT			0.5	A
MAX. LOAD (NO OPERATION)			2	A



Directions on the operation of exchanger

During operation at nominal conditions, check the water sudden temperature change. If this is lower than what mentioned in the rating plate, it is possible to reduce the water flow.

If the inlet temperature is lower than 20°C, internal condensate is likely to be formed. Consequently temperature must be increased, by means of preheating or mixing with the outgoing water.

When user system is stopped, it is not advisable to have the water circulating in the exchanger due to the risk of forming condensate.

GENERAL CLEANING

Cleaning the windings

When cleaning assembled machines, it is advisable to firstly remove by an efficient suction all dirt that has accumulated.
Remove all grease with dry, soft cloths that do not leave threads, or using a brush with very flexible bristles.
On completion of these operations, use compressed air to remove any waste still present.
During this operation, pay attention to prevent the jet of compressed air does not push the waste into a corner from where extraction is difficult.
Pressure of the compressed air used must be lower than 2.5 bar.
Whenever the machine is too dirty to be cleaned using a brush or dry cloth, a liquid solvent can be used, suitable for the insulating material used. This solvent must be non-toxic and non-inflammable, be very volatile and have good solvent power on grease and oil but not on the resins of the insulation system.
The cleaning operation using liquid solvent must be performed in a way that the solvent remains in contact with the winding for the least time possible.
Windings cleaned using solvent must be dried using a jet of hot air before being powered. The time required to obtain a satisfactory drying strongly depends on environmental conditions such as temperature and humidity.
Windings cleaned using solvent, dry in approximately two hours at ambient temperature. The drying process can be accelerated (about 1 hour) by raising the temperature by about 15°C or, alternatively, by using forced-circulation dry air.

NOTES

The insulation resistance value is a useful indication for the evaluation of the humidity absorbed by the winding, however it might not be indicative of the state of the insulation in the presence of solvents.
Before measuring the insulation resistance to evaluate the drying status sufficient for the application of voltage, it is necessary to ensure that the winding is absolutely free from solvent.
The winding can also be cleaned using a light solution of water and detergent paying particular care and by specialised staff. The pressure must be lower than 2 bar and temperature lower than 90°C.
To minimise the effect of the detergent solution on the winding protective insulating resin, it is advisable to use a 1/60 solution in volume of water and detergent with low electric conductivity.
If a system that heats and distributes the pressurised solution is not available, spray the solution using a spray gun, or use soft cloths, which do not leave threads, to apply the solution.
After cleaning with detergent, rinse the windings well, using water or low pressure steam.

Drying the windings

Humidity deteriorates the insulation resistance of the electric machines windings and must be eliminated before the machine is used.
Therefore, if the machine is exposed to rain or in open environments with high humidity, it is absolutely necessary to dry it well.
If motors are provided with an anti-condensation heating element, when the motor is not powered, the anti-condensation heating element must be powered to prevent the formation of condensate.
Appropriate provisions must be taken to prevent the heating element remaining powered when the motor is operation. In this case, localised over-heating might occur which could damage motor insulation.

NOTES

Independently of the method used to dry the windings, they must not exceed a temperature of 90°C, measured for resistance, with thermometers or using thermal detectors.
If a heating method is used that involves the application of direct current to the winding, it is advisable not to exceed a temperature of 80°C, measured as above.
Pay attention that the time taken during heating to reach normal working conditions is possibly about 5 - 6 hours. If this period of time is not compatible with operational requirements, it is advisable that the heating time is however at least longer than 2 hours.

MAINTENANCE OF THE BEARINGS

Good and well-programmed bearing maintenance is an indispensable condition to ensure a long life to this important component, without problems.
Bearings are lubricated with grease contained in a chamber adjacent to the individual bearing.
Due to the effect of localised heating, the grease releases the oil it contains, which is then distributed on the bearing balls by centrifugal force, lubricating it.
The soap and oil used are collected in the lower part of the bearing to be easily eliminated through the drain hole.
This way, the bearing works in the best conditions, excess grease is avoided, less grease is consumed, the intervals between lubrication are lengthened and replacement is made easier.
The typical function of the grease is to supply the necessary oil to the lubrication contained in the soap. The ball bearings consume a small amount of lubricant, but this must always be present to prevent rapid deterioration and malfunctioning of the bearings. To extend bearing life to a maximum, it is necessary to use grease that has the recommended consistency and to follow the instructions concerning the lubrication interval.
The machine is delivered from the factory already complete with lubrication grease.
If the machine is stored for several months, it is advisable to renew the bearing grease before starting the machine.
The lubrication interval is mentioned on the motor plate and on the data sheets concerning the motors.
If not otherwise specified, these lubrication intervals refer to normal operation conditions in clean environments. This period of time must be appropriately reduced if duty is particularly heavy and if the environmental air contains dust particles or noxious vapours.

Features of the grease

For re-greasing, only use specific lubricants for ball bearings, having the following features:
- Good quality grease with a lithium complex soap and with mineral or PAO oil
- Base oil viscosity of 100-150 cST at 40°C
- Consistency NLGI grade 2 or 3
- Continuous temperature range -30°C (-20°F) - +120°C (250°F).

Lubricant properties are available at the main manufacturers.
The grease normally used for lubricating bearings is type **SKF LGHP2**

Alternatively the following types of high performance lubricant can be used (or similar) can be used:

ESS0	BEACON 3
IP	ATHESIA Gr 2
MOBIL	MOBILPLEX 47
SHELL	ALVANIA GREASE R2
BP	GREASE LTX2
CHEVRON	DURALITH GREASE EP2

Consult ELECTRO ADDA SpA in case you change the lubricant brand or in case of doubt about its compatibility.

WARNING :
Many types of lubricant may cause skin irritation or eye inflammation. Follow the safety precautions specified by the manufacturer.

Lubrication interval values mentioned on the motor plate and data sheet are referred to a motor operating at rated power with a bearing temperature of approx. 85°C. In case of higher operating temperatures, lubrication interval should be halved for every 15°C increase in the bearing temperature.

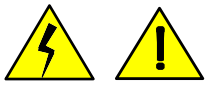
In case of lower temperatures, intervals could be increased, however it is advised to renew grease at the intervals mentioned on the plate.

If an automatic re-lubrication system is used, the quantities of grease mentioned on the plate should be doubled.

The maximum permitted temperature for the bearings is 120°C
The maximum operating temperature for grease and for bearings must not be exceeded.

The following directions are of general nature. It is advised to look at the assembly drawing normally belonging to the motor monograph.

Changing the grease
Motor re-greasing can also be performed while the motor is in operation.



CAUTION
Pay particular attention to the rotary moving parts.

To lubricate motors during operation:

- Remove the grease drain plug, if available.
- Insert new grease into the bearing until the existing grease is completely discharged.
- Let the motor run for 1-2 hours to make sure that all excess grease is forced out of the bearings.
- Reinstall the drain plug, if available.

If possible, lubrication can be performed with motor at a standstill.
In this case, only use half of the required grease quantity, then let the motor run for a few minutes at rated speed.
Stop the motor, add the remaining grease quantity until the old grease is completely replaced.
After 1-2 hours operation, reinstall the grease drain plug.

In case of automatic lubrication remove the grease drain plug permanently.

Cleaning the bearings
The rolling bearing lubrication method tends to release the used grease from the collection chamber and therefore the grease does not require frequent total replacement.
However, every time the motor is disassembled for general cleaning, it is advised to wash the bearings with a solvent. (e.g. petrol).

Disassembly of the bearings

Bearings are one of the most important points for the correct operation of an electric machine. The bearings installed in the motor are of the best quality available on the market and are carefully fitted and with accurate machinings. However, sometimes it is necessary to remove them for maintenance or to replace them.

An extractor must be used to remove the bearings, after having disassembled covers and shields.

If the same bearings are to be re-used, proceed carefully to prevent damages on the ball or roller tracks.

If the motor must be disassembled, it is advised to replace the bearings as it is often very difficult to evaluate the state of the disassembled bearings and therefore it is not generally worth re-mounting the same bearings and risk having to disassemble the motor for the replacement of damaged bearings.

Mounting the bearings

Before mounting a bearing it is necessary to clean it carefully with a suitable solvent (e.g. petrol).

The parts adjacent to the bearing must also be cleaned well, e.g. shield machined surfaces, covers, grease boxes, etc., verifying that there are no burrs or damage to the seats. If an emery cloth or a grinding wheel must be used to eliminate scratches or other problems, pay attention that metal dust does not deposit in or around the bearings.

Spread a thin layer of grease on the pin surfaces and other parts indicated above to protect them from corrosion.

Heat the bearing in an oil bath at 70 ÷ 80 °C, mount it onto the seat and hold it against the shaft shoulder until the bearing has cooled down.

SPARE PARTS

Ordering spare parts

On ordering spare parts, it is necessary to supply a precise description of the requested component, in addition to the features indicated on the motor rating plate and in particular the motor serial number.

The type of machine stamped on the rating plate and the serial number allow identification of all spare parts.

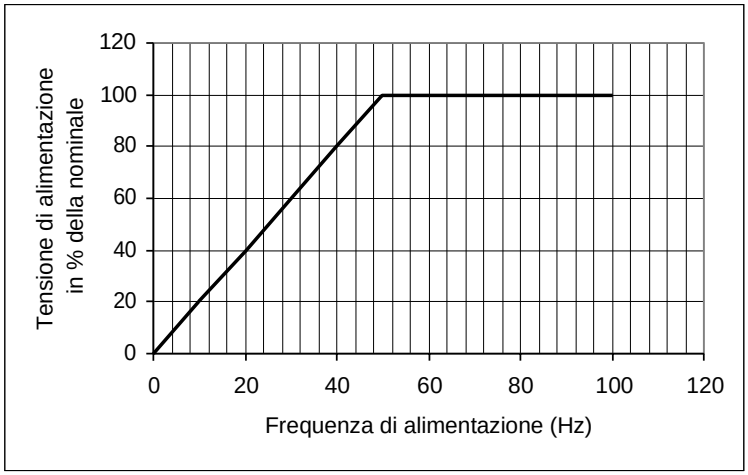
Storage of spare parts

Spare parts must be preserved in a clean, dry, ventilated environment.

It is advised to check the spare parts periodically to verify their condition.

MOTORS SUPPLIED BY INVERTER (SPECIAL DIRECTIONS)

The W Line motors can be designed in order to be particularly suitable to be supplied by inverter.
The real features of these motors are contained in the sheets related to every single motor.
Usually W Line motors with independent ventilation can be driven up to the rated frequency (50Hz) with supply voltage proportional to the frequency. (See diagr.1), at higher frequencies they can be supplied at constant voltage up to the achievement of the maximum speeds expected for each motor.



Diagr. 1 - Supply voltage - frequency diagram.

By the type of supply shown in diagr. 1, the flux created by the stator windings will be constant from 0 frequency to 50 Hz frequency and consequently a constant torque in all this speed control range is available. At frequencies higher than 50 Hz, the flux will be lower than the maximum value and the motor can run at constant power and therefore at a power decreasing with the increase of frequency (see diagr.2). Consequently the pattern of the deliverable power output will be as shown in diagr. 3.
(Note: At low frequencies (0 ÷ 10 Hz.) due to the voltage drops, in order to keep the flux constant, it is necessary to slightly increase the supply voltage. This voltage increase depends both on the motor type and on the inverter type.)

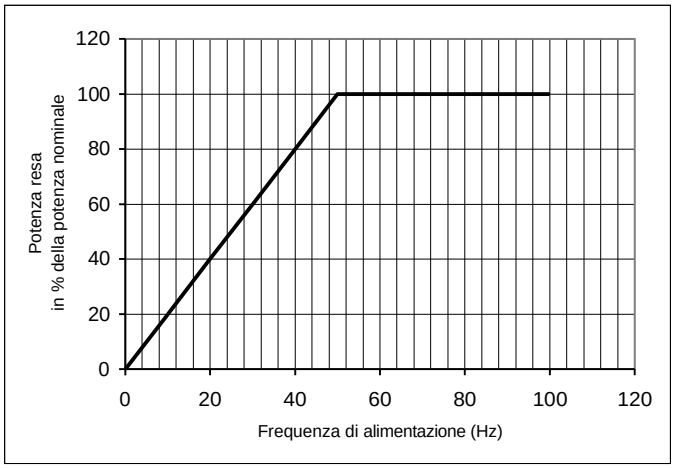


Fig. 2 - Power output - frequency diagram

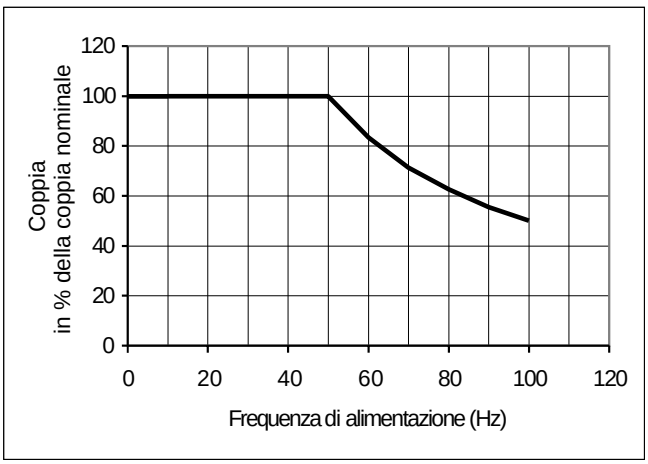


Fig. 3 - Torque - frequency diagram

The asynchronous three-phase W Line motors to be used for inverter supply are designed and manufactured based on design and manufacturing choices that allow an optimum and reliable operation.

It has to be considered that generally the inverter supplies the asynchronous motor with a non-sinusoidal current having a certain harmonic contents.
This is due in particular: to the type of inverter, to the value of the commutation frequency, to the length of the supply cables. Moreover steep voltage fronts to the motor terminals (dv/dt) originated by the short commutation times of the IGBT, generate considerable stresses on the insulating materials.
Consequently the motor insulation must be carried out with the utmost care since it has to be able to withstand such higher stresses.

Therefore, in the motors of this Line, designed on purpose for inverter supply, the following construction technologies are used:

- Low-loss silicon lamination with inorganic insulation to reduce losses in the magnetic core.
- Windings made using copper electrolytic wire with double insulation, special for inverters, with thermal class 200°C.
- Nomex® insulation between phases, in the slots and on the winding heads.
- Impregnation treatment under vacuum in autoclave and subsequent oven drying to allow a higher resistance to electrodynamic stresses.
- Insulated non-drive end bearing (ex. SKF INSOCOAT®), in order to eliminate the effect of the shaft currents, typical in supplies with high commutation frequency.
- W Line motors designed for inverter supply have a rotor with single welded copper cage, in order to obtain a better efficiency and optimum characteristics in the inverter supply. The use of the single cage considerably reduces the high frequency harmonic currents, present in the rotor cages.
- Motors are prepared for encoder mounting.

CAUTION
Because of their single cage, these motors are not suitable for starting from the mains.

Upon request it is possible to manufacture motors suitable to be supplied both from the mains and from an inverter.
These motors are designed to correctly run with a maximum dV/dT of 2000V/μsec.
In case of higher values it is advisable to use a proper filter between motor and inverter to reduce stresses on the motor.
Similarly a filter is necessary in case of too long supply cables (distance between motor and inverter higher than 50 metres).

MEASUREMENT OF INSULATION RESISTANCE

The insulation resistance test is carried out to check if the resistance of the insulations and impregnation varnishes used is sufficient to allow a good operation of the motor.

CAUTION

BEFORE MEASURING THE INSULATION RESISTANCE, THE MACHINE MUST BE AT A STANDSTILL FOR A SUFFICIENTLY LONG PERIOD OF TIME TO ALLOW TOTAL DISCHARGE OF RESIDUAL VOLTAGE.

TEMPORARILY EARTH THE WINDINGS THROUGH THE FRAME TO CHECK THAT DISCHARGE HAS TAKEN PLACE.

The test is carried out using a Megger, which is able to supply a voltage of 500V. The Megger is connected to the windings and the earth by means of appropriate push rods.
The instrument scale is calibrated directly in mega ohm and indicates the insulation resistance value.
The test is then repeated by connecting a winding phase to a push rod of the instrument and the earth to the other push rod (of course after having opened the winding connections).
Measurement of the insulation resistance does not supply the quantitative measurement but only qualitative.

Generally, for new motors in normal climatic conditions, the insulation resistance value easily exceeds the value of 100 Mohm.

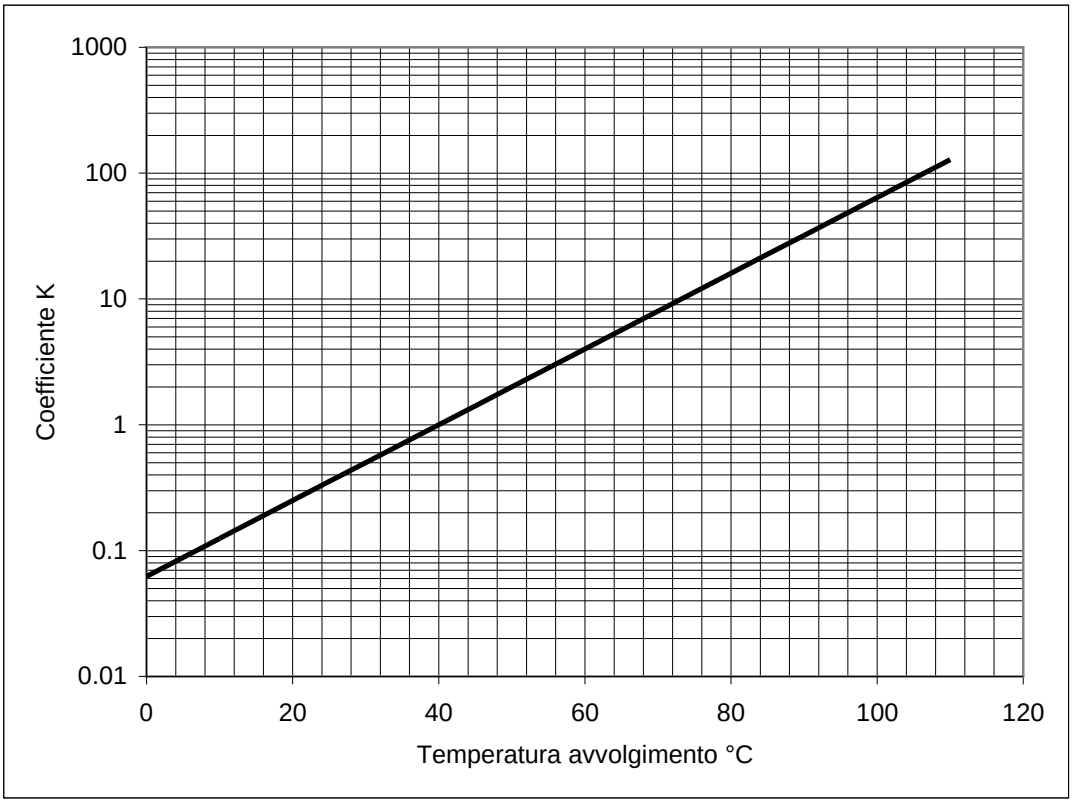
In the case of rewound motors or motors exposed to wet operation conditions, the minimum insulation resistance value can be estimated around 20 Mohm at 15 ÷30°C.

If the measurement is carried out at temperatures higher than 40°C, the values detected must be brought to 40° C using the following formula:

$$R_{40} = K_t \times R_t$$

where: R_{40} = *insulation resistance in Mohm corrected to 40°C*
R_t = *insulation resistance at temperature t*
$K_t = 10^{((0.0301 \times t) - 1.2041))}$

The Kt coefficient can also be obtained from the undermentioned diagram.



Approximately the resistance doubles with every 10°C decrease in temperature.

Even if the insulation system used for the machine windings allows their correct live operation also with insulation resistance values equal to 1/10 of those prescribed previously, it is advised not to allow the insulation resistance to fall below the recommended values.

The variation through the time of the insulation resistance during application of the test voltage supplies an additional indication of the insulation conditions.

B&P ELEKTROMOTOREN BV

Expeditieweg 21
6657 KM Boven-Leeuwen

info@bnpelektromotoren.nl
+31 (0)344 616 267

BTW nr. **NL819113918B01**
KvK nr. **30237800**
ING Bank **NL60 INGB 0675 304 792**

B&P Elektromotoren