OUR ENERGY – YOUR SUCCESS

Explosion proof 3DX motors

Installation and service instructions

IEC 80-355

BEVI

Every care has been taken to ensure the accuracy of the information contained in this publication.

Due to BEVI's policy of continuous development and improvement, BEVI reserves the right to supply products which may differ slightly from those illustrated and described in this manual.

Descriptions and technical features listed in this manual may not to be considered as binding. Under no circumstances should be considered as a contractual obligation.

The data in this manual may change without prior notice.

Table of content

1. Introduction

First thank you very much for selecting the flameproof three phase induction motors supplied by BEVI. Before you run the motors, please read this Operation Instructions carefully, which tell you how to operate and maintain the motors to serve you better. Please contact BEVI without any hesitation if you have any questions.

WARNINGS

1. Read the Operation Instructions carefully before commission and run the motors.
2. All the fasteners must be tightened after motor is reassembled.
3. If the parts, components or kits must be replaced due to rustiness, damage or other means, please contact BEVI for them. Parts, components or kits from other sources are not allowed to use as replacements.

In terms of Directive 89/392/CEE low voltage motors are to be considered as components to be installed on machines. Commissioning is forbidden until the final product has been checked for conformity.

The information contained in this documentation is intended only for use by qualified personnel, whom are familiar with the current rules and regulation in forces.

1.1. Validity

These instructions are valid for BEVI flameproof motors type 3DX. For limits for site conditions see 4.1 and for storage see 3.2. If ambient conditions exceed these limits, please contact BEVI for more information.

1.2. Conformity

As well as conforming to the standards relating to mechanical and electrical characteristics, motors designed for explosive atmospheres must also conform to one or more of the following European, IEC-standards as well as the China National Standards GB3836.1 and GB3836.2:

Product standards	
IEC/EN 60079-0	Equipment general requirements
IEC/EN 60079-1	Equipment protection by flameproof enclosures ”d”

Table 1 - Product standards

2. General descriptions

3DX Flameproof three-phase induction motors can be used as drivers in the locations where explosive gas exists.

The motors are designed and manufactured into flameproof type and the flameproof properties conform to above standards. The marks of explosion protection are Ex db IIB T4 Gb or Ex db IIC T4 Gb.

Example of classification of flammable gases and vapours usually encountered and the temperature class are shown in Table 2 - Classification of the more common combustible gases and vapours according to temperature class and group.

The legible and durable raised sign "Ex" should be marked on the right top of nameplates and the distinct position of the enclosure of motors. The Ex mark is also stamped on the nameplate, which consists also of type of protection, explosion group and temperature class.

Group	Temperature classes					
	T1	T2	T3	T4	T5	T6
I	Methane (firedamp)					
IIA	Acetic acid Acetone Ammonia Benzoyl Benzene Butanone Carbon monoxide Ethane Ethyl Acetate Ethyl Chloride Methane Methanol Methyl Acetate Methyl Alcohol Methyl Chloride Naphthalene Propane Toluene Xylene	Acetic anhydride I amyl acetate n butane n butyl alcohol Amylic alcohol Butyl acetate Cyclohexanone Ethyl alcohol Iso butylic alcohol Liquefied gas Natural gas Propyl acetate	Cyclohexane Cyclohexanol Decane Diesel fuels Gasoline Heating oil Heptane Hexane Jet fuels Pentane Petroleum[1]	Acetaldehyde Ether		
IIB	Coke-oven gas Water gas (carburetted)	1,3- butadiene Ethylene Ethylbenzene Ethylene oxide	Hydrogen sulphide Isoprene Petroleum*	Ethyl ether		
IIC	Hydrogen	Acetylene				Carbon disulphide Ethyl nitrate

[1]depending on composition

Table 2 - Classification of the more common combustible gases and vapours according to temperature class and group

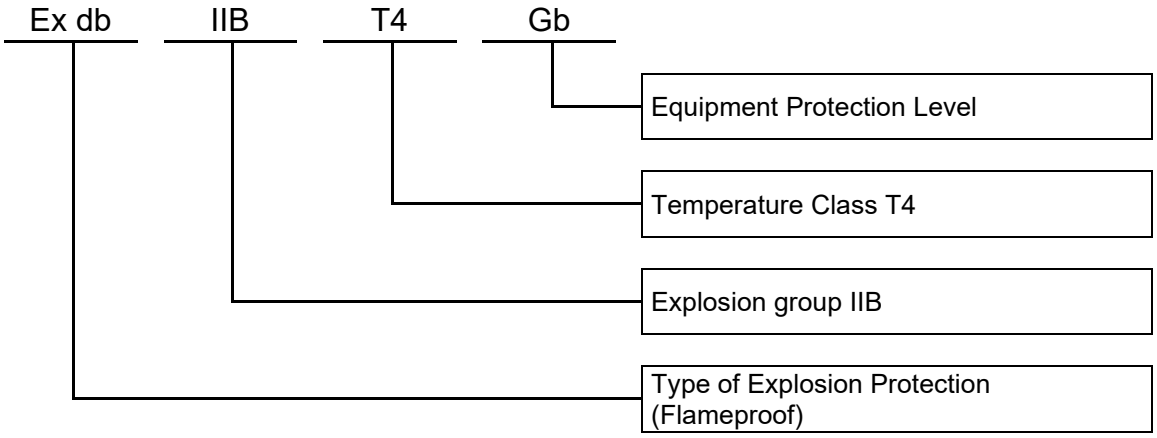


Table 3 - Protection type

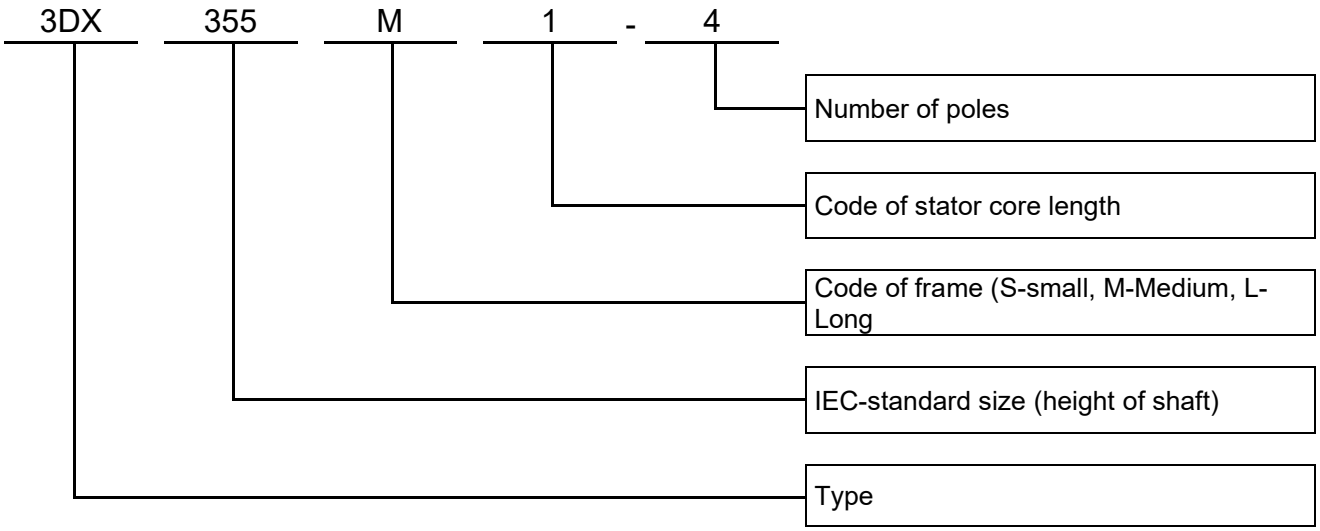


Table 4 - Explanation of type designation

3. Before installation

3.1. Control at reception

Immediately upon receipt, check the motor for external damage (e.g. shaft, shields and flanges and painted surfaces) and, if found, inform the forwarding agent without delay.

Check all rating plate data, especially voltage, winding connections (star or delta), category, type of protection and temperature class.

3.2. Transportation and storage

The motors can be forwarded in any covered transport means free of violent shocks or blows.

Motors fitted with cylindrical roller and/or angular contact bearings should have the shaft secured during transportation

Lifting of motors should only be done through the lifting eye if it is placed on the motor frame. Storage of motors can take place in rooms in which have:

- max relative humidity does not exceed 80 % at 20 °C
- ambient temperature ranges from -10 °C to +40 °C, non-condensing).
- no access of dusts, gases and caustic vapours as well as other corroding chemical fumes destructive to insulation or casing.
- no vibrations

In the stored motors, the machined unprotected surfaces (shaft ends and flanges) should be protected against atmospheric influences by coating them with thick grease or easily removable anticorrosive lacquer.

4. General conditions

4.1. Site conditions

- Ambient temperature within -20 °C - +40 °C.
- Altitude up to 1000m above sea level (asl)
- The maximum relative humidity 95% (when ambient at +25 °C).

4.2. Electrical operating conditions

Please check that the motor plate states the same voltage, frequency etc. as you have at your facilities before connecting the motor. Motors can be ordered as following:

Rated frequency: 50Hz or 60Hz

- The rated voltage: 220/380, 230/400, 240/415, 250/440, 265/460, 277/480, 440, 460, 480, 525, 575, 380/660, 400/690, 415/720 or 690V. Dual or single voltage available.
- The standard duty type is S1 (continuous duty). The motors can also be used for intermittent duty or duty via inverter supply. Inverter duty is an option. If inverter duty the motor needs to be approved for it as well as cooling according to IC416 (forced ventilation). Please contact BEVI for details.
- The stator windings are of Class F insulation. Class H insulation is an option.

4.3. Construction features

- The degree of protection of motor enclosure is;
  - IP55 or IP65 for IIB
  - IP56 or IP66 for IIC
- The stator winding adopts Class F insulated polyester enameled round copper wires. The complete winding and stator cores are vacuum-pressure-impregnated (VPI) to make them be a solid integral. This process enables the winding to possess excellent electrical and mechanical properties, high moisture-resistant ability and thermal stability. The casted aluminium rotor is well balanced to make the motor run smoothly with little vibration.
- The basic mounting arrangements are IMB3, IMB35, IMB5, IMB14, IMB3/B14 and IMV1. Other mounting arrangements can also be met.

- The cooling method adopts IC411 (totally enclosed self-fan cooled).
- The motors are provided with a cylindrical shaft extension and transmit by means of coupler or gear unit. When the gear is adopted, the pitch diameter should not be 3 times less than the diameter of motor shaft extension. Double shaft extensions or special shaft extension can also be produced if required.
- The terminal box is located on the top of the motor. There are 3 terminals in the box for single voltage connection or 6 terminals for dual voltage connection. If the motor is provided with two cable entries but only one is used, the other entry should be plugged with a blind plug with the same protection level as rest of the motor Ex db IIB T4 Gb or Ex db IIC T4 Gb or better, to ensure the flameproof property.
- There is a steel or brass screw inside the box for internal earthing. The cable entries are suitable for rubber insulated cables, conduits and explosion-proof flexible pipe (armored cables). The protection degree of terminal boxes is IP55 or IP65 for IIB and 56 or 66 for IIC.

4.4. Dimensions

4.4.1. Terminal box and thread for cable entries

Size of terminal box	For frame size	Number of entries for main supply	Cable gland for main supply	Cable gland for heater or ptc
M5 Small	80-100	1	M25×1.5	M20×1.5
M5	112	1	M25×1.5	M20×1.5
M5	132	1	M40×1.5	M20×1.5
M6	160-180	1	M40×1.5	M20×1.5
M8	200-225	1	M50×1.5	M20×1.5
M10	250-280	1	M63×1.5	M20×1.5
M10	250-280	2	M50×1.5	M20×1.5
M16	315	2	M63×1.5	M20×1.5
M16	355	2	M72×2	M20×1.5

Table 5 - Terminal box and thread for cable glands

Gland thread size	Clamping range	OD of thread AG	Length of thread GL	H	Wrench size
M16×1.5	6~12mm	16mm	15mm	29mm	26mm
M20×1.5	10~15mm	20mm	15mm	29.5mm	30mm
M25×1.5	14~18mm	25mm	15mm	29.5mm	34mm
M32×1.5	22~27mm	32mm	15mm	32mm	50mm
M40×1.5	26~33mm	40mm	15mm	32mm	55mm
M50×1.5	32~41mm	50mm	15mm	37mm	65mm
M63×1.5	48~57mm	63mm	20mm	38mm	80mm

Table 6 - Cable glands

4.4.2. Bearing information

Frame size	Pole	Bearing	
		DE-side	NDE-side
80	2,4,6,8	6204-2RZ/C3	6204-2RZ/C3
90	2,4,6,8	6205-2RZ/C3	6205-2RZ/C3
100	2,4,6,8	6206-2RZ/C3	6206-2RZ/C3
112	2,4,6,8	6206-2RZ/C3	6206-2RZ/C3
132	2,4,6,8	6208-2RZ/C3	6208-2RZ/C3
160 (Ex db IIB)	2	6209/C3	6209/C3
160 (Ex db IIB)	4,6,8	6309/C3	6209/C3
160 (Ex db IIC)	2	6209-2RZ/C3	6209-2RZ/C3
160 (Ex db IIC)	4,6,8	6309-2RZ/C3	6209-2RZ/C3
180	2,4,6,8	6311/C3	6211/C3
200	2	6212/C3	6212/C3
200	4,6,8	6312/C3	6212/C3
225	2	6312/C3	6312/C3
225	4,6,8	6313/C3	6312/C3
250	2	6313/C3	6313/C3
250	4,6,8	6314/C3	6313/C3
280	2	6314/C3	6314/C3
280M	4,6,8	6317/C3	6314/C3
315	2	6316/C3	6316/C3
315	4,6,8,10	6319/C3	6319/C3
355	2	6319/C3	6319/C3
355	4,6,8,10	6322/C3	6319/C3

Table 7- Bearings

Note that for size 160 the bearings are different for IIB and IIC.

For the rest of the sizes the bearings are the same in both IIB and IIC.

5. Installation and commissioning

5.1. Mounting

The rotor is dynamically balanced. The balancing has been done with a half key fitted to the shaft, according to IEC 60034-14. This means that, in order to avoid vibrations, coupling halves and pulleys shall be balanced with a half key, after the making of the key way.

Before setting up the motor on site:

- remove bearing protections (if such are provided)
- check motor for possible mechanical transport or storage damages
- measure insulation resistance to frame: The lowest insulation resistance at a winding temperature of approx. 20 °C should at least to 1 MΩ for size 80-180 and 5MΩ for size 200-355 (greater than 100 MΩ is recommended before start-up of motor). If the measured insulation resistance is lower, the motor has to be subjected to drying. During the drying process the conditions should be such that the humidity is removed from the windings, i.e. at least the terminal box cover must be removed to facilitate the air exchange within the motor. The drying temperature must not exceed 100 °C.
- For motors with re-greaseable bearings the grease quality shall be checked when the motors have been stored for a period longer than 0,5 year. In such case it is best to change the grease using the grease stated in Table 8 - Lubrications of bearings. It is also possible to use equivalents of these greases. When changing the grease grade the bearings are to be washed with a proper bearing cleaning liquid and dried thoroughly.

On the site the motor is to be set up so as to ensure an easy access in case of inspection and maintenance.

A flexible coupling or pulley thoroughly balanced with half key is to be fitted onto the shaft end´s shaft neck, as follows:

- remove protective varnish from the shaft neck,
- apply a thin layer of grease or oil on then cleaned shaft neck
- warm the coupling half or sheave up to approx. 85 °C and with a suitable washer and bolt, using the threaded hole in the shaft end shaft neck or an appropriate jig, fit the coupling or sheave onto the shaft end shaft neck. Do not use a hammer as its blows may damage the motor bearings.

The installed motor shaft centre line may show a misalignment of up to 0,1 mm with respect to that of the driven machine shaft. A clearance of min. 1 mm must be allowed between the coupling halves.

In belt drives excessive tensioning of belt is to be avoided as it leads to reduced lifetime of bearings and the overloading of shaft.

Secure the cooling of motor by controlling the distance between fan cowl and closest wall. It must be 11-125 mm depending on motor size. Recommended distance from end of the fan cover to nearest wall is ≥ ¼ of the fan cover diameter.

5.2. Connection to power supply

Before connecting the motor to power supply compare the data in the rating plate with the mains voltage.

The designation of terminals and winding connection is given on the plate with connection diagram provided inside the terminal box cover. The motor must be installed in accordance with the generally in force principles and regulations, and must be installed by a qualified electrician

5.2.1. Insulation resistance test

Measure insulation resistance before commissioning or when winding dampness is suspected.

Insulation resistance, corrected to 20 °C, may not in any cases be below $3\times U_N/1000$ MΩ (U_N: rated voltage in V), otherwise the motor must be dried until the insulation resistance achieves the specified value (measured with 500 or 1000 VDC). The insulation resistance value is halved for each 20 °C increase in temperature.

If the reference resistance value is not attained, the winding is too damp and must be oven dried. The oven temperature should be 90 °C for 12–16 hours followed by 100 °C for 6–8 hours.

If fitted, drain plugs must be removed and closing valves must be opened during heating. After heating, make sure the drain plugs are refitted. Even if the drain plugs are fitted, it is recommended to disassemble the end shields and terminal box covers for the drying process.

Windings drenched in seawater normally need to be rewound.

5.2.2. Check before operation

The following points must be observed before installing flameproof motors. No operation is allowed if any one of these points is unsatisfactory.

- The sign “Ex”, the certificate number and CE mark must have been attached to the motor. Check whether the mark of explosion protection matches the explosion gas atmosphere where the motor is intended to use;
- All the bolts are tightened and spring washers are present. All parts of the flameproof enclosure are connected properly;
- No cracks or defects affecting the flameproof property could be found on all the flameproof parts (For the new motor having not been used, this item can be omitted.);
- For the motor with re-greasing device, the grease replenish pipes shall be unblocked;
- For the motor with bearing temperature detector, after the device being set up, be sure that its flexible cord shall not touch the fan to prevent the motor from accident.
- For motors intended to work in hazardous areas Ex db the motor type and temperature classification must comply with the area rating.
- If there is a “X” on the motor plate near to the certificate number, it is necessary to check on the certificate which additional conditions are required for proper working. See 8 Special conditions – “X”.
- During installation, care must be exercised in lining up, as misalignment can be detrimental to bearings and shaft of both the motor and driven equipment. Check whether the coupler or screw and pin on gear is fastened, the unit runs smoothly, or abnormal movement and noise are present. If abnormal movement and noise; check whether the fastening bolts are tightened firmly or the bearings are short of grease.
- For the variable-frequency motors which are forced ventilated (IC416) and have B5 arrangement, appropriate support devices should be employed to reinforce mounting rigidity.
- Check whether the protective devices conform with the requirements and they are installed firmly and reliably.
- Check whether the control device is connected properly, whether it runs smoothly, whether the contactors are in good condition and whether the metal enclosure of the driven machine has been earthed.
- Check whether three-phase power supply voltage is normal. No phenomenon of overvoltage or undervoltage or asymmetry of three phase voltage are present.
- Check bearing and lubrication system to see whether the grease in bearings is dirty or dried. The grease should be cleaned away and replenished as required if necessary.

5.3. Explosion protection features

5.3.1. General

3DX series motors are so designed in mechanical construction that should the explosive mixture in the environment, invaded the inside the motors and be ignited, the flameproof enclosures are capable of preventing the ignition of explosive mixtures outside the motor. The flameproof properties are determined by the enclosure strength, the airgap, diameter difference and length of flameproof joint surfaces of the parts of the enclosure, as well as the maximum allowable surface temperature of the enclosure.

5.3.2. Flameproof enclosure

In order to ensure flameproof properties of the enclosure, the fixing bolts are equipped with locking gaskets to protect them from loosening.

5.3.3. Earthing

There is one earthing terminal inside the terminal box and one external outside the motor body.

The external earthing bolt is located on the distinct position of the enclosure with earthing symbol. ⏚

5.4. Connecting with power source

The terminal box is located on the top of the motor and can be turned every 90° for IIC and every 180° for IIB.

The cable glands and the terminal box are connected together horizontally and the cables can be brought out in a horizontal level on the other side. The power cables should be correctly selected according to motor's current and service conditions.

5.4.1. Terminal board with three terminals

For the terminal box with three terminals with separate marks U, V and W, the connection diagram is shown in Figure 1 - Connection with three terminals

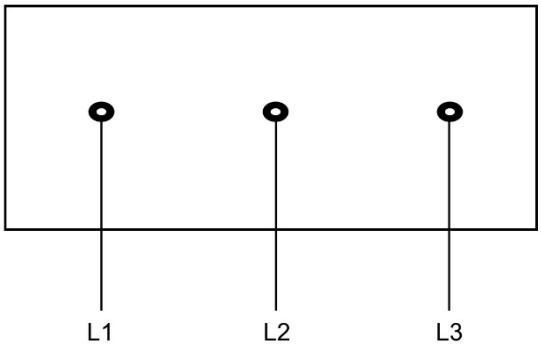


Figure 1 - Connection with three terminals

5.4.2. Terminal board with six terminals

The connection can be changed by swapping the connecting lugs according to the voltage requirement. The terminals are marked separately with U1, U2, V1, V2, W1 and W2. They are connected according to the voltage specified on the nameplate. The connecting diagram is shown in Figure 2 - Connection with six terminals

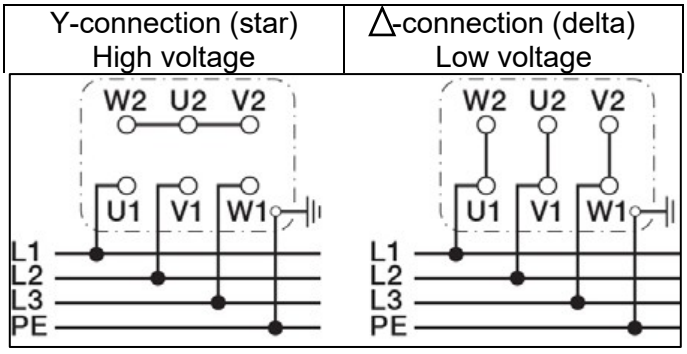
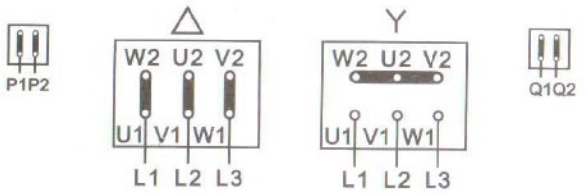


Figure 2 - Connection with six terminals

5.4.3. Connection of heaters and ptc

For the stator winding with temperature-detector and space heater, the lead cables of such devices can be connected either in the main terminal box or in a separate terminal box. The connection diagrams are shown in Figure 2 - Connection for heaters and ptc



P1 & P2: Connectors for PTC in winding

Q1 & Q2: Connectors for heaters

Figure 3 - Connection for heaters and ptc

5.4.4. Connection of heaters and/or PT100

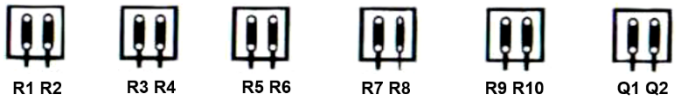


Figure 4 - Connection for heaters and PT100

R1R2, R3R4, R5R6:
Connectors for PT100 for stator winding

R7R8: Connectors for PT100 for DE Bearing

R9R10: Connectors for PT100 for NDE Bearing

Q1 & Q2: Connectors for Heater
(provided in terminal box or auxiliary box)

Recommended voltage supply for thermistors is 2,5-7,5VDC. The maximum measuring voltage for the thermistors is 30VDC. The maximum measuring current for Pt100 is 5 mA. Using a higher measuring voltage or current may cause errors in readings or a damaged temperature detector.

5.4.5. Rotation

Clockwise rotation will be viewed from the drive end if the motor's phase sequence U, V, W corresponds to the power phase sequence L1, L2, L3 or else vice versa. If the rotation direction is different from the required one, swap any two power phase sequences to achieve the correct rotation direction.

5.4.6. Connections for different starting methods

The terminal box on single speed motors normally contains a terminal block with six winding terminals and at least one separate earth terminal. This enables the use of DOL- or Y/D -starting. See Figure 1 - Connection with six terminals

For two-speed and special motors, the terminal connection must follow the instructions inside the terminal box.

The voltage and connection are stamped on the motor plate.

Direct-on-line starting (DOL):

Y or D winding connections may be used.

For example, 690 VY, 400 VD indicates Y-connection for 690 V and D-connection for 400 V.

Star/Delta (Y/D) start method:

The supply voltage of the motor must be equal to the rated voltage when using a D-connection. Remove all connection straps from the terminal block.

5.4.7. Check before start

All motors for explosive atmospheres must be protected against overloads, see installation standards IEC/EN 60079-14 and local installation requirements.

- When connecting, the strands of cables should be set with spring washer, flat washer and cable lug or two strap clamps.
- The earthing should be set with spring washer, flat washer and cable lug to the earthing bolt and be earthed reliably in order to ensure that electric contact and clearance conforms to the requirement.
- After finishing connection, check whether there is any substance or dust in the box and whether the connection conforms to supply voltage and data specified on the nameplate. The terminal box cover shall not be fastened until everything is correct.
- The cable brought into the box must be fixed in the gland by clamping plate to prevent the cable from being pulled out.
- The external ground bolt should be earthed reliably. Check the effectiveness of earthing
- Check, whether a free cooling air intake to the fan is ensured.
- For the motors with specified rotation direction, the rotation direction should be

conform before starting operation to the direction of the arrow in the indication plate.

- After finishing connection, the motor shall be energized to carry out a no-load test. For the motors provided with forced ventilation the motor for forced ventilation shall be started first. When stop, the main motor shall be stopped before the forced ventilation. During start, observe whether any abnormal phenomenon appears or not. The motor can operate at load only after it operates normally at no load.
- Whenever the motor operates either at no load or at load, intermittent or abnormal noise or vibration shall not be present.
- Check the electrical installation, the circuit breaker, measuring instruments and other auxiliary and protection equipment for correct operation,

5.4.8. Attentions for Starting

- After energizing, if the motor does not run, de-energize it immediately to avoid burning. Check the motor and solve the problem then re-start it.
- When the motor is started at reduced voltage, it must be at no-load or low load. It is only allowed to start the motor twice at cold and once at hot per hour.
- Carry out a test run. During test run of the set, check:
    - line voltage,
    - current,
    - motor revolutions sense,
    - effectiveness of motor cooling and correct coupling with driven machine,
    - whether abnormal vibrations or other malfunctions of the motor are present,
    - temperature rises of respective motor elements, such as bearing shields, bearings, frame.
    - starting-up equipment elements, control and protection gears, for correct operation.
    - electrical parameters attained by the motor and evaluate the correctness of motor type selection.

After reaching operating temperature, it is recommended to stop the motor and tighten all electrical connections once more.

If the motor operates under conditions were vibrations are unavoidable, the electrical connection should be checked regularly and be made with cables with multi stranded cores. After the above recommended procedures are accomplished and correct operation of the drive motor and driven machine is attained, the motor may be regarded as commissioned after installation.

6. Maintenance

WARNING

Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

Standards IEC/EN 60079-17 and -19 relating to repair and maintenance of electrical apparatus in explosive atmospheres must be taken into consideration. Only competent personnel acquainted with these standards should handle this type of apparatus.

Sticker on terminal box for information:

WARNING
DO NOT OPEN WHEN ENERGIZED
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.

BEVI-EX-LB001

6.1. General inspection

The maintenance and repair procedures shall be established for the motors, which could be divided into monthly maintenance and annual maintenance (i.e. routine repair and overhaul).

6.1.1. Monthly maintenance

- Cleaning: Clean away the dust and dirt on the motor surface and measure the insulation resistance. Keep the motor clean and ensure free ventilation airflow. If the motor is used in a dusty environment, the ventilation system must be regularly checked and cleaned.
- Check the condition of shaft seals and replace if necessary, with original parts.
- Check terminal connections: the connecting bolts, screws or nuts in terminal box to see

whether they are loose or not, fasten and replace them if necessary.

- Check earthing connection: the earthing bolts, screws or nuts connections, check the fastening bolts on end shields, inner and outer bearing caps.
- Check the bearing condition by listening for any unusual noise, vibration measurement, bearing temperature, inspection of spent grease or SPM bearing monitoring. Pay special attention to bearings when their calculated rated lifetime is ending. Also check bearings and lubricating system to see whether the grease in bearings is dirty, dry or short. Clean away the old grease and replenish new one if necessary.
- Check the fan to see whether it is broken or damaged, check whether the fixing bolts are loose, damaged, worn or deformed. Replace the fixing bolts or the fan if necessary.
- Check mounting and assembly bolts.

When signs of wear are noticed, dismantle the motor, check the parts and replace if necessary. When bearings are changed, replacement bearings must be of the same type as those originally fitted. The shaft seals have to be replaced with seals of the same quality and characteristics as the originals when changing the bearings.

If motors are equipped with drain plug, periodically open the drain plug, by turning it counterclockwise, tap it to check free operation and close it by pressing and screwing it clockwise. This operation must be done when the motor is at standstill. The frequency of checks depends on the humidity level of the ambient air and on the local weather conditions.

6.1.2. Annual maintenance

Annual maintenance includes the monthly maintenance as well plus:

- Check the external of motor to see whether the external parts are damaged whether the components are present. Clean away dust and dirt on the surface and repair the damaged positions.
- Clear and check the internal of motor:
    - Check whether the stator windings are dirty or damaged. Clean away dust and dirty on the stator. If oil dirt is founds, clean it with dry cloth first, then clean it by cloth with gasoline. Meanwhile check the winding insulation carefully to see whether the insulation is aged or damaged. If these traces are present, the stators should be repaired and varnished.
    - Check whether the rotor is dirty or damaged. Observe the rotor visually and compare the surface color to see whether the rotor is broken, dirty or damaged.
    - Check stator and rotor cores to see whether they are deformed. They should be repaired if deformation is found.
- Measure insulation resistance on all the live parts with a megger and the insulation resistance should be larger than 5MΩ.

- Bearing cleaning and check:
    - Put the bearing into a container filled with gasoline and stir it for sometimes. Then hold the inner bearing ring and rotate the outer bearing ring. During rotation, put the bearing into another container with gasoline and hold it by hand for cleaning.
    - Check bearing surface, rolling elements and the bearing races to see whether the bearing has become purple or has been annealed by heating. Replace the bearing if necessary.
    - Measure the inner and outer bearing diameters and width if possible.
    - Hot fit is allowed to assemble the bearing onto the shaft. When heating the bearing, the engine oil temperature should not exceed 100 ℃ and bearing should be heated evenly.

Trial operation should be done after overhaul. Measure insulation resistance and check whether all parts are in good conditions. Run the motor at no load for half an hour, and then run it at load.

6.2. Standby motors

If the motor is in standby for a longer period of time on a ship or in other vibrating environment the following measures have to be taken:

- The shaft must be rotated regularly every 2 weeks by means of starting of the system. In case a startup is not possible, for any reason, at least the shaft has to be turned by hand in order to achieve a different position once a week. Vibrations caused by other vessel equipment will cause bearing pitting which should be minimized by regular operation/hand turning.
- The bearing must be greased while rotating the shaft every year. If the motor has been provided with roller bearing at the driven end, the transport lock must be removed before rotating the shaft. The transport locking must be remounted in case of transportation.
- All vibrations must be avoided to prevent a bearing from failing.

6.3. Check bearings during operation

The maximum permissible bearing temperature should not exceed 95 °C (check by thermometer or mounted Pt-100 if the motor is equipped with that option.). The bearing must be inspected once per 2500h operation.

6.4. Lubrication

In addition, it is necessary to change the lubricating grease in time if it turns bad. When changing the grease, clean always the old grease inside the bearing chamber and re-greasing pipe and clean the bearing with a solvent (Veidec Brake Cleaner or equivalent). After degreasing you must be sure that the used solvent has completely dried before you apply the new grease the new grease could be refilled directly to the bearing chamber. The quantity is half of bearing chamber volume for 2 pole motors and two-thirds of the bearing chamber volume for 4 pole and up motors. Grease could be refilled during operation. The recommended interval and amount are shown in Table 8 - Lubrications of bearings The recommended grease is Mobil UNIREX N2, BP LS3 SHELL ALVANIA R3. Different greases are not allowed to be mixed, as they are perhaps not compatible with each other.

Frame size	Amount of grease (g)	Speed (r/min)					
		3600	3000	1800	1500	1000	500-900
Ball bearings - Lubrication intervals in duty hours							
160	20	3200	4200	6000	7000	9000	10000
180	20	3200	4200	6000	7000	9000	10000
200	25	1800	3100	5500	6500	8500	9000
225	25	1800	3100	5500	6500	8500	9000
250	35	800	2000	5000	6000	8000	8500
280	35	800	2000	5000	6000	8000	8500
315	50	800	2000	4600	5500	7000	8000
355	60	400	1000	4000	5000	7000	8000
Roller bearings - Lubrication intervals in duty hours							
200	25	900	1500	4300	5000	6500	7000
225	25	900	1500	4300	5000	6500	7000
250	35	400	1000	3300	4500	6300	6800
280	35	400	1000	3300	4500	6300	6800
315	50	400	1000	2700	3800	6000	6500
355	60	400	1000	2200	3200	5500	6000

Table 8 - Lubrications of bearings (regreasing)

6.5. Notes for disassembling

When disassembling the motor, all the machined surfaces should be coated with rust resistant grease and kept properly to avoid damage.

When the rotor is withdrawn or inserted, care must be taken to prevent the stator winding and insulation from being damaged.

When renewing windings, the winding data and insulating configuration should not be changed. Or the performances would worsen and result in failures.

Replace the sealing gaskets in the terminal if they are aged.

The V seal or the skeleton oil seal in the shaft opening shall be replaced in time if it is aged or worn out.

7. Use at specific conditions

7.1. Auxiliary devices

The motors can be equipped with auxiliary devices, heaters, thermal detectors such as thermocontact, PTC (thermistors) or PT100 etc.

7.1.1. Anti-condensation heaters

The anti-condensate heaters installed inside of stator winding have maximum power of 110W and are allowed to be in operation only when the motor is not powered.

The lead cables of heaters are brought to the main terminal box (frame 80-280) or auxiliary terminal box (frame 315-355) with marks Q1/Q2 in the box.

A warning label shall apply if space heater is equipped outside the terminal box:

CAUTION: HEATER ENERGIZED

BEVI-EX-LB003

7.2. Motors supplied via inverters

The motor intended for inverter duty is equipped inside of stator winding with one PTC or PT100 thermal detectors per phase for temperature control.

The user must connect the PTC or PT100 to a tripping relay (cut-out) capable of ensuring that the power supply is cut off whenever a dangerous temperature is reached. The reset of said cut-off must be performed manually only, not automatically.

In observance of the standards the user must:

- Use a cut-out in compliance with the principles of the IEC 61508 standards (Fail Safe type)
- Use a dual protection circuit

The cables of PTC are brought to the main terminal box (frame 80-280) or auxiliary terminal box (frame 315-355) with marks P1/P2 in the box.

PT100 are only available for the motors with auxiliary terminal box (frame 250-355). The lead cables of PT100 are brought to the auxiliary terminal box with marks R1/R2, R3/R4 and R5/R6).

The choice of type of frequency inverters must be taking into account that the motor must not be subjected to voltage peaks exceeding 2,8 times the nominal voltage of the motor. It is necessary to consider in this respect that the voltage peaks value is also influenced by the length of power supply cables.

When power is supplied by frequency converter, the installer bears responsibility for checks and any measures required to comply with immunity and emission limits as laid down by the standards.

A warning label shall apply on the motor if PTC or PT100 is equipped inside:

CAUTION: WINDING PROTECTED WITH PTC THERMISTORS

BEVI-EX-LB002

Or

CAUTION: WINDING PROTECTED WITH PT100 DETECTORS CALIBRATED AT 120°C

Motor intended to be operated from an inverter shall additionally be marked:

- “For inverter supply”
- Speed range or frequency range
- Minimum switching frequency
- Type of torque application e.g.:
  - Variable torque
  - Constant torque
  - Constant power
  - Torque limits

7.3. Forced cooling IC416

The cooling is IC411 as standard. Forced ventilation, IC416, can be achieved by means of certified auxiliary motor.

7.4. Warning about high ambient temperature

The motor intended to use with ambient temperature > 50 ℃ shall be labelled as:

The motor intended for use with ambient temperature > 50 °C shall be fed with cable of thermal stability not less of 95 °C

7.5. Output from motor during special ambient situations

The output of motor is based on the operation conditions; ambient -20 ℃ - + 40 ℃, altitude up to 1000m and S1 duty. If the motor operates at different conditions, the following derating or rating factors shall apply:

7.5.1. Ambient temperature

Maximum ambient temperature is +60 °C, with a derating of output above +40 °C as in table:

Ambient temperature	45 °C	50 °C	55 °C	60 °C
Output factor	95%	93%	90%	86,5%

7.5.2. Altitude

Maximum altitude above sea level is 4000 m, with a derating of output above +1000 m as in table:

Altitude	1500 m	2000 m	2500 m	3000 m	3500 m	4000 m
Output factor	96%	92%	88%	84%	80%	76%

7.5.3. Different supply

Motor winded for 50 Hz can also be supplied with 60 Hz and increase the output accordingly. Below table is based on winding 400 V 50 Hz and the alternative voltage is for 60 Hz:

Voltage at 60Hz	415 V	440 V - 480 V
Output factor	105%	120%

7.5.4. Intermittent duty

The rated output is based on S1-duty. If the duty cycle is intermittent an increase of output is possible.

NOTE When intermittent duty a PTC or PT100 thermal detectors per phase for temperature control. More information see under 7.2.

S2-duty

Duty	S2-10min	S2-30min	S2-60min	S2-90min
Output factor	150%	120%	110%	105%

S3-duty

Duty	S3-15%	S3-25%	S3-40%	S3-60%
Output factor	150%	140%	120%	110%

S6-duty

Duty	S6-15%	S6-25%	S6-40%	S6-60%
Output factor	160%	150%	140%	120%

7.6. Motor with cables permanently connected

The motor when provided with cables permanently connected shall have these cables protected against the risk of damage due to mechanical stresses. The end connection shall be made according to one of the types of protection indicated in the EN60079-0 standard and in accordance with the installation rules in force in the site of installation.

When the flying leads are adopted, the ATEX and IEC Ex certified cable glands shall be adopted.

7.7. Paint for Group IIC motor intended for marine application

For the Group IIC motor intended for marine application, the paint thickness may exceed 0.2mm. A WARNING label shall apply

WARNING-POTENTIAL ELECTROSTATIC CHARGING HAZARD- clean the motor with a wet or by non-fractional means.

BEVI-EX-LB004

8. Special conditions – “X”

The certificate number contains the letter “X” for the following reasons:

a) Field repairs of flameproof joints should not be undertaken by the end user. In the event that flameproof joint must be repaired, contact the manufacturer. Repairs of flameproof joints must be made in compliance with the structural specifications in manufacturer´s drawings. Repairs must NOT be made on the basis of values specified in table 2 and 3 of the IEC 60079-1.
b) The anti-condensate heaters installed inside of the motor of stator winding have maximum power of 110 W and are allowed to be in operation only when the motors are not powered.
c) Motors supplied by inverters are equipped inside of stator winding with PTC thermal detectors per phase for temperature control. These are to be connected to a protection circuit so as to limit the stator temperature to maximum 120 °C for temperature class T4. See also 7.2 Motors supplied via inverters
d) Motors intended to use with ambient temperature >50 °C shall be fed with cable of thermal stability not less than 95 °C.
e) The motors when provided with cables permanently connected shall have these cables protected against risk of damage due to mechanical stresses. The end connection shall be made according to one of the types of protection indicated in the IEC 600749-0 standard, certified for the intended use in accordance with installation rules in force in the site of installation.
f) When the flying leads are adopted, the IECEx certified cables glands certified for the intended use shall be adopted.
g) For Group IIC motors intended for marine application, the paint thickness might exceed 0,2mm. In this case clean the motor with a wet rag or by non-fractional means. See also 7.7.

9. Trouble shooting

These instructions do not cover all details or variations in equipment nor provide information for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be required, please contact BEVI

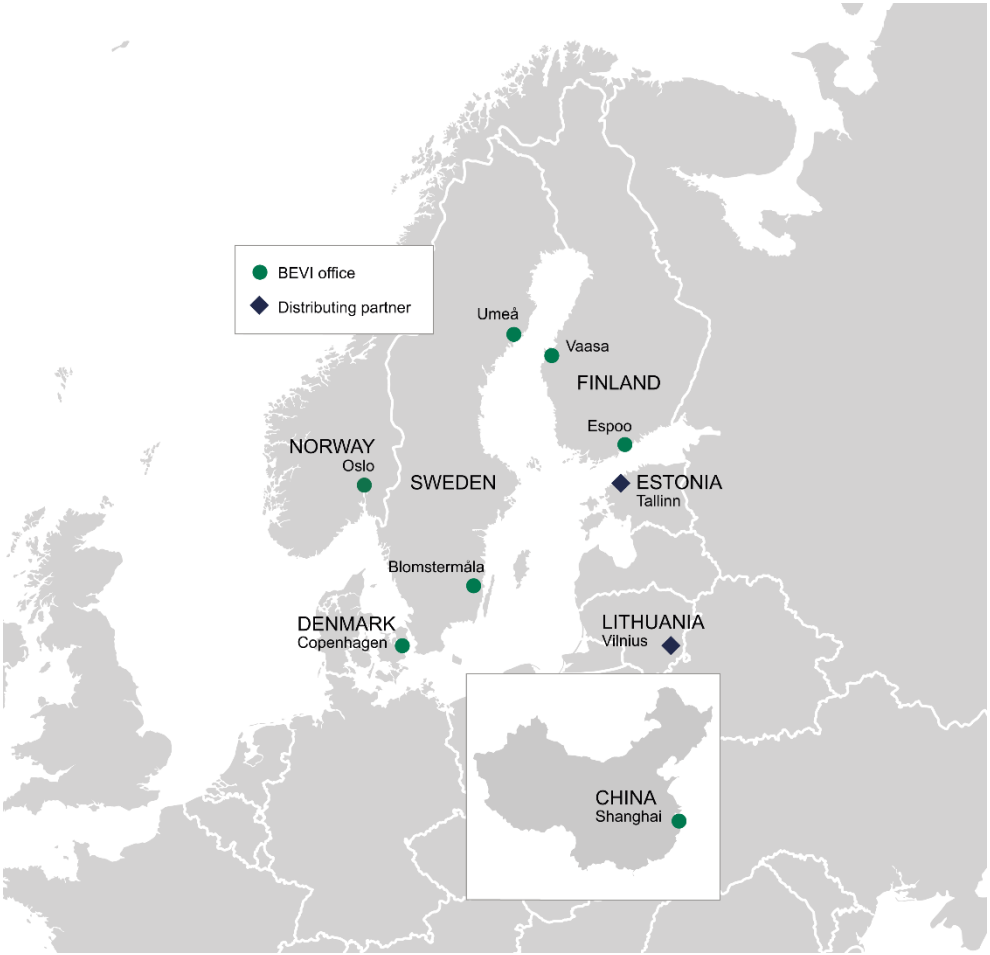
The normal electrical failures and solutions are shown in Electrical failure. The normal mechanical failures and solutions are shown in Mechanical failure.

Electrical failure	Cause	Solution
1 - Motor fails to start	1) Power supply is not switched on.	1) Check switch, fuses, contactors and motor cable lugs.
	2) Stator winding is broken.	2) Leave the motor to skilled and certified service partner who will heat the broken part to the permissible insulation temperature to soften the varnish, pick up the disconnected wires and weld them. Then wrap the coils, varnish them and make them dry.
	3) Either winding earthed or short circuit between phases.	3) Leave the motor to skilled and certified service partner who will use the same method as 2) and make the earthed or short circuit portion insulated then varnish and dry the part.
	4) Connection mistakes in stator winding.	4) Leave the motor to skilled and certified service partner who will check connection diagram，heat the end turns and reconnect them correctly, then wrap, insulate and varnish them.
	5) Fuse burnt out.	5) Troubleshot and find out the cause. Replace the fuse with a new one.
	6) Wrong connection in the control device.	6) Check and correct the wiring connection.
2 - Fuse burnt after motor energized	1) Single-phase start.	1) Check power source cables, motor cables, fuses and switch contactors to find the broken wires or connection failures then solve the problems.
	2) Motor is overloaded or locked.	2) Adjust load value to rated one and deal with driven machine failure.

Electrical failure	Cause	Solution
3 - After energized, motor cannot start but has noise	1) Motor is overloaded or locked.	1) Inspect equipment and shoot the trouble.
	2) Check power sources so all phases have correct voltage.	2) Check connection of supply and/or feed. Replace fuse, fasten the loosened bolts the terminals, check the power source cables etc. with an instrument suitable for this work.
	3) too low voltage.	3) Change to Delta connection if it was misconnected as Star; Contact the power supply station if it is caused by power source; Adopt bigger cables if it is caused by the voltage drop of cables.
	4) Stearin grease or tight fitness for small-sized motors.	4) Select applicable grease and increase assembly quality.
4 - Live motor enclosure	1) Mix the power source cables and earthing cables.	1) Correct the mistake.
	2) Stator winding becomes damp and insulation ages severely.	2) Dry the motor and renew the aged insulation.
	3) Lead cables and terminal box are earthed.	3) Bind or renew outlet insulation and repair terminal box.
5 - Hard to start and speed lower than rated speed at full load	1) Power source voltage is too low.	1) Measure the power voltage at input points with a voltmeter or avometer and find the solution.
	2) Delta connection is misconnected as Star.	2) Change Star connection back to Delta.
	3) The rotor is coming off or broken.	3) Check and repair the rotor.
	4) Coils are more than original when rewound the winding.	4) Rewind the coils according to correct numbers.
	5) Winding gets moist or motor suffers from rain.	5) Heat to dry the motor.
	6) Aged winding insulation.	6) Coat the winding insulation or replace the insulation.
6 - Low insulation resistance	1) Winding gets moist or motor suffers from rain.	1) Heat to dry the motor.
	2) Aged winding insulation.	2) Coat the winding insulation or replace the insulation.

Electrical failure	Cause	Solution
7 - Abnormal noise during operation	1) Bearings are worn.	1) Repair or replace bearings.
	2) Stator or rotor core is loose.	2) Find the cause of vibration, re-press the core.
	3) Voltage is too high or unbalanced.	3) Measure the voltage on power source, find the cause and solve it.
	4) Bearing short of grease.	4) Clean the bearing and replenish grease with the amount of one-third to half of the bearing chamber volume.
	5) Fan contacts fan cover or the ventilation is blocked.	5) Repair fan and fan cowl and clear up ventilation area.
8 - Motor overheat or smoking	1) Too high-power source voltage makes flux density in stator core oversaturated and results in high temperature rise.	1) If supply voltage excesses standard value too much, contact power supply department.
	2) Too low power source voltage makes high temperature rise at full load.	2) Replace the cables by bigger ones if it is caused by voltage drop. Contact the power supply department if it is caused by low voltage.
	3) Stator and rotor interfered.	3) If it is caused by larger bearing clearance, replace the bearing. If it is caused by the shaft which is bent, align it. Repair the core if it is loose or deformed.
	4) Motor overload or big resistance from the driven machine, which lead to high temperature.	4) Solve the trouble of driven machine, reduce load if exceeding rated current as per the indication, adopt a larger motor or increase the capacity.
	5) Frequently starting or too many reverse rotations.	5) Reduce number of starts and reverse rotations or adopt an applicable motor.
	6) Fan failure or poor ventilation.	6) Check the fan to see whether it is damaged or the blades are deformed or not fixed properly. Replace the fan if necessary.
9 - Unbalanced no load current at big difference	1) Unbalanced power source voltage.	1) Measure the source voltage to find the cause.
	2) Winding failures such as short circuit coils, wrongly connected coils and etc.	2) Disassemble the motor to check polarity and failures in windings, correct polarity or shoot the troubles.
	3) Coils and turns are not equally distributed after rewind the stator winding.	3) Rewind the stator winding as per the instructions.

Mechanical failure	Cause	Solution
1 - Vibration	1) Worn bearing or the poor bearing clearance.	1) Check bearing clearance.
	2) Air gaps are not even.	2) Adjust air gap to meet specifications.
	3) Unbalanced fan or rotor.	3) Find out the cause and balance the fan, the rotor or the motor.
	4) The rigidity of enclosure or the foundation is not strong enough.	4) Find the root to reinforce the enclosure rigidity or foundation. Align the motor and fasten it.
	5) Shaft is bent.	5) Align the shaft.
	6) Rotor core is deformed or loose.	6) Adjust the iron core and then stack it again.
	7) Loose mounting/fixing bolts.	7) Fasten the bolts or replace them by qualified ones.
2 - High bearing temperature	1) Either too much or too less grease.	1) Replenish the bearing with grease according to operation instructions.
	2) Poor grease with impurities.	2) Check the impurities of grease and change to clean grease.
	3) Oil seal is fit too tight.	3) Repair or replace the oil seal.
	4) Eccentric inner bearing cap contacts the shaft.	4) Repair inner bearing cap to keep proper gap with shaft.
	5) End shields or bearing caps are not assembled properly.	5) Put end shield or bearing cap into spigot by correct process and then fasten bolts evenly.
	6) Bearings are worn or dirt etc.	6) Replace the damaged bearing. Clean the dirt bearings thoroughly and replenish grease.
	7) Eccentric coupling connection or too tight belt.	7) Align the motor with driven machine and adjust the tension of belt.
	8) Improper bearing size.	8) Select proper bearing size.
	9) Too big or too less bearing clearance.	9) Replace the bearing.



Sweden

BEVI AB (Headquarters)
Blomstermåla
Tel. 0499-271 00
Fax 0499-200 08
info@bevi.se
www.bevi.se

BEVI AB (Regional office)
Umeå
Tel. 090-70 44 30
Fax 090-13 96 60
bevinord@bevi.se
www.bevi.se

Denmark

BEVI A/S
Hedehusene
Tel. +45 39 67 36 05
Fax +45 39 67 56 60
bevi@bevi.dk
www.bevi.dk

Finland

BEVI Finland OY AB
Espoo
Tel. +358 9 2709 1210
Fax +358 9 2709 1219
info@bevi.fi
www.bevi.fi

Norway

BEVI Norge AS
Oslo
Tel. +47 23 19 16 50
info@bevi.no
www.bevi.no

China

BEVI Electric Shanghai Co., Ltd.
Shanghai
Tel. +86 21 5032 5200
Fax +86 21 5032 5202
sales@bevi.cn
www.bevi.cn