METHODS OF INSTALLATION AND MAINTENANCE

Electric motors and electric generators with low voltage and short-circuit armature supplied by "PAVEL KUSÝ-KEM"
3-phase asynchronous motors are manufactured under strictly observed procedures of quality control and have excellent functional and technical characteristics and robust frames. In order to achieve optimum characteristics and operational durability of these motors, follow the instructions set forth below.

1. SAFETY WARNING

Electric motors supplied by KEM are designed for operation in industrial applications. In regular operation, there may be danger caused by rotating parts or live terminals. It is important for motors to be installed and operated by qualified personnel only in order to prevent injuries, death or damage to the equipment or buildings.

In the event of any problems related to motor safety, contact the KEM company which will be happy to assist you.
In the event of any doubts concerning safety, do not attempt to install and operate the motor.
KEM cannot be held accountable for damages caused by installation or operation carried out by unqualified personnel.

2. ACCEPTANCE INSPECTION

When accepting motors, please observe the following steps:

a) Check if the description on the delivery note corresponds with the specification of your order.
b) Check if nominal values, rotational speed etc. are in accordance with your requirements.
c) Inspect the motors for damage and for the presence of rust, dirt, foreign substances etc.
All motors should be delivered with shafts protected with plastic covering - protection during storage and shipping.
d) Check the direction of rotation, if determined. If the motor is equipped with a fan for one direction of rotation and reduced noise level, then it is marked with an arrow indicating the direction of rotation.
e) All motors with axial height of 160 and above are supplied with fixed shafts. After the removal of the safety lock, turn the shaft manually and check if it turns smoothly and quietly.

If the motor is to be transported again, either separately or together with the equipment it operates, the rotor and shaft must be secured again to prevent the damage of bearings. Electric motors should not be shipped by railway transport because increased vibrations might cause damage to bearings.

Should you find any defect, contact KEM and provide the following information:

- full label data
- order number and quota list
- full description of the defect.

3. BEFORE COMMISSIONING

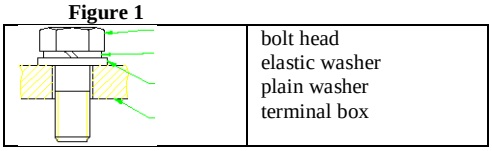
Satisfactory operation of the electric motor depends on its position. Make sure the following factors are taken into consideration:

a) Ambient temperature
Ambient temperature range in which the standard motor can operate without any problems is between –15°C and ++40°C. If you need the motors to operate outside this temperature range and the motors were not specifically ordered and supplied for such operation, contact KEM where you will receive advice on how to proceed.
b) Ventilation
Make sure the motor is installed in an environment with proper ventilation. Make sure that there is open space of at least one fourth of the axial height of the electric motor in front of the air supply. Air from the exhaust port must not be recirculated back above the motor since this would reduce the efficiency of the cooling system.
c) Dust
If the ambient air contains high concentrations of dust that settles on the exterior areas of the motor, it may cause overheating. If dust causes problems, you might want to consider the use of a special motor.
d) Dangerous environment
Make sure that the motor is certified for use in the environment in which it is to be operated. Dangerous environments require special certified motors. The user is responsible for the selection of motor for specific environment.
e) Vibration
Make sure that the motor is installed on a fixed floor, foundation or foundation slab with no risk of external vibrations.
f) Mounting
The basic models are designed for horizontal mounting. Motors from axial height 100 are equipped with suitably placed condensation outlets. All motors with frame size of up to 280 are mechanically adapted to mounting in any position. Condensation outlets must be placed so that they enable the drainage of condensate. If you need to mount motors with larger frame sizes other than horizontally, contact KEM.
g) Cover
All motors are fully enclosed, cooled and have IP55 cover as a minimum. Motors with better cover may be supplied. However, we recommend the use of motors with IP56 and IP66 cover together with heating units - protection against water condensation.

4. MOUNTING OF CONNECTORS AND ADJUSTMENT

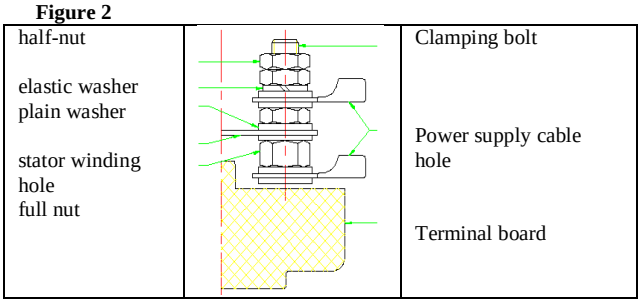
It is necessary to pay maximum attention to the alignment of connectors, since wrong alignment may cause damage to the shaft and bearings. With direct drives, we recommend the use of flexible connectors. Please make sure you follow the manufacturer's instructions regarding alignment. We recommend connectors and belt pulleys to be drilled with H7 tolerance. Never use force when mounting connectors, belt pulleys etc. All motors are equipped with a screw hole in the shaft on the side of the drive which facilitates mounting and dismounting. A screw should be inserted in the hole. For pushing a connector or belt pulley against the shaft shoulder, use a nut with a large washer. It is also necessary to make sure that bearings are under no axial pressure induced by the two halves of the connector pushed too tightly against one another.
Please make sure that all connectors, belts, belt pulleys etc. are properly and permanently protected against accidental touch during operation; if necessary, secure them with a protective cover.
Make sure that fastening bolts are properly tightened. We recommend the use of a plain and elastic washer preventing high load on the motor shoulder or flange. Proper tightening of fastening bolts is shown in Figure 1. You should use common manual tools and bolts should be tightened only until the elastic washer between the plain washer and bolt head is fully compressed.

Figure 1



Electric junctions should be secured so that the connection is tight and there are no hot junctions. Proper arrangement on the terminal is as follows: one plain washer, stator winding hole, another washer, full nut, plain washer. The arrangement for the wye-delta connection is plain washer, half-nut, power supply cable hole, plain washer, elastic washer and two half-nuts. All these nuts should be tight but not too much, see Figure 2. Check all fastening bolts and electric junctions after 100 to 200 hours of operation and tighten as necessary.

Figure 2



Recommended tightening torques for electric terminals in Nm - tightening to the right

Thread diameter	M4	M5	M6	M8	M10	M12	M16
Tightening torque (Nm)	0.8..12	1.8..2.5	3.0..4.0	8.0..9.0	10..17	20...30	60..73

5. BELT TRANSMISSIONS

Please make sure that V-belts are by the same manufacturer and have the same dimensions and that they are properly tightened according to the manufacturer's recommendation. If the V-belts are not properly tightened, it may lead to the wear and tear of the belt and belt pulley or damage to the shaft and bearings. When changing belts, we recommend to change all belts simultaneously. Generally, the use of bipolar motors for belt transmissions is not recommended. Discuss such requirements with KEM.

6. COMMISSIONING

Before commissioning, make sure that the following aspects have been checked:

a) Safety / jacking

All motors with frame size of 100 and more are equipped with jack screws with holes as standard. These screws are designated only for jacking of motors, not for jacking of equipment connected to motors such as transmissions, pumps etc.

b) Connection

Check the motor label for the method of connection. All motors are supplied with the connection diagram on the inside of the lid of the terminal box or on the motor label. Make sure the motor is connected correctly with regard to
the starter.
All standard motors with output of 3 kW and less are supplied for operation with two voltage values, e.g. 400VY - wye, 230 VD - delta. This should allow for the use of motors with three-phase power supply of 230 V with variable frequency. These motors cannot be operated via the wye-delta starter. All motors with output of 4 kW and higher are supplied in delta connection with six inputs. These motors can be operated via the wye-delta starter.

c) Connection

All motors are equipped with two earthing points ensuring a reliable and permanent connection between the motor and the earth via a protective conductor. The internal connection is located next to the feeder terminals inside the terminal box. With all motors, the external connection is mounted on the stator frame.

d) Insulation resistance

Check the insulation resistance between the phase and the earth and between phases by means of the resistance measuring device for 500 V or 1,000 V for 60 s. The deducted value (at winding temperature of 20ºC) must not be less than 5 MΩ. After a longer period of storage or shutdown in humid environment, we recommend you to dry the motors or let them run idle at 20% of rated voltage - removal of humidity inside the motor.

e) Launching

When the motor is launched for the first time, we recommend you to let it run unloaded and check the correct direction of rotation and whether there are excessive vibrations and noise. Before you operate the motor, make sure that any loose parts such as shaft springs are removed or secured in such a way that they cannot "fly away" and injure the operator!
All motors are balanced with a half-spring in the production plant.

f) Reversation

If you wish to reverse the direction of rotation, change any two of the three power supply inputs. In the event of wrong rotation of a motor equipped with a fan for one direction of rotation only, contact KEM.

g) Launching frequency

Standard motors may be launched twice in a row at a normal operating temperature, while each launch will last 3 seconds. Standard motors are also suitable for six evenly distributed launches per hour. If you require a higher frequency, contact KEM.

h) Thermal resistors

Motors with axial height of 280 and more are supplied with thermal resistors as standard. Thermal resistors are input into the main terminal box. Please note that if you want to check the continuity of thermal resistors, the maximum applied voltage MUST NOT exceed 2.5 V DC (you may use an ohm-meter but not any other measuring device). Thermal resistors must be connected to a suitable relay. If they are connected, they provide reliable protection of the motor, therefore we recommend their use.

7. BEARINGS

The grease load of bearings is based on lithium. Motors that operate at extremely high or low ambient temperatures may require special bearings and grease. As standard, motors are supplied with the following bearings:

a) Motors with axial height of 63 - 132

These motors have ball bearings ZZ with internal tolerance C3. These bearings are not additionally lubricated and their service life is 20,000 h.

b) Motors with axial height of 160 - 280

These motors have open bearings with internal tolerance C3. Greasing nipples are used and motors are designed for additional lubrication as standard. These motors are equipped with a stopper for grease discharge which must be removed during lubrication to discharge the old grease.

We recommend you to let the motor run with the stopper removed for l 2 hours. We recommend you to check these motors every three months and lubricate them as necessary. See the separate annex for bearings and lubrication.

If you cannot access the bearing caps due to an inconvenient placement of the motors, bearings are lubricated according to the specified intervals, and old grease is discharged during shut-down (however, no later than within three years).

c) Motors with axial height of 315 - 355

These motors have open bearings with internal tolerance C3 and automatic grease discharge as standard. We recommend you to check the bearings of these motors every three months and lubricate them as necessary.

We recommend you to lubricate these motors during operation. It is important to clean the greasing nipples before every lubrication to ensure that no dirt gets inside the bearings.

Greases recommended for regular applications are as follows:

Motors with axial height of 160 – 355 ESSO UNIREX N3

Mixing different greases is not allowed, as not all of them are mutually compatible.

If the motor is exposed to any axial load, contact KEM, as you might need special axial bearings.

In the case of motors without a stopper for grease discharge, old grease must be removed manually from time to time. The bearing cap and/or bearing bracket must be removed, the bearing and housing filled with grease and the bearing cap and/or bearing bracket mounted again. The bearing housing must not be overfilled. The grease level should not exceed one fourth of the housing after reassembly.

8. MAINTENANCE

If the motor is operated permanently, we recommend you to shut it down every five years, check it and disassemble it. The inspection should focus on:

a) Insulation resistance and temperature at which it is measured. (Note that if the motor is hot, the level of insulation is low).
b) Inspection of bearings and check of the grease colour change.
c) Tightness of V-belts and connector alignment.
d) Tightening of holding bolts and stability of the motor base.
e) Cleanliness inside and outside the motor.

The inspection results should be recorded.

9. TROUBLE TRACING

(separate sheet - Annex 2)

10. BEARING ARRANGEMENT AND LUBRICATION

(separate sheet - Annex 1)

Motors with axial height of 80 - 132

Standard bearing arrangement.
Suitable for B3 and V1

Motors with axial height of 160 - 280

Standard bearing arrangement with additional lubrication and grease discharge.
Suitable for B3 and V1.

Motors with axial height of 315 - 355

Standard bearing arrangement with additional lubrication and grease discharge.
Suitable for B3 and B35

Motor V1 with axial bearing of series "7" on the side of the fan.

NOTE: Other bearing arrangements are also possible. The arrangement depends on the specific motor application.

1. Recommended greases

Motors with axial height of 160 – 355 ESSO UNIREX N3

2. Vertical motors should be lubricated twice as often as horizontal motors.

3. We recommend you to replace ZZ bearings with new ones at the end of their service life. Their lubrication is not recommended by manufacturers even if it is feasible from the outside after the removal of the cover. Grease is held between the inner bearing cover and the bearing bracket seal. All motors have IP55 cover and are equipped with seal at both ends.
4. The lubrication intervals should be shortened if the ambient temperature is above 40 °C.

List of parts and arrangements

Motors with axial height of 80 / 132

Description of parts

1. Bearing bracket with shaft seal on the side of the drive
2. Wave washer
3. Bearing on the side of the drive
4. External earthing bolt
5. Terminal box
6. Terminal box lid
7. Packet of stator stampings
8. Packet of rotor stampings
9. Stator frame
10. Bearing bracket with shaft seal on the side of the fan
11. Bearing on the side of the fan
12. Fan
13. Fan cover

Specifications

Standard model

- Cast-iron frame and bearing brackets
- Cast-iron terminal box
- Pressed steel fan cover
- Bearing brackets with oil seals
- Polypropylene fan
- NSK, SKF, NTN bearings

Characteristic features

- Dimensions and nominal values according to IEC 72
- IP55
- Terminal box mounted on the upper side of the motor
- Terminal box rotates by 90 degrees°
- Drilled holes with threads in the shaft on the side of the drive
- IC0141 cooling

Mounting

- Foot model B3
- Flange model B5 - horizontal
- Foot-flange model B3/B5
- Flange model V1 - vertical

List of parts and arrangements

Motors with axial height of 160 / 280

Description of parts

1. External bearing cap with shaft seal on the side of the drive
2. Wave washer
3. Bearing on the side of the drive
4. Internal bearing cap on the side of the drive
5. Bearing bracket on the side of the drive
6. Terminal box lid
7. Terminal box
8. External earthing bolt
9. Packet of rotor stampings
10. Packet of stator stampings
11. Label
12. Stator frame
13. Internal bearing cap on the side of the fan
14. Bearing bracket on the side of the fan
15. Fan
16. Fan cover
17. Bearing on the side of the fan
18. External bearing cap on the side of the fan

Specifications

Standard model

- Cast-iron frame, bearing brackets, terminal box
- Cast-iron bearing lids with oil seals
- Polypropylene fan
- Pressed steel fan cover
- NSK, SKF, NTN bearings

Characteristic features

- Dimensions and nominal values according to IEC 72
- IP55
- Terminal box mounted on the upper side of the motor
- Terminal box rotates by 90 degrees°
- Drilled holes with threads in the shaft on the side of the drive
- IC0141 cooling

Mounting

- Foot model B3
- Flange model B5 - horizontal
- Foot-flange model B3/B5
- Flange model V1 - vertical

List of parts and arrangements

Motors with axial height of 315 / 355

Description of parts

1. Oiling ring on the side of the drive
2. External bearing cap with shaft seal on the side of the drive
3. Bearing on the side of the drive
4. Internal bearing cap on the side of the drive
5. Bearing bracket on the side of the drive
6. Terminal box
7. Terminal box lid
8. Terminal box extension
9. Detachable terminal box board
10. External earthing bolt
11. Packet of stator stampings
12. Packet of rotor stampings
13. Stator frame
14. Internal bearing cap on the side of the fan
15. Bearing bracket on the side of the fan
16. Fan
17. Fan cover
18. Bearing on the side of the fan
19. External bearing cap on the side of the fan
20. Oiling ring on the side of the fan

Specifications

Standard model

- Cast-iron frame, bearing brackets
- Cast-iron terminal box
- Pressed steel fan cover
- Cast-iron external bearing lids with oil seals
- Aluminium fan
- NSK, SKF, NTN bearings

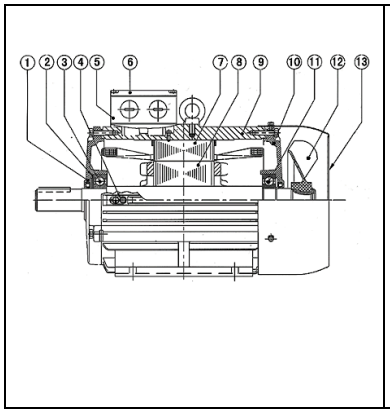
Characteristic features

- Dimensions and nominal values according to IEC 72
- IP55
- Terminal box mounted on the upper side of the motor (315)
- Terminal box 45° from the upper part (355)
- Terminal box rotates by 90 degrees°
- Drilled holes with threads in the shaft on the side of the drive
- IC0141 cooling

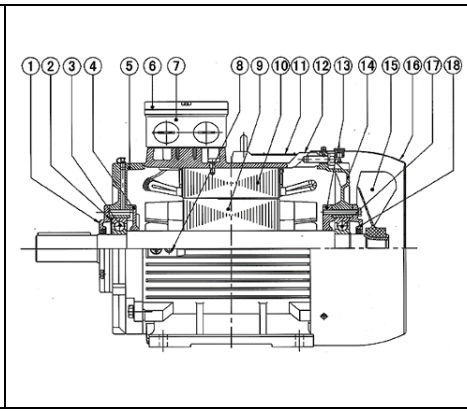
Mounting

- Foot model B3
- Foot-flange model B3/B5
- Flange model V1 - vertical

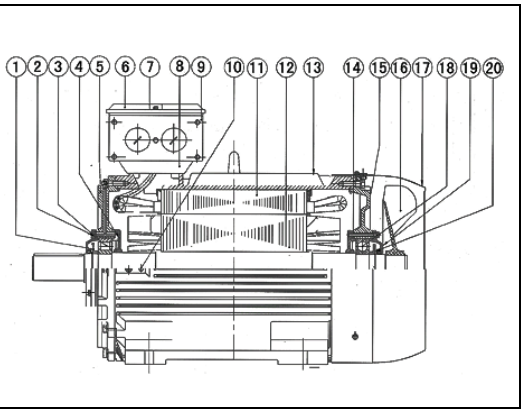
Motors with axial height of 80 – 132



Motors with axial height of 160 – 280



Motors with axial height of 315 - 355



Annex 1 to "Methods of Installation and Maintenance" - 7 (b) and (c)

Additional lubrication of open bearings C3

Axial height	back bearing on the side of the drive	front bearing on the side of the fan	Lubrication interval at ambient temperature of 40°C			amount of grease
			up to 3,600 rev.	up to 1,800 rev.	up to 1,200 rev.	g
160	6309 C3	6309 C3	6,000	12,000	18,000	13
180	6311 C3	6311 C3	4,000	11,000	16,000	15
200	6312 C3	6312 C3	3,500	8,500	13,000	20
200*	NU312	6312 C3	1,800	4,250	6,500	20
225	6313 C3	6313 C3	3,000	6,000	9,000	22
225*	NU313	6313 C3	1,500	3,000	4,500	22
250	6314 C3	6314 C3	2,000	5,000	8,000	23
250*	NU314	6314 C3	1,000	2,500	4,000	23
280 2P	6314 C3	6314 C3	1,200	-	-	30
280 4-8P	6316 C3	6316 C3	-	4,000	6,000	30
280 4-8P*	NU316	6316 C3	600	2,000	3,500	30
315 2P	6316 C3	6316 C3	1,200	-	-	30
315 4-8P	N319 C3	6319 C3	-	2,000	3,000	45
355 2P	6319 C3	6319 C3	1,200	-	-	30
355 4-8P	N322 C3	6322 C3	-	1,400	2,200	60

Vertical motors and motors with axial size of 200-280 and roll bearings of series NU have to be lubricated in half intervals.

At ambient temperature of 55°C, it is necessary to double the number of lubrications.

Among recommended greases for the lubrication of bearings of electric motors sized 160-400 are ESSO UNIREX N3.

Annex 2 to "Methods of Installation and Maintenance" - 9

Trouble tracing

Despite the care given to our motors during production and testing and despite qualified operators, there may be defects in operation. These defects are caused by natural wear and tear, undetectable damage to the material or incorrect operating conditions of the mains or other equipment.

DEFECT	CAUSE	TROUBLE-SHOOTING
Motor is connected, does not start and is quiet.	*There is an absence of voltage in the mains. Melted fuse or circuit breaker shut off. Motor lead disconnected. Motor winding damaged.*	*Secure the line feed. Replace the fuse, turn on the circuit breaker. Repair the motor lead. Consult with the supplier.*
Motor does not start.	*Low voltage in the mains.*	*Ensure the correct voltage according to the rating plate*
Motor does not start and drones.	*Motor is overloaded.* *Motor winding damaged. One fuse is melted. One phase is interrupted.*	*Reduce the overload or use a larger motor.* *Consult with the manufacturer. Replace the fuse. Repair the phase lead.*
The rotational speed is decreasing.	*Incorrect application. Motor overload. Low supply voltage.* *One phase disconnected.*	*Consult with the supplier. Reduce the load. Ensure correct supply voltage according to the rating plate. Check the fuse, relay shutting down when overloaded, starter and button connections.*
Motor runs and then the rotational speed is decreasing.	*Defect in the power supply.*	*Check the connection of the entire circuit, cables, fuse etc.*
It takes a long time for the motor to start.	*Overload. Low voltage.*	*Reduce the load. Ensure the correct voltage.*
Motor does not reach the maximum rotational speed.	*Incorrect construction. Low voltage caused by a reduction of voltage in the mains. High starting load.*	*Consult with the supplier. Use an appropriate cable or transformer tap with higher voltage. Check the starting power input.*
Motor is overheated during operation.	*Shortage of the frame coil, disconnected winding, partially shorted circuit. Unbalanced terminal voltage.* *Low supply voltage. Overload. Increased ambient temperature.* *Foreign object in vent holes.*	*Find the defect and repair.* *Check the power line, connection and transformer tap. Ensure the correct voltage. Reduce the load or use a larger motor. For higher ambient temperatures, special winding is often necessary (from 55°C). Clean the motor.*
Fuse is melting or circuit breaker is shutting down.	*Motor is overloaded. Incorrect connection. Motor winding damaged.*	*Reduce the load. Check the connection. Find the defect and repair.*
Unbalanced supply current during regular operation.	*Unbalanced terminal voltage.* *One phase disconnected.*	*Check the entire circuit and all connections.* *Check the correctness of connection on all terminals.*
Motor vibrates during operation.	*Misalignment of motor and the operated machine. Weak or uneven base. Unbalanced connection or belt pulley. Unbalanced operated machine. Damaged bearing. One phase disconnected.*	*Balance the axes of both machines. Reinforce or even up the base. Balance the connection or belt pulley. Balance the operated machine. Replace the bearing. Check and repair the disconnected circuit.*
Noisy bearing.	*Damaged bearing. Dry bearing.*	*Replace the bearing. Clean the bearing with alcohol and fill with grease.*
Overheated bearing.	*Overfill of bearing with grease. Contamination of bearing or grease. Unsuitable grease. Damaged bearing due to incorrect mounting of connectors. Too tight belt. (This will show at the bearing on the side of the belt pulley). Axial overload of the bearing.*	*Remove excessive grease. Clean the bearing, change grease. Change lubricant grease. When mounting connectors, the other end of the shaft must be supported. Reduce prestressing of the belt.* *Reduce axial load.*

Motors must be protected against vibrations that may be caused by the operated machines or machines next to the motors. Vibrations decrease the load capacity of bearings. Particular attention must be paid to motor bases with roll bearings in cases when motors are exposed to vibrations caused by other machines. Bearings of motors vibrating during idling time become noisy over time and their service life quickly shortens. If the problem with vibrations is not solved, it will persist even after replacing the bearings.