

**Instruction Book For**  
**3 Phase High Voltage Induction Motor**

**Wuxi Xianfeng Electric Manufacturing Co., Ltd.**

# Contents

<b>Preface</b> .....	<b>1</b>
<b>1 General</b> .....	<b>1</b>
1.1 Scope of Application and Product Characteristics.....	1
1.2 Executive Standard.....	1
1.3 Motors.....	2
1.4 Motor operating condition.....	3
<b>2 Structural Feature</b> .....	<b>3</b>
2.1 Structural Feature.....	3
2.2 Structure Introduction.....	4
<b>3 Junction Box and Wiring Diagram</b> .....	<b>5</b>
3.1 Main Power Junction Box and Wiring Diagram.....	5
3.2 Temperature Measuring Junction Box and Wiring Diagram.....	6
<b>4 Reception check</b> .....	<b>7</b>
4.1 Reception.....	7
4.2 Lift.....	7
4.3 Temporary Storage.....	7
<b>5 Assembling and Debugging</b> .....	<b>8</b>
5.1 Motor Size.....	8
5.2 Field.....	8
5.3 Foundation.....	8
5.4 Installation.....	8
5.4.1 Connection of Motor and Base.....	8
5.4.2 Coupling Choosing.....	9
5.5 External Connection.....	9
5.6 Change the Rotating Direction.....	9
5.7 Centering.....	10
5.8 Mechanical Installation.....	10

5.9 Vibration.....	10
5.10 Install the Location Pin.....	10
<b>6 Operation.....</b>	<b>10</b>
6.1 Initial Start.....	10
6.2 Stop Using/Storage.....	11
6.2.1 Clean.....	11
6.2.2 Insulation resistance Test.....	12
6.3 Normal Operation.....	12
<b>7 Troubleshooting.....</b>	<b>12</b>
<b>8 Maintenance .....</b>	<b>14</b>
8.1 General.....	14
8.2 Preventive Maintenance.....	15
8.2.1 Cleanliness.....	16
8.2.2 Load.....	16
8.2.3 Temperature.....	16
8.2.4 Vibration.....	17
8.3 Normal Maintenance.....	17
8.3.1 Low Insulation resistance.....	17
8.3.2 Clean.....	17
8.3.3 Insulation resistance.....	18
8.3.4 Insulation Dry.....	19
8.4 Bearing.....	19
8.4.1 Bearing Structure.....	19
8.4.2 Rolling Bearing Lubrication.....	21
8.4.3 Bearing Replacement.....	22
<b>9 Spare Parts.....</b>	<b>23</b>
10 Service.....	24

## **Preface**

Thank you for selecting our motor and become our customer.

Our company specializes in manufacturing 3 phase high voltage induction motor, Z series, Z4 series DC Motor, YCT series electromagnetic variable-speed motor, BPY series variable-frequency and variable-speed motor and so on. For many years, our products have passed inspections of State Bureau of Technical Supervision. We obtained the certificate of ISO 9001:2000 quality systems in 2000. The stable quality products are well sold on domestic and foreign markets and deeply trusted by customers.

All the staff members in the company follow the aim of “Quality first, Customer first and Reputation first” to cooperate and go forward hand in hand with our new and old customers.

Please read this instruction carefully before you install and use our product, and install, debug and use it according to relevant requirements.

The information in this instruction can help the operators to know about the general features of the purchased motor, but it does not exclude users adopt their previous experiences in equipment installation, operation and maintenance. If the general descriptions and diagrams are in conflict with supplement files, subject to the latter.

The diagrams in this instruction describe the typical motor case; these diagrams are not applicable for special cases.

### **Dangerous!**

Voltages which can cause a series of dangers and injuries exist in the motor parts, if you didn't obey the safety rules, you may be electrocuted or damage the equipment. In order to avoid this series of human body or equipment damages, before you debug, use, connect wires, and replace parts or any other direct contacts with the equipment charged body or working parts, all the equipments must be out of power, disassembled and isolated, to avoid the unexpected contact between charged bodies and rotating parts.

The normal and safe operation depends on correct design and manufacture, also depends on correct transportation, installation, operation and maintenance. If certain basis installation and maintenances were wrong, it may result in physical dangers, motor faults or other feature damages. You must read this instruction carefully before you install, operate or maintain this equipment.

Only the trained and qualified operators can participate in the inspection, maintenance and repair, and must comply with all safety procedures.

A qualified operator must be familiar with the equipment structure, installation, operation and its risk.

The electric motor assembling and earthing must be in accordance with national standard.

When the motor is running, shall not exceed the rated value on the nameplate, nor on the contrary with the instructions. Motors were tested before leave factory, and are all acceptable products. Running over rated value may cause abnormal stress and strain. If you ignore this kind of warnings, it may cause motor damages or physical risks.

# Instruction Book for 3 Phase High Voltage Induction Motor

## 1 General

### 1.1 Scope of Application and Product Characteristics

This instruction is suitable for the following motors:

Common characteristics: high voltage 3 phase induction motor, insulation grade F, install form IMB3, working system S1.

Y series high voltage 3 phase induction motor (seat number 355-630), protection grade IP23, Cooling Model IC01.

YKS series high voltage 3 phase induction motor (seat number 355-630), protection grade IP54, Cooling Model IC81W.

YKK series high voltage 3 phase induction motor (seat number 355-630), protection grade IP54, Cooling Model is IC611 or IC616.

YR series high voltage 3 phase wound-rotor induction motor (seat number 355-630), protection grade IP23, Cooling Model IC01.

YRKS series high voltage 3 phase wound-rotor induction motor (seat number 355-630), protection grade IP54 (protection grade of collector ring is IP23), Cooling Model IC81W (the cooling model of collector ring is IC01).

YRKK series high voltage 3 phase wound-rotor induction motor (seat number 355-630), protection grade IP54 (protection grade of collector ring is IP23), Cooling Model IC611 or IC 616 (the cooling model of collector ring is IC01).

This instruction is also available to the subseries of above motor series.

### 1.2 Executive Standard

We perform the following motor standards:

GB 755 “Electrical Rotating Machine Rating and Performance”

GB/T 997 “Motor Structure and Installation Form Code”

GB/T 1032 “Test Methods of 3 Phase Induction Motor”

GB/T 1993 “Cooling Methods of Electrical Rotating Machine”

GB/T 4772.2 “Size and Output Power Grade of Electrical Rotating Machine The second part: seat number 355-1000 and flange number 1180-2360”

GB/T 4831 “The model designation of motors”

GB/T 4942.1 “Protection Grade of Electrical Rotating Machine (IP code)”

GB 10068 “Mechanical vibration of certain machines with shaft heights 56 mm and higher--measurement evaluation and limits of vibration severity”

GB/T 10069.1 “Measurement of airborne noise emitted by rotating electrical machinery and the noise limits--Engineering method for the measurement of airborne noise”

GB/T 10069.2 “Measurement of airborne noise emitted by rotating electrical machinery and the noise limits--Survey method for the measurement of airborne noise”

GB/T 10069.3 “Measurement of airborne noise emitted by rotating electrical machines and the noise limits-- Noise limits”

### 1.3 Electric Motor

The motor model contains 3 parts: series code, specification code and environment code.

Example: YRKK 5601-4 -W

YRKK: the series code, it stands for closed wound-rotor induction motor with air-air cooler

Y-- Induction motor

R-- wound-rotor

KK-- closed and with air-air cooler

KS-- closed and with air-water cooler

5601-4: specification code, it means that the shaft height is 560 mm, 1# iron core length, 4 poles

-W: environment code, W means outdoors. (if no protection requirements indoors, it can be omitted)

The letter Y in the series code can be combined with other letters to stand for various series motors. For example: YR stands for 3 phase wound-rotor induction motor, YRKK stands for closed 3 phase wound-rotor induction motor with air-air cooler.

#### 1.4 Motor operating condition

##### **Dangerous!**

All series of motors in this instruction can not be operated in explosive gas atmosphere. For explosive gas atmosphere, you should choose explosion-proof motor, refer to GB 3836.

Unless otherwise specified, the motor should be suitable to the following field operation condition:

Altitude above sea level shall not exceed 1000M.

Ambient air temperature should not exceed 40 °C.

For motors with air-water cooler, the water temperature at the inlet of the cooler should not be above 25°C (According to our natural environment, if necessary, cooling water temperature should not be higher than 33° C), and should not be less than 5°C.

Motor electrical operating conditions refer to GB755.

##### **Attention!**

For special on site operating conditions, you should specify in your order, and choose motors used for special purpose.

## **2 Structural Features**

### 2.1 Structural Feature

All series of motors in this instruction have the following structural features:

The motor adopts square case structure, and has light weight and good stiffness. Both side faces and (or) the top of the motor base has square holes. So the motor is easy to maintain, and on the other hand, it can easily be changed to a motor with different cooling type and protection grade. Thus it can improve its universality.

The stator winding is F grade insulation material, end winding is fixed and binded reliably, and be treated with vacuum pressure impregnating in solvent free paints processing (VPI). Motors have good insulation performance, high mechanical strength, high moisture resistant ability and long service life.



There are two structures of squirrel cage rotor, cast aluminum and copper bar. Squirrel cage rotor was made by advanced cast aluminum process or welding process, and has passed the balance verification to ensure the steady and reliable operation of the motor.

There are two forms of the bearing, rolling bearing and the sliding bearing, which were depended on the motor power and rotating speed. The protection grade of bearing assembly is IP44 or IP54. Rolling bearing is provided with a non-stop injecting and discharging oil device.

The main junction box is arranged on the right side of the motor (look from the shaft extension end), and we also have motors with the main junction box on the left according to customer requirements. There are separate earthing terminals both inside and outside the junction box.

The stator winding and bearing temperature measuring devices chosen by customers can be benefit for on site inspection and remote monitoring, to ensure the steady and reliable operation of the motor.

Assemble condensate proof heat in the motor according to customer choice.

## 2.2 Structure Introduction

Y series high voltage 3 phase induction motor, protection grade IP23, Cooling Model IC01, installation form IMB3, working form S1.

Motors of this structure are open type; there are two inner fans, so that the cooling air can circulate inside and outside the motor. Ambient air enters into the motor through the jalousie on the top protective cover. When the cooling air flow through the heating parts such as stator rotor core and coils, it will take the heat away. Heat air inside the motor can flow out from the jalousie on the top protective cover to achieve the cooling purpose. The jalousies on shaft extension end and non shaft extension end are air inlet; jalousies on both sides are air outlet.

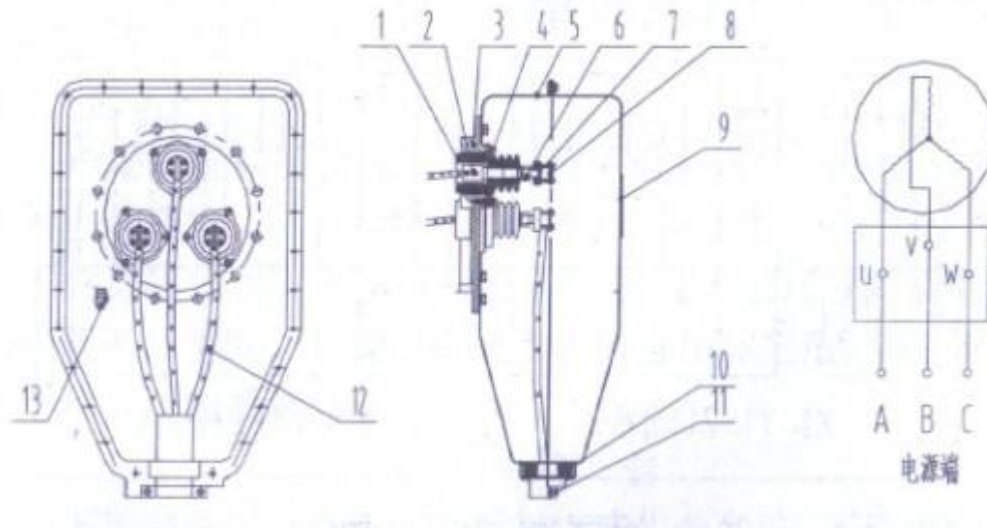
YKS series motor structure features: Protection Grade IP44 or IP54, Cooling Model IC81W, installation form IMB3, working form S1. This kind of motor is closed type, and air inside and outside the motor can not exchange. Cooling air driven by inner fans only circulate in the motor. When the cooling air flow through the heating parts such as stator rotor core and coils, it will take the heat away. When the cooling air flows through the air-water cooler, the heat will transfer to the cooler and be taken away by circulating water to achieve the cooling purpose.

YKK series high voltage 3 phase induction motor: Protection Grade IP44 or IP54, Cooling Model IC611 or IC616, installation form IMB3, working form S1. Install a air-air cooler on the motor base. Install a external fan with fan cover on the non shaft extension end motor shaft. This kind of motor is closed type, and air inside and outside the motor can not exchange. Cooling air driven by inner fans only circulate in the motor. When the cooling air flow through the heating parts such as stator rotor core and coils, it will take the heat away. When the cooling air flows through the air-air cooler, the heat will transfer to the cooler. External fan is installed in the fan cover, it will drive the ambient air flow through the cooling pipes of the cooler, then the heat will be taken away and miss in the ambient environment to achieve the cooling purpose.

### 3 Junction Box and Wiring Diagram

#### 3.1 Main Power Junction Box and Wiring Diagram

There are three connection bolts (or wiring board) in the main power junction box of the motor. The structure diagram and wiring diagram can be seen in the following figures. In the figures, there are three connection bolts and one earthing bolt. The three connection bolts are separately U, V, W phase. The power input cable enters into the junction box through the seal ring on the connection bucket. The input cable is fixed with the snap-gauge on the connection bucket.



- |                              |                             |                       |
|------------------------------|-----------------------------|-----------------------|
| 1. Electrical insulator      | 2. Connection bolts         | 3. Wiring board       |
| 4. Fixed plate               | 5. Junction box base        | 6. Nuts               |
| 7. Upper line pressing plate | 8. Down line pressing plate | 9. Junction box cover |
| 10. Seal ring                | 11. Snap-gauge              | 12. Power input cable |
| 13. Earthing bolt            |                             |                       |

#### Main Power Junction Box Structure Diagram and Wiring Diagram

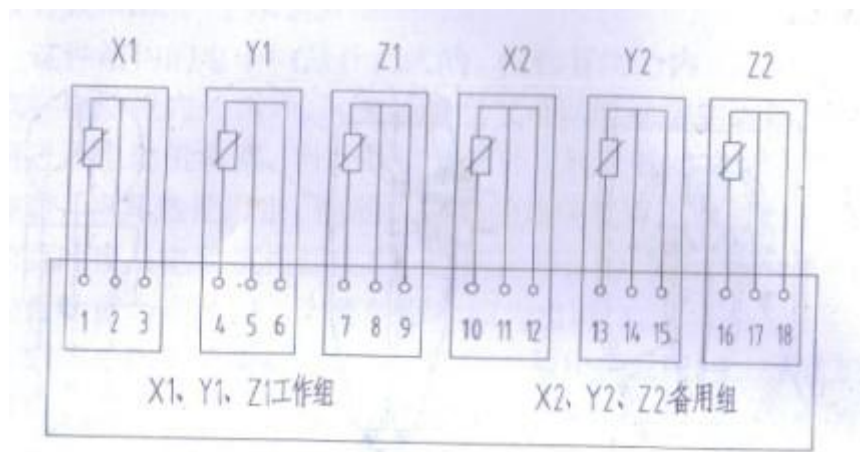
### 3.2 Temperature Measuring Junction Box and Wiring Diagram

For the stator winding and bearing temperature measuring devices chosen by customers, if no special instructions, the temperature measuring element is platinum thermal resistance Pt100.

Each bearing has a temperature measurer which was assembled close to the heating part.

The stator temperature measuring element is embedding in the stator slot, between the upper and lower coils, two pieces of each phase, totally 6 pieces. Among which three pieces are used and other three pieces are standby. The lead wire of temperature measuring element will be lead to a separate junction box.

When the motor works normally, the measured temperature of the two bearing temperature measuring elements may be different. It is a normal phenomenon, the main reason is: 1) temperature measuring element error; 2) bearing quality; 3) lubricating conditions; 4) cooling conditions; 5) loads; 6) effect by the uneven temperature of the motor.



Stator Temperature Measuring Wiring Diagram

The rated voltage of the heating zone is 220V, and the rated frequency is 50Hz.

The heating zone will be used when the motor was shut down. It can not be used during the operating of the motor.

In order to prevent condensing on the winding, if the motor doesn't have or doesn't use the condensation-preventing space heater, the motor shouldn't be stored or intermittently operated at the temperature shock area. If the motor was intermittently operated at a damp place, you should use the condensation-preventing space heater to protect it. If there is no condensation-preventing space heater in the motor, you should check the insulation resistance of the winding before use, and the insulation resistance should not be lower than the provision in 8.3.3. If it is lower than 8.3.3, it should be dried insulated.

## **4 Reception check**

Compare to the guarantee clauses in the purchase contract and inspect term by term.

### 4.1 Reception

Check the motor to see if there are any damages during the transportation when you receive it. And you should also check before the motor was unloaded from the truck. If there were obviously barbaric unloading, you can immediately make a claim to the transporter and inform us.

Check and accept with according to the transportation list, read all the labels and instructions, make sure that the motor will not be damaged.

The rolling bearing was lubricated before transportation, and it can be put into operation directly.

### 4.2 Lifting

The motor should be gently lifted and put down, during the hoisting process, you should avoid impact and hit to the shaft, coupling and bearing parts. Because impact and hit may damage the bearings.

You must pay attention to the motor weight, installation size diagram and the marked weight on the motor nameplate. You can only use the lifting lug on the motor base, tighten the sling, do not yank or move the motor suddenly.

### **Warning!**

Incorrect lifting may cause serious damages or life danger. Do not lift the motor with lifting lug on the cooler or protection cover. Pay attention to all the warning labels on the motor and comply with the instructions of each label.

### 4.3 Temporary Storage

If the motor will not be immediately installed and put in to operation after you received it, please store it in a clean, dry, rain-proof and draughty place, and far away from places with big vibration and temperature difference.

At least rotate 10 rounds of the shaft per month, paint the lubricant on the bearings to prevent corrosion, oxidation and possible friction corrosion.

## **5 Assembling and Debugging**

### 5.1 Motor Size

For the motor shape and installation size, you can refer to the motor sample.

#### **Warning!**

In order to avoid personal injury or equipment damage, before you debug, use, connect wires, and replace parts or any other direct contacts with the equipment charged body or working parts, all the equipments must be out of power, disassembled and isolated, to prevent the unexpected contact between charged bodies and rotating parts.

### 5.2 Field

The field should be clean, dry and draughty. The drainage facilities should be well equipped and easy to be checked, lubricated and maintained. Outdoor installation should not be subject to wind and rain erosion.

### 5.3 Foundation

Foundation weight should be greater than 2.5 times the weight of the machine.

### 5.4 Installation

#### 5.4.1 Connection of Motor and Base

Install the motor base to the foundation or other supports, add thin gaskets to level it and be sure that the base upper surface is in the same horizontal surface after you tighten up the foundation bolt. Put the motor on the base; tighten up the base bolts (or nuts).

#### **Attention!**

Do not hit the motor with heavy things during installation to avoid the motor base deformation or the damages of bearings and other parts.

The installation of all the motors and driven equipments has the temporary alignment problem. Some parts of the motor may deform during the transportation, so you must align it after installation.

#### 5.4.2 Coupling Choosing

At the premise of meet the use performances, you should choose couplings which are convenient to assemble and disassemble, easy to maintenance and with low cost. For example, the rigid coupling has the advantages of simple structure and convenient assembly and disassembly, wherein the clamp coupling, can be assembled and disassembled without move the two shafts, and it can be used in low speed, high rigidity transmission shaft. The

The general non-metal elastic element couplings (for example, elastic sleeve pin coupling, quincunx elastic coupling, the elastic pin coupling and so on) are suitable for general small and medium-sized power transmission due to its good comprehensive performance.

#### 5.5 External Connection

Check 6.1 before the motor was put into operation.

The start control and overload control must be in accordance with the motor rated value. In view of safety and convenience, they can be fitted at a place which has a certain distance with the motor. Properly install the motor and connect the wires according to the control system manufacturer's instructions. That is:

When the letter order (U, V, W) of binding terminals in the motor junction box is of the same direction as the voltage phase order (A, B, C), if connect U and A, V and B, W and C, the rotating direction of the motor is clockwise (see from the motor shaft extension end). If any of above connections were changed (for example, change to U and C, V and B, W and A), the motor rotating direction will change.

#### **Warning!**

For motors which have the rotating direction requirements, if the rotating direction is wrong, the motor will be over heated; you need to replace the fan or contact with us. After replace the fan, you must rebalance and re-align the rotor.

#### 5.6 Change the Rotating Direction

Check the rotation plate, the rotation plate may be assembled on the base of the motor shaft extension end or on the fan cover of non shaft extension end.

## 5.7 Centering

Between the motor and driven equipment, the transmission shaft must be accurately centered. If they were not centered, it may cause vibration, bearing overload and shaft overstress. The flexible coupling can only balance out small misalignment.

## 5.8 Mechanical Installation

After determine the rotor axial movement and to accurately centered, we recommended you to drill and ream the foundation plate and the motor base to make the positioning pin, see 5.11.

Before assemble bolts to the coupling, check the parallel and alignment again.

## 5.9 Vibration

When the motor has no load, according to GB 10068 “Mechanical vibration of certain machines with shaft heights 56 mm and higher-measurement evaluation and limits of vibration severity”, at the condition of free suspended, the measured vertical and horizontal vibration intensity value is no more than 3.5 mm/s; at the rigid mounting conditions, the measured vertical and horizontal vibration intensity value is no more than 2.8 mm/s, and the axial vibration intensity value is no more than 4.5 mm/s.

After align and tighten up the foot bolts, operate the motor at no load (or very little load) conditions, and check the motor vibration. If the motor has good alignment but the vibration is out of limits, you can loose a shaft extension end foot bolt to check the foot plate surface.

The rigidity of the base or foundation can effect the vibration, you should check the resonance of the support structure.

## 5.10 Install the Location Pin

# 6 Operation

## 6.1 Initial Start

After the motor was assembled, do the initial start according to the following procedures before it was put into operation:

- a) Be sure that all the temporary supports (such as bearing protector) have been disassembled.
- b) Check the motor, starter and the control connection parts according to the wiring diagram.
- c) Check whether the voltage, phase and frequency of the power supply system are in accordance with the rated values on the motor nameplate.
- d) If the motor is disuse or stored, check before this process

e) Check the motor using records and labels. Confirm the bearing lubricated conditions and inject oil according to the requirements.

If possible, disassemble the motor and driven equipment, rotate the shaft to ensure a Flexible rotation. Above procedures can be finished during the installation; after installation, if no changes, you needn't to repeat this check.

f) If the motor was not connected with driven equipment and was operated with no load, be sure you have enough time to determine there are no abnormal cases. Monitor the noises, vibrations, crash, abnormal sounds and the oil ring rotating conditions. If there were abnormal cases, shut down the motor immediately, find the reasons and solve them.

g) If the motor can not be disassembled with the driven equipment, cut the start return circuit when the motor is accelerated to the low speed. Carefully observe the abnormal cases from the motor running down to stop running. If necessary, you can repeat above process, but no more than twice.

### **Warning!**

Repeated start may cause overheat of the motor. The motor is allowed to start twice at cool conditions (the motor should be natural stopped between the two starts); or at heat conditions after the rated operation, it can be start once.

a) For coil wound rotor motor, you should check the contact conditions of electric brush and collecting ring, and the contact area should be no less than 70%. Check the activity of electric brush in the brush holder; check whether the connection of electric brush and junction box is reliable; check whether the connection of collecting ring and start control parts is correct.

b) When all the inspection results are consistent with the requirements, the motor should be operated at a load as small as possible and check if there were abnormal cases. Slowly increase the load to the max value, and check the running condition at the same time, to see if there were abnormal cases.

At the end of the starting of coil wound rotor motor, the rotor winding three phases should be short connected through the starter.

## 6.2 Stop Using/Storage

### 6.2.1 Clean



Both inside and outside the motor shall be no oil, no water, no dust and dirt. The outside should be scrubbed clean, and for the inside of it, you can blow the sundries and dust with low pressure compressed air or small hand bellow.

Use a clean cloth with petrol to wipe off the anti-rust layer. Be sure there is no dust and sundries in the bearing and lubricating cavity and install the oil plug. You must carefully remove the traces of hitting, scraping and rusting.

### 6.2.2 Insulation resistance Test

No matter what storage method you adopt, the winding of each motor must be tested before it was put in to service. See 8.3.3 for insulation resistance test.

### 6.3 Normal Operation

Start the motor according to relevant starting equipment instructions. The load should be decreased to the minimum value, especially when the reduced-voltage starting and (or) the flywheel torque is very large. During normal running of the coil wound rotor motor, the rotor winding three phases should be short connected through the starter.

## 7 Troubleshooting

Table 1 Troubleshooting

Trouble	Cause	What to do
Motor fails to start	Normally it is line fault--power supplying system problem or single phase load too large caused by the starter	Check the power; be sure to prevent check with electricity. Check the overload, control and fuse; check the voltage value and compare it to the rated value on the nameplate.  Disassemble the motor and loads to check the no load starting of the motor. Decrease the load or change to a large capacity motor
Too big alternating current hum	Voltage too high The rotor is not balanced The sliding bearing has a high abrasion	Check if the input voltage and connection are correct. Re-balance the rotor If there were scratches, it means that you should replace the bearing before the stator collides with the rotor. Check the alignment.
Regular click	Foreign matters exist in the air gap	Pull out the rotor and take out the foreign matters
Quick hit	The bearing is not good The lubricant is dirty	Replace the bearing Clean the oil cavity and update the lubricant

Vibration	<p>Problem with the coupling centering Fan dust deposition Vibration of the driven equipment</p> <p>System resonance The rotor is not balanced, the balance weight or fan on the rotor changed Wound rotor motor rotor starting resistance three phase is not balanced</p>	<p>Re-centering Clean the motor Disassemble the motor and driven equipment to find the vibration source and solve it.</p> <p>Change the foundation structural stiffness Re-balance the rotor Adjust the rotor starting resistance</p>
Motor over heat (measure the temperature with thermal resistance or thermal couple, do not use hand)	<p>Overload Single phase running The motor or vent pipe dust deposition</p> <p>The voltage is not balanced. Friction of the rotor and stator</p>	<p>Measure the load and compare it to the rated value on the nameplate. Check if there is large friction in the motor or the whole actuating device. Decrease the load or change to a large capacity motor. Check each phase current Check the air flow If filter was assembled, you must also check and blow the motor and vent pipe, clean the winding with solvents. If necessary, clean the pipes of tubular shell motor with cleaning rod.</p> <p><b>Warning!</b> In order to avoid personal injuries, you should wear protective glasses when you use the compressed air. Check each phase voltage Clean the air gaps and check the coaxiality; replace the bearing if necessary.</p>
The motor continuous overheat	<p>Stator coil is open circuit. Over voltage/ low voltage Grounding fault Wrong connection</p>	<p>Disassembled the motor and loads to check whether each phase current is balanced with no load. Check whether each phase resistance of the stator is balanced. Check the voltage and compared it to the rated value. Check and repair it with test lamp or tramegger Re-check the connections</p>
Centering problem Coupling problem	<p>There are fine dusts on the coupling during the motor operation (non-metal elastic elements flexible coupling)</p>	<p>Re-centering Check the coupling</p>
Bearing overheat	<p>Centering problem Too big axial force Too much lubricating grease</p>	<p>Re-centering Decrease the axial force from the loads, and check the installation and alignment again. Appropriately decrease the lubricating</p>

	(rolling bearing)  Oil ring blocked (sliding bearing)  Oil ring is not round (sliding bearing) Insufficient oil lubricating (sliding bearing) Misuse of the lubricating grease or lubricant	grease according to the requirements on the instructions or bearing nameplate. Clean, repair or replace the oil ring, and check again. Installation  Repair or replace the oil ring Add oil to the correct oil level Change lubricating grease or lubricant
Oil leakage or large oil consumption	Pressure inside the bearing cavity is too high or there is low pressure area outside the bearing cavity. 1. Gas seal tube blocked 2. Oil return not free 3. The bearing gap is too large 4. seal problem 5. Gas seal tube loose 6. Gas seal ring loose 7. Gap between float labyrinth ring and bearing is too large 8. Gap between gas seal ring and bearing is too large	Clean the gas seal tube Check the oil return pipes and solve it Replace the bearing, check the coaxiality Check the seal parts Repair the gas seal tube Tighten up the gas seal ring Repair or replace the float labyrinth ring Replace the gas seal ring

## 8 Maintain and Repair

### 8.1 General

We have considered ensuring the safe running of the motor and decrease maintain as possible as we can when we design it. But we can't image the motor can work stably without in time maintenance or even ignore the maintenance.

In order to avoid the winding break down, serious damages and frequency shut down, you should set a preventive maintain and check list. This list is depending on the motor running condition and similar motor using experiences. In order to ensure appropriate maintenances, you should keep the complete records of each motor, including the operating instructions, rated value, maintain lists, necessary repair and running conditions.

The motor should be maintained and checked periodically, and be sure that:

- a) The motor is clean; vent pipes of the stator and rotor were not blocked.
- b) The load should be no more than the rated value and coefficient of performance.
- c) The coil temperature rising should be no more than the rated value.
- d) The insulation resistance should be higher than the recommended minimum value.

**Dangerous!**

The high voltage used in the insulation test may cause damages and life danger, only qualified people can do this test. Pay attention to the safe section in the test device instructions.

- e) The change of voltage and frequency should be in accordance with the provision in 1.5.
- f) For sliding bearing motor, you should check the gas gap, record and keep it for later comparison.
- g) The bearing temperature should not exceed the shut down value in Table 4. For sliding bearing, you should keep the lubricant clean and appropriate oil level. For the force lubricated motor, the oil return pipes should be free-flowing and no press-back oil.
- h) No abnormal vibrations and noises.
- i) Storage of necessary parts and spare parts storage list.
- j) Centering data (deviation with accuracy centering, high temperature allowable value)
- k) Normal check results (record them on the “using record”).
- l) Repairs (record them on the “using record”).
- m) Lubricating data:
  - 1) Using method.
  - 2) Lubricating grease types which were used in damp, dry and heat place.
  - 3) Storage of lubricating grease and oil.
  - 4) Maintenance period.
  - 5) Make record of each equipment (record them on the “using record”)

## 8.2 Preventive Maintenance

The following are some important projects of preventive maintenance, the rest conditions will be additionally discussed when harmful and abnormal conditions appear. You should check each motor in specified periods. The check times and sufficiency depend on the running time, using character and operating environment. Disassemble the cooler or protective cover or the jalousie at the side of motor base; you can observe the inside of the motor. The disassembling method is as follows:

- a) Disassemble the lug between the motor base and cooler or protective cover, or disassemble the fastening bolts of the jalousie at the side of motor base.
- b) For motor with fan on its rolling shaft, you should first disassemble the external fan, and then you can disassemble the fan cover.

c) The bearing cover and bearing base of end cover type spherical sliding bearing are connected with a bolt, disassemble this bolt, you can disassemble the bearing cover of the sliding bearing.

The whole process will neither affect the bearing nor affect the centering of the motor and loads.

### 8.2.1 Cleanliness

The inside of the motor must have no oil, no dust, no dirt, no water and no other chemicals.

#### **Warning!**

In order to delay the corrosion, when the motor passed the maintenance check and re-assembled, anti-rust oil should be painted on the joint surface of the motor.

### 8.2.2 Load

Overload running may cause overheat and decrease the insulation life. If the winding temperature was 10 °C higher than its insulation grade maximum limit temperature, its insulation life will reduce by half.

### 8.2.3 Temperature

Under normal conditions, the motor will become heated with its running. Although the hand feel in some places is very hot, the motor temperature is still within the limit range, you should measure the coil temperature with heat resistance or heat couple.

The coil temperature (rather than temperature rising) measuring is the safe running basis of the motor. If you measure the temperature with the temperature measuring element which was insert in the winding, the temperature should be no more than 155 °C. If the temperature exceeded 155 °C, you should check the running conditions of the motor.

For the stator winding and bearing temperature measuring elements chosen by customers, if no special instructions, the temperature measuring element is platinum thermal resistance Pt100.

The warning value and stopping value of the stator and bearing temperature should be determined according to the actual conditions. Under the highest temperature and largest loads, the stator and bearing temperature should be separately plus 5 °C as warning value, and plus 10 °C as stopping value. The recommended highest stator and bearing temperature warning value and stopping value are listed in Table 2.

Table 2 Warning Value and Stopping Value of the Stator Temperature and Bearing Temperature

	Stator temperature	Bearing temperature		
		Rolling bearing	Sliding bearing (forced lubricating)	Sliding bearing (self-lubricating)
Warning value	150	90	75	90
Stopping value	155	95	80	95

#### 8.2.4 Vibration

If there were big vibrations, you can primarily check it with your eyes and hands, but the final results should be subject to the measuring instruments.

### 8.3 Normal Maintenance

The two elements need normal maintenance are electrical failures and mechanical failures. The first representation of electrical failures is usually the low insulation resistance. The mechanical failures are often too loud bearing noises or overheat.

#### 8.3.1 Low Insulation Resistance

Normally, elements which can lead to low insulation resistance are:

- a) Dirty coil (with oil, dust, lubricating grease, salts and so on)
- b) Too damp
- c) Insulation mechanical damages
- d) Insulation thermal metamorphism

The dirty coil can be cleaned, and if too damp, you can dry it. But if it is c) and d), it must be repaired in the manufacturing plant or special repairing center.

#### 8.3.2 Clean

Clean the inside and outside of the motor periodically. The actual operating conditions determine the clean frequency. When you clean the motor, you should comply with the following procedures:

a) Wipe off the external dust, dirt, oil, water and so on. The above things may be brought into the winding to cause overheats and damage the insulation.

b) Remove the dirt, dust and other scraps in the air-vent and air outlet. The air passageway can not be blocked or have bad flowability during the motor running.

**Warning!**

The compressed air may endanger personal safety. You should use safe and reliable equipments.

c) Rotor clean: disassemble the rotor, check the air passageway, and remove the materials which may block or affect air flow.

d) Stator clean: insulation windings treated with VPI vacuum pressure impregnating in solvent free paints processing can be wiped with cotton cloth and quick dry solvents or be cleaned with low pressure clean steam. Then dry the whole stator at 90 °C for 6 hours. You should check the insulation resistance value each time when you finished clean the stator coil.

For windings which are not VPI insulation system, when you clean the motor rotor, we do not recommend you use water and detergent. You should use solvent to clean it; this solvent should be compatible with the insulation system and drying.

### 8.3.3 Insulation Resistance

You should check the insulation resistance periodically; normally the tramegger will be used in this application. Choose the tramegger according to the motor rated voltage in Table 3.

Table 3 Tramegger choosing

V

Motor rated voltage	tramegger
≤3000	1000
>3000	2500

When you measure the insulation resistance of embedded thermometry meter (for example, platinum thermal resistance Pt100 embedded between the up and low windings), you should adopt a tramegger no more than 250V.

When the motor winding insulation resistance is under cool state, it should be no less than the value calculated by the following formula:

$$R \geq \frac{2U \text{ (voltage)}}{1000} \text{ (megohm)}$$

In the formula: R—insulation resistance of the motor windings, megohm (MΩ)

U—rated voltage of the motor windings, voltage (V)

When in cool state, the insulation resistance of normally use voltage grade windings should be no less than the specified values in Table 4.

Table 4 Windings Insulation Resistance

Rated voltage of the motor windings (V)	3000	6000	10000
Insulation resistance of the windings (megohm)	6	12	20

#### 8.3.4 Insulation Dry

The insulation dry temperature is 120°C, and it should be slowly heated. You should first dry it at 90°C for 6 hours (to prevent steam entering into the windings). And then slowly rise to 120°C.

Before heating, you should check the insulation resistance, and after that, check it every 2 to 3 hours. Observe the resistance change.

#### **Attentions!**

As the motor temperature rises, the insulation resistance will decrease. If it was continuous dried, the insulation resistance value will recover.

#### **Warning!**

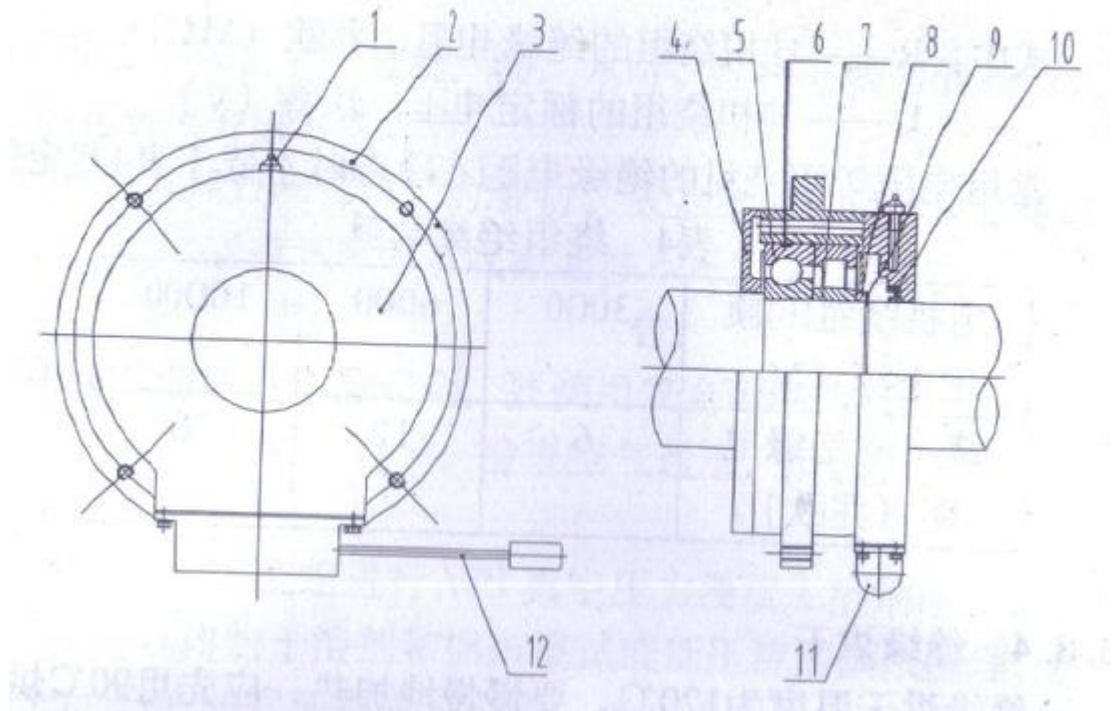
High temperature may damage the insulation. Control the temperature and avoid overheat.

### 8.4 Bearing

During the running of the motor bearing, according to correct maintenance, ensure it has good centering, good lubricating performance, and the bearing service life will be extended. The bad centering of coupling may lead to bearing overload and generate overlarge vibrations and thrust.

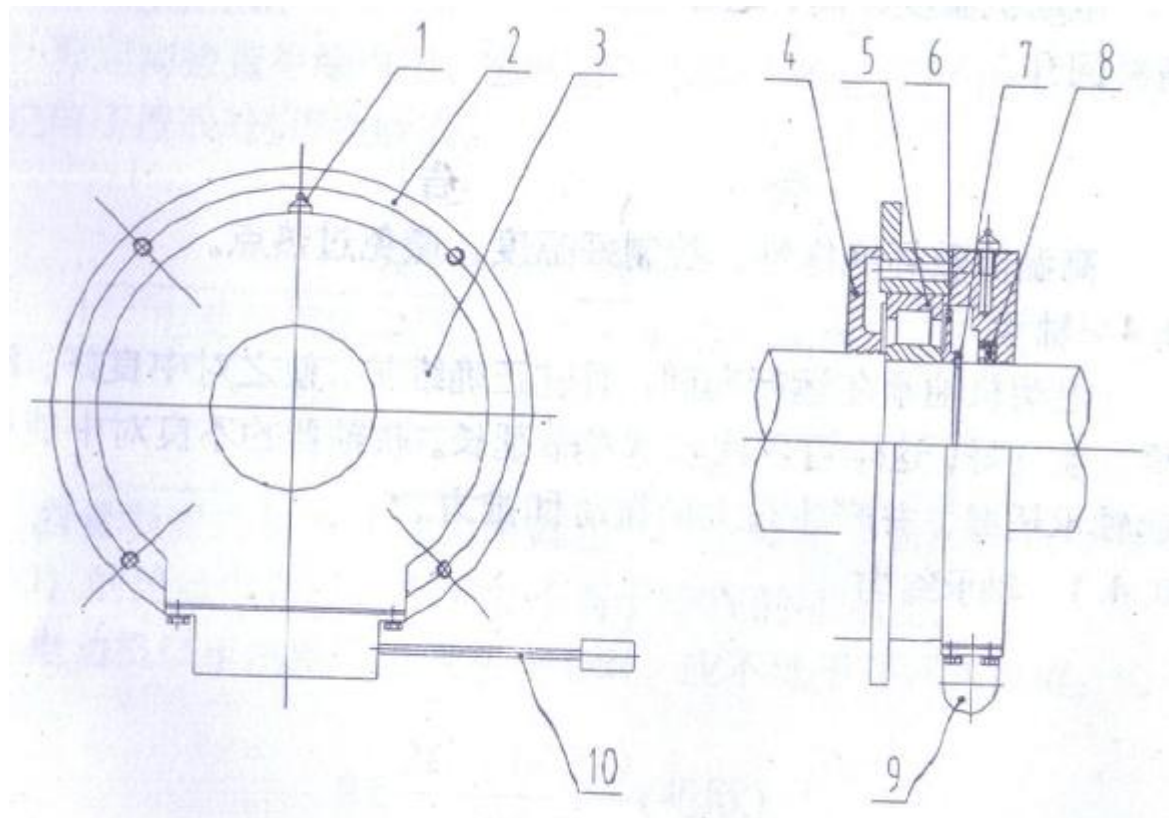
#### 8.4.1 Bearing Structure





1. oil cup      2. bearing sleeve      3. bearing external cover      4. bearing internal cover  
 5. deep groove ball bearing      6. rubber strip      7. cylindrical roller bearing  
 8. oil slinger      9. washer on shaft      10. seal ring      11. oil drain box  
 12. oil drainer

Shaft extension end bearing structure



- 1. oil cup            2. bearing sleeve            3. bearing external cover            4. bearing internal cover
- 5. cylindrical roller bearing            6. oil slinger            7. washer on shaft
- 8. seal ring            9. oil drain box            0. oil drainer

Non-shaft extension end bearing structure

The deep groove ball bearing external ring of the shaft extension end does not directly contact the bearing sleeve. Usually the unilateral gap is 0.5mm, and it doesn't bear the radial force, but bear a certain axial force, and it has the function of axial positioning. The bearing external ring and bearing sleeve were rubbed together with an oil resistant rubber strip which diameter is  $\phi 3\text{mm}$  to avoid the relative movement between bearing external ring and bearing sleeve and avoid heat generating from the Mutual friction of the bearing external rings. The rubber strip was bonded to the ring slot of the bearing sleeves.

The cylindrical roller bearing of the shaft extension end and non-shaft extension end should be fitted with the bearing sleeve and bear the radial force. The bearing sleeve was connected with end cover.

**Attention!**

When you repair or replace the bearing, do not reverse the deep groove ball bearing and cylindrical roller bearing of the shaft extension end. The rubber strip bonding in the ring slot of the bearing sleeves should be reliable. Or else it may affect the bearing life even cause bearing sticking.

8.4.2 Rolling Bearing Lubrication

The lubricating period of rolling bearing and the adding quantity of lubricating grease depend on the rotating speed and running conditions. The recommended lubricating period is in Table 5.

Table 5 Lubricating Times

Motor speed (r/min)	Lubricating period
3000	Running for half month or 360 hours
$\leq 1500$	Running for one month or 720 hours

The using environment and running conditions can determine the lubricating period. If there is good using condition, low bearing temperature, good running condition, you can increase the lubricating period, or else you should decrease the lubricating period.

Before the motor left factory, lubricating greases have been added in the rolling bearing to ensure that the motor can be directly put into use under normal conditions. After it was put into use, you should often check the motor lubricating grease.

**Attention!**

Pay attention to the over lubricating of the bearing. If the lubricating grease increased without opening the oil drain device, the surplus lubricating grease may run around and may enter into the winding through the bearing inner cover. Harms caused by over lubricating may exceed that caused by insufficient lubricating.

Lubricating grease with good performances is synthesized with lithium-based grease and high quality petroleum products. We recommended you to use the #2 lithium-based lubricating grease. If various lubricating greases were mixed together, the lubricating greases will be softened and the lubricating performance will be damaged.

The running temperature range of rolling bearing is  $-15^{\circ}\text{C}$  to  $95^{\circ}\text{C}$ . Many petroleum companies have high quality bearing lubricating grease. For some special requirements, you can consult the petroleum companies.

The lubricating grease adding method is as follows:

- a) Take down the oil protective cover, and disassemble the oil drainer form the bearing outer cover.
- b) Use oil injection gun to add lubricating grease through the oil cup. The adding quantity is in accordance with the requirements on the bearing nameplate.
- c) Clean the lubricating grease which overflows form the oil cup.
- d) Drain the residual lubricating grease from the oil drainer hole, and run for at least one hour.
- e) Clean the discarded lubricating grease with oil drainer.
- f) Install the cleaned oil drainer.

**Attention!**

If the motor rotating speed is 3000 r/min, 1500 r/min, and the oil temperature is above  $80^{\circ}\text{C}$ ; or the rotating speed is 1000 r/min or less than 1000 r/min, and the oil temperature is above  $65^{\circ}\text{C}$ , you should use lubricant with higher viscosity. Under a certain running temperature, when you choose the appropriate lubricants, the viscosity is the most important, and it will be various with the climate change.

#### 8.4.3 Bearing Replacement

The replaced bearing may be manufactured by different company, but it should be same as the bearing original used in the motor. Pay attention to the following points when you order a bearing:

a) Adopt high quality and famous bearing, there should be marks on the bearing (for the bearing type, you can refer to the bearing nameplate on the motor).

b) Pay attention to the accuracy grade to the bearing.

Rolling bearing replacement:

a) Disassemble the fixed bolt between the bearing outer cover and bearing sleeve, and disassemble the bearing outer cover.

b) Disassemble the fixed bolt (if have) between the bearing sleeve and end cover, and disassemble the fixed bolt between end cover and motor base.

c) Disassemble the end cover use jackscrew in the jackscrew hole of the end cover outer ring and inner ring.

d) Disassemble the bearing sleeve use puller.

e) Disassemble the washer on shaft which was at the outside of the oil slinger

f) Heat the oil slinger and disassemble it.

g) Take down the bearing inner ring from the bearing use bearing puller.

#### **Attention!**

Protect the bearing ends with cover plate. If the bearing can be reused, the pull force of the puller should be acted on the bearing inner ring. If the puller can not hook the bearing inner ring, you should make an open bearing sleeve, and assemble it between the bearing and the puller hook.

h) Check whether the shaft neck size with micrometer.

i) Heat the bearing to  $95 \pm 5^{\circ}\text{C}$  use dryer or induction heater. After heated, put the bearing on the shaft. Make the bearing inner ring tightly lean against the shaft shoulder. Do not hit the bearing.

j) Let the bearing cool down, and add clean lubricating grease to the bearing housing. After cleaning and replacing, the lubricating grease adding quantity should be 1/2 (for bipolar motor) or 2/3 (for motors of level four and above level four) of the net capacity of the bearing housing.

k) Re-assemble the bearing sleeve and end cover.

## **9 Spare Parts**

There are nameplates on the motor base, and all the necessary information of the motor are on the nameplates. When you order spare parts or motors, you should record all the data on the nameplates.

## **10 Service**

If the customer correctly uses and stores the motor according to the operating instructions, the manufacturer ensures that the motor will in good operation since it was put into use within one year, but no more than two years since the delivery from the manufacturing factory. If the motor was damaged or out of normal operation due to poor manufacturing quality during the above specified period, the manufacturer should repair or replace the parts until the motor can be normally operated.

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