INSTRUCTIONS

FOR

THREE PHASE

INDUCTION MOTORS

TECO Electric & Machinery Co., Ltd.

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1. INTRODUCTION

This and the following instructions address the more common situations encountered in motor installation, operation and maintenance. For the TECO motor warranty to be and to remain in effect, the motor must be installed and operated in strict accordance with the outline drawing, motor nameplates and these instructions and must not be altered or modified in any unauthorized manner.

During these installations and operation of motors in heavy industrial applications there is a danger of live electrical parts and rotating parts. Therefore to prevent injury and/or damage the basic planning work for installation, transport, assembly, operation, etc.… needs to be done and checked by authorized and competent personnel only.

Since these instructions cannot cover every eventuality of installation, operation and maintenance, the following points should however be considered and checked.

- The technical data and information on permissible use such as assembly, connection, ambient and operating conditions given in the related catalogue, operating instructions, nameplates and other production documentation.
- The general erection and safety regulations.
- The local and plant-specific specifications and requirements.
- The proper use of transport, lifting devices and tools.
- The use of personal protective equipment.

Following indications should be observed when reading these instructions.

Safety instructions are marked as follows：

Warning of electric hazards for personnel.

Warning of dangers for personnel.

ATTENTION！
Warning of damage for the motor or installation.

This instruction manual is for TECHNICAL USE ONLY, NOT FOR COMMERCIAL PURPOSE. The warranty is limited to coverage expressed in your sales contract. Documentation of storage, transportation, installation and examination, if required, shall be inquired of TECO's service center before start and maintenance.

2. ACCEPTING, INSPECTION, STORAGE, TRANSPORTATION

2.1 Inspection upon receipt

Check the following points upon receipt：

- Are the nameplate ratings identical with what you ordered？
- Are dimensions and color in compliance with your specifications？
- Are the nameplate ratings for heater, thermal protector, temperature detector, etc. identical with what you ordered？
- Is there any damage？
- Are all accessories and accompanying instruction manuals in good order？
- Please ensure that the arrowhead indicator really indicates direction of revolution.
- If there are any specific requirements, please ensure they are in conformity with your specification.

2.2 Storage

When motors are not in operation, the following precautionary measures should be undertaken to assure best performance.

2.2.1 Place

(a) High and dry, well-ventilated without direct sun, dust or corrosive gas.

(b) Not located near to a boiler or freezer.

(c) Entirely free from vibration and easy for movements.

(d) Motors should be put on pallets to prevent moisture.

2.2.2 Well protection

Motors should be well shielded from dust, but under well-ventilated circumstances. For those water-cooling motors or using bearings with water-cooling coils, please make sure the water already dried off to prevent tube corrosion or danger of frost.

2.2.3 Moisture prevention

Since moisture can be very detrimental to electrical components, the motor temperature should be maintained about 3℃ above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

2.2.4 Insulation resistance test

Even during storage, the insulation resistance should be kept above the specified values.

(a) For measurement of insulation resistance and acceptable standard values, please refer to measures stated in 4.1.2 "Measurement of insulation resistance".

(b) Insulation resistance test should be performed once every three months.

2.2.5 Long period storage

If the motor is not in operation for a long period (one week and above) after installation or has been in operation but stopped for a period of time, the following precautions must be taken.

(a) Protect the motor as measures stated in 2.2.3.

(b) Insulation resistance test should be performed as stated in 2.2.4.

(c) Bearing protection per 2.2.6.

(d) Operation test should be performed once every three months.

(e) Storage maintenance is to be documented for warranty data.

2.2.6 Bearing protection

(b) Motors equipped with oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gauge with the correct grade of turbine oil. To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions about every month ensuring the shaft does not come to rest in its original position. If the motor is not in operation over six months, dismount the upper cover of the bearing housing and check the anti-corrosion protection.

(c) Motors with anti-friction bearings are properly lubricated with the correct grade of grease at the factory and no further greasing is required in storage. If the motor is not in operation over three months, add grease to each bearing per lubrication nameplate. The shaft should be rotated several revolutions about every month to maintain proper distribution of the grease within the bearings.

2.2.7 Prevent rusting

ATTENTION！

Cares should be taken to keep parts such as fitting surface, key, shaft extension and axial central hole from any collision with foreign matters. Grease should also be generously applied to prevent rusting.

2.3 Transportation

ATTENTION！

To keep the rotating parts of motors from moving, thus preventing damage and scratching during transportation, they should be held securely with a locking device. Remove all transit clamps before operating the motor. It is very important that this device be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported.

The vertical mounting type motors should be transported in the vertical position.

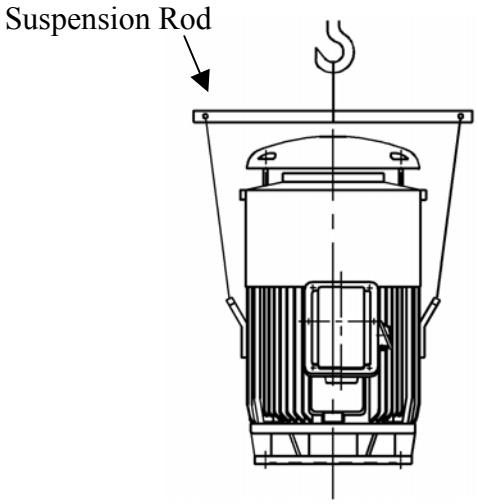
Do not use the hoisting hook to lift more that the motor itself. They are designed to support the motor only.

Make sure the hoisting hook is correctly attached to the lugs of the motor and that

the lugs are fully screwed in before hoisting. Also note such parts as fan cover, may have their own hoisting lugs which can only carry their own weight. Nothing extra should be attached while hoisting.

Do not twist the steel wires and make sure the eyebolts have been firmly screwed and the sling angle is correct.

Fig. 2



3. INSTALLATION

3.1 Site and environment for motor installation

3.1.1

Standard environment and site conditions for the installation of motors are usually set as follows：

(a) Ambient temperature：-20 ~ +40 ℃

(b) Humidity：Relative humidity shall be below 95%RH for totally-enclosed types.

(c) Elevation：Below 1000 meters.

(d) Harmful gases, liquids, dusts, high moisture should be absent.

(e) Foundations should be strong and free of vibration.

For those water-cooling motors or using bearings with water-cooling coils, the ambient temperature shall not below 0°C to prevent danger of frost. If there are any special environmental conditions, please inform us upon ordering.

3.1.2 Ventilation and space

(a) Installation area should be well-ventilated.

(b) The installation space should be large enough to facilitate heat dissipation and maintenance.

3.2 Foundation

Motor manufacturer is not responsible for the foundation design. Motor weight, thrust load, twisting moments, seismic forces and other external applied loads must be considered in foundation design.

3.2.4 The foundation of vertical induction motor (Also the foundation of pump)

(a) Foundation of motor/pump must be rigid and secure to provide adequate support. There must be

no vibration, twisting, misalignment etc. due to inadequate foundations.

(b) A massive concrete foundation is preferred in order to minimize vibration. Rigidity and stability are enhanced by prop plate and foundation bolt. As shown in Fig.6 and Fig.7.

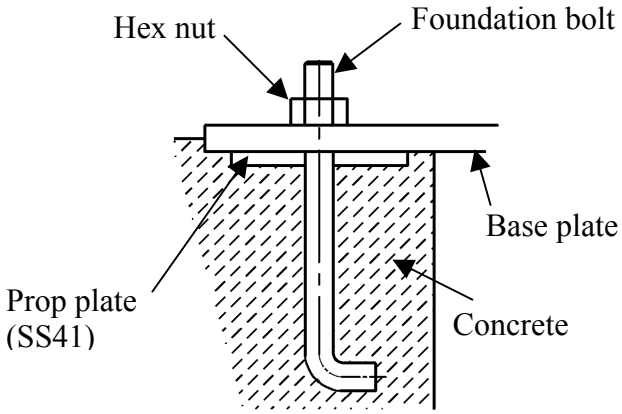


Fig. 6

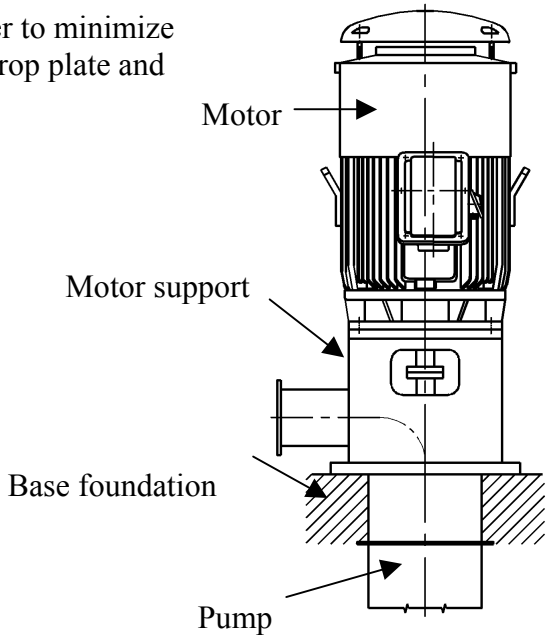


Fig. 7

3.3 Installation of shaft coupling (Vertical hollow shaft motor only)

Bolted coupling as Fig.11

(a) Bearings are provided to absorb some upward shaft thrust when the coupling is fitted.

(b) The coupling is fastened with bolts.

(c) This coupling type is not auto-release type.

Note：Standard high thrust motors can absorb momentary up-thrust load up to 30% of the standard down-thrust load. If the up-thrust is long duration (over 10 seconds) and/or exceeds 30% of the standard high thrust rating, special design arrangements are required and a standard motor is not suitable.

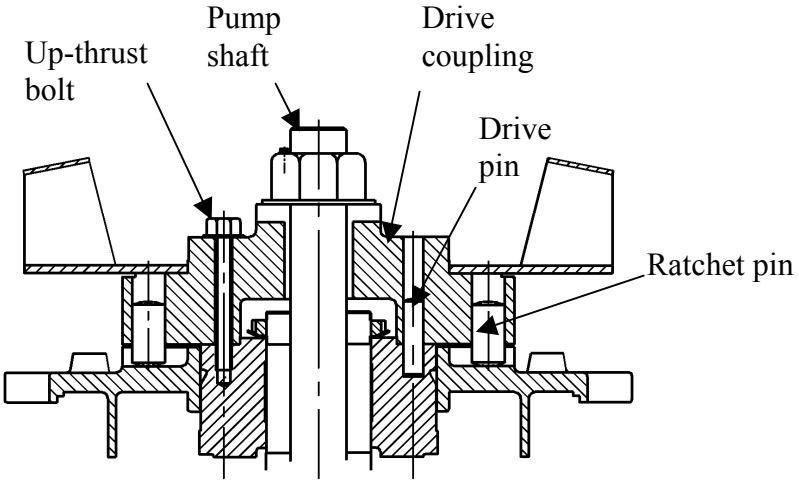


Fig. 11

3.3.9 Non-reverse ratchet/coupling, as Fig. 11 (If necessary)

The non-reverse coupling is also a bolted type and,

(a) It prevents the pump and motor from rotating in the reverse direction.

(b) It also prevents damage from over speeding and damage to pump shaft and bearings.

(c) The ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed.

(d) When power is removed, speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

(e) When installing the non-reverse coupling, do not use lubricant. Lubrication will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the plate.

(f) As with the bolted coupling, the upthrust capabilities are 30% of the standard high thrust rating for downthrust.

ATTENTION！

Do not apply non-reverse ratchets on applications in which the pump reversal time from shutdown (the instant the stop button is pressed) to zero speed is less than one second.

3.6 Electrical connections

All interconnecting wiring for controls and grounding should be in strict accordance with local requirements such as the USA National Electrical Code and UK IEE wiring regulations or as per AS3000.

Wiring of motor and control, overload protection and grounding should follow the instructions of connection diagrams attached.

3.6.1 Power

The rated conditions of operation for the motor are as shown on the nameplate. Within the limits, given below, of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at the rated conditions：

+/- 10% of rated voltage

+/- 5% of rated frequency

+/- 10% combined voltage and frequency variation so long as frequency variation is no more than +/- 5% of rated

Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage to or failure of the motor.

3.6.2 Main lead box

The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables.

The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.

3.6.3 Grounding

Either fabricated motors or fan cooled cast frame motors are all provided with grounding pads or bolts.

The motor must be grounded by a proper connection to the electrical system ground.

3.6.4 Rotation direction

The rotation direction of the motor will be as shown by either a nameplate on the motor or the outline drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner：
While the motor is uncoupled from the load, Remove the non return ratchet start the motor and observe the direction of rotation.

Allow the motor to achieve full speed before disconnecting it from the power source. Refer to the operation section of these instructions for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any two (2) incoming cables.

3.6.5 Auxiliary devices

Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate in their own enclosures elsewhere on the motor. Such information can be obtained by referring to the outline drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings or attached nameplates.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation.

Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.

4. OPERATION

4.1 Examination before start

4.1.1 Wiring check

When motors are installed in good manner, ensure the wiring is according to the diagram. Also, the following points should be noted：

(a) Make sure all wiring is correct.

(b) Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.

(c) Ensure all connections are properly insulated for the voltage and temperature they will experience.

(d) Ensure the capacity of fuse, switches, magnetic switches and thermo relays etc. are appropriate and the contactors are in good condition.

(e) Make sure that frame and terminal box are grounded.

(f) Make sure that the starting method is correct.

(g) Make sure switches and starters are set at their right positions.

(h) Motor heaters must be switched off when the motor is running.

4.1.2 Measurement of insulation resistance

During and immediately after measuring, the terminals must not be touched as they may carry residual dangerous voltages. Furthermore, if power cables are connected, make sure that the power supplies are clearly disconnected and there are no moving parts.

(a) For rated voltage below 1000V, measured with a 500VDC megger.
For rated voltage above 1000V, measured with a 1000VDC megger.

(b) In accordance with IEEE 43-2000, there are three recommendation minimum insulation resistance values. These values corrected to 40℃ are：

(1) kV+1 in Megohms for most windings made before 1970, all field windings and windings not otherwise described.

(2) 100 Megohms for most DC armatures and AC windings built after about 1970 with form wound coils.

(3) 5 Megohms for machines with random wound stator coils and for form wound coils rated below 1kV.

ATTENTION！

After measurement the winding must be grounded for discharging the winding.

(c) On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to a winding：

(1) If the motor is equipped with space heaters, they can be energized to heat the winding.

(2) Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 20% of rated full load current. If the motor has only three leads, two must be connected together to form one circuit through the winding. In this case, one phase will carry the full applied current and each of the others, one-half each. If the motor has six leads (3 mains and 3 neutrals), the three phase should be connected into one series circuit.

Ensure there is adequate guarding so live parts cannot be touched.

(3) Heated air can be either blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor.

ATTENTION！

Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15-20 hours.

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 40℃ for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 10℃ increase in insulation temperature above the dew point temperature.

(d) Should the resistance fail to attain the specified value even after drying, careful examination should be undertaken to eliminate all other possible causes, if any.

4.1.3 Power source

(a) Ensure the capacity of the power source is sufficient.

(b) Ensure the supply voltage and frequency ratings are identical to those on the nameplate.

(c) Voltage variation should be confined to within ±10% of the rated value and the phase to phase voltages should be balanced.

4.1.4 Bearing lubrication

(a) On self-lubricated bearings, the standstill oil level will be at the center of the oil gauge. The proper oil is a rust and oxidation inhibited, turbine grade oil. Refer to the lubrication nameplate for the recommended viscosity.

(b) If the motor is in storage for over three (3) months, refilling of some new oil should be undertaken before operation to prevent bearing damage due to dry friction. The oil level should be kept at the center of the oil gauge. If necessary, drain some oil after refilling.

(c) Grease lubricant type

(1) The bearings have been well greased at factory before delivery. However, regreasing is required if a significant period has elapsed between manufacture and use or in storage. Fill new grease until it overflows and the old grease is entirely replaced.

(2) Unless otherwise specified, SHELL Alvania RL3 is the standard applied to TECO motors.

4.1.10 Test run

Make sure the items above are examined. Test the motor running with or without load. Record and check according to "Maintenance" at 15 minutes intervals during the first three hours of operation. Then regular examinations should take place at longer intervals. If operation is satisfactory the motor can be classified as "in good order".

4.2 Starting operation

4.2.1 Starting load

Initially run the motor unloaded prior to coupling to other machines. Unless otherwise specified, a motor usually starts with light load which is then gradually increased proportional to the square of speed and at last reach 100% load at full load speed.

4.2.2 Starting

Too frequent starts can harm the motors. The following restrictions should be observed：

(a) Motor can be restarted should the initial start fail. Two starts are generally permissible when the motor is cold.

(b) Motor can be started only once when it is at normal running temperature.

(c) Should additional starts be necessary beyond the conditions stated above, the following restrictions should be noted：

(1) Let the motor cool down for 60 minutes before restarting, fully loaded.
(2) Let the motor cool down for 30 minutes before restarting, unloaded.
(3) Two inching starts can be regarded as one normal start.

(d)

ATTENTION！

If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately.
Investigate thoroughly and take corrective action before attempting a restart.

(1) Too low a voltage at the motor terminals.

(2) The load is too much for the rotor to accelerate.

(3) The load is frozen up mechanically.

(4) All electrical connections have not been made.

(5) Single phase power has been applied.

(6) Any combination of the above.

4.2.3 Rotating direction

(a) Most TECO motors are bi-directional. However, when some special types, such as high speed 2P, certain large capacity motors, those with a non-reverse ratchet etc. should rotate in one direction, please ensure the rotation is in conformity with the directional arrow-mark shown on the attached nameplate.

(b) To reverse a bi-directional motor, cut the power and wait until the motor stops. Then interchange any two of the three phases. With Vertical Hollow shaft replace the non return ratchet with the correct one for that direction of rotation.

4.2.4 Power source, Voltage, Current

(a) Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate.

(b) Voltage variation should be confined to within ±10% of the rating and the three phase voltages should be in full balanced.

(c) Ensure the motor phase currents, when without load, are within ±5% of the average values.

4.2.5 Frequency

Frequency variation should be confined to within ±5% of the rating. The aggregate variation of voltage and frequency should be confined to within ±10% of the absolute value of the ratings.

4.2.6 Starting time and unusual noises

ATTENTION !

Starting time is longer for the motors with large inertia. However, if starting time is longer than usual or if there is difficulty in starting, or there is abnormal noise, do not run the motor and refer to TECO.

4.2.8 Bearing temperature rise

Following the initial start-up, the bearing temperatures should be closely monitored. The rate of rise

ATTENTION !

If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.

in bearing temperature is more indicative of impending trouble than is the actual temperature.

If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperatures stabilize.

Recommended limits on bearing temperature are as follows：

Anti-Friction Bearings.	Alarm temperature.	Trip temperature
・By permanently installed detector	95℃(203℉)	100℃(212℉)

4.2.9 Noise and Vibration

> **ATTENTION！**
> **Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.**

4.2.10 Recommendation of winding operating temperature settings

The limit temperatures can be set 10K higher than the operating temperature at maximum load and ambient temperature. When B rise (80℃) of winding temperature is specified at standard ambient temperature (40℃), the recommendation operating temperature settings as follows：

	Alarm	Trip
Service Factor 1.0	130℃ (266°F)	150℃ (302°F)

5. MAINTENANCE

5.1 Major points in regular inspection and maintenance

For safety, maintenance and repairs must only be carried out by properly trained personnel.

Some testing, such as insulation resistance, usually requires the motor to be stopped and isolated from power supplie(s).

Routine inspection and maintenance are usually performed by looking, listening, smelling and simple meters.

High temperature may arise under operating conditions on the motor surfaces, so that touching should be prevented or avoided.
Keep away from moving and live parts.
Unless deemed necessary, do not remove guards whilst assessing the motor.

Timely replacement of worn parts can assure longevity and prevent breakdown.

Routine inspection and regular inspection and maintenance are important in preventing breakdown and lengthening service life.

Owing to the varied time and circumstances that motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide it is recommended to be performed periodically according to factory maintenance program. Generally, the inspection scope determined by the following factors：

(a) Ambient temperature.
(b) Starting and stopping frequency.
(c) Troublesome parts usually affecting motor functions.
(d) Easily abraded parts.
(e) The important position of motor in the operational system of a factory should be duly recognized. Therefore, its health and wellbeing should be fully protected, especially when it is operating in severe conditions.

5.2 Motor windings

(a) Measurement of insulation resistance and standards to determine quality of insulation resistance, please refer to measures stated in 4.1.2 "Measurement of insulation resistance".

(b) Inspection of coil-ends：

(1) Grease and dust accumulated on coils may cause insulation deterioration and poor cooling effect.

(2) Moisture must not accumulate. Keep coils warm when motor is not in use if moisture can be seen.

(3) Discoloring. This is mainly caused by overheat.

(c) Ensure no untoward change of wedges from original position.

(d) Ensure the binding at the coil end is in its normal position.

5.3 Clean the interior of the motor

(a) After a motor is in operation for some time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage. Regular cleaning and examination is necessary to assure top performance.

(b) Points to note during cleaning：

(1) If using compressed air or a blower：

a) Compressed air should be free of moisture.

b) Maintain air pressure at 4 kg/cm^2, since high pressure can cause damage to coils.

(2) Vacuum

Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tools should be non-metallic to avoid any damage to the winding insulation.

(3) Wiping

Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent.

In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

ATTENTION！

Solvents of any type should never be used on windings provided with abrasion protection. Abrasion protection is a gray, rubber-like coating applied to the winding end-turns.

⚠ **Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an air line respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.**

(4) Keep core ducts completely clean. The difference in temperature rise could be around 10℃ before and after cleaning.

5.4 Clean the exterior of the motor

(a) On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement.

ATTENTION！

Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

5.5 Maintenance of anti-friction bearing

5.5.1 Frequency of relubrication

The life of grease varies greatly as a result of types of model, revolution speed, temperature, operational conditions etc. It is, therefore, impossible to be precise about replenishment intervals. However, for normal direct coupling transmission, the periods shown as Table 1 may be used as a guide.

Remarks：

(a) The periods shown in Table 1 should be halved where bearings are used for belt drive and/or in dirty, or high ambient temperature or high humidity environments.

(b) Please refer to the lubrication nameplate, if attached to the motor.

(c) For bearing numbers outside the range of Table 1, please contact TECO.

(d) If the periods referred to Table 1 for drive-end bearing and opposite drive-end bearing are different, for the convenience of maintenance operation, please take the shorter one the required grease replenishment period of these bearings.

TABLE 1

Bearing number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM	3000 RPM	3600 RPM
62XX 63XX 72XX 73XX	6210										
	12									2000Hrs	
	13										
	14									1000Hrs	
	15										
	16									720 Hrs	
	17							2000Hrs			
	18			3000Hrs							
	20										
	22										
	24							1500Hrs			
	26										
	28					2000Hrs		1000Hrs			
	30										
	32							500 Hrs			
	34					1500Hrs					
	36										
	38			2000Hrs		1000Hrs					

Bearing number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
NU2X X NU3X X	NU21 4								
	15							2000Hrs	
	16								
	17								
	18			3000Hrs				1500Hrs	
	20								
	22							1000Hrs	
	24								
	26					2000Hrs			
	28							500 Hrs	

ATTENTION！

Do not mix different kinds of grease.

Mixing grease with different type of thickeners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects.

	30				
	32				
	34		2000Hrs	1000Hrs	
	36				
	38	2000Hrs			
	40				
	44		1000Hrs		
	48	1000Hrs			

Bearing number		600 RPM	720 RPM	750 RPM	900 RPM	1000 RPM	1200 RPM	1500 RPM	1800 RPM
222XX	22220							300Hrs	
223XX	2								
	24	1000Hrs				500 Hrs			
	26								
	28								
	30					300 Hrs			
	32			500 Hrs					
	34								
	36								
	38	500 Hrs							
	40			300 Hrs					
	44								
	48	300 Hrs							

5.5.2 Kinds of grease

SHELL Alvania RL3 grease is standard for TECO motors except some special models for which special grease will be shown on the lubrication nameplate. Please use identical grease or its equivalents when maintaining.

5.5.3 Grease quantity

The amount of grease per replenishment depends on the type, size and construction of the bearings. The maximum amount of one replenishment for each bearing is shown in Table 2.

TABLE 2

Bearing No.		Amount of replenishment
62XX	6210	30g
72XX	6212	40
NU2XX	6213	50
222XX	6214	50
	6215	60

Bearing No.		Amount of replenishment
63XX	6310	40g
73XX	6312	60
NU3XX	6313	80
223XX	6314	80
	6315	100

	6216	60		6316	100
	6217	80		6317	120
	6218	80		6318	120
	6220	100		6320	160
	6222	120		6322	220
	6224	120		6324	270
	6226	140		6326	300
	6228	160		6328	400
	6230	180		6330	450
	6232	200		6332	500
	6234	250		6334	600
	6236	300		6336	700
	6238	350		6338	800
	6240	400		6340	900
	6244	450		6344	900
	6248	500		6348	900

* Fill new grease until it overflows and the old grease is entirely replaced.

5.5.4 Re-greasing

If relubrication is to be performed when the motor is running, stay clear of rotating parts.

It is advisable to re-grease when the motor is running to allow the new grease to be evenly distributed inside the bearing.

Before re-greasing, the inlet fitting should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The outlet of grease drainage should be opened to allow the proper venting of old grease.

Use a grease gun to pump grease through grease nipple into bearings. After re-greasing, operate the motor for 10-30 minutes to allow any excess grease to vent out.

5.5.5 Oil relubrication (For oil lubrication types only)

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and on to the rotor, but also because too high an operating oil level prevents the bearing form clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gauge, drain enough oil to bring the level back within the recommended operating range.

Do not permit the operating level to fall below the minimum shown on the gauge.

ATTENTION！

Should it ever become necessary to add excessive amount of make-up oil, investigate immediately for oil leaks.

Change the oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions, such as high ambient temperature, may require more frequent changes. Avoid operating the motor with oxidized oil.

Use only good grade, oxidation-corrosion-inhibited turbine oils produced by reputable oil companies. The viscosity of the oil to be used depends upon the type and size of the bearing, its load and speed, the ambient temperature, and the amount and temperature of the cooling water (if used). The lubrication nameplate or instructions with each motor specifies the viscosity range of oil suitable for average conditions. The usual oil viscosity recommendations are summarized in Table 3 and Table 4. Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of special oil. Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Be sure that the oil metering hole is clear, and then dry the housing thoroughly before reassembly, and ensure all traces of cleaning solvent have been removed.

Table 3 oil viscosity for vertical motors**

Bearing Type	Oil viscosity	Range of pole
Angular contact ball (72XX，73XX)	ISO VG32 (150 SSU/100℉)	2 pole

**Remark: When a lubrication nameplate is attached to the motor, use lubrication oil it stipulates or an equivalent.

5.5.6 Cleaning and installation of bearings

(a) Apply the proper amount of grease to disassembled parts of the bearing after they have been thoroughly cleaned with high quality cleaning oil. Then protect them from contamination before and during assembly.

(b) Bearing installation

ATTENTION！

Before installing the bearings, make sure that the shaft mounted parts inside the bearings are in place before installation.

Since the bearing is a high precision component, it is important to avoid ingression of dust and foreign matter, and hammering during cleaning and installation. Use extreme care and ensure clean conditions during installation and assembly.

ATTENTION！

The best way for bearing installation is heat shrinking. Knocking and hammering during installation should be avoided absolutely.

The bearing should be heated in a bath of clean oil at temperature of approx. 80℃. After warming, slide the bearings in place quickly and nimbly so that it has not shrunk before being

fully in position.

Grease the bearing after the temperature returns to normal, and then reassemble the motor.

5.8 Maintenance of non-reverse ratchet mechanism (For Vertical high Thrust Motor only)

5.8.1 Non-reverse ratchet mechanism

In the pump piping system, a check valve and a stop valve should be installed in the discharge line. The check valve, placed between the pump and the stop valve, is to protect the pump from reverse flow and excessive back pressure. The stop valve is used in priming, starting and when shutting down the pump. It is advisable to close the stop valve before stopping the pump. This is especially important when the pump is operated against a high static head.

TECO vertical high thrust motors are equipped with non-reverse ratchet (N.R.R.) mechanism only when requested by the pump manufacturer. Typical construction of N.R.R. mechanism is shown as Fig.23 below.

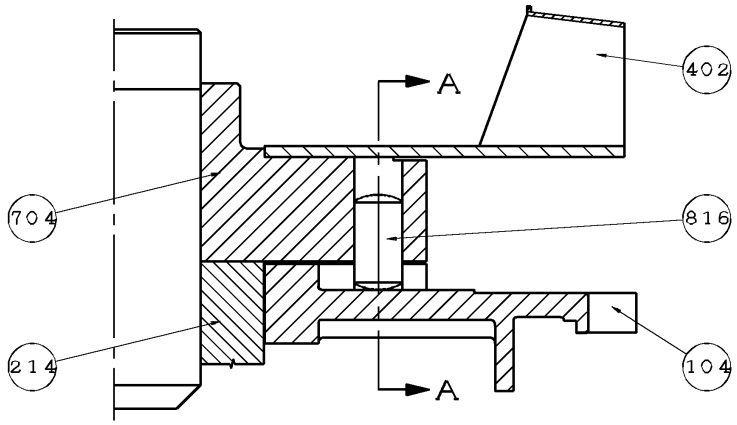


Fig. 18

ITEM	NAME
104	RATCHET
214	BEARING SEAT
402	EXTERNAL FAN
704	RATCHET PIN CARRIER
816	RATCHET PIN

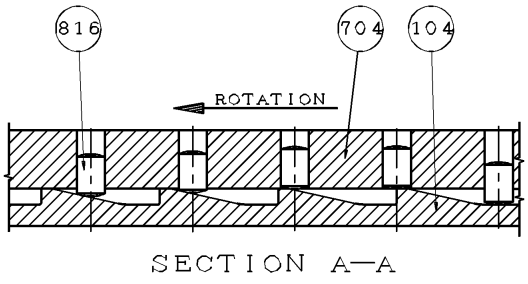


Fig. 23

The N.R.R. mechanism keeps the pump and motor from rotating in the reverse direction. Thus prevents damage from over speeding and damage to water-lubricated pump shaft bearings when, on

shutdown, the falling water column tends to drive the pump in the reverse direction.

In normal operation, the ratchet pins are lifted by the ratchet teeth and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation.

5.8.2 Service life

The service life of ratchet pins depends not only on the reverse shock load between the pin and ratchet tooth when pump stopped but also the frequency of pump starting and stop in application.

Provided that the pins are deformed due to thus reverse shock load, then the up and down motion of ratchet pins could be sluggish or jammed and that unusual noises shall arise.

The recommended replacement period for these ratchet pins is every three (3) years. If the reverse shock load is greater than 30% of motor rated torque or the starting frequency is more than twice per day, then the replacement period is to be halved.

ATTENTION！

The check valve and stop valve in the discharge line should be regularly inspected and maintained to assure the normal function of these valves. This is important to protect the pump and motor from damage and increase the service life of N.R.R. mechanism.

6. FAULT FINDING AND RECOGNITION

Kinds of Breakdown	Symptoms	Possible causes	Remedies
Fail to start without load	Motionless and soundless	Power-off	Consult power company
		Switch-off	Switch-on
		No fuse	Install fuse
		Broken wiring	Check wiring and repair
		Broken lead	Check wiring and repair
		Broken windings	Check windings and repair
	Fuse blowing. (Automatic switch trips off, slow start with electromagnetic noise)	Short circuit of circuit switches	Check circuit switches and replace
		Incorrect wiring	Check wiring according to nameplate
		Poor contact at terminals	Lock tightly
		Windings grounded	Factory repair
		Broken windings	Factory repair
		Poor contact of circuit switches	Check and repair
		Broken wiring	Check and repair
		Poor contact of starting switches	Check and repair
		Short circuit of starting switches	Check and repair
		Incorrect connections of starting switches	Connect according to nameplate
Loading after start	Fuse blowing. Fail to restart due to trip-off of automatic switch	Insufficient capacity of fuse	Replace fuse if wiring permits
		Overload	Lighten load
		High load at low voltage	Check circuit capacity and reduce load
	Overheating motor	Overload or intermittent overload	Lighten load
		Under-voltage	Check circuit capacity and power source
		Over-voltage	Check power source
		Ventilation duct clogged	Remove the foreign matter in the duct
		Ambient temperature exceeds 40°C	Correct insulation class to B or F, or lower ambient temperature.
		Friction between rotor and stator	Factory repair
		Fuse blown (Single-phase rotating)	Install the specified fuse
		Poor contact of circuit switches	Check and repair
		Poor contact of circuit starting switches	Check and repair
		Unbalanced three-phase voltage	Check circuit or consult power company

Kinds of Breakdown	Symptoms	Possible causes	Remedies
Loading after start	Speed falls sharply	Voltage drop	Check circuit and power source
		Sudden overload	Check machine
		Single-phase rotating	Check circuit and repair
	Switch overheat	Insufficient capacity of switch	Replace switch
		High load	Lighten load
	Bearing overheating	High belt tension	Adjust belt tension
		Slack belt tension	Adjust belt tension
		Misalignment between motor and machine shafts	Re-align
		Over speed of bearing outer-ring	Adjust bracket
		High bearing noise	Replace the damaged bearing
Noise	Electromagnetic noise induced by electricity	Occurrence from its first operation	May be normal
		Sudden sharp noise and smoking	Short circuit of windings Should be repaired at factory
	Bearing noise	Noise of low shishi or Thru-Thru	May be normal
		Kala-Kala as result of poor lubrication	Grease
		Kulo-Kulo as a result of deteriorated grease	Clean bearing and grease
		Sa-Sa or larger noise	Replace the damaged bearing
	Mechanical noise caused by machinery	Loose belt sheave	Adjust key and lock the screw
		Loose coupling or skip	Adjust the position of couplings, lock key and screw
		Loose screw on fan cover	Lock fan cover screw tightly
		Fan rubbing	Adjust fan position
		Rubbing as a result of ingression of foreign matters	Clean motor interior and ventilation ducts
		Wind noise	Noise induced by air flowing through ventilation ducts
		Induced by conveyance machine	Repair machine
Vibration	Electromagnetic vibration	Short circuit of windings	Factory repair
		Open circuit of rotor	Factory repair
	Mechanical vibration	Unbalanced rotor	Factory repair
		Unbalanced fan	Factory repair
		Broken fan blade	Replace fan
		Unsymmetrical centers between belt sheaves	Align central points
		Central points of couplings do not lie on the same level	Adjust the central points of couplings to the same level
		Improper mounting installation	Lock the mounting screws
		Motor mounting bed is not strong enough	Reinforce mounting bed
		Mounting bed vibration caused by near machines	Eliminate the vibration source near motor

Remarks:

(1) Circuit switches: These include knife switches, electromagnetic switches, fuse and other connection switch etc.

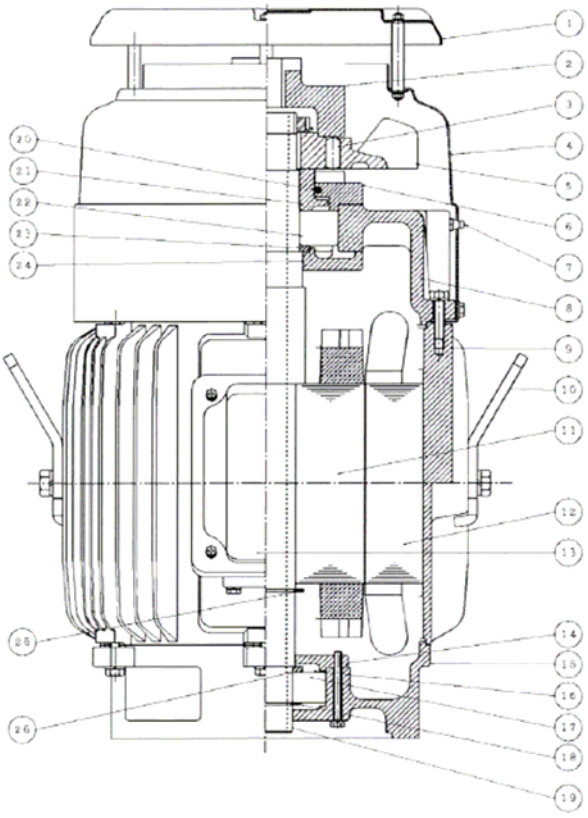
(2) Starting switches: These include Delta-Star starters, compensate starters, reactance starters, resistor starters, starting controllers etc.

8. Cross sectional

drawings

ISSUED	SCHEMATIC DRAWING	MODEL
1-Jul-04		AEBH - - - R
REVISED	HIGH THRUST HOLLOWSHAFT PUMP MOTORS FRAME SIZE 160M ~ 180L	PAGE 7 of 9

Totally Enclosed Fan Cooled Vertical Type . Squirrel Cage Rotor .

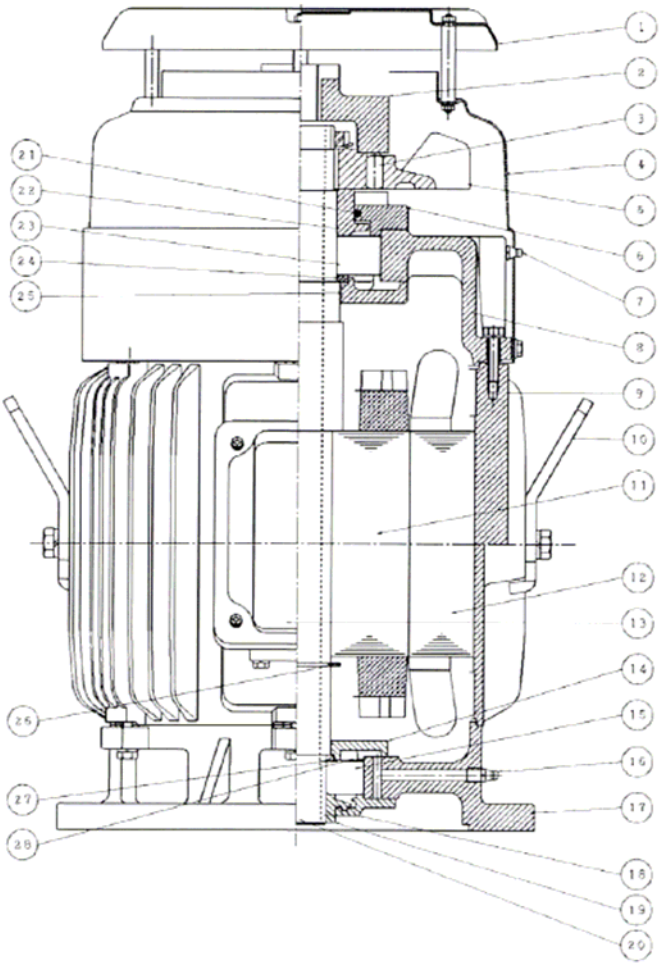


ITEM	NAME
1	VERTICAL SPLASH COVER
2	COUPLING
3	RATCHET PIN
4	FAN COVER
5	EXTERNAL FAN
6	BEARING COVER - OUTER
7	GREASE NIPPLE
8	END BRACKET
9	FRAME
10	HOOK
11	ROTOR
12	STATOR
13	TERMINAL BOX
14	BEARING COVER - INNER
15	FLANGE BRACKET
16	PRE - LOAD SPRING
17	BEARING
18	OUTSIDE RETAINING RING
19	SHAFT
20	FELT
21	GREASE FLINGER
22	BEARING
23	STOP RING - BEARING
24	BEARING COVER - INNER
25	OUTSIDE RETAINING RING
26	STOP RING - BEARING

APPD.	M.C.Tsai	30-Jun-04	TECO Electric & Machinery Co., Ltd.	DWG NO. 31049J16606
CHKD.	Teng-Yun.Wu	25-Feb-04		
DWN.	Clive.Huang	17-Jan-04		

ISSUED	SCHEMATIC DRAWING	MODEL
1-Jul-04		AEBH - - - R
REVISED	HIGH THRUST HOLLOWSHAFT PUMP MOTORS FRAME SIZE 200L ~ 225S (4P) & 225M (4P ABOVE)	PAGE 8 of 9

Totally Enclosed Fan Cooled Vertical Type . Squirrel Cage Rotor .



ITEM	NAME
1	VERTICAL SPLASH COVER
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5	EXTERNAL FAN
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10	HOOK
11	ROTOR
12	STATOR
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14	BEARING COVER - INNER
15	BEARING
16	GREASE NIPPLE
17	FLANGE BRACKET
18	BEARING COVER - OUTER
19	GREASE FLINGER
20	SHAFT
21	FELT
22	GREASE FLINGER
23	BEARING
24	STOP RING - BEARING
25	BEARING COVER - INNER
26	OUTSIDE RETAINIG RING
27	STOP RING - BEARING
28	PRE - LOAD SPRING

APPD.	M.C.Tsai	30-Jun-04	TECO Electric & Machinery Co., Ltd.	DWG NO. 31049J16607
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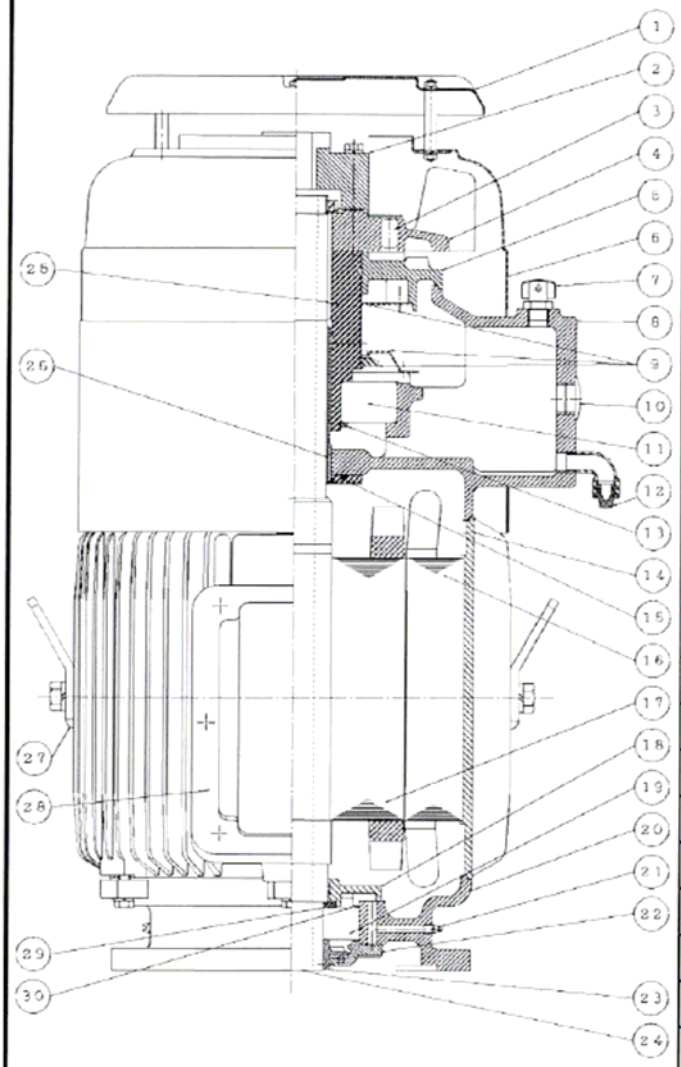
ISSUED	SCHEMATIC DRAWING	MODEL
1-Jul-04		AEBH - - - R
REVISED	HIGH THRUST HOLLOWSHAFT PUMP MOTORS FRAME SIZE 225M (2P) & 250S ~ 250M	PAGE 9 of 9

Totally Enclosed Fan Cooled Vertical Type . Squirrel Cage Rotor .



ITEM	NAME
1	VERTICAL SPLASH COVER
2	COUPLING
3	RATCHET PIN
4	EXTERNAL FAN
5	RATCHET
6	FAN COVER
7	PLUG (OIL INLET)
8	END BRACKET
9	OIL BAFFLE
10	OIL GAUGE
11	BEARING
12	PLUG (OIL OUTLET)
13	OUTSIDE RETAINIG RING
14	FRAME
15	O - RING
16	STATOR
17	ROTOR
18	BEARING COVER - INNER
19	BEARING
20	FLANGE BRACKET
21	GREASE NIPPLE
22	BEARING COVER - OUTER
23	GREASE FLINGER
24	SHAFT
25	BEARING SEAT
26	OIL SEPARATOR
27	HOOK
28	TERMINAL BOX
29	STOP RING - BEARING
30	PRE-LOAD SPRING

APPD.	M.C.Tsai	30-Jun-04	TECO Electric & Machinery Co., Ltd.	DWG NO. 31049J16608
CHKD.	Teng-Yun.Wu	25-Feb-04		
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