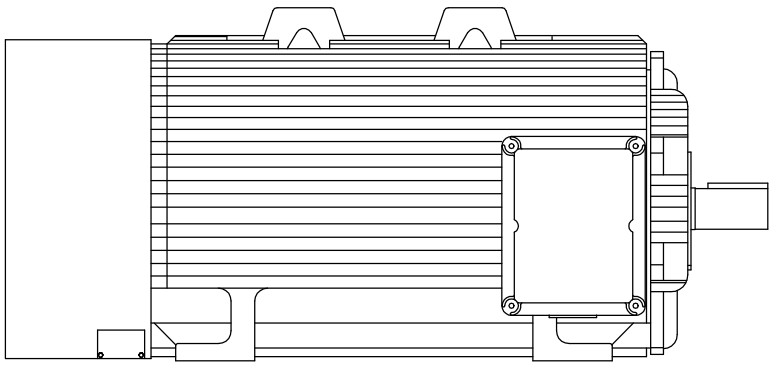
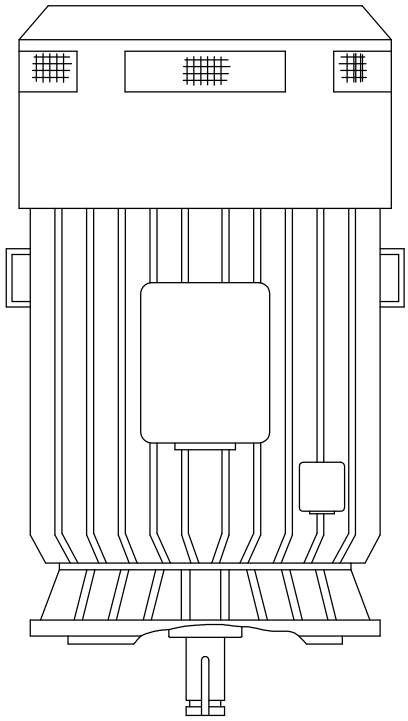
INSTALLATION AND MAINTENANCE MANUAL

INDUCTION MOTOR





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CONTENTS

1. RECEIVING CHECKS

1.1 Check on receiving Merchandise.

Thank you very much for your order.

Well designed, manufactured and properly installed Tatung 3-phase induction motors function excellently and have long service life expectancy. To provide you, our customers, with the necessary technical knowhow in installation, operations and maintenance of Tatung motors, we have prepared these instructions.

In addition, your attention is also called to the specifications on the nameplate of the motor and in other pamphlets related to accessories included with the motor.

Please check the following items on receipt of motors:

A) Inspect the crates and packaging of motor(s).
Should there be any damage during shipment or transportation, open the package with a witness in witness of all damage and breakage to the Transportation Company.

B) Unpack the motors carefully, pay special attention to the accessories on the motor, such as temperature sensors, indicating meters, oil sight gauge, control modules, etc. Check to see whether they are damaged.

C) Check the packing list, make sure no parts or accessories are missing or inconsistent with the specification and/or order.

If there are any problems or discrepancies found, please contact Tatung Electric or the authorized Tatung service station nearest to you, with the following information: The type, poles, output capacity, voltage and frequency shown on the nameplate; also the test number and manufacture number (i.e. serial number) (they are marked on the nameplate)

If the motors are not to be placed in service immediately, they should be stored in a clean, dry and well ventilated place. Motors equipped with space heaters should have the heaters connected and energized. Shafts should be rotated by hand periodically to prevent rust or corrosion of the bearings. Oil lubricated motors are shipped without oil. If these machines are to be stored for extended periods they should be filled to the higher level with circulating type oil. Oil should be changed every 12 months and must be drained and replaced by the proper lubrication oil before the motor is placed in service.

2. INSTALLATION

2.1 Environment

Since proper match of motor to environment contributes greatly to proper functioning of motors, careful consideration of this matter is needed in preparing the purchase specifications. To insure successful operation and safety, the following items are listed for your information:

A) Temperature
1. For standard motors, environmental temperature is normally within the range of –15 to 40° C.
2. In case of excessive temperature, or excessive heat, protective measures, such as forced cooling or heat-insulating should be taken. The load should be reduced.
3. On the contrary, if the environmental temperature is too low, heating measures will be necessary.
4. In case, the motor is operated in an environment where the temperature falls out of normal range as stated above, for extended period's reconsideration of the insulation, lead wire, lubrication, bearing fittings, etc. may be necessary.

B) Good ventilation
1. If the free circulation of cooling air into the motor is blocked or impeded, abnormal temperature will result.
2. Clearance of at least 8 inches from ventilation ports is required around motor to assure proper airflow.

C) Poorly ventilated room or enclosure
If the motor is installed in poorly ventilated room, steps have to be taken to prevent the motor from over-heating.

D) Humidity
If the motor is installed outdoors in very damp or wet environments, steps have to be taken to prevent the motor from excessive moisture.

E) Dust
In excessively dusty environments, problems may arise; and a periodical cleaning is recommended.
1. Open type
A large accumulation of dust on windings and cooling ducts to the motor will result in over-heated windings. Moreover, dust and the moisture retained by it can cause insulation breakdown. In severe cases, dust accumulated on the rotor, not evenly distributed, can cause vibration. If dust particles get into the bearings, the lubricant should be changed as soon as possible to prevent damage.
2. Totally-enclosed type
Large accumulations of dust on fins of the frame and other surfaces will greatly reduce heat dissipation. If the dust accumulated on fans or transmission device which is not evenly distributed, poor balance and, consequently vibration can occur.

F) Gases and Steam
If corrosive, inflammable or other chemical gases, or steam exist in the environment,

motors of explosion-proof type or corrosion protective motors should be chosen; particular attention should be placed on motor selection, when inflammable gases, dust, or steam, which are all liable to fire hazard, exist. Check the requirements in NEMA and UL standards to make sure the explosion-proof motors selected are satisfactory. Note UL labeling (certification) is required in some hazardous locations.

G) Site

Sites for installing motors should be accessible, i.e., in an open area so that motors can be moved to the site and installed conveniently. Moreover, the performance of routine inspection, cleaning and maintenance (especially lubricating) should not be encumbered.

H) Foundation

1. Motors should be installed on a solid foundation base or floor not susceptible to vibration from surrounding equipment.
2. Severe vibration from the environment may induce vibration on motors causing some damage. Depression on roller bearings can occur during the idle periods (when the motors are not running)

I) The ground foot or foundation on which motors are installed must be rigid and stable; otherwise, vibration may become excessive, especially when coupled to machines such as crushers and reciprocating compressors. Vibration of high amplitude while the motor is running can bring about the following failures:

1. The service life of bearings may be reduced.
2. Parts may become loose or displaced.
3. Cooling fans or other parts on rotor may fail due to material fatigue.
4. The insulation of the windings could be damaged.

J) Power Supply

1. The supply voltage should be stable and the voltage drop should be kept to minimum under loaded condition.
2. If the motor is to be powered by voltage and frequency other than its rated ones, please refer to Tatung Electric for information. The motor may become overheated and its performance may become unsatisfactory.

K) Altitude

If the motor location is higher than 3300 feet above sea level, the operating temperature of the motor will be 5 to 10° C higher: the motor may require de-rating to allow for this additional heating.

2.2 Foundation

A foundation is required to support the pump unit to which a vertical motor attaches. Reinforced concrete makes the best foundation, especially for a large motor and driven unit. The foundation must provide sufficient rigid support to minimize deflection and vibration. Since foundation-laying procedures are a special technique, they will not be discussed here. A “Rule of Thumb” however is that the foundation be able to bear approximately 2.5 times the total unit weight.

2.3 Alignment Procedures

Since poor alignment will bring about vibration and early bearing failure it is essential to be accurate when doing alignment of the motor to the driven equipment.

1. Use a level instrument to adjust the level mounting plate or surface to which the flange of the motor will mount. Adjust the level until maximum slope is within 0.02 mm per meter.

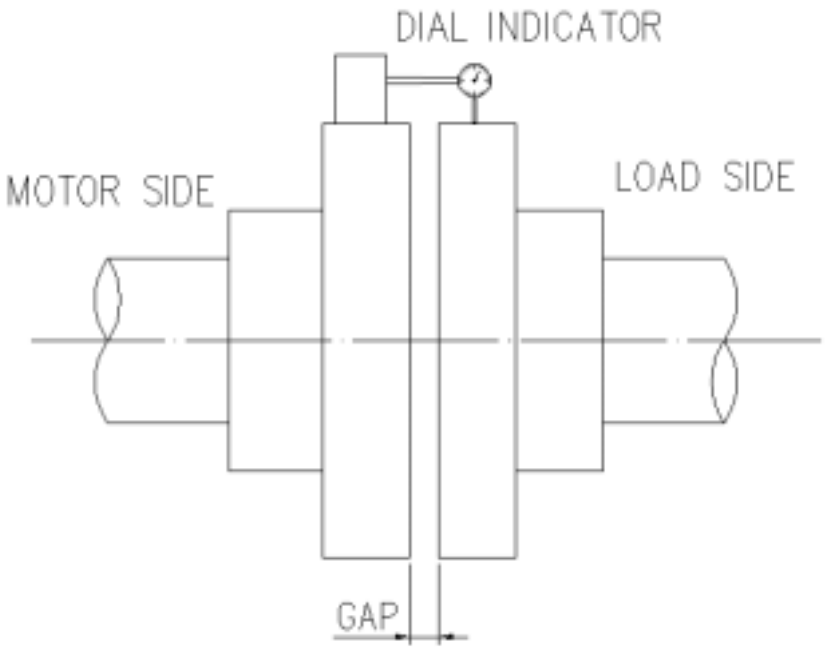
2. Check the (up and down) endplay of the shaft of driven machine.

3. Mount the motor on the mounting plate, install mounting bolts but do not tighten.

4. Check angular alignment by using a gap gauge of feeler gauge between coupling hubs at four points, 90 degrees apart. Position motor to obtain best possible alignment and correct coupling hub separation (This can be obtained from supplier of the coupling). Maximum allowable angular misalignment is 0.02 mm.

5. Check the offset alignment between the two shafts. Use a dial indicator mounting on one hub (motor side, for example), with the dial indicator button contacting the alignment surface of the opposite hub. Rotate the opposite shaft slowly by hand and take reading on at least four equally spaced points. Move motor until the indicator movement does not exceed 0.02 mm. Transfer indicator to opposite hub and recheck. Recheck angular alignment as described in above.

6. After each corrective adjustment is made, connect the couplings and tighten the motor and mounting plate bolts. Recheck the alignment, correct if necessary.



ALIGNMENT METHOD OF COUPLING

3. START-UP

3.1 Check before start-up

A) Power Lines
Check, the power distribution diagram, the power supply, magnetic switch and other protective devices. Star-delta starter, reactor, compensator, lead wires for space heaters, and thermal protectors.

B) Wiring
Make sure all wire connections are securely fastened bolted or soldered; their insulation is in good condition, and the terminals are properly spaced from each other.

C) Grounding
Check and make sure the frame or terminal box of the motor is grounded.

D) Insulation Resistance
1. "Megger" test the stator and rotor windings by their terminal connectors with a D.C. Megohmmeter.
2. Testing device of 500Vdc to be used to test stator windings below 0.6Kv, and stator windings above 0.6KV should be tested by 1000Vdc device.
3. Insulation resistance varies with rated output, voltage, insulation classification and rpm of the motor. However, it also varies with temperature, moisture, dust condition, service period, testing voltage and testing period. Minimum acceptable Megohm readings are as follows:

$$Rm=KV+1$$

Rm is minimum recommended insulation resistance in megohms at 40 C. KV is rated motor voltage in Kilovolts.

4. If insulation resistance becomes low, the windings must be dried by hot air, vacuum, or by electric current (short circuit, low voltage DC current) as the situation dictates. If the resistance can not be brought up to the minimum level after drying, some major defects may exists. If minor repair will not resolve the low Megohm readings or can not be done, please contact Tatung Electric Company or an authorized service station nearest you.

E) Motors are properly greased during assembly. However, it may be a relatively long time from the completion of assembly in our plant to the motor start-up. It may be necessary to replenish with new lubricant. Tatung motors are greased with ESSO BEACON #2, When re-greasing, use the same or comparable products. For motors requiring special types of lubricant, the specification and quantity of grease to be used are noted on the nameplate.

For oil lubricated motors, especially vertical motors mounted vertically during shipping, the units are filled with a small amount of oil only. Be sure to drain the shipping oil first, and then refill the oil chamber with proper lubrication oil. The quantity of oil needed is indicated on the oil levels (between the top and bottom lines of oil sight gauges) when the motor is not running.

F) Before starting, double check and make sure the coupling is properly bolted aligned and

is in good condition. Check tension of the belts and fastening devices, pulleys, hold down bolts, etc. to insure proper assembly.

Check and make sure there is no tools or other objects left in or near the motor or its coupling.

G) Special instruction for wound rotor motors

Due to the inherent low starting torque and high starting current, wound rotor motors should be started with secondary circuit short circuited. Be sure the total external resistor is in the rotor circuit before starting, i.e., the change over switch must set at "START" position.

3.2 Checking points During Start-up

A. No load test

As a general rule, motor should be started without load for initial test running. If the motor runs successfully for one hour after normal start up, it can be coupled to the driven machine for further load testing.

1. Direction of Rotation

When viewing the motor from the non-drive end clockwise rotation is considered standard. If terminal connectors 1, 2, and 3 are connected to the lines a, b, and c from the power supply, the motor will rotate clockwise viewing the non-drive end. If the motor rotates counter clockwise, interchange any 2 of the 3 connections. Most motors can rotate in either direction. However, some 2 or 4 pole motors with high rpm or motors with large cooling fans, have single direction of rotation limited to either clockwise or counter clockwise. In this case, a plate bearing an arrow to show the direction of rotation will be attached to the motor.

2. Supply Voltage

Make sure supplied voltage agrees with or is within plus or minus 10% of that shown on the nameplate.

3. No Load Current

Make sure supplied 3-phase voltages are balanced between phases. A small unbalance voltage interphases causes unbalanced currents of considerable values causing excessive losses and heating of the motor.

4. Frequency

The maximum variation between rated and supplied frequencies should be within 5 percent at rated voltage. If both voltage and frequency vary at the same time, the result of the combined variation should be within 10 percent.

5. Number of Starts

Two successive starts from cold or ambient temperature; one start from hot or operating temperature will not cause injurious heating of the motor. If the first start is aborted, a re-starting can be made. However, as a precaution, only two successive cold starts can be made. A 30-minute interval should be allowed for primary and secondary conductors to cool, before re-starting.

6. Vibration

At full speed the vibration of the motor should not exceed the data shown in section 5.3 E – Vibration.

B. Load Test

Motors are usually started with light load and then fully loaded after full speed is reached.

1. Starting Time and Noise

   Record noise levels of installed equipment to determine if levels are less than 90 dBA at a distance of 5 feet from the motor.

   If the inertia of the driven machine is large, a longer starting time may be required. However, if it is difficult to start, the starting time is excessively long; or if severe noise is noted during startup, please contact Tatung or an authorized service center.

2. Vibration

   Determine the value of vibration with vibration instrument and compare with the data shown in Section 5.3E – Vibration. Keep the motor running under full load for 3 hours and take vibration readings every 15 minutes. If nothing abnormal is found, the motor should continue running while other tests are made. After 48 hours of continuous operation, if nothing abnormal is found, the motor will be considered serviceable and may put into service.

3. Bearing Temperature

   Identify operating conditions in and out of cooler for lubricating oil temperature and lubricating oil pressure. To properly monitor the motor bearing oil temperature, identify temperature for motor bearing alarmed provides corrective procedures.

4. DISASSEMBLY AND REASSEMBLY OF MOTOR

4.1.1 Disassembly of Motor (Vertical Motor)

A. Disconnect power and assure against accidental of motor.

B. Remove the fan cover.

C. Drain oil from upper bearing bracket and remove the outer fan and the shaft nut.

D. Remove upper bearing runner and bearing (with housing).

E. Remove upper bearing bracket..

F. Lay down the motor on the smooth ground.

G. Disconnect the lower bearing cap and remove the lower bearing bracket (flange).

H. Remove whole rotor assembly from frame.

4.1.2 Disassembly of Motor (Horizontal Motor)

A. Disconnect power and assure against accidental of motor.

B. Remove the fan cover.

C. Remove the external cooling fan.

D. Remove driven end and non-driven end bearing brackets..

E. Remove whole rotor assembly from frame.

F. Lay down the motor on the smooth ground.

4.2 REASSEMBLY OF MOTOR

A. All parts are to be thoroughly cleaned and inspected before reassembling motor as reverse procedure for disassembly. (item A through F in 4.1)

B. When motor is fully assembled and outer bearing caps have been filled with grease or oil, turn the shaft by hand to observe for free rotation.

5 Maintenance

There is an old saying: Prevention prior to maintenance, maintenance prior to repair. An excellent routine preventive maintenance program not only can reduce the possibility of shutdown to the minimum and prolong the service life of a motor, but it can also find a malfunction in preliminary stages and reduce the repair cost to the minimum.

A controlled planned maintenance program consists of two major elements, i.e.

A) Well-trained personnel who familiarize themselves with the equipment

.

B) Systematic routine and records, which contain at least the following.

1. Complete nameplate data
2. Prints (including diagrams, certified drawings)
3. List of spare parts and storage of essential parts.
4. Service records. (Including dates and the results of routine inspections and repairs).
5. Lubrication data, including types of lubricants used and the maintenance cycle.

Some of the more important items of routine maintenance are tabulated below. Others may be added when adverse or unusual service conditions exist.

5.1 Routine Maintenance

A) Keep a record of the following items:

1. At what time (year, month, day and hour) and in what weather the test is conducted. Note relative humidity.
2. Voltage and frequency of power supply; load current.
3. Ambient temperature and temperature (rise) of frame and/or windings.
4. Temperature (rise) of air exhaust.
5. Vibration and noise.
6. Check for sparking and/or normal noise in slipping assembly. (Wound rotor motor only).
7. Check the oil rings, for smooth vibration free rotation (for sleeve bearings only).

B) When the motor is shut down temporarily, make a complete inspection of the following items:

1. Check the oil level, of oil lubricated bearings, to insure it is between upper and lower limits of the oil sight gauges.
2. Measure the air gap and compare with historical values to see if the bearings are worn badly. (Sleeve bearings only).
3. Check the pressure exerted on brush by constant force spring. Adjust if necessary. (Wound rotor motor only).
4. Check for brush powder left in the motor.
5. Measure the insulation resistance of the motor and check against historical values. Should there be a large drop in reading, dismantle the motor as soon as possible, and make a more detail examination of the windings.

5.2 Knock-down Examination

For motors running continuously, 24 hours a day, a complete knock- down inspection should be made every two years. For motors running for shorter periods 8 to 12 hours/day, knock-down inspection should be made every 3 to 4 years, depending upon the environment.

A) Clean the motor, inside and out

1. Wipe off dirt, dust, oil (or grease), water or other liquids from exterior surfaces of motor. These materials may be carried into the winding and cause overheating and/or contamination and insulation breakdown.
2. Remove dirt, dust or other debris from ventilating air inlets and exhaust ports (and tubes of fan-cooled tube type CACA motor). Never operate a motor with air passage clogged or blocked, the motor will be severely overheated.
3. If windings are generally coated with oil, grease or other contamination, disassemble the motor and clean thoroughly with solvents. Use solvents with high flash naphtha or mineral spirits. Wipe the motor with solvent-dampened cloth or use soft bristle brush to clean windings. Never soak the motor directly with solvent. Before reassemble, the windings must be heated and thoroughly dried by electric oven or other means. After cleaning and drying the motor, recheck the insulation resistance. If readings are below safe operating levels a re-treatment may be required. Consult the nearest Tatung authorized service center.

B) Inspect the insulation material and winding for discoloration and possible overheating.

C) Inspect for broken rotor bars and/or cracks between bars and short rings (squirrel cage motors).

C) Inspect the binding of rotor windings for discoloration or loosening.

E) Inspect all bearings for signs of excessive wear, corrosion or overheating. Replace if necessary.

5.3 Some useful information regarding operation and maintenance

A) Variations from rated voltage and rated frequency Motors shall operate satisfactorily under running conditions at rated load with a variation in the voltage or the frequency up to the following limits:

1. Plus or minus 10 percent of rated voltage, with rated frequency.
2. Plus or minus 5 Percent of rated frequency, with rated voltage.
3. A combined variation in voltage and frequency of plus or minus 10 percent (sum of absolute values) of the rated values, provided the frequency variation does not exceed plus or minus 5 percent of rated frequency.

Performance within these voltage and frequency variations will not necessarily be in accordance with the standards established for operation at rated voltage and frequency.

Table 1 shows the general effect of voltage and frequency variation on induction-motor performance characteristics.

TABLE 1. General Effect of Voltage and Frequency Variation on Induction Motor Characteristics

Characteristic	AC induction Motor			
	Voltage		Frequency	
	110%	90%	105%	95%
Torque, Starting and max running	Increase 21%	Decrease 19%	Decrease 10 %	Increase 11%
Speed:				
Synchronous…	No change	No change	Increase 5%	Decrease 5%
Full load...	Increase 1%	Decrease 1.5%	Increase 5%	Decrease 5%
Slip…	Decrease 17%	Increase 23%	Little change	Little change
Efficiency:				
Full load …	Increase 0.5 to 1 Point	Decrease 2 points	Slight increase	Slight decrease
3/4 load …	Little change decrease 1 to	Little change	Slight increase	Slight decrease
1/2 load …	2 points	Increase 1 to 2 points	Slight increase	Slight decrease
Power Factor:				
Full load…	Decrease 3 points	Increase 1 point	Slight increase	Slight decrease
3/4 load …	Decrease 4 points	Increase 2 to 3 points	Slight increase	Slight decrease
1/2 load …	Decrease 5 to 6 points	Increase 4 to 5 points	Slight increase	Slight decrease
Current:				
Starting….	Increase 10 to 12%	Decrease 10 to 12%	Decrease 5 to 6%	Increase 5 to 6%
Full load …	Decrease 7%	Increase 11%	Slight decrease	Slight increase
Temp. rise …	Decrease 3 to 4^{o}C	Increase 6 to 7^{o}C	Slight decrease	Slight increase
Max. overload Capacity….	Increase 21 %	Decrease 19%	Slight decrease	Slight increase
Magnetic noise…	Slight increase	Slight decrease	Slight decrease	Slight increase

REMARK: 1. The starting and maximum running torque of AC induction motors will vary as the square of the voltage.

2. The speed of AC induction motors will vary directly with the frequency.
3. This table shows general effects which will vary somewhat for specific ratings.

B) Effects of unbalanced voltages on the performance of polyphase induction motor.

When line voltages applied to a polyphase induction motor are not equal, unbalanced currents in the stator winding will result. A small percentage voltage unbalance will result in a much larger percentage current unbalance. Consequently, the temperature rise of the motor operating at a particular load and voltage unbalance will be much greater than for the motor operating under the same conditions with balanced voltages. Should voltages be unbalanced, the rated horsepower of the motor should be derogated by the factor shown in figure 1 to reduce the possibility of damage to the motor. Operation of he motor above a 5 percent voltage unbalance condition is not recommended.

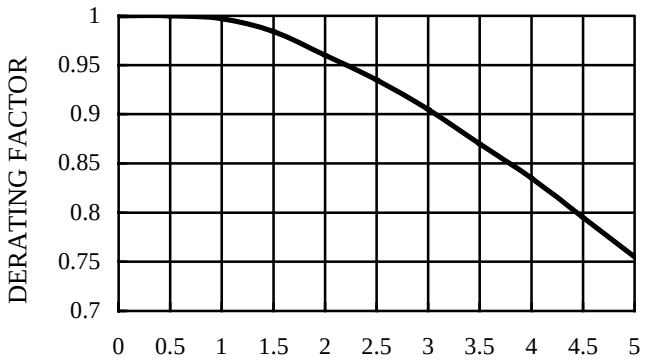


Fig1. Integral Horsepower Motors Derating Factor Due to Unbalanced Voltage

The voltage unbalance in percent is defined as follows:

$$\text{Percent Voltage Unbalance} = 100 \times \frac{\text{Maximum voltage deviation from average voltage}}{\text{Average voltage}}$$

C) Special features of wound rotor motor as compare with squirrel cage rotor motor (for wound rotor motor)

1. Loaded starting to the extent that cage rotor motor cannot overcome.
2. Suitable for rather heavy inertia (WK^2) load and capable of enduring the longer starting time. (the considerable heat accumulation while starting can be dissipated from the secondary rheostat which connected with the rotor circuitry)
3. Easily coped with the requirement of least starting current with adequate starting torque. (as for insufficient power source installation of the user)
4. Frequently starting; stopping; reversing operated load classification.
5. As the motor intend to apply speed control during the running operation or energy saving requirement.

D) Temperature rise

The observable temperature rise under rated load conditions of each of the various parts of the induction motor, above the temperature of the cooling air, shall not exceed the

values given in table2 shown as below:

Table 2. Limits of temperature rise for induction motors

PART	INSULATION CLASS			
	E	B	F	H
STATOR WINDING	75℃	80℃	100℃	125℃
BEARING	40℃ (detected from outer surface) 45℃ (detected with inserted probe)			

* By RESISTANCE method

* Based on a max. ambient temperature of 40℃

E) Vibration

Severe vibration may adversely affect the windings, bearings and coupling mechanism and other mechanical parts of the motor, thereby causing them to breakdown. When motor is running under load, the values of vibration must be not more than those listed below. If the values of vibration are beyond the desired values, remedial measures must be adopted.

1. Allowable vibration values of motors with load.

   0.001 for 2 pole motors

   0.002 for 4 pole motors

   0.0025 for 6 and more pole motors

   Maximum amplitude in inches, peak to peak displacement.

2. Possible causes for abnormal vibrations.

   a. Misalignment of coupling.

   b. Poor connection of couplings or balance of coupling.

   c. Weak foundation construction.

   d. Accumulation of dirt on fan or rotor.

   e. Rotor out of balance.

   f. Shaft bent or flange face run out excessive.

   g. System natural frequency (resonance).

3. Analysis of vibration causes

   a. Disconnect the load, and let the motor run alone, to identify if the vibration results from motor side or driven machine side.

   b. If after disconnecting the load the motor vibration is still unacceptable, please proceed as follows:

      * Tighten the foundation bolts.

      * Check if base or motor mounting plate vibrates.

      * Check vibration with coupling or belt/pulley removed.

* Inspect bearing for excessive wear. For sleeve bearings, if worn bearings cause the clearance to be vary large, there is a tendency the vibration will be high.

c. If vibration level increase after connection with the load, please investigate the following items:

* Investigate the variation of vibration levels from start-up to several hours later.

* Determine if vibration changes with load.

* Determine the variation of vibration with power source switched off as motor coasts to complete stop.

* Check the balance of the driven machine.

d. After making all the corrective measures stated above, if vibration levels are still excessive, a vibration frequency analyzer is needed to make a more advanced analysis. Consult the nearest Tatung authorized service center.

F) NOISE

1. Analysis of noise cause

a. If noise level increase after coupling with the load, please investigate the following items:

* Whether the noise level changes with load fluctuation.

* Investigate the noise level variation during the duration from start up to several hours later.

* Switch off the power supply as motor coasts to complete stop to verify the noise orientation.

* Disconnect the load machine to check the motor's noise levels to discrete the noise source.

b. After making all the corrective measures stated above, if noise level still excessive, a noise frequency analyzer is needed to make a more advanced analysis. Please consult Tatung authorized service center for details.

5.4 Lubrication

A) Grease Requirement

The amount of grease to be used when repackaging a bearing after cleaning or replacement is:

TYPE	GREASE QUANTITY		
BEARING	OUTER CAPS	INNER CAPS	BEARING
OPEN BALL AND ROLLER	1/2 Full	1/2 Full	Pack all open bearings full between balls or rollers but remove excess grease on outside of retainers

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RELUBRICATION

BEARING NO	REPLENISH QUANTITY (Gram)	REPLENISH INTERVAL (DAYS)			
		3600rpm	1800rpm	1200rpm	900rpm
6210	30	70	130	130	130
6211	30	70	130	130	130
6212	30	70	130	130	130
6213	30	50	130	130	130
6214	30	50	130	130	130
6215	30	50	130	130	130
6216	30	30	130	130	130
6217	30	30	100	130	130
6218	50	30	100	130	130
6219	50		100	130	130
6220	50		100	130	130
6221	50		100	130	130
6222	80		70	130	130
6224	80		70	130	130
6226	80		70	130	130
6228	80		30	130	130
6230	115		30	100	130
6232	115		30	100	130
6234	115			70	130
6236	150			70	130
6238	150			50	100
6240	150			50	100
6244	180			50	100
6248	180			50	80
6310	30	50	130	130	130
6311	30	50	130	130	130
6312	30	50	130	130	130
6313	30	50	130	130	130
6314	50	40	100	130	130
6315	50	40	100	130	130
6316	50	40	100	130	130
6317	80		100	130	130
6318	80		100	130	130
6319	80		100	130	130
6320	80		70	130	130
6321	80		70	130	130
6322	115		50	130	130
6324	115		50	100	130
6326	115			100	130
6328	150			100	130
6330	150			50	130
6332	180			50	100
6334	180			50	100

BEARING NO	REPLENISH QUANTITY (Gram)	REPLENISH INTERVAL (DAYS)			
		3600rpm	1800rpm	1200rpm	900rpm
NU216	30	30	130	130	130
NU220	50	50	100	130	130
NU222	80	40	100	130	130
NU224	80	30	50	130	130
NU226	80	30	50	130	130
NU228	80	30	30	100	130
NU230	115	30	30	100	130
NU232	115		30	70	130
NU234	115		30	70	130
NU236	115		30	50	100
NU238	150			50	100
NU240	150			30	100
NU244	180			30	70
NU248	180			30	70
NU312	30	70	130	130	130
NU313	30	70	130	130	130
NU314	50	50	100	130	130
NU315	50	60	100	130	130
NU316	50	50	100	130	130
NU317	50	50	100	130	130
NU318	80	40	70	130	130
NU319	80	40	70	130	130
NU320	80	40	70	130	130
NU322	80	30	50	130	130
NU324	115		50	100	130
NU326	115		50	100	130
NU328	150			100	130
NU330	150			70	130
NU332	150			70	130
NU334	175			70	130
NU2224	115	30	80	115	130
NU2226	115	30	80	115	130
NU2228	115	30	50	80	130
22224	115	30	80	115	130
22226	115	30	80	115	130
22228	115	30	50	80	130
22230	115	30	50	80	130
22232	150		50	80	130
22234	180		30	50	115
22236	180		30	50	80
22238	240		30	50	80
22240	240			50	80
22244	320			30	80
22228	380			30	80

B)Oil Requirement

Motor with oil lubricated bearing are shipped without oil. Before starting the motor, fill each reservoir to the level between high and low marks shown on the sight gage. Use only the oil specified on the lubrication nameplate or the lubrication instructions supplied with each motor. (See the table 1 & table 2)

During storage period fill oil to the H (high) level shown on the gage. Before operating the motor drain this oil and refill as instructed previously.

TABLE 1 OIL VISCOSITY FOR VSS & VHS MOTOR

BEARING FUNCTION AND LOCATION	BEARING TYPE	OIL VISCOSITY	
		AT 100^{O}F	AT 210^{O}F
THRUST BEARING (UPPER)	ANGULAR CONTACT BALL	150 SUS	45 SUS
	SPHERICAL ROLLER	600 SUS	70 SUS
	PLATE (KINGSBURY)	300 SUS	53 SUS
GUIDE BEARING (LOWER)	BALL, CYLINDRICAL ROLLER OR SLEEVE	150 SUS	45 SUS

TABLE 2 RECOMMENDED OIL FOR VSS & VHS MOTOR

MANUFACTURER	VISCOSITY RANGE		
	135 SUS TO 175 SUS AT 100^{O}F	270 SUS TO 350 SUS AT 100^{O}F	500 SUS TO 700 SUS AT 100^{O}F
GULF OIL CORP.	HARMONY 32	HARMONY 68	HARMONY 115
ESSO OIL CO.	THRESSO 32	TERESSO 68	TERESSO 100
SHELL OIL CO.	TURBO OIL T32	TURBO OIL T68	TURBO OIL T100
MOBIL OIL CO.	MOBIL DTE LIGHT	MOBIL DTE OIL HEAVY MEDIUM	MOBEL DTE OILEXTRA HEAVY
STANDARAD OIL CO.	CHEVRON OC TURBINE 32	CHEVRON OC TURBINE 68	CHEVRON OC TURBINE 100
TEXACO INC.	RANDO OIL A (R&O)	RANDO OIL C (R&O)	RANDO OIL F(R&O)
CALTEX OIL CO.	USRA P-32	USRA P-68	USRA P-100
B P OIL CO.	BP ENERGOL HL-C32	BP ENERGOL HL-C68	BE ENERGOL HL-C100

6. Troubleshooting and Repair

Lists below are typical Problems with their corresponding causes and recommended countermeasures;

Problem	Cause of Problem	Countermeasures
Failure to start	Over current trips relay	This may result from overload; wait until temperature of motor cools down to room temperature; if still unable restart, check the following
	Power source unconnected	Check circuits and contactors connecting motor and power source through motor controller.
	Fuse blown	Check the fuses in motor controller and primary panel.
	Controller misconnect	Check and compare actual connections with wiring diagram.
	Power cable terminals loosened	Tighten all terminals of lead wires.
	Driven machine locked or jammed	Disconnect load from motor. If motor can be started independently, then check the driven machine.
	Stator and/or rotor coils broken-open circuit	Check coils for open circuit.
	Coil grounded	Check windings for grounded condition
	Bearing fit excessively tight	Dismantle and inspect bearings. .
	Controller malfunction	Check controller.
	Terminal voltage too low	Check terminal applied voltage.
Abnormal noise and/or vibration	Single phase running	Stop running and restart. If motor can't be restarted, probable cause is single phase. Check for one phase of power source to motor to be open circuit.
	Unbalance of electrical supply	Check for power supply voltage unbalance.

Problem	Cause of Problem	Countermeasures
(continued)	End-play of shaft	Check coupling and pulley alignment; check belt. If pedestal type bearing, check rotor shaft center and endplay.
Abnormal Noise And/or Vibration	Vibration	Could be due to driven machine. Disconnect load from motor, if motor vibrates, may require balance of rotor.
	Non uniform air gap	Align rotor to center of stator; change bearings if necessary.
	Core lamination loosened, Loose fit between rotor core and shaft	Tighten all set screws. Tighten all clamping bolts.
	Contact or rubbing between rotor and stator	Align center of stator and rotor. Change bearings if necessary.
	Foreign materials between fan and fan cover	Dismantle, remove and clean.
	Motor loosely bolted to the base	Tighten mounting screws, note any deviation resulting from this action.
	Loose coupling	Check coupling, realign if necessary, tighten set screws.
Excessive Temperature Rise And/or Smoke	Overload	Check load. Check current, reduce load if it is in excess of rating.
	Unbalance of electrical supply	Check for voltage unbalance or single -phasing
	Power fuse blown, Breakdown of controller, Etc.	Check power source, adjust controller as required.
	Block of cooling air passage	Clean air passage and winding coils.
	Wrong voltage or frequency.	Check power source against nameplate data for terminal voltage and frequency.
	Stall condition results from too tight of driven machine or bearing	Immediately cut off power. Check for locked or jammed condition in motor bearings and driven equipment.

Problem	Cause of Problem	Countermeasures
Excessive temperature rise and/or smoke	Stator coils short-circuited	Contact Tatung Electric for solutions.
	Stator coils grounded	Ditto.
	Overtension of belt	Reduce tension.
Excessive temperature rise in bearings	Bearing bracket loosened or inaccurately positioned	Check for perpendicular fit between bearing and bracket and properly fastened bolts.
	Overtension of belt or overthrust of gear	Reduce overtension belt exerts onto the bearings and align shafts. Check for gear thrust applied to the bearings, if so, new special purpose bearings may be required.
	Bending of shaft between rotor and stator	Straighten shaft; if unable to repair consult the nearest Tatung authorized service center.
	Insufficient cooling water	Check water'level. Check for proper flow of cooling water supply.
Sleeve bearings	Insufficient Lubricating oil.	Refill oil, if oil level is too low, Drain and refill with proper lubricant
	Oil mixed with foreign particles or oil deteriorates	Drain and refill the recommended high-grade oil.
	Oil ring rotates too slow or stops rotating	Specific density of oil is too high. Check oil rings for nicks, bend or other damage. Replace oil rings if defective.
	Excessive inclination of motor mounting	Adjust motor level.
	Damaged oil ring while assembling or dismantling	Replace oil ring. Do not attempt to run motor with damaged oil rings.

Problem	Cause of Problem	Countermeasures
Sleeve bearings	Thrust result from motor inclination	Adjust motor to level to reduce thrust, or replace bearing with ones suitable for continuous thrust.
	Bearing or shaft surface defective	Replace bearing and/or regrind shaft surface.
	Shaft currents	Check for voltage unbalance. Check for non-uniform air gap. Check for proper bearing clearance. Check for proper lubricating oil. Bearings can be insulated if necessary . Contact Tatung Electric.

7. STORAGE

7.1 INTRODUCTION

The intent of these storage instructions is to establish the minimum standards (requirements) for the referenced motors. For motors, which will not be put into service shortly, the following precautions should be taken to protect the motor while in storage.

7.2 STORAGE AREA

To insure proper maintenance of the motor, the motor should be stored in a clean, dry, heated warehouse. The storage area should be free of ambient vibration.
Where indoor storage is not available, motor should be loosely covered with a tarpaulin plastic cover or similar type of protective cloth. Covering should extend to the ground and must not tightly wrap the motor. This will allow the motor to proper breathe. When storage period is greater than one year, indoor storage is mandatory.
When no heat is available in the warehouse, space heaters, if supplied, or some other type of reliable heating means should be used to keep the temperature of motor above dewpoint temperature of the surrounding air. For critical motors, an alarm signal of warm should be supplied, if these means become inoperative.

7.3 STORAGE MAINTENANCE

To keep the motors always in good conditions, the following procedures should be taken periodically.

(1) Visual Inspection

The motors should be inspected for signs of unusual dirt built up, rust, or general deterioration.

For long term storage, the shaft extension, mounting flange of the motor and other exposed-machined surfaces should be coated with anticorrosive coatings. The anticorrosive coatings should be examined periodically. If there is a scratch on the coating, surfaces must be finished and re-coated.

(2) Megger Stator and /or Rotor Windings

Measure the insulation resistance every three months during the storage. The insulation resistance between the winding and earthed stator frame should be at least as shown below:

(a) 10 Mega Ohm or above with 1000 V Meggermeter for motor voltage rating over 600 V.

(b) 3 Mega Ohm or above with 500 V Meggermeter for motor voltage rating below 600 V.

Record the resistance values and pay attention to its variation. When the resistance value is varied remarkably, check the environment of storage place and improve it.

When the resistance value is less than the above value, dry the equipment until the resistance

value goes up to the above said before starting operation. The winding surface is best dried with warm air at about 80° C or put in a heated oven. Self-drying, i.e. idling the machine at roughly 20-25% of its rated voltage can be used if necessary.

(3) Bearings

a. Oil-lubricated bearings

All motors with oil-lubricated bearings are operated and tested in our factory with a rust-inhibiting oil in the lubrication system. Although the motors are shipped without oil in the oil reservoirs, a rust-inhibiting film remains on the critical bearing surfaces during transit and for up to 6 months of storage.

When the motor is received, it is recommended that the bearing oil reservoirs be filled to the proper oil level with a good grade of rust-inhibiting oil. The shaft should be rotated by hand or other suitable means several revolutions to insure the journals are thoroughly coated with oil. Rotation of shaft should be done at least one-month interval for outdoor storage and three months intervals for clean, dry, indoor storage locations.

The following oils or equivalents are recommended for use during the storage periods.

Shell Oil Company – Ensis Oil 10 or 30. Texaco, Inc. – Preservative Lubricant Oil Code 788-30. Mobil – Mobilkote 500 Series.

Prior to startup, the oil must be drained, and bearing chamber be flushed and then new lubricating oil (Please refer to nameplate) should be filled.

b. Grease-lubricated bearings

Tatung grease lubricated motors are shipped with proper amount of grease in each bearing. If the motor is placed in storage for a period in excess of three months, it is recommended that the shaft be turned over slowly by hand or by use of suitable wrench at least once in every three-month period. This will distribute the grease and prevent bearing corrosion due to condensation or contaminating gases in the vicinity of the motor.

If the motor is exposed directly to weather conditions during storage, it is important that a check be made to determine if the motor has actually become wet and if the grease contains droplets of water which have entered the bearing chamber due to normal breathing. If water has become mixed with the grease during the storage period, it is desirable to flush the bearing of old grease and replace with new lubricant of the type recommended. (Shown in nameplate).

7.4 STORAGE INSPECTION RECORDS

Records must be maintained for all scheduled maintenance over the storage period.

SUGGESTIONS: For a period of storage exceeds two years, it is recommended to dismantle motor completely, inspect and clean thoroughly prior to any startup.

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