

INSTALLATION AND MAINTENANCE FOR POLYPHASE AC INDUCTION MOTORS



This manual includes procedures for the safe and proper transportation, installation, connection, operation and maintenance of Hyundai electric motors.

Read these instructions carefully before attempting to install, operate or service the motors and retain for future reference.

Safety precautions must be observed to protect personnel from possible injury which can be caused by improper handling of the motor, including high voltages, hot surfaces and rotating parts.



RECEIVING

- ☑ Check the motor nameplate data (HP, # of poles / RPM, Voltage, Frame Size, Enclosure, etc.) and confirm that it corresponds to your requirements.
- ☑ Check for any damage that could have been caused by transportation. Make sure that there are no loose parts on the motor, inside the fan cover on TEFC motors, or visible through the cooling openings on ODP motors:
- ☑ If a shaft clamp or other shipping braces (painted yellow) are installed on the motor for transport, remove these and retain for future use.
- ☑ Turn the shaft by hand to ensure that it rotates freely and smoothly. Listen for any sounds of mechanical resistance or impact. If any are present, please check with your local representative.



CAUTION

If the motor is supplied with eyebolts for lifting purposes, make certain that these are tightened securely. Use these for lifting the motor only. Do not use these for lifting any equipment mounted to the motor. Note that the direction of lift should not exceed 15 degrees from the shank of the eyebolt.



WARNINGS

- ! ▶ High voltage, hot surfaces and rotating parts of electrical machinery can cause serious or fatal injury to persons and property. Only properly trained, qualified personnel should perform installation, operation and maintenance on the equipment, and this should be done in accordance with NEMA MG-2, National Electrical Code, CSA C22-100(C.E.C.), IEC 364(prEN50110-1), and all local and utility regulations and safety standards.
- ! ▶ When preparing to service the motor, all power sources to the motor and accessory devices must be de-energized and disconnected. All rotating parts of the equipment must be at a standstill. Follow all regulations in locking out the power source to prevent accidental reconnection.
- ! ▶ Before the motor is re-energized, make sure that all safety guards are in place and that the shaft key is fully captive or removed.
- ! ▶ When working near machinery with high noise levels, proper ear protection must be used. Refer to local and national safety regulations.
- ! ▶ Automatic reset thermal protection should not be used where an unexpected automatic restart would be hazardous to personnel.
- ! ▶ The motor should be grounded properly to protect against fatal injury to personnel. Refer to NEC, CSA and local utility regulations for correct method of doing this. Note that grounding cables must be securely fastened to be effective, and that the lugs must be crimped to the cable using a proper crimping tool.
- ! ▶ The repair of explosion proof motors should be made only by Hyundai or an authorized service center that is certified by UL, CSA or other appropriate agency. Failure to comply with this will violate the hazardous duty certification of the motor. The use of non explosion proof motors in hazardous areas is strictly prohibited. Contact Hyundai or your local authorized representative for assistance.

STORAGE

1. When the motor is not in operation, the following precautionary measures must be undertaken to ensure that motor life is not reduced.
 - ▶ The location should be dry, without direct sunlight, well ventilated, and free of dust or corrosive gas.
 - ▶ The motor should not be stored near a heat or cold source(i.e. boiler/freezer)
 - ▶ The storage area should be free of vibration.
 - ▶ The motor should be easily accessible.
2. Specific precautions should be taken to prevent the entrance or moisture, dust or dirt.
3. Before commissioning, the motor's insulation should be tested with a 500VDC megger. If the resistance value of the insulation is less than 1 M Ω , the windings must be dried prior to energizing.

LOCATION

- Open drip proof motors (IEC protection \leq IP23) are intended for use in a well ventilated area where the atmosphere is reasonably free of dirt; moisture and corrosive agents, and is not intended for use outdoors.
- Totally enclosed motors (IEC protection \geq IP44) are intended for use where they are exposed to dirt, moisture, dust and most outdoor conditions. Standard enclosed motors require special feature in environments where there is extremely fine abrasive dust or corrosive chemicals present, or in outdoor applications where weather protection should be considered.
- Explosion proof motors are intended for use in hazardous areas classified by Underwriters' Laboratories, National Electrical Code, Canadian Standards Association, and IEC79(EN 50014 and EN 50018).
- Mill and Chemical, heavy duty totally enclosed motors are intended for use in areas the same as standard enclosed motors, but where there are also corrosive agents or high moisture content in the environment.
- Standard motors are suitable for use in ambient temperatures between -20 $^{\circ}$ C(-40 $^{\circ}$ C with low temperature grease) to +40 $^{\circ}$ C, and at elevations at or below 1000 meters (3300 feet) above sea level.

MOUNTING

1. Make certain that the underside of the motor feet and/or the flange are clean and free of dirt. If necessary, wipe with a clean cloth using a non abrasive cleaning solution. Remove any masking materials or any rust inhibitive coating from the mounting surfaces and the shaft.
2. Motor must be mounted securely on a firm and flat base or onto a rigid flange capable of supporting the entire motor weight. The mounting bolts and base assembly must be carefully tightened to prevent change in alignment and possible damage to equip applying the recommended tightening torques shown in table 1.
Use the recommended torques for medium carbon steel bolts identified by three radial lines at 120 degrees on the head and use 50% of the recommended torques for low carbon steel bolt with no ID marks. in case of motors with 8 holes in feet, these 8 holes are used for the application of dual frame size. Only 4 holes are used for mounting in accordance with outline drawing.

MOUNTING

(continued)

TABLE #1

Bolt Size (Metric)	Recommended Torque(N-M)	Bolt Size (inch)	Recommended Torque(lb-ft)
M6	11	1/4	8
M8	21	5/16	15
M10	43	3/8	31
M12	75	1/2	55
M16	121	5/8	90
M20	350	3/4	260
M24	600	1	440
M30	1240	1 1/4	915

*The tolerance of tightening torques is $\pm 10\%$

3. All ball bearing motors frame up to and including NEMA 326T(IEC 200L) can be mounted in all positions shown in NEMA MG1-4.03, provided that the mounting surface is stable and solid and the drain holes are located properly. For recommendations for other applications, refer to your nearest Hyundai sales office.
4. When using a direct coupling, align motor shaft to driven shaft as accurately as possible. Although a flexible coupling is designed to transmit power with some angular and parallel misalignment, this will have an effect on the life of the motor bearings.
5. If bolted on bases are removed from totally enclosed motors, the integrity of the enclosure must be maintained by resealing the bolt holes using shorter bolts. Do not reuse the original bolts as these will be too long and will interfere in the proper operation of the motor.
6. Remove drain plugs from the endshield or frame on totally enclosed motors. It is critical that the motor be mounted with these at the lowest point of the frame. If the motor is to be mounted with the feet in any position except down, these must be relocated to the appropriate position. Contact your local Hyundai representative for assistance.
7. The use of pulleys, sheaves, sprockets or gears on motor shafts is defined in NEMA MG1-14.07. The application of V-belt sheave dimension on AC motors is shown in NEMA MG1-14.41. The pitch diameter must not be less than indicated in Table 2, and the maximum sheave width must not exceed:
 - ▶ (N-W) for narrow type(3V, 5V, 8V) sheaves
 - ▶ $2 \times (N-W) - 1/4"$ for Conventional type (A, B, C, D, E) sheaves
 - ▶ N-W is the usable shaft length (IEC designation is dim. E)
8. For sheave ratios greater than 5:1 and center distances less than the diameter of the large sheave, refer the application to your local Hyundai representative.
9. Mount the pulley or half coupling to the motor shaft using a non impact method. Do not hammer on the motor shaft as this will cause brinelling of the bearing, leading to premature failure of the motor.
10. The motor is balanced using a half key, therefore the motor pulley or half coupling should be balanced with a half key.
11. After mounting the coupling or the belt and pulleys, a guard must be placed over all of the moving parts to protect against accidental contact and injury.

MOUNTING

(continued)

12. Do not over tension the belts as this will lead to excessive overhung load on the motor bearings, causing a significant reduction in bearing life and premture failure of the motor.
13. Make certain that there is adequate space around the motor for ventilation. If using a belt pulley, the ventilation opening at the rim of the pulley is essential for the motor's cooling. All ventilation openings must not be obstructed, and any wall or divider should be mounted a minimum of 1 inch (25mm) away from the motor.



CAUTION

In all cases, no surrounding structure should obstruct normal flow of ventilation air through or over the motor.

TABLE #2

Horsepower at Synchronous Speed, RPM				V-belt Sheave	
				Conventional A,B,C,D,E	Narrow 3V,5V,8V
3600	1800	1200	900	Minimum Pitch Diameter(in)	Minimum Outside Dia. (in)
1.5	1	0.75	0.5	2.2	2.2
2-3	1.5-2	1	0.75	2.4	2.4
3	3	1.5	1	2.4	2.4
...	...	2	1.5	2.4	2.4
5	...	...	...	2.6	2.4
7.5-10	5-7.5	3-5	2-3	3.0	3.0
15	10	7.5	5	3.8	3.8
20-25	15	10	7.5	4.4	4.4
...	20	15	10	4.6	4.4
...	25	...	...	5.0	4.4
...	.30	20	15	5.4	5.2
...	40	25	20	6.0	6.0
...	50	30-40	25-30	6.8	6.8
...	60	...	...	7.4	7.4
...	...	50	40	8.2	8.2
...	75	...	...	9.0	8.6
...	...	60	...	9.0	8.0
...	...	...	50	9.0	8.4
...	100	...	...	10.0	8.6
...	...	75	60	10.0	10.0
...	125	...	...	11.5	10.5
...	...	100	...	11.0	10.0
...	...	...	75	10.5	9.5
...	150	...	...	...	10.5
...	...	125	100	12.5	12.0
...	200	...	...	...	13.2

POWER SUPPLY AND CONNECTIONS

1. The wiring of the motor and control, as well as the grounding and overload protection must be performed in accordance with National Electrical Code, CSA C22-100(C.E.C.), and all local and utility regulations and safety standards. Installation should be done only by properly trained and qualified personnel.
2. The power supply must agree with the nameplate voltage and frequency. The permissible variation on the power supply is:
 - ▶ for NEMA rated motors:
 - rated voltage: $\pm 10\%$
 - rated frequency: $\pm 5\%$
 - combined: $\pm 10\%$ (with frequency component not to exceed $\pm 5\%$)
 - ▶ for IEC rated motors(per IEC 34-1, EN60034-1):
 - rated voltage: $\pm 5\%$
 - rated frequency: $\pm 2\%$
3. Thermally protected motors will have 2 wires in the main terminal box identified as 'P1' and 'P2'. These should be connected to the motor starter or control circuit according to the connection diagram found inside the terminal box.



CAUTION

All explosion proof motors are equipped with thermostats. These must be connected to the motor control in order to maintain the factory warranty, and for the installation to comply with CSA, UL, NFPA, WCB, and other governing regulations.

Motors equipped with manual reset buttons or automatic reset overloads do not require any external hookup to the control circuitry. Manual protected motors can be reset after the motor has cooled down by pushing the 'reset' button. Automatic type overloads do not have an external button and will reset by themselves when the motor has cooled down sufficiently.



WARNING

Do not use automatic reset protected motor where unexpected start could cause injury to operating personnel.

4. Dual voltage motors can be hooked up for the desired voltage as shown in the connection diagram inside the conduit box.
5. The main terminal box supplied with the motor has been sized to provide adequate space for the connections between the motor leads and the incoming power cables. These connections must be made and insulated in a workmanlike manner following the best trade practices and in strict adherence to local regulations.
6. Before closing the terminal box, make certain that the opening around the incoming power cables and any other opening is completely sealed and a proper cable gland is in place. When installing the terminal box cover to the base, install the gasket provided and that the components fit together properly. Any modifications done to the terminal box must allow it to maintain the same enclosure as that of the motor and the original box.

POWER SUPPLY AND CONNECTIONS (continued)

7. For motors equipped with a mechanical brake, check that the brake operates properly prior to commissioning the motor.
8. Standard connections for three phase motors are shown in diagrams A-G. Use appropriately sized cable connectors when making the connections, and ensure that these are tight and insulated properly before applying power.
To change the direction of rotation, interchange any 2 of the incoming power leads.

	<p>CAUTION If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY.</p>
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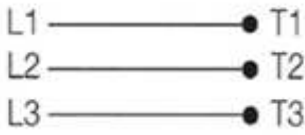
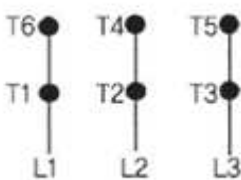
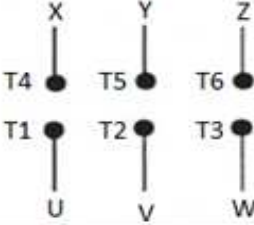
DIAGRAM A	DIAGRAM B	DIAGRAM C
<p>a) Single voltage, 3 leads</p> 	<p>a) Single voltage, 6 leads D.O.L. (Δ RUN)</p> 	<p>a) Single voltage, 6 leads Y-Δ START</p> 

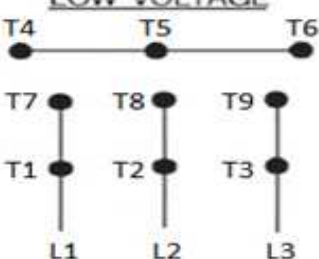
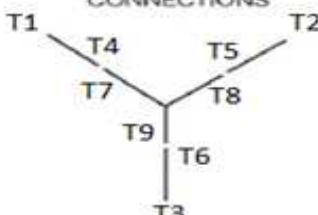
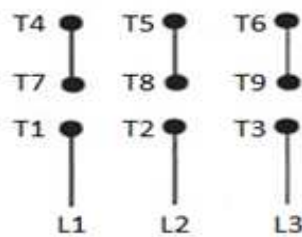
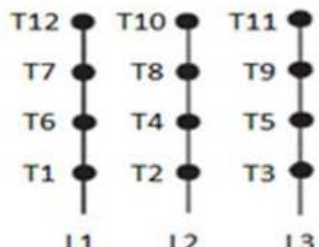
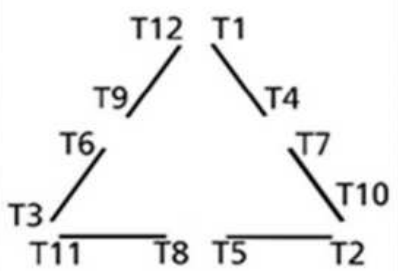
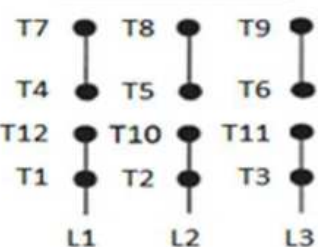
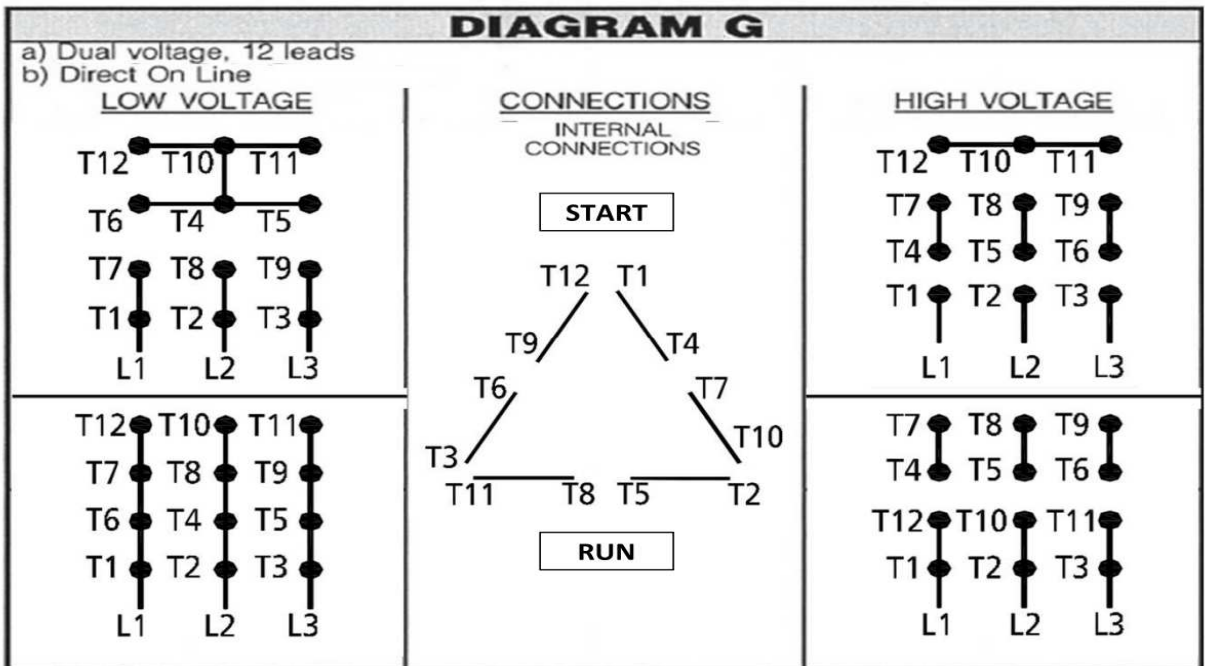
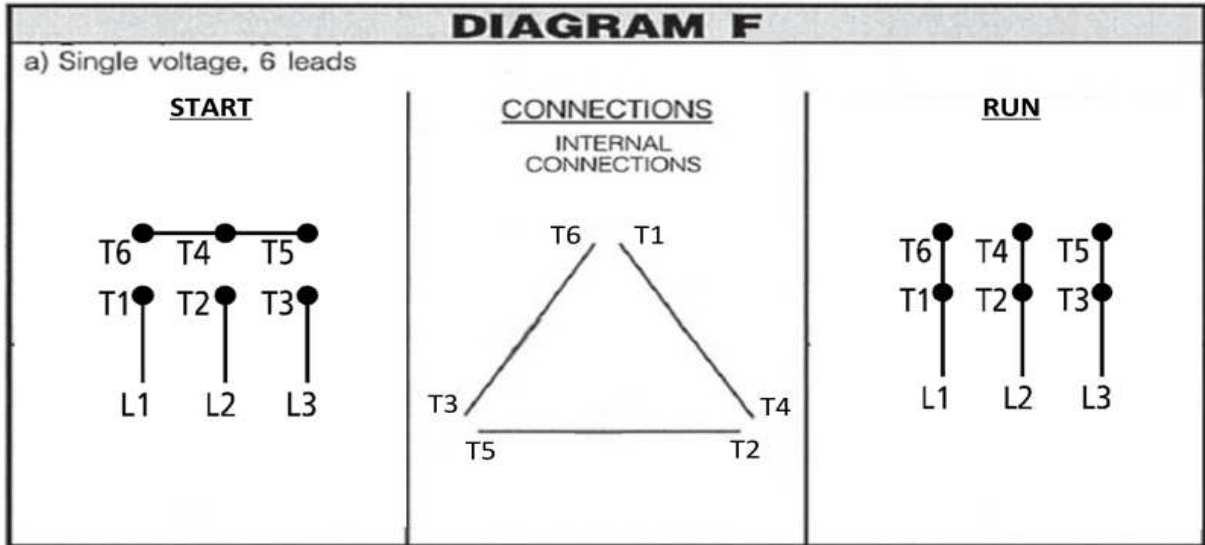
DIAGRAM D		
<p>a) Dual voltage, 9 leads LOW VOLTAGE</p> 	<p style="text-align: center;">CONNECTIONS INTERNAL CONNECTIONS</p> 	<p style="text-align: center;">HIGH VOLTAGE</p> 

DIAGRAM E		
<p>a) Dual voltage, 12 leads b) Direct On Line</p> <p>LOW VOLTAGE</p> 	<p style="text-align: center;">CONNECTIONS INTERNAL CONNECTIONS</p> 	<p style="text-align: center;">HIGH VOLTAGE</p> 

POWER SUPPLY AND CONNECTIONS (continued)



TESTING

If the motor has been in storage for an extensive period of time or has been subjected to adverse moisture conditions; it is best to check the insulation resistance of the stator winding with a megohmmeter. Depending on the length and conditions of storage it may be necessary to regrease or change rusted bearings.

If resistance is lower than 1 megohm, the windings should be dried in one of the following ways;

1. Bake in oven at temperatures below 194°F until the insulation resistance remains constant for a minimum of 30 minutes.
2. Enclose the motor with a canvass or similar covering leaving an opening at the top for moisture to escape. Insert heaters or lamps into this enclosure taking care not to place these devices in a way to create hot spots in the motor windings. Leave the heating devices in the enclosure until the insulation resistance remains constant for a minimum of 30 minutes.
3. With the rotor locked, apply low voltage (approx. 10% nameplate voltage) and gradually increase current through windings until temperature measured with thermometer reaches 85°C(184°F). Do not exceed this temperature. Maintain this temperature until the insulation resistance remains constant for a minimum of 30 minutes.

Turn the shaft manually to check for any deterioration in the bearings on the motor. Depending on the length and conditions of the storage it may be necessary to regrease or change rusted bearings.

START-UP

1. Start the motor with the load disconnected(make sure key is removed from motor shaft). Check direction of rotation. Interchange any two leads of a three phase motor to change the direction of rotation.
2. Connect the load and operate for an initial period of at least one hour. Check for any unusual noise, vibration or hot spots. These items should also be checked periodically as part of a maintenance schedule even after a successful start-up.

Acceptable vibration levels at no load condition are defined in

TABLE #3										
NEMA FRAME SIZE		140 ≤ NEMA FRAME ≤ 210			210 ≤ NEMA FRAME ≤ 440			440 < NEMA FRAME		
Vibration Grade	Mounting	Displacement mils pk - pk	Velocity in/s g pk	Acceleration g pk	Displacement mils pk - pk	Velocity in/s g pk	Acceleration g pk	Displacement mils pk - pk	Velocity in/s g pk	Acceleration g pk
A	Resilient	2.4	0.15	0.61	2.4	0.15	0.61	2.4	0.15	0.61
	Rigid	1.9	0.12	0.49	1.9	0.12	0.49	1.9	0.12	0.49

TABLE #4					
Vibration Grade	Shaft height	56 ≤ H ≤ 132		132 < H	
	Mounting	Displacement µm(r.m.s)	Velocity mm/s(r.m.s)	Displacement µm(r.m.s)	Velocity mm/s(r.m.s)
A	Free suspension	45	2.8	45	2.8
	Rigid mounting	-	-	37	2.3

START-UP **(continued)**

3. Check the operating current against the nameplate current. Be careful not to exceed the value of the nameplate amperes under continuous load. Motors with a service factor greater than 1.0 can be operated continuously with the current not exceeding the nameplate value multiplied by the service factor.
4. When operating 208-230/460 voltage motors at 200 volts, the slip of the motor will increase by approximately 30%, and the torques will be reduced 20 to 30%. Before starting the unit make certain that the motor will start and accelerate the load without injurious heating and adequate torque. Consult your local Hyundai representative for assistance.

MAINTENANCE

INSPECTION

When the motor is in operation, examine the motor at regular intervals. Keep motor clean and ventilation openings clear.

If the motor is to be in storage for one month then:

- ▶ The shaft must be turned by hand to check for smooth rotation of the bearings each month.
- ▶ The insulation resistance should be tested with a megger at least once every three months (refer to "Testing" for minimum value and corrective action)

LUBRICATION

1. Standard motors contain prelubricated, double shielded/sealed ball bearing which are adequately greased for life at the factory and do not require relubrication.
2. Motors with open type or single shielded/sealed bearings have provisions for grease nipples and discharge plugs on the motor to allow grease to be inserted into the bearing cavity in more severe condition applications. Motors are shipped with grease for initial running and do not need additional lubrication except in certain instances (i.e. storage in excess of 2200hrs or in the presence of construction dust). Refer to **TABLE 5** for guidelines in order to provide the maximum bearing life. Note that excessive or too frequent lubrication may damage the motor.
3. Make certain that the fittings are clean and free from dirt. Using a low pressure grease gun, pump in the recommended amount of grease until new grease appears at grease discharge point.
4. Use EXXON MOBIL Polyrex EM or equivalent polyurea based grease with the same thermal properties, unless a special grease is specified on the nameplate. Failure to maintain grease compatibility will shorter bearing life significantly.
5. Regreasing of the bearings should be performed with the motor running. This will ensure an even dispersion of the grease in the bearing and cavity.



WARNING

Make sure all guards are in place and stay clear of all moving parts.

6. After re-greasing, continue to run the motor for ten to thirty minutes.
7. Refer to **TABLE 5** for the amount of grease initial supply and resupply by bearing size.
 - ▶ The resupply interval of the bearing is 2200hrs for 2P and 4500hrs for 4P or more.
 - ▶ Regardless of the number for poles, the resupply interval of the NU bearing is 2200hrs .

MAINTENANCE – LUBRICATION

(continued)

TABLE #5							
Grease quantity and greasing interval for LV Motors							
Bearing No.	Initial greasing quantity (gr)	Regreasing quantity (gr)	Greasing interval (Hours)				
			2 POLE	4 POLE	6 POLE	8 POLE	
62	06	15	10	2200	4500	4500	4500
	08	30	10	2200	4500	4500	4500
	11	33	10	2200	4500	4500	4500
	12	42	12	2200	4500	4500	4500
	13	50	14	2200	4500	4500	4500
63	07	30	12	2200	4500	4500	4500
	09	46	12	2200	4500	4500	4500
	10	60	15	2200	4500	4500	4500
	11	94	20	2200	4500	4500	4500
	12	94	20	2200	4500	4500	4500
	13	116	23	2200	4500	4500	4500
	14	140	26	2200	4500	4500	4500
	15	170	30	1500	4500	4500	4500
	16	200	33	1500	4500	4500	4500
	17	240	37	1000	4500	4500	4500
	18	280	40	1000	4500	4500	4500
	19	324	45	-	4500	4500	4500
	20	369	50	-	4500	4500	4500
	22	517	60	-	4500	4500	4500
24	634	71	-	4500	4500	4500	
26	777	81	-	4500	4500	4500	
NU3	14	120	26	-	2200	2200	2200
	16	160	33	-	2200	2200	2200
	17	200	37	-	2200	2200	2200
	18	230	41	-	2200	2200	2200
	19	270	45	-	2200	2200	2200
	20	320	50	-	2200	2200	2200
	22	330	60	-	2200	2200	2200
	24	350	71	-	2200	2200	2200
26	375	81	-	2200	2200	2200	
73	15A	327	59	1500	4500	4500	4500
	16A	390	66	1500	4500	4500	4500
	17A	465	74	1000	4500	4500	4500
	14B	263	52	2200	4500	4500	4500
	16B	370	66	1500	4500	4500	4500
	17B	445	74	1000	4500	4500	4500
	18B	515	80	-	4500	4500	4500
	19B	600	90	-	4500	4500	4500
	20B	700	100	-	4500	4500	4500
	22B	645	120	-	4500	4500	4500
	24B	665	140	-	4500	4500	4500
	26B	690	160	-	4500	4500	4500

* if 73 type (Double bearing) amount of supplied grease shall be 2 times.

SERVICE

Hyundai motors should be serviced by properly trained and qualified personnel only using the proper tools, equipment and genuine Hyundai renewal parts. For further information, please contact your nearest Hyundai representatives.

When ordering spares or renewal parts please specify complete nameplate information such as model number, serial number, HP(or kW), frame size, number of poles., enclosure, etc.



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