



# Installation and Maintenance Manual

## Hyundai Low Voltage Motors

This operation manual includes important information for the installation, assembly, operation and maintenance of Hyundai Low Voltage Motors. Please read this manual carefully before you start using this product. Please contact WorldWide Electric's customer service department at 1-800-808-2131 if you have any questions regarding this information. Failure to follow the instructions outlined in this manual may result in loss of your right to fulfillment of any claim under limited product warrant and potentially may cause injury to personnel, equipment and/or property, including loss of life. WorldWide Electric Corporation assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of these operating instructions. In such cases, any liability for defects is excluded.



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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

1. Check the motor nameplate data (HP, RPM, voltage, frame size, enclosure, etc.) and confirm that it corresponds to your requirements.
2. Check for any damage that could have been caused by transportation. Make sure that there are no loose parts on the motor or inside the fan cover.
3. If a shaft clamp or other shipping braces (painted yellow) are installed on the motor for transport, remove these and retain for future use.
4. 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

1. 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 (prEN50110-01), and all local and utility regulations and safety standards.
2. 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.
3. 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.
4. When working near machinery, high noise levels and proper ear protection must be used. Refer to local and national safety regulations.
5. The motor should be grounded properly to protect against 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 lugs must be crimped to the cable using a proper crimping tool.
6. The repair of explosion proof motors should only be made by an authorized service center that is certified by Underwriters Laboratories (UL), Canadian Standards Association (CSA) or any other appropriate agency. Failure to comply with this will violate the hazardous duty certifications of the motor. The use of a non explosion proof motor in hazardous areas is strictly prohibited. Contact WorldWide Electric or your local authorized representative for assistance.

# Storage

1. When 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 of 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  $1M\Omega$ , the windings must be dried prior to energizing.

# Location

1. 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, corrosive agents, and is not intended for use outdoors.
2. 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 features in environments where there is extremely fine abrasive dust or corrosive chemicals present, or in outdoor applications where weather protection should be considered.
3. Explosion proof motors are intended for use in hazardous areas classified by UL, National Electrical Code (NEC), CSA, and IEC79 (EN 50 014 and EN 50 018).
4. IEEE-841 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.
5. Standard motors are suitable for use in ambient temperatures between  $-20^{\circ}\text{C}$  ( $-40^{\circ}\text{C}$  with low temperature grease) to  $+40^{\circ}\text{C}$ , and at elevations at or below 1,000 meters (3,300 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 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. Motors 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 must be tightened evenly to a minimum of the torque specified in (TABLE 1) to prevent a change in alignment and the resulting damage to equipment. These values are for medium carbon steel bolts (identified by 3 radial lines at 120° on the bolt head ANSI Grade 5). For low carbon steel bolts (ANSI Grade 2) use 50% of this torque.

TABLE 1

Bolt Size		Recommended Torque	
Inch	Metric	Ft.Lb.	N-M
1/4"	M6	7-11	9-15
5/16"	M8	14-21	19-28
3/8"	M10	25-37	34-50
1/2"	M12	60-90	81-122
5/8"	M16	120-180	163-244
3/4"	M20	210-320	285-433

3. All ball bearing motors (frame up to and including NEMA 326T) can be mounted in all positions shown in NEMA MG1-4.03 provided that the mounting surface is stable, solid and the drain holes are located properly. For recommendations for other applications please contact WorldWide Electric.
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 affect 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.

## Mounting (Continued)

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 a WorldWide Electric 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 dimensions 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
  - $2x(N - W) - \frac{1}{4}$ " 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, please contact WorldWide Electric Corporation.
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 bearings, 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.
12. Do not over tension the belts as this will lead to excessive overhung load on the motor bearing, causing a significant reduction in bearing life and premature failure of the motor.
13. Make certain that there is an 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" (25mm) away from the motor.

# Mounting (Continued)

TABLE 2 – Belted Application Guidelines

These guidelines were created to help users get the longest service and reliability from WorldWide Electric and Hyundai Electric Motors. Refer to NEMA MG1-14.47 for additional information.

Suggestions for minimizing bearing loads:

1. Use the largest possible sheave (see minimum sheave size in the table below, being careful not to exceed the rim speed suggested by the sheave manufacturer).
2. Use the fewest number of belts (see maximum number of recommended belts in the table below).
3. Keep sheaves as close to the bearing as possible.
4. Do not over-tension belts (see deflection values in the table below).

HP	1200 RPM				1800 RPM			
	Min. Sheave Diameter (in.)	Belt Type	Max. Belts	Deflection (lbs.)	Min. Sheave Diameter (in.)	Belt Type	Max. Belts	Deflection (lbs.)
1	2.4	3VX	1	4	2.2	3VX	1	3.1
1.5	2.4	3VX	2	3.1	2.4	3VX	2	2.1
2	2.4	3VX	3	2.8	2.4	3VX	2	2.9
3	3	3VX	2	2.9	2.4	3VX	3	2.9
5	3	3VX	3	4	3	3VX	3	3.7
7.5	3.8	3VX	4	4.7	3	3VX	4	4.1
10	4.4	3VX	4	5.4	3.8	3VX	4	4.3
15	4.4	3VX	5	5.4	4.4	3VX	4	5.4
20	5.2	3VX	6	6	4.4	3VX	6	4.8
25	6	3VX	7	5.6	4.4	3VX	7	5.2
30	6.8	3VX	7	6	5.2	3VX	7	5.3
40	6.8	5VX	4	12	6	3VX	7	6
50	8.2	5VX	4	14.5	6.8	3VX	8	6
60	8.2	5VX	5	14	7.4	5VX	4	13.5
75	10	5VX	5	14.5	8.6	5VX	4	14.5
100	10	5VX	6	16	8.6	5VX	6	13
125	12	5V	7	14	10.5	5VX	6	13
150	13.2	5V	7	15.5	10.5	5VX	7	13.5
200	15	5V	8	16	13.2	5VX	8	13
250	15	8V	6	28	14	5VX	9	14
300	16	8V	7	27	14	5V/8V	11/7	14/24
350	16.5	8V	7	30	14.5	5V/8V	12/7	14/26
400	17.5	8V	8	29	15	5V/8V	13/8	15/26
450	18	8V	8	32	16	5V/8V	14/9	15/25
500	18.5	8V	9	31	16.5	8V	15/9	15/27
600	---	---	---	---	17.5	8V	11	26



# 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 for T4 temperature code.

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.

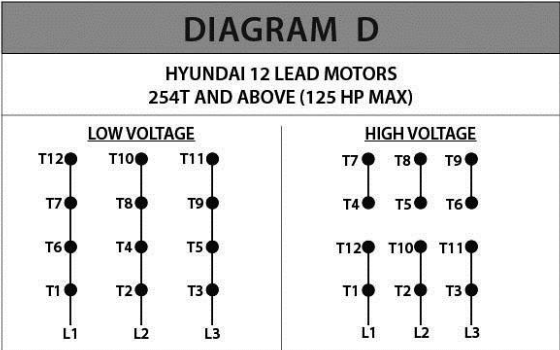
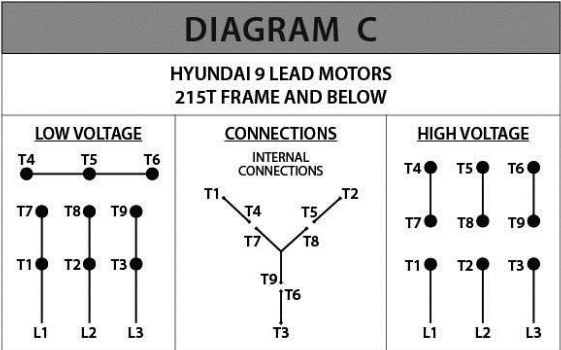
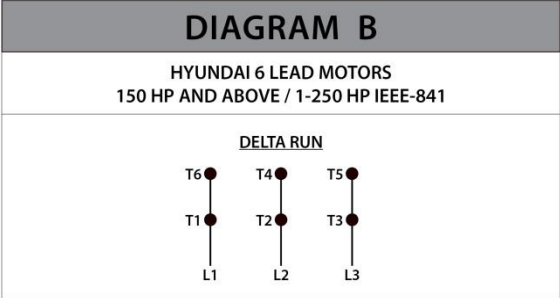
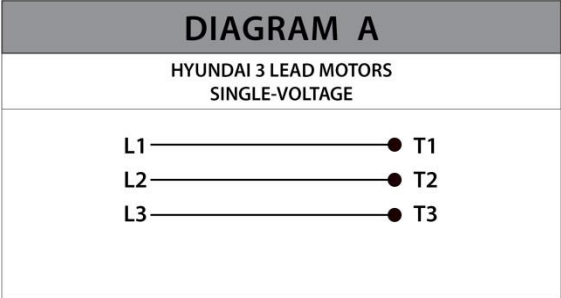
# Power Supply and Connections (Continued)

- 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 ensure 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.
- 7. For the 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-D). 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 of two of the incoming power leads.

## Connection Diagrams



**CAUTION:** If rotation must be changed, ALLOW THE MOTOR TO STOP COMPLETELY.



# Testing

If the motors have been in storage for an extensive period of time or have been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmmeter. If resistance is lower than 1 megohm, the windings should be dried in one of the following ways:

1. Bake in oven at temperature below 194°F until insulation resistance remains constant for a minimum of 30 minutes.
2. Enclose the motor with a canvas or similar covering, leaving an opening at the top for moisture to escape. Insert a heater or lamps into this enclosure, taking care not to place these devices in a way that creates 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 (approximately 10% of 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.
4. Depending on the length and condition of 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 a part of a maintenance schedule even after a successful start-up. Acceptable vibration levels at no load condition are defined in:
  - *NEMA MG1-7:*
    - 2-6 pole: 0.15in/s peak
    - 8 pole: 0.12in/s peak
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, however, the life span of the insulation system may be reduced.
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 the motor will start and accelerate the load without injurious heating and adequate torque. Contact WorldWide Electric for assistance.

# Lubrication

1. Some motors contain pre-lubricated, double shielded/sealed ball bearings which are adequately greased for life at the factory and do not require relubrication.
2. Motors with open type or single shielded/sealed ball 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 3 months or in the presence of construction dust). In order to provide the maximum bearing life, refer to (*LUBRICATION SCHEDULE*) for guidelines. 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 MOBIL POLYREX-EM grease or equivalent polyurea based grease with the same thermal and viscosity properties, unless a special grease is specified on the nameplate. Failure to maintain grease compatibility will shorten 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. After regreasing, continue to run the motor for ten to thirty minutes.



CAUTION: Please use lubrication schedules.

# Lubrication (Continued)

## LUBRICATION SCHEDULE

HP	RPM	Frame	DE Bearing					ODE Bearing				
			Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months	Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months
1	3600	143T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	143T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
1.5	3600	143T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	182T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
2	3600	145T	6205ZC3	9	3	14	6	6204ZC3	8	3	12	6
	1800	145T	6205ZC3	9	6	14	12	6204ZC3	8	6	12	12
	1200	184T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
3	3600	182T	6206ZC3	10	3	15	6	6206ZC3	10	3	15	6
	1800	182T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
	1200	213T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
5	3600	184T	6206ZC3	10	3	15	6	6206ZC3	10	3	15	6
	1800	184T	6206ZC3	10	6	15	12	6206ZC3	10	6	15	12
	1200	215T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
7.5	3600	213T	6307ZC3	15	3	30	6	6307ZC3	15	3	30	6
	1800	213T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
	1200	254T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
10	3600	215T	6307ZC3	15	3	30	6	6307ZC3	15	3	30	6
	1800	215T	6307ZC3	15	6	30	12	6307ZC3	15	6	30	12
	1200	256T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
15	3600	254T	6309ZC3	20	3	60	6	6309ZC3	20	3	60	6
	1800	254T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
	1200	284T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
20	3600	256T	6309ZC3	20	3	60	6	6309ZC3	20	3	60	6
	1800	256T	6309ZC3	20	6	60	12	6309ZC3	20	6	60	12
	1200	286T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
25	3600	284TS	6310ZC3	25	3	80	6	6310ZC3	25	3	80	6
	1800	284T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
	1200	324T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
30	3600	286TS	6310ZC3	25	3	80	6	6310ZC3	25	3	80	6
	1800	286T	6310ZC3	25	6	80	12	6310ZC3	25	6	80	12
	1200	326T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
40	3600	324TS	6313ZC3	23	3	100	6	6211ZC3	25	3	80	6
	1800	324T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
	1200	364T	6314C3	26	6	150	12	6213C3	14	6	80	12
50	3600	326TS	6313ZC3	23	3	100	6	6211ZC3	25	3	80	6
	1800	326T	6313ZC3	23	6	100	12	6211ZC3	25	6	80	12
	1200	365T	6314C3	26	6	150	12	6213C3	14	6	80	12
60	3600	364TS	6213C3	14	3	80	6	6213C3	14	3	80	6
	1800	364T	6314C3	26	6	150	12	6213C3	14	6	80	12
	1200	404T	6316C3	33	6	180	12	6313C3	23	6	100	12
75	3600	365TS	6213C3	14	3	80	6	6213C3	14	3	80	6
	1800	365T	6314C3	26	6	150	12	6213C3	14	6	80	12
	1200	405T	6316C3	33	6	180	12	6313C3	23	6	100	12
100	3600	405TS	6313C3	23	3	100	6	6313C3	23	3	100	6
	1800	405T	6316C3	33	6	180	12	6313C3	23	6	100	12
	1200	444T	6318C3	41	6	240	12	6316C3	33	6	180	12


# Lubrication (Continued)

## LUBRICATION SCHEDULE

HP	RPM	Frame	DE Bearing				ODE Bearing					
			Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months	Size	Make-Up Amount (g)	Make-Up Months	Exchanging Amount (g)	Exchanging Months
125	3600	444TS	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	444T	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	445T	6318C3	41	6	240	12	6316C3	33	6	180	12
150	3600	445TS	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	445T	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	447T	6318C3	41	6	240	12	6316C3	33	6	180	12
200	3600	447TS	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	447T	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	449T	6318C3	41	6	240	12	6316C3	33	6	180	12
250	3600	449TS	6314C3	26	3	150	6	6314C3	26	3	150	6
	1800	449T	6318C3	41	6	240	12	6316C3	33	6	180	12
	1200	L449T	6322C3	100	4	334	8	6318C3	41	6	240	12
300	3600	L449TS	6315C3	32	2	106	4	6315C3	32	2	106	4
	1800	L449T	6322C3	100	4	334	8	6318C3	41	6	240	12
	1200	L449T	6322C3	100	4	334	8	6318C3	41	6	240	12
350	3600	L449TS	6315C3	32	2	106	4	6315C3	32	2	106	4
	1800	L449T	6322C3	100	4	334	8	6318C3	41	6	240	12
	1200	5008/9	6324C3	130	4	434	8	6320C3	41	6	300	12
400	3600	L449TS	6315C3	32	2	106	4	6315C3	32	2	106	4
	1800	L449T	6322C3	100	4	334	8	6318C3	41	6	240	12
	1200	5010/11	6324C3	130	4	434	8	6320C3	41	6	300	12
450	3600	5008/9	6315C3	32	2	106	4	6315C3	32	2	106	4
	1800	5008/9	6324C3	130	4	434	8	6320C3	41	6	300	12
	1200	5010/11	6324C3	130	4	434	8	6320C3	41	6	300	12
500	3600	5010/11	6315C3	32	2	106	4	6315C3	32	2	106	4
	1800	5010/11	6324C3	130	4	434	8	6320C3	41	6	300	12
600	1800	5010/11	6324C3	130	4	434	8	6320C3	41	6	300	12

## Service

HYUNDAI motors should only be serviced by properly trained and qualified personnel using the proper tools, equipment and genuine HYUNDAI replacement parts. For further information please contact WorldWide Electric. When ordering spare or replacement parts please specify complete nameplate information such as model number, serial number, HP, RPM, voltage, frame size, enclosure, etc.



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