### 6. Installation

Install the motor in a location suitable for the installation environment (refer to section '3.3 Installation Environment'). If the motor will be used at a high altitude or in an area with very low or high ambient temperatures, consult technical department of Hyosung Heavy Industries. The motor must be installed in a location with good ventilation, low dust and moisture, and easy access for inspection. Avoid locations with moisture, oil, or excessive external vibration.

Do not install an indoor type motor outdoors. if dust or moisture gets inside the electric motor, it can cause machine malfunctions and damage. Make sure to use a motor with the appropriate protection grade. Using a motor outside its rated protection grade may lead to damage, such as the inflow of foreign objects.

Check the items below before proceeding with the motor installation.

- (1) Insulation resistance: The measured value must be within acceptable limit (refer to '5.1 Insulation resistance').
- (2) Bearings: Check the grease condition, as well as for rust and noise caused by long-term storage. If the motor will not be operated immediately, manually rotate the shaft at least 10 times every two weeks to prevent oil separation of grease and rust.
- (3) Terminal box: Ensure that the terminal box is properly sealed and that its interior is clean, dry, and free of corrosion. Ensure that the cable inlet is completely sealed and inspect the gasket for proper condition.
  - When assembling the terminal box cover, ensure that the gasket is securely fitted between the box and the cover to maintain the protection grade specified on the motor's nameplate.
- (4) Cooling: Ensure that the frame cooling fins and cooling intake vents are clean and free from any external obstructions. Install the motor at least 8 inches away from walls or other obstacles. If sufficient clearance is not provided, cooling can be compromised, resulting in overheating and motor damage.
- (5) Drain: If the motor has a drain plug on the load-side bracket or other locations, it is shipped from the factory with the drain plug closed. Users should periodically open the drain to release any accumulated condensation, then securely close it again.



If the motor is used in a hazardous area (such as environments with flammable or explosive gases, dust, etc.), ensure that the motor complies with explosion protection standards. Using a non-explosion proof motor may lead to explosions or fires, causing damage.

#### 6.1 Foundation

The user is responsible for providing the necessary foundation for motor installation. To ensure optimal performance and longevity, the foundation should meet the following requirements:

- (1) Smooth, level surface
  - (a) It should be smooth, level, and as vibration-free as possible.
  - (b) The foundation must be elevated above ground level and provide proper drainage.
  - (c) It should be designed to prevent vibration from being transferred to the motor and avoid resonance.
- (2) Surface uniformity of support
  - (a) The foundation surface should provide uniform support for the motor foot or flange.
  - (b) Precautions in design and installation must be taken to prevent motor frame deformation.
  - (c) The level difference between the surfaces supporting the motor foot or flange should be within ±0.004 inches.
  - (d) The motor should be rigidly supported on all four feet without any vibration. If there is a height difference between the feet, shim plates can be used if necessary.

### (3) Resonance prevention

To ensure the safe operation of the motor, a stable foundation is required, as well as a resonance margin for the natural frequency of the entire system. (E.g.: motor + bed + foundation + pipes, etc.) A resonance margin of at least 20% must be maintained at the frequencies corresponding to the motor's 1X RPM, twice the 1X RPM (2X), and twice the motor's power frequency (2FL).

## 6.2 Mounting

When mounting the motor to the load, secure it to a stable, level foundation using strong feet or flanges. Ensure the motor is properly aligned and level with the driven machine. Incorrect alignment or leveling can cause excessive vibration, potentially damaging the bearing.

When tightening the bolts for mounting the motor and assembling the base, do so carefully to avoid misalignment or damage to the machine. The threaded mating length of the bolts used for assembly should be at least 1.5 times the diameter of the bolt.

To correct any flatness deviations during mounting, the motor must be leveled. The leveling can be carried out by using compensation shims.

If a metallic base is used to adjust the height of the motor shaft end to match that of the driven machine, ensure that only the metallic base is leveled in relation to the concrete base. Record the maximum leveling deviation in the installation report.

### 6.3 Balancing

The motor is shipped standardized for balancing with no-load operation. The required special balancing quality level must be specified in the purchase order. Before assembling power transmission components such as pulleys and couplings onto the motor shaft, they must first be balanced with a half-key. Record the maximum balancing deviation in the installation report.

### 6.4 Connection and alignment of the motor

Proper alignment of the motor is critical to reduce vibration, damage to bearings and couplings. If you have

instructions from the coupling manufacturer, follow the coupling manufacturer's instructions for assembly and alignment.

### (1) Direct coupling type

The motor center and the driven machine axis must be properly aligned. When mating shafts and couplings, apply the specified lubricant and gently insert them using a resin hammer to avoid impact and damage. Couplings that must be forcibly fitted onto the shaft should be heated with a heater before being pressed onto the shaft.

The motor shaft must be accurately aligned, both axially and radially, with the driven machine shaft using the appropriate tools and equipment, such as dial gauges and laser alignment instruments. If the coupling manufacturer's instructions are unavailable, it is recommended to base the connection tolerance of the coupling on Figure 6.1.

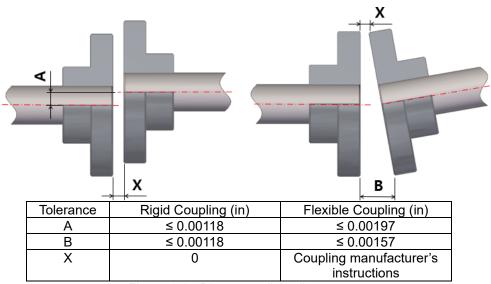


Figure 6.1 - Direct coupling alignment

### (2) Belt Type

Align the shaft ends of the motor and the driven machine so that the centers of the pulleys are in line with each other and in perpendicular with the shafts. (Please refer to Figure 6.2)

In general, the closer a pulley, sheave, sprocket, or gear is mounted to the bearing side of the motor shaft, the less load it places on the bearing. The center point of the belt or system of V-belt must not be beyond the end of the motor shaft. The inner edge of the sheave or pulley rim should not be closer to the bearing than the shoulder on the shaft, but it should be positioned as close to this point as possible. The outer edge of the chain sprocket or gear must not go beyond the end of the motor shaft.

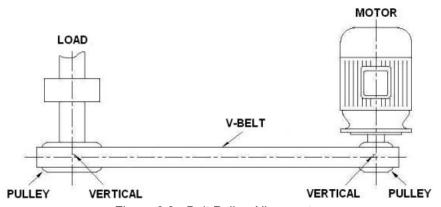
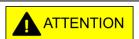


Figure 6.2 - Belt Pulley Alignment

When mounting shafts and pulleys, apply lubricant and gently tap them into place with a resin hammer or a similar tool to prevent impact and damage. Belt tension and pulley diameter significantly affect the bearing life and shaft strength of the motor, so it's important to install these components according to their specifications.

Set the belt tension to the initial tension by running the belt 3 to 4 times after installation. After 24 hours of operation, readjust the belt tension to account for initial elongation. Afterward, check the belt and adjust the tension every 3 months. Recommend that you record the maximum alignment deviation in the installation report.



- If the motor is driven by a belt, select the pulley according to the standard specifications. Please refer to Table 6.1.
- Ensure proper belt tension and check the parallelism of the pulleys. Devices driven by any type of belt must be equipped with a protective guard to prevent injury from the belt.
- Do not belt-couple a high-speed, 2-pole motor with a capacity greater than 10 HP to a motor intended for direct coupling only. This coupling can cause the shaft rupture and result in an accident.

Table 6-1 - Recommendation on V-Belt and V-Pulley selection

Mote	or		Star	ndard V-belt		Narrow width V-belt			
Rated Output (HP)	Pole	Belt Type	Number of Belt	Diameter of Pulley Pitch (in)	Width of Pulley rim (in)	Belt Type	Number of Belt	Diameter of Pulley Pitch (in)	Width of Pulley rim (in)
0.5		Α	1	2.953	0.787	3V	1	2.795	0.685
1		Α	1	3.150	0.787	3V	1	2.795	0.685
2		Α	2	3.150	1.378	3V	1	2.953	0.685
3	2	Α	2	3.543	1.378	3V	1	2.953	0.685
5		Α	3	3.543	1.969	3V	2	2.953	1.091
7.5		Α	3	4.409	1.969	3V	3	2.953	1.496
10		Α	3	5.197	1.969	3V	4	3.150	1.902
0.5		Α	1	2.953	0.787	3V	1	2.795	0.685
1		Α	1	3.150	0.787	3V	1	2.795	0.685
2		Α	2	3.543	1.378	3V	2	2.953	1.091
3		Α	2	3.937	1.378	3V	2	2.953	1.091
5		Α	3	4.409	1.969	3V	2	3.937	1.091
7.5		В	3	4.921	2.480	3V	3	3.937	1.496
10		В	3	5.906	2.480	3V	3	4.921	1.496
15		В	4	6.299	3.228	3V	4	4.921	1.902
20	4	В	5	6.693	3.976	3V	6	4.921	2.713
25		В	5	7.874	3.976	3V	6	5.512	2.713
30		В	5	8.819	3.976	3V	6	6.299	2.713
40		С	5	8.819	5.354	5V	4	7.087	3.067
50		С	6	8.819	6.358	5V	4	7.874	3.067
60		С	6	10.433	6.358	5V	4	8.819	3.067
75		С	7	10.433	7.362	5V	5	8.819	3.756
100		С	8	12.402	8.366	5V	6	9.843	4.445
125		-	-	-	-	5V	6	9.843	4.445

Moto	Motor		Star	ndard V-Belt		Narrow width V-belt			
Rated Output (HP)	Pole	Belt Type	Number of Belt	Diameter of Pulley Pitch (in)	Width of Pulley rim (in)	Belt Type	Number of Belt	Diameter of Pulley Pitch (in)	Width of Pulley rim (in)
0.5		Α	1	3.150	0.787	3V	1	2.795	0.685
1		Α	2	3.150	1.378	3V	1	2.953	0.685
2		Α	2	3.937	1.378	3V	2	2.953	1.091
3		Α	3	3.937	1.969	3V	2	3.543	1.091
5		В	3	4.921	2.480	3V	3	3.937	1.496
7.5		В	3	5.906	2.480	3V	3	5.512	1.496
10		В	4	5.906	3.228	3V	4	5.512	1.902
15		В	5	6.693	3.976	3V	5	5.512	1.902
20		В	5	8.819	3.976	3V	6	6.299	2.713
25	6	С	4	8.819	4.350	5V	3	7.087	2.378
30		С	5	8.819	5.354	5V	4	7.087	3.067
40		С	5	10.433	5.354	5V	4	8.819	3.067
50		С	6	10.433	6.358	5V	4	8.819	3.067
60		С	7	11.024	7.362	5V	5	8.819	3.756
75		С	8	11.811	8.366	5V	6	9.843	4.445
100		D	6	13.976	9.173	5V	6	12.402	4.445
125		D	6	15.748	9.173	5V	6	13.976	4.445
150		D	7	15.748	10.630	8V	4	13.976	4.874
175		D	7	18.701	10.630	8V	4	15.748	4.874

#### 6.5 Electrical Connection

The motor control circuit, overload protection device and grounding are to be in accordance to relevant electric standards. Wiring and connection must be done and verified by qualified personnel.

Verify that the voltage and frequency supplied match the specifications on the motor nameplate. When connecting the lead wires in the terminal box, ensure proper insulation for electrical safety.

## **MARNING**

- The electrical connection must follow the diagram provided on the nameplate. (Please refer to Table 6.2)
- Always disconnect the power before starting work. Do not bend or pull the lead wires by force as
  it may cause fire or electric shocks from internal short circuit.
- The regulations regarding electrical connections always take precedence over the connection guidelines.

## **MARNING**

- For terminal voltage (e.g. 230/460V) or Y-△ starters, refer to the wiring diagram on the nameplate and connect according to the applicable LOW/HIGH voltage or START/RUN configuration. Otherwise, incorrect connections may damage the motor.
- For Y-△ starter motors, start with the Y connection and operate with the △ connection. If the operation in continued with Y, it may cause voltage drop, overload and overheating, potentially resulting in motor damage. When operating the motor with Y-△, it must be △ connected when it is direct on line.
- In particular, be cautious not to link the wires incorrectly due to linked wires(terminal voltage, double voltage, Y-D, where the lead wires are not 3 strands) in the terminal block.

# **ATTENTION**

- Y-\( \Delta\) Connection must be made at the control panel.
- When using a Y-∆ starter, a switch must be installed on the primary circuit and it must be left open when not in use.
- When continuous power is supplied to the motor's primary circuit, creeping discharge may deteriorate and damage the insulation. So be cautious at all times. (Apply 3 contactor method by primary circuit electro-magnetic switch.)

Table 6.2 - Standard wiring diagram for a three-phase induction motor

Qty. of Leads	Connection Diagram				
3	● 1 ● 2 ● 3 L1 L2 L3				
6	6 4 5 ● 1 ● 2 ● 3 L1 L2 L3 YY (START)	● 6 ● 4 ● 5 ● 1 ● 2 ● 3 L1 L2 L3 △ (RUN)			
9	4 5 6	4 5 6 7 8 9 1 1 2 13 1 1 L2 L3 Y (HIGH VOLTAGE) 6 4 5 7 8 9 1 1 2 13 △(HIGH VOLTAGE)			
12	10 11 12 12 10 11  4 5 6 7 8 9  7 8 9 6 4 5  1 2 2 3 1 2 3  L1 L2 L3 L1 L2 L3  YY (START)	↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑			

If the motor is equipped with a terminal block, refer to Table 6.3 for the correct procedure when connecting the power cable. Ensure that the nuts are tightened securely to prevent the terminal lugs on both the power source and the motor from loosening.

table 6.3 - Tightening torque of terminal block (brass bolt)

Stud/Nut Nominal Diameter	Tightening torque (lb-ft)
M4	0.89~ 0.96
M6	2.21~ 2.44
M8	4.43~ 4.87
M10	7.38~ 8.11
M12	10.33~ 11.37

If the motor does not come with a terminal block, first fasten the motor terminal lugs and the power source terminal lugs securely using bolts and nuts to prevent disconnection. After securing them, insulate the cable terminals with an appropriate insulating material that complies with the supply voltage and insulation class specified on the nameplate.



- In particular, be cautious not to link the wires incorrectly due to linked wires (terminal voltage, double voltage, Y-D, where the lead wires are not 3 strands) in the terminal block.
- Applying excessive force beyond the specified tightening torque may cause the terminal block to break during tightening.



- After completing the wiring, ensure that no tools or debris are left inside the terminal box. Then, securely close the terminal box cover. There is a risk of electric shock.
- Take the necessary precautions to ensure the protection level specified on the motor nameplate is maintained.
- Any unused cable inlets in the terminal box must be properly sealed with blanking plugs.
- Ensure that the terminal box cover is properly closed and sealed to prevent moisture and dust from entering.
- Cable entries used for power supply and control must be equipped with components (cable glands, conduits) that meet the applicable standards and regulations in each country.

## **6.6 Connecting Accessories**

If the motor is equipped with accessories such as a thermal protection device (Pt100, Thermistor, Thermostat, etc.), space heater, brake, vibration sensor, encoder, or other components, follow the instructions on the accessory nameplates when connecting them to the control device. Failure to follow this procedure can result in damage to the motor and void the product warranty.

### 6.6.1 Resistance Temperature Detector (Pt100)

Pt100 sensors are made of platinum, and their resistance changes with temperature, providing accurate temperature measurements. The '100' refers to the sensor's resistance of 100 ohms at 32°F (0°C), which is one of the values recognized as an international standard and is the standardized resistance value for Pt100 sensors. This value serves as a reference point for measuring the motor's temperature. As the temperature of the sensor changes, the temperature is determined by measuring the corresponding change in resistance. (Refer to Table 6-5 for resistance values at different temperatures.)

Pt100 sensors are installed individually, one for each phase (the quantity can be adjusted based on customer requirements). Wire the system as shown in Figure 6-3.

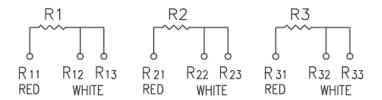


Figure 6.3 - Pt-100 Wiring Diagram

The alarm and trip temperatures for the motor's windings and bearings can be adjusted based on the customer's control scheme, but the trip temperatures must not exceed the values listed in Table 6.4.

Table 6.4 - Maximum Allowable	Temperatures for	Thermal Protection

	Temperature	Maximum allowable temperature (°F)			
-	rise	Alarms	Trips		
Winding	Class B	248	266		
	Class F	293	311		
Bearing	ALL	203	221		

Table 6.5 - I	Equivalence	between the	e Pt-100	resistance	and the to	emperature	(unit: O)

T			valence					•	•		T
Temp. °F	0	1.8 1	3.6 2	5.4 3	7.2 4	9 5	10.8 6	12.6 7	14.4 8	16.2 9	Temp °C
-58	80.31	79.91	79.51	79.11	78.72	78.32	77.92	77.52	77.12	76.73	-50
-40	84.27	83.87	83.48	83.08	82.69	82.29	81.89	81.50	81.10	80.70	-40
-22	88.22	87.83	87.43	87.04	86.64	86.25	85.85	85.46	85.06	84.67	-30
4	92.16	91.77	91.37	90.98	90.59	90.19	89.80	89.40	89.01	88.62	-20
14	96.09	95.69	95.30	94.91	94.52	94.12	93.73	93.34	93.95	92.55	-10
32	100.00	99.61	99.22	98.83	98.44	98.04	97.65	97.26	96.87	96.48	0
Δ°F	0	1.8	3.6	5.4	7.2	9	10.8	12.6	14.4	16.2	-
_	0	1	2	3	4	5	6	7	8	9	Δ°C
32	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51	0
50	103.90	104.29	104.68	105.07	105.46	105.85	106.24	106.63	107.02	107.40	10
68	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.29	20
86	111.67	112.06	112.45	112.83	113.22	113.61	114.00	114.38	114.77	115.15	30
104	115.54	115.93	116.31	116.70	117.08	117.47	117.86	118.24	118.63	119.01	40
122	119.40	119.78	120.17	120.55	120.94	121.32	121.71	122.09	122.47	122.86	50
140	123.24	123.63	124.01	124.39	124.78	125.16	125.54	125.93	126.31	126.69	60
158	127.08	127.46	127.84	128.22	128.61	128.99	129.37	129.75	130.13	130.52	70
176	130.90	131.28	131.66	132.04	132.42	132.80	133.18	133.57	133.95	134.33	80
194	134.71	138.88	135.47	135.85	136.23	136.61	136.99	137.37	137.75	138.13	90
212	138.51	142.67	139.26	139.64	140.02	140.40	140.78	141.16	141.54	141.91	100
230	142.29	146.44	143.05	143.43	143.80	144.18	144.56	144.94	145.31	145.69	110
248	146.07	150.22	146.82	147.20	147.57	147.95	148.33	148.70	149.08	149.46	120
266	149.83	153.96	150.58	150.96	151.33	151.71	152.08	152.46	152.83	153.21	130
284	153.58	157.70	154.33	154.71	155.08	155.46	155.83	156.20	156.58	156.95	140
302	157.33	161.43	158.07	158.45	158.82	159.19	159.56	159.94	160.31	160.68	150
320	161.05	165.14	161.80	162.17	162.54	162.91	163.29	163.33	164.03	164.40	160
338	164.77	168.65	165.51	165.89	166.26	166.33	167.00	167.37	167.74	168.11	170
356	168.48	172.54	169.22	169.59	169.96	170.33	170.00	171.07	171.43	171.80	180
Δ°F	0	1.8	3.6	5.4	7.2	9	10.8	12.6	14.4	16.2	-
-	0	1	2	3	4	5	6	7	8	9	Δ°C

#### 6.6.2 Thermistor

As the winding temperature increases, the resistance change of the device is minimal. However, beyond a certain temperature, it exhibits a positive thermal coefficient (PTC) characteristic, where the resistance changes increase significantly. These thermistors are typically used with a Relay Unit (or 'controller'), which disconnects the mains power. Therefore, it is essential to use a Relay Unit with the correct specifications.

Use three thermistors in series, one for each phase (the quantity and installation method can be adjusted based on customer requirements). Wire the system as shown in Figure 6-4.

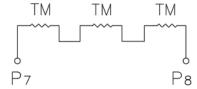


Figure 6.4 - Thermistor Wiring Diagram

Refer to the temperature-specific resistance values of the thermistors in Table 6.6 to set up the Relay Unit.

	Table 6.6 Resistance values by Thermister Temperature							
Temperature	Reference	Reference	Reference	Reference				
rise	Temperature	Temperature - 9°F	Temperature +9°F	Temperature +27°F				
	(°F)	(Ω)	(Ω)	(Ω)				
Class B	266	≤ 1650	≥ 3990	≥ 12000				
Class F	302	≤ 1650	≥ 3990	>12000				

Table 6.6 - Resistance Values by Thermistor Temperature

#### 6.6.3 Thermostat

Bimetals use 'B' contacts (normally closed contact), which are flat before current flows. When current passes through and the bimetal reaches a certain temperature, it bends and the contact opens.

Use three thermistors in series, one for each phase (the quantity and installation method can be adjusted based on customer requirements). Wire the system as shown in Figure 6-5.

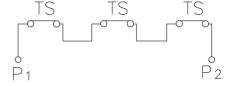


Figure 6.5-Thermostat Wiring Diagram

Refer to Table 6.7 Thermostat Operating Temperature

Table 6.7 - Thermostat Operating Temperatures

Temperature rise	Operating temperature (°F)	Return Temperature (Reference, °F)	Note
Class B	248±9	170.6±27	250 Vac
Class F	284±9	190.4±27	250 Vac

### 6.6.4 Space Heater

To protect motor windings from internal condensation and moisture during storage and after operation, a space heater is installed. Refer to Figure 6.6 below for the wiring diagram of the space heater.

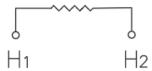


Figure 6.6 - Space Heater Wiring Diagram

Our space heaters use conductive carbon particles arranged in an infinite parallel circuit, rather than traditional resistance elements. It provides a self-regulating feature that adjusts heat output according to changes in ambient temperature. With this feature, an inrush current—ranging from 2 to 5 times the rated current—may occur for a few seconds when power is applied. This may cause a protective fuse to blow.

During cold winter conditions when the ambient temperature is low, a higher current may be drawn to generate a large amount of heat quickly. To address this, we recommend the following: Increase the fuse capacity, use a time-delay fuse, or replace the fuse with a circuit breaker designed for wiring.



Do not supply power to the space heater while the motor is operating.



Do not apply voltage or current exceeding the allowable limits for each accessory.

## 6.7 Start-up Method

As for start of the motor, DOL (direct on line) is recommended at rated voltage. However, if high staring current caused by DOL affects to the power source, you can use indirect starting method as it is compatible with voltage over load and motor to reduce starting current. Using a reduced voltage starter allows decrease in start torque of the motor, so please choose right starting way as refer to the below Table 6.8.

Besides, DOL is available through motor connection even you use different types of voltage starter.

Table 6.8 - comparison on voltage, starting torque, and current according to different starting methods.

Starting	method	Voltage	Starting Torque	Start Current
Full voltag	ge starting	100%	100%	100%
Y-∆St	arting	57.7%	33.3%	33.3%
Starting	80% TAP	80%	64%	64%
compensator	65% TAP	65%	42%	42%
(AUTO Tr.)	50% TAP	50%	25%	25%
	Resistance-start motor (general) (adjust 80% of previous voltage)		64%	80%
	50% TAP	50%	25%	50%
Reactors	45% TAP	45%	20%	45%
	37.5% TAP	37.5%	14%	37.5%

Note) The voltage, torque, and current is percentage value under DOL start at rated voltage

## 6.7.1 VFD (Variable Frequency Drive) Start

If the motor has to operate with variable frequency drive (VFD) for the purpose of efficiency, power factor control and other reasons, the operation has to comply with described standard according to NEMA MG1 Section 4 Part 31 and service condition as written on nameplate (voltage, current, frequency range, etc.).

When inverter is used, please conduct additional review on the following items to avoid burnout of motor

- (1) When it comes to VFD (variable frequency drive), it has to be chosen appropriately according to motor's power and power supply condition (e.g. Voltage, and current capacity, etc.).
- (2) We recommend an inverter switching frequency as a range from 2.5 kHz to 5 kHz. If you use excessively beyond the range, inverter noise can occur, so please reach to the inverter supplier (company) when you are faced the situation.
- (3) To prevent electric shock, the motor, VFD, metal conduit, and all metal parts have to be connected to grounded circuit.
- (4) If the motor and VFD has a distance between them, reflected wave results in increase of micro surge voltage, leading to the motor's breakdown; therefore, the VFD has to be placed close to the motor as much as possible. Cable distances are for reference only and can be further limited by hot and humid environments (refer Table 6.9). if the power lead distance is exceeded, appropriate protective measures must be taken to protect the motor, such as installing a surge filter.

Table 6.9 – Max. Cable distance from VFD output to motor (For reference only)

Switching Frequency	380V	460V	575V
2.5 kHz	220 ft	130 ft	50 ft
5 kHz	160 ft	100 ft	40 ft

- (5) Proper gauge, and the shortest length of conductor as much as possible are used, and metal conduit is used for construction. In addition, shielding of the conductors can reduce electromagnetic interference with other electronic equipment.
- (6) It is recommended that using different types of filter (e.g. dv/dt filter, common mode filter, etc.) on inverter to prevent the motor's breakdown and electrolytic corrosion on bearing derived from high level of surge voltage of inverter.
- (7) When you operate the motor with VFD, winding insulation is going to be weaken as the motor temperature climbs up due to harmonics. Also, do not operate beyond the operating frequency range indicated on the nameplate; because, operation under low frequency will increase the temperature due to lack of the motor's cooling capacity.
- (8) As to equipment operated with motor, it has its own resonant frequency; if the rotation speed is changed with VFD, the equipment can make loud vibration and noise at a junction(matching) point. Sometimes, it causes damage to the equipment. If the resonance cannot be avoided, there is an inverter's jump function possible to avoid the resonance as letting the inverter's output frequency (it is resonance frequency) moves up and down.
- (9) The output waveform of VFD, it is a power source based on pulse type unlike with commercial power source; due to the switching frequency making this waveform of the power source, it makes electronic noise of the motor. Noise reduction measures when using VFDs include changing the carrier frequency, attaching noise filters, and separating the power and control lines.

## **M** WARNING

- Always follow the VFD manufacturer's safety instructions before operating the motor with VFD. Even power is not provided to VFD, high AC and DC voltage exist in VFD. To keep away from damage to humans, refer to VFD operation instructions.
- Proper programming of VFD parameter is the most critical point. Read and understand the VFD manufacturer's instruction manual. Use the data on the motor nameplate. VFD programming should only be performed by qualified personnel.