

Safety Standards

The safety of the component parts is an important consideration in equipment design. However, a part-by-part analysis of component quality and design is too time consuming for design and quality personnel. To get around this problem, safety standards have been designed to assure component safety. The following section describes the safety standards with which Oriental Motor is concerned.

■ Safety Standards

● UL Standards (United States)



UL, or Underwriters Laboratories Inc., is a non-profit testing organization that was founded in 1894 by a group of American fire insurance companies.

Their aim was to prevent loss of human life and damage to property from fires and other hazards by ensuring that machinery, tools and materials were safe. To this end, UL developed a

variety of tests and research methods for machinery, tools and materials, which resulted in the compilation of the UL standards. These standards are used for common items such as electronic equipment, motor-powered devices and electronic parts. The most important aspect to the UL standards for a manufacturer is that legal provisions in many American states require that such products must have passed the relevant UL safety tests and be listed in the UL Directory before being offered for sale. Although some states do not explicitly require UL-listing by law, there are cases where insurers refuse to cover the risk of fire or damage caused by a product that is not UL-listed. This is almost equivalent to the legal sales restrictions in the other states, and under such circumstances the customer will obviously only purchase items that are UL-listed. For a product that is to be sold in the United States, recognition or listing by UL is recommended.

Also, UL has been accredited as a verification agency by the Standards Council of Canada (SCC) and is recognized by all Canadian provinces. Therefore, it is possible to have testing for Canadian safety standards performed at UL. Products that are recognized as conforming with Canadian safety standards can display the c-UL mark, and their sale and use is permitted in Canada.

● CSA Standards (Canada)



CSA stands for "Canadian Standards Association", a private, non-profit testing organization established after an inquiry by the Canadian government. To protect human life and property from fire hazard and accidents, provincial laws in Canada forbid the sale and use

of any electrical machinery, electrical parts, and so on, unless its safety has been confirmed by CSA. For this purpose, CSA has established standards detailing mandatory tests and requirements to ascertain component safety.

Also, the CSA has been accredited by the United States Occupational Safety and Health Administration (OSHA) as a national research and testing laboratory (NRTL) and is now able to undertake testing under American safety standards. Products that are recognized as conforming with American safety standards may display the CSA mark with NRTL added, and their sale and use is permitted in the United States.

● EN Standards (EU member states)



The European Union continues to coordinate the industrial and safety standards of individual member states under the aegis of the Council of European Standardization (CEN) and the Council of European Electrical Standardization (CENELEC). The unified standards for all of Europe are called the Harmonized Standards. The numbers for Harmonized Standards all begin with an "EN". EN standards apply

to the design and manufacture of products exported to the EU area. (IEC and VDE standards apply when an EN standard has not yet been enacted.)

Certification is given by private inspection organizations such as TÜV Rheinland, VDE and DEMKO. Qualifying products may display the various safety marks.

● Electrical Appliance and Material Safety Law



Effective April 1, 2002, Japan's Electrical Appliance and Material Control Law was revised and renamed the "Electrical Appliance and Material Safety Law". The purpose of the new law is to prevent the occurrence of danger and trouble resulting from electrical appliances and materials by

regulating the manufacture, sale and other activities involving electrical appliances and materials, while promoting the voluntary efforts of private businesses in order to ensure their safety. Accordingly, the authorizations (tests) and other safety checks, which under the old law were conducted directly by the government, have become the responsibility of the manufacturers, etc., which must now ensure the safety of their own products through the introduction of a third-party certification system. The Electrical Appliance and Material

Safety Law applies to the electrical appliances and materials generally used in homes, offices, etc. They are classified into two categories— "special electrical appliances and materials" and "products other than special electrical appliances and materials" –according to the level of danger they present. Special electrical appliances and materials are subject to compliance tests and the retention of compliance certificates performed/issued by the Japan Electrical Safety & Environment Technology Laboratories (JET) or other test laboratory certified (or approved) by the Ministry of Economy, Trade and Industry, and must also bear the diamond-shape PSE mark. Products other than special electrical appliances and materials must comply with the relevant technical standards and bear the circular PSE mark.

■ Standards for Motors and Fans

The following is a listing of the standards pertaining to electrical motors and fans.

● UL Standards

◆ UL1004: Electric Motors

Establishes general requirements for all types of electrical motors.

◆ UL2111: Overheating Protection for Motors

Establishes requirements for overheating protection for motors. Previously, requirements for impedance protected motors were established under UL519 while requirements for thermal protectors for motors were established under UL547. UL2111 was published on March 28, 1997, combining UL519 and UL547, and partially harmonizing C22.2 No. 77 (Motors with Inherent Overheating Protection) under the CSA standards.

◆ UL507: Electric Fans

Establishes general requirements for electrical fans and blowers that have an input voltage of 600V or lower. Note that motor parts of fans and blowers must also comply with requirements of UL2111 and UL1004.

◆ UL60950-1 (=IEC60950-1):

Safety of Information Technology Equipment

This standard covers information technology equipment, including electrical business equipment.s

● CSA Standards

◆ C22.2 No.100: Motors and Generators

Establishes general requirements for motors.

◆ C22.2 No.77: Motors with Inherent Overheating Protection

Establishes special requirements for motors with inherent overheating protection that supplement those of C22.2 No.100.

◆ C22.2 No.60950-1:

Safety of Information Technology Equipment

This standard covers information technology equipment, including electrical business equipment.

◆ C22.2 No.113: Fans and Ventilators

Establishes general requirements for fans.

● EN Standards

VDE, TÜV and DEMKO approved motors and fans are evaluated in accordance with the items required for motors under the following standards. Forty-eight hour humidity experiments are conducted in addition to experiments with motor and fan characteristics.

◆ EN60034 (= IEC60034, DIN VDE0530)

Rotating Electrical Machines

Stipulates general requirements for motors.

◆ EN60950-1 (= IEC60950-1)

Safety of Information Technology Equipment

This standard covers information technology equipment, including electrical business equipment.

● IEC Standards

Shown below are two standards for motors and fans under the IEC standards.

◆ IEC60034 (=DIN VDE0530)

Rotating Electrical Machines

Establishes general requirements for motors. There are over 20 parts, and IEC60034 covers some parts which are not yet published by EN60034.

◆ IEC60664 (=DIN VDE0110)

Insulation Coordination for Equipment within Low-Voltage-Systems

Stipulates insulation distances for motors.

■ Standards for Control Circuits

● UL Standards

◆ UL508: Industrial Control Equipment

This standard covers industrial control devices used to start, stop, regulate, control, or protect motors. This standard covers speed control packs.

◆ UL508C: Power Conversion Equipment

This standard covers equipment used to supply power to control motors activated by a frequency or voltage which is different than the input supply voltage. This standard covers drivers.

◆ UL1917: Solid-State Fan Speed Controls

These are standards for control of single-phase 300V max variable speed fans.

◆ UL60950-1 (=IEC60950-1)

Safety of Information Technology Equipment

This standard covers information technology equipment, including electrical business equipment.

● CSA Standards

◆ C22.2 No.14: Industrial Control Equipment

This standard covers industrial control equipment used to start, stop, regulate, control or protect motors. This standard covers speed control packs and drivers.

◆ C22.2 No.113: Fans and Ventilators

Establishes general requirements for fans.

● **EN and Other Standards**

The speed control packs and drivers approved by VDE, TÜV and DEMKO conform to the following standards.

◆ **EN60950-1 (=IEC60950-1)**

Safety of Information Technology Equipment

This standard covers information technology equipment, including electrical business equipment.

◆ **EN50178 (Overvoltage test, EMC excluded)**

Electric equipment for use in power installations

General regulation of electronic equipment that can be used in power facilities.

◆ **DIN VDE0160 (Overvoltage test, EMC excluded)**

Electric equipment use in electrical power installations and assembly into electrical power installations

This standard covers electric equipment use in electrical power installations and assembly into electrical power installations.

- JIS: Japanese Industrial Standards
National standards for Japanese mining and manufacturing industries.
- IEC: International Electrotechnical Commission
The IEC promotes unification and coordination of international standards on electrical and electronic equipment. IEC standards are issued with the ultimate goal of having individual countries reflect international standards within their own standards.
- DIN: Deutsches Institute für Normung e. V.
The German standards association. It's standards range from basic to wide-ranging standards that cover all industrial fields.
- VDE: Verband Deutscher Elektrotechniker e. V.
This German association of electrical engineers enacts safety standards for electricity that are issued as DIN-VDE standards.

■ **Safety Considerations and Tests**

A comparison of the items evaluated by various testing agency reveals that there are a few points of particular concern for motors and fans.

● **Construction**

◆ **Devices to Prevent Overheating**

UL, CSA, EN and IEC standards require that any equipment using a motor also possess a device to protect the motor from overheating which can be caused by overload, intentional or unintentional locking of the rotor, etc. All Oriental Motor approved products include impedance protection or thermal protectors in the motor (brushless DC motors excluded).

◆ **Insulation Materials**

Oriental Motor's motors and fans have class E insulation (World **K** Series, **V** Series, and **BH** Series have class B insulation). The insulation class indicates the division of heat-resistant grades, and is specified as shown in the table below by JIS C4003 (IEC60085).

Also, the insulation is certified as class E by EN/IEC standards (World **K** Series, **V** Series, and **BH** Series are class B) but recognized as class A by UL and CSA standards (World **K** Series, **V** Series, and **BH** Series are class B).

Table 1: Insulation Class and Temperature

Insulation Class	Maximum Temperature
Class Y	194°F (90°C)
Class A	221°F (105°C)
Class E	248°F (120°C)
Class B	266°F (130°C)
Class F	311°F (155°C)
Class H	356°F (180°C)

Table 2: Insulation Materials

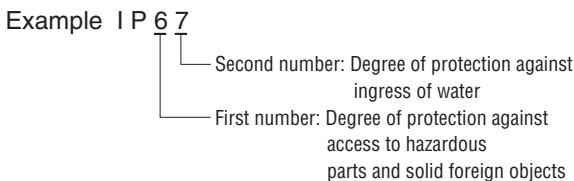
Safety Standard	Insulation Materials
Japanese Safety Standards for Electrical Equipment (Fans)	Insulation materials that are registered or temporarily registered with the Japan Electrical Equipment Laboratory, the material experiment organization for the Japanese Safety Standard for Electrical Equipment, and have been assigned a heat resistance grade of class E [248°F (120°C)] are used.
UL Standards (Motors) CSA Standards (Fans)	All grommets, lead wires and some slot insulations are approved products while all other insulation materials satisfy UL and CSA standard requirements.
EN Standards (Motors) IEC Standards (Fans)	The insulation materials satisfy EN and IEC standard requirements.

◆ **Minimum Spacing Between Live Materials**

To prevent accidents caused by short circuits between live materials or between live materials and user-accessible materials (normally not live materials), minimum spacing distances between such materials have been defined. All Oriental Motor products comply with the relevant requirements.

◆ **Degree of Protection**

IEC60529 and EN60034-5 (=IEC60034-5) classify the dust-resistance and waterproofing into grades. The test methods are shown below. A third-party certification body has certified that Oriental Motor's watertight motor **FPW Series** confirms to IP67.



An "X" is used when one of the two protection classes is not specified in the name (e.g., IPX5 or IP4X).

Table 3: Meanings of Markings and Testing Conditions

IP Code	Degree of protection against access to hazardous parts and against solid foreign objects	
First Number	Description	Definition and Test Conditions
IP0X	None	None
IP1X	Protection against approach by hands	Cannot be penetrated by a solid object 1.97 in. (50 mm) or more in diameter.
IP2X	Protection against approach by fingers	Cannot be penetrated by a solid object 0.79 in. (12 mm) or more in diameter.
IP3X	Protection against tips of tools, etc.	Cannot be penetrated by a solid object 0.09 in. (2.5 mm) or more in diameter.
IP4X	Protection against wire, etc.	Cannot be penetrated by a solid object 0.04 in. (1.0 mm) or more in diameter.
IP5X	Protection against dust	Cannot be penetrated by dust that could interfere with normal operation.
IP6X	Completely dust-proof design	Cannot be penetrated by dust

IP Code	Degree of protection against ingress of water	
Second Number	Description	Definition and Test Conditions
IPX0	None	None
IPX1	Protection against water drops falling vertically.	Water drops falling at a rate of 3 to 5 mm/min. from a height of 7.87 in. (200 mm) for 10 minutes.
IPX2	Protection against water drops falling vertically over a 15° range.	Water drops falling over a 15° range at a rate of 3 to 5 mm/min. from a height of 7.87 in. (200 mm) for 10 minutes.
IPX3	Protection against water drops falling vertically over a 60° range.	Water drops falling over a 60° range at a rate of 10 ℓ /min. from a height of 7.87 in. (200 mm) for 10 minutes.
IPX4	Protection from spray of water from all directions.	Water sprayed from all directions from a distance of 11.81 in. (300 mm) to 11.69 in. (500 mm) at a rate of 10 ℓ /min. for 10 minutes.
IPX5	Protection against jets of water from all directions.	Jets of water sprayed from a distance of 9.84 ft. (3 m) from all directions at a rate of 12.5 ℓ /min. at a pressure of 30 kPa for 3 minutes.
IPX6	Protection against strong wave-like jets of water.	Jets of water sprayed from a distance of 9.84 ft. (3 m) from all directions at a rate of 100 ℓ /min. at a pressure of 100 kPa for 3 minutes.
IPX7	Usable after immersion in water under fixed conditions.	Immersion to a depth of 3.3 ft. (1 m) for 30 minutes.
IPX8	Usable under water	Determined through cooperation between user and manufacturer.

◆ **Capacitor**

Capacitors, supplied with single-phase AC motors and fans, are approved separately from the motor or fan.

◆ **Motor Fan Protective Gear (Finger Guards)**

When a fan is used in a device, measures must be taken to protect people from harm.

Oriental Motor finger guards are designed to pass all tests stipulated under the UL Standards, CSA Standards and Japanese Safety Standards for Electrical Equipment when used on a compatible product. (Protective gear cannot be certified as stand-alone equipment, since it is used when installed on another product as an accessory.)

◆ **Plug Cord for Connecting Power Supply**

The optional plug cord that can be used with the **MU** Series of fans is recognized by UL (unlisted component) and certified by CSA. Also **PCA2B** is certified by JET.

● **Performance**

◆ **Temperature Test**

Test Item	Standard
	UL2111, CSA C22.2 No.77 (Class A/Class B)
Overload operation test for thermal-protected motor	Winding temperature is 284°F (140°C) /329°F (165°C) or less when temperature is stabilized and the thermal protector does not work with applying maximum load.
Locked-rotor temperature rise test for impedance-protected motor	Winding temperature is 302°F (150°C) /347°F (175°C) or less when a 72-hour locked-rotor test is performed at a test voltage of 120 V or 240 V (when rated voltages are 115 V or 230 V) with rated capacitor connected, rotor locked or capacitor short-circuited. No deterioration on insulation material of the windings after above test.
Locked-rotor temperature rise test for thermally-protected motor	Winding temperature is in the following range when 72-hour locked-rotor test is performed at a test voltage of 115 V or 240 V (when rated voltages are 115 V or 230 V) with rated capacitor connected. · Maximum temperature in first hour is 392°F (200°C) /437°F (225°C) or less. · Maximum temperature after one hour is 347°F (175°C) /392°F (200°C) or less. · Calculated average value of maximum temperature and minimum temperature after one hour is 302°F (150°C) /347° (175°C) or less.

- For winding temperature rise, Oriental Motor products are designed to meet the UL standard and CSA standard for Class A insulation. The insulation material is also a Class E heat-resistant grade under the Electrical Appliance and Material Safety Law (World **K** Series, **V** Series and **BH** Series are Class B).
- The following are tested by the Electrical Appliance and Material Safety Law:
 Rated operation: The constant winding temperature reached for rated operation must be no greater than 239°F (115°C).
 Rotor constraint protection performance: When the test piece is placed on a wooden table at least 10 mm thick and covered with gauze, and the constraint test is run at rated frequency and rated voltage until the temperature stabilizes, the test piece, wooden table and gauze must not burn and the insulation resistance at 500 V must be 0.1 MΩ min.
- Temperature tests are stipulated in the EN and IEC standards (Class E insulation. World **K** Series, **V** Series and **BH** Series are Class B). Oriental Motor products have all been certified to perform normally in these tests.

◆ **Endurance Test**

Test Item	Standard
	UL2111, CSA C22.2 No.77
Endurance test for impedance-protected motor	No deterioration on insulation material of windings when continuing the locked-rotor test for another 15 days after the aforementioned 72-hour locked-rotor test for a total of 18 days. (UL60950 required another 12 days, total 15 days locked-rotor test) a) No deterioration on insulation material of windings. b) The fuse in the grounding conductor shall not open. c) The motor shall still electrically operate.
Endurance test for thermal-protected motor	No deterioration on insulation material of windings when continuing the locked-rotor test for another 15 days after the aforementioned 72-hour locked-rotor test for a total of 18 days. a) No deterioration on insulation material of windings. b) The fuse in the grounding conductor shall not open. c) The motor shall still electrically operate.

- The UL and CSA standards cover the endurance tests as noted above. These rules were established to prevent motors and fans from burn-out when they are locked.
- All Oriental Motor approved products passed these tests. Our approved fans employ high-grade (V-0) non-flammable resins for the fan blades.
- Temperature tests are stipulated in the EN and IEC standards (Grade E insulation). Oriental Motor products have all been certified to perform normally in these tests.

◆ **Dielectric Voltage - Withstand Test**

All motors and fans are sufficient to withstand this test, which is carried out by applying the voltage listed in the table below between the motor case and lead wires, without insulation breakdown.


Test Item	Standard	Electrical Appliance and Material Safety Law	UL Standard	CSA Standard
Less than 150 V		1000 V 1 minute	60Hz, 1000 V, 1minute	60Hz, 1000 V, 1minute
Over 150 V		1500 V 1 minute	Common to impedance-protected and thermally-protected motors	Common to impedance-protected and thermally-protected motors


- The EN and IEC standards stipulate 1500 V for 1 minute.


Evidence of Product Approval


Approved Mark


The following marks are indicated on the nameplates of approved products.




- Japanese Safety Standards for Electrical Equipment Certified by Japan Electrical Safety & Environment Technology Laboratories 

- UL recognized component 

- Recognized to Canadian safety requirements under the component Recognition Program of Underwriters Laboratories Inc. 

- Recognized to Canadian Safety requirements and UL under the component Recognition Program of Underwriters Laboratories Inc. 

- CSA certified component 

- EN and IEC certified component (indicates that VDE, TÜV Rheinland or DEMKO has certified that the product meets EN or IEC standards.) 





Factory Inspection

Even after a product has been recognized or certified, UL and CSA inspectors verify continued compliance of products and manufacturing process with the relevant standards by regular visits to the factory.

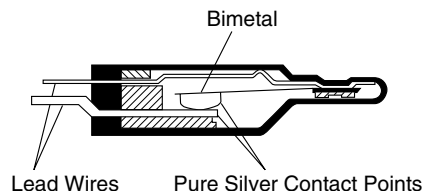
UL:	Four times a year	VDE:	Once a year
CSA:	Twice a year	DEMKO:	Once a year
TÜV:	Once a year	JET:	Once a year

Overheating Protection Devices

Overheating may be caused by overload, no load or extremely small load, intentional or unintentional locking of the rotor, or use in very high ambient temperatures. This results in a drastic shortening of the life of the insulation system or, in extreme cases, fire. To prevent degeneration of the insulation materials and burning out the windings as a result of overheating or rotor locking, Oriental Motor products approved by UL, CSA, EN and IEC standards are equipped with the following overheat protection devices.

Thermally Protected Motors

AC motors with a frame size of 2.76 in. sq. (70 mm sq.), 3.15 in. sq. (80 mm sq.), and 3.54 in. sq. (90 mm sq.), and AC fans **MRS** Series, **MB** Series [impeller dia. 3.15 in. (φ80 mm) or larger], and **MF** Series contain a built-in automatic reset thermal protector. The construction of a thermal protector is shown in the following figure.



The thermal protectors employ a bimetal contact, using pure silver. Pure silver has the lowest electrical resistance of all materials and has thermal conductivity second only to copper.

Operating temperature of thermal protector

- Open: 248°F±9°F (120°C±5°C) or 266°F±9°F (130°C±5°C)
- Close: 170.6°F±59°F (77°C±15°C) or 179.6°F±59°F (82°C±15°C)

Motor winding temperature where the thermal protector is working is slightly higher than the operating temperature listed above.

Impedance Protected Motors and Fans

Impedance protection is used in AC motors with frame sizes smaller than 2.36 in. sq. (60 mm sq), and AC fans **MU** Series, **MB** Series [impeller φ2.36 in. (φ60 mm) or smaller], and the **SMK** Series. Impedance protected motors are designed with higher impedance in the motor windings so that even if the motor locks, the increase in current (input) is reduced and temperature does not rise beyond a certain constant level.

Brushless DC Motors

The motor and driver are equipped with overloading and overheating protection features to control temperature rises by cutting off the input current from the driver to the motor when a malfunction occurs.

Stepping Motors

Stepping motors are designed with impedance protection in case they are stopped with five-phase excitation (with the rated current flowing).

DC Fans

These fans include solid state control circuitry that incorporates a limiting, current shut-down circuit, which controls the fan during locked rotor conditions.

■ CE Marking

To distribute equipment within the European Union, the CE marking is mandatory for certifying that the equipment complies with EC Directives (safety).

To obtain a ruling that the equipment satisfies the required items of each directive, the manufacturer must usually verify that the equipment complies with the EN standards applicable to the EC Directives or, if not available, with the IEC standards. The manufacturer then composes a declaration stating compliance with the directives and applies the CE marking.

(However, depending on the risk of danger, formal testing by an approving authority may be required and the self-composed declaration is then issued after receiving proof of formal testing.)

Products with a declaration of voluntary compliance have the following mark either on the nameplate or on the package label.



The major scope of compliance and period of obligation are as follows:

Machinery directives: 98/37/EC

Applicable to equipment with moving parts that could cause human injury. (Mandatory as of 1 January 1995)
89/392/EEC, 91/368/EEC, 93/44/EEC have been newly issued as 98/37/EC.

EMC directives: 89/336/EEC, 92/31/EEC

Applicable to equipment that could cause electromagnetic interference (EMI) and equipment that could be affected by electromagnetic interference (EMS). (Mandatory as of 1 January 1996)

Low voltage directive: 73/23/EEC

Applicable to equipment used with 50-1000 VAC or 75-1500 VDC. (Mandatory as of 1 January 1997)

● The Advantages of Approved Components

Under EC Directives, not all components in a device or piece of equipment have to be approved. However, when nonapproved components are used, the manufacturer of the equipment must evaluate and verify the safety of the component itself. If approved components are used, the manufacturer has the advantage of the benefits listed below:

- 1) Simplified component safety evaluation
- 2) Simplified documentation and testing when lodging equipment standards applications with an approving authority

● Oriental Motor's Approach to CE Marking

To ensure that the company's products comply with the low voltage directives, we have issued a declaration of voluntary compliance with the standards imposed by the approving authorities within the EU (or a declaration of voluntary compliance based on EN standard).

Our view is that the EMC Directives do not directly pertain to our products themselves since all of Oriental Motor sales are to equipment manufacturers. The controllers used in the

company's products and equipment, as well as equipment as a whole, including electrical components, are subject to the EMC Directives. Additionally, since the properties of equipment in relation to EMC Directives will vary depending upon the controller, electrical component configuration, wiring, general configuration and level of danger, clients should verify compliance with EMC Directives themselves. When a client is using our products in other equipment, Oriental Motor will provide methods such as adequately efficient filters and ferrite cores required by EMC measures. AC motors and AC fans are outside the range of applicability of EMC Directives because it has been judged both theoretically and experimentally that there is no influence on emissions or immunity. Also, DC fans that function alone conform to EMC Directives.

● Compliance ①

Oriental Motor's products have received the following VDE, TÜV Rheinland and DEMKO approval.

For the recognized or certified model name, see the list starting on page G-10.

* Refer to page G-2 for the details of applicable standards of Oriental Motor's recognized or certified products. Clients should inquire at their local Oriental Motor sales office when a copy of the company's product approval or declaration of voluntary compliance with the low voltage directives is required for lodging an application with approving authorities.

● Installation Conditions ②

The following installation conditions must be rigidly adhered to in order to ensure that products are used with greater safety.

- Over voltage: Category II (For AC input products)*
- Pollution Degree: Class 2 (Products with the protection class of IP54 can be used in pollution degree of class 3.)
- Protective Structure: It depends upon the models. See the following pages for details.

* For **BH** Series (with terminal box, single-phase 110 V/115 V, single-phase 220 V/230 V type) and **AXU** Series, Over voltage category: III

● Protection Against Electrocutation ③

Oriental Motor products are designed with Class I Equipment basic insulation. When being used, the following must always be observed:

- 1) Install products inside protective grounded enclosures so that they are out of the direct reach of users.
or
- 2) Always ground any product housing that is within the direct reach of users. Be sure to ground any product using the Protective Earth terminal.

Equipment with DC input is designed with Class III Equipment structure. The power should be supplied from the primary winding and a safety power supply with reinforced insulation.

①

● Generally, EN60204 applies to electricity in industrial equipment and EN60950 applies to electrical business equipment and information technology equipment. EN60204 satisfies the requirements of EN60034-1 (IEC60034-1) but, for the incorporation of equipment, EN60950-conforming motors can be handled likewise.

②

● Overvoltage Category*

This signifies the size of the shock produced at an input power terminal to which the equipment is directly connected.

Category **I** : Circuits, secondary circuits on transformers in industrial machinery, home appliances powered by commercial electrical power, office equipment and other power sources where major overvoltage is not produced.

Category **II** : Power supplies from primary circuits on transformers, general plant control panels and other power sources where major overvoltage is anticipated.

* The term "Installation Category" has been replaced with "Overvoltage Category".

● Pollution Degree

This signifies the level of pollution in the environment where the equipment can be used

Degree 1: No possibility of machine contamination through pollution because the environment is normally clean, dry and completely free of pollutant particles (inside packed with plastic, etc.)

Degree 2: Possible machine contamination through pollution due to the presence of charged particles with moderate pollutant forming tendencies (homes, offices, research laboratories).

Degree 3: Charged particles will contaminate machinery (boiler rooms and general plants).

In the event that the construction of the equipment creates internal pollution in equipment in a Degree 2 environment, that equipment must be designed to comply with a lower degree.

● Degree of protection (Degree of protection: signified by IP Code) This refers to the grade of dust-resistance and waterproofing of equipment (IEC60529).

Equipment can be given a higher IP grade by providing protection with an appropriate enclosure.

● Oriental Motor's motors have been assessed under EN60034-5 (IEC60034-5, IEC60529).

③

● Methods of protection against electrocution by equipment are divided into the following protection classes (Protection Class).

Class **I** Equipment:

Equipment with basic insulation and protective grounding for protection against electrocution; at sections where electrocution is a possible danger, protection against electrocution should be provided through protective grounding in case the basic installation is damaged.

Class **II** Equipment:

Equipment for which reinforced insulation or double insulation, consisting of the basic insulation plus extra insulation, is used as an added precaution. Therefore, there is no protective grounding as in Class **II** equipment.

Class **III** Equipment:

Equipment for which all the power is fed from a SELV circuit. Therefore, no danger of electrocution exists.