

NEMA Standards Publication

*A Brief Comparison of
NEMA 250—Enclosures for Electrical Equipment (1000 Volts Maximum)
and
IEC 60529—Degrees of Protection Provided by Enclosures (IP Code)*

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Section 1 GENERAL

1.1 WHAT IS IEC 60529 AND WHAT DOES IT COVER?

IEC 60529 is a standard developed through the International Electrotechnical Commission (IEC) that describes a system for classifying the degrees of protection provided by an enclosure. An “enclosure” as used in 60529 is “a part providing protection of equipment against certain external influences and in any direction protection against direct contact.” As such, 60529 may be applied to products other than just metal or polymeric enclosures for electrical equipment for particular environmental conditions as covered by NEMA 250. (For example: An individual circuit breaker, switch, contactor, etc. may have an IEC 60529 IP rating. Until it is enclosed in a metal or polymeric enclosure, NEMA 250 would not apply.)

1.2 WHAT IS NOT COVERED BY IEC 60529?

IEC 60529 is NOT a “product standard” and does not cover enclosure requirements **other than** the “degree of protection” provided. For instance IEC 60529 does not specify the corrosion protection and other environmental operating requirements and tests defined in NEMA 250.

1.3 WHAT DOES “DEGREE OF PROTECTION” MEAN IN IEC 60529?

“Degree of protection” is a term used in the standard to describe the following:

- the protection of persons against access to hazardous parts inside the enclosure;
- the protection of the equipment inside the enclosure against ingress of solid foreign objects;
- the protection of the equipment inside the enclosure against harmful effects due to the ingress of water.

Section 2 IP CODE

2.1 WHAT IS AN “IP CODE?”

The IP Code is a designation that indicates the level, or amount, of the protection. The IP Code designation consists of the letters IP (International Protection) followed by two numerals.

2.2 WHAT DOES THE FIRST NUMERAL OF AN IP CODE INDICATE?

The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons having access to hazardous parts and with respect to solid foreign objects entering the enclosure. The first number specifies the following as described in Table 2–1:

**Table 2–1
IEC 60529 DEGREES OF ACCESS
TO HAZARDOUS PARTS, FIRST CHARACTERISTIC NUMERAL**

First Characteristic Numeral	With Respect to Persons	With Respect to Solid Foreign Objects
0	Non-protected.	Non-protected.
1	Protected against access to hazardous parts with the back of a hand.	Protected against solid foreign objects \geq 50 mm diameter.
2	Protected against access to hazardous parts with a finger.	Protected against solid foreign objects \geq 12.5 mm diameter.
3	Protected against access to hazardous parts with a tool.	Protected against solid foreign objects \geq 2.5 mm diameter.
4	Protected against access to hazardous parts with a wire.	Protected against solid foreign objects \geq 1.0 mm diameter.
5	Protected against access to hazardous parts with a wire.	Dust-protected (Dust shall not penetrate in quantity to interfere with satisfactory operation of the apparatus or to impair safety).
6	Protected against access to hazardous parts with a wire.	Dust-tight (No ingress of dust).

2.3 WHAT DOES THE SECOND NUMERAL OF AN IP CODE INDICATE?

The second characteristic numeral indicates the degree of protection provided by the enclosure with respect to the harmful ingress of water. The second number specifies the following as described in Table 2–2:

**Table 2–2
IEC 60529 DEGREES OF PROTECTION
AGAINST WATER INGRESS, SECOND CHARACTERISTIC NUMERAL**

Second Characteristic Numeral	With Respect to the Harmful Ingress of Water
0	Non-protected.
1	Protected against vertically falling water drops.
2	Protected against vertically falling water drops when enclosure tilted up to 15°.
3	Protected against spraying water.
4	Protected against splashing water.
5	Protected against water jets.
6	Protected against powerful water jets.
7	Protected against the effects of temporary immersion in water.
8	Protected against the effects of continuous immersion in water.

Section 3

NEMA ENCLOSURE TYPE RATINGS/ IEC ENCLOSURE CLASSIFICATION DESIGNATIONS

3.1 IF A REQUIREMENT FOR AN ENCLOSURE TYPE IS SPECIFIED, CAN AN EQUIVALENT IP RATED ENCLOSURE BE SUBSTITUTED?

NO! The IP Code only addresses requirements for protection of people, ingress of solid objects, and ingress of water. There are numerous other requirements covered by the Type designations that are not addressed by the IEC 60529/IP Codes. IEC 60529 does not specify the following:

- Construction requirements
- Door and cover securement
- Corrosion resistance
- Effects of icing
- Gasket aging and oil resistance
- Coolant effects

The Type designation specifies requirements for these additional performance protections. For this reason, the IEC enclosure IP Code designations cannot be converted to enclosure Type numbers.

3.2 CAN A SPECIFICATION FOR AN IP CODE BE MET BY USING A TYPE ENCLOSURE?

Possibly! Table 3–1 shows a matrix of the NEMA Type and IP Code designations for enclosures. This table provides a summary of the NEMA Type Enclosure Ratings that exceed the specification requirements for the respective IEC IP Code designations. This Table was created after a detailed review of each test requirement specified for a particular NEMA Type number, versus the test requirements specified for each IP Code. As previously stated, Table 3–1 cannot be used to convert from IEC IP Codes to enclosure Type numbers.

3.3 WHAT VALID USAGE EXISTS FOR IP CODES IN NORTH AMERICA?

NEMA 250 is a product standard that addresses many aspects of enclosure design and performance requirements; IEC 60529 addresses only the degree of enclosure protection provided. As such an IP Code can only be used to supplement the NEMA Type designation; it cannot necessarily be used instead of a required NEMA Type designation.

Two examples illustrate this point:

Example #1: An enclosure meets all the requirements for a NEMA Type 4X rating and can be marked by an appropriate label. If the enclosure additionally meets the requirements for IP 56, it is appropriate to claim IP 56 compliance for the enclosure.

Example #2: If a compartment within a NEMA Type 1 rating has been evaluated for compliance with the “finger protection” requirements of IEC 60529, it would be appropriate to claim IP 20 compliance for that compartment in addition to the NEMA Type 1 designation for the overall enclosure.

**Table 3-1
CONVERSION OF NEMA ENCLOSURE TYPE RATINGS TO IEC 60529 ENCLOSURE CLASSIFICATION DESIGNATIONS (IP)
(CANNOT BE USED TO CONVERT IEC CLASSIFICATION DESIGNATIONS TO NEMA TYPE RATINGS)**

IP First Character	NEMA Enclosure Type														IP Second Character	
	1	2	3	3R	3S	4	4X	5	6	6P	12	12K	13			
IP ₀	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	IP ₀
IP ₁	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	IP ₁
IP ₂	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	IP ₂
IP ₃			■	■	■	■	■	■	■	■	■	■	■	■	■	IP ₃
IP ₄				■	■	■	■	■	■	■	■	■	■	■	■	IP ₄
IP ₅					■	■	■	■	■	■	■	■	■	■	■	IP ₅
IP ₆								■	■	■	■	■	■	■	■	IP ₆
										■	■	■	■	■	■	IP ₇
																IP ₈
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B

A = A shaded block in the “A” column indicates that the NEMA Enclosure Type exceeds the requirements for the respective IEC 60529 IP First Character Designation. The IP First Character Designation is the protection against access to hazardous parts and solid foreign objects.

B = A shaded block in the “B” column indicates that the NEMA Enclosure Type exceeds the requirements for the respective IEC 60529 IP Second Character Designation. The IP Second Character Designation is the protection against the ingress of water.

EXAMPLE OF TABLE USE

An IEC IP 45 Enclosure Rating is specified. What NEMA Type Enclosures meet and exceed the IP 45 rating?

Referencing the first character, 4, in the IP rating and the row designated “IP4_” in the leftmost column in the table; the blocks in Column “A” for NEMA Types 3, 3S, 4, 4X, 5, 6, 6P, 12, 12K and 13 are shaded. These NEMA ratings meet and exceed the IEC protection requirements against access to hazardous parts and solid foreign objects. Referencing the second character, 5, in the IP rating and the row designated “IP_5” in the rightmost column in the table; the blocks in Column “B” for NEMA Types 3, 3S, 4, 4X, 6 and 6P are shaded. These NEMA ratings meet and exceed the IEC requirements for protection against the ingress of water. The absence of shading in Column “B” beneath the “NEMA Enclosure Type 5” indicates that Type 5 does not meet the IP 45 protection requirements against the ingress of water. Likewise the absence of shading in Column “B” for NEMA Type 12, 12K and 13 enclosures indicates that these enclosures do not meet the IP 45 requirements for protection against the ingress of water. Only Types 3, 3S, 4, 4X, 6 and 6P have both Column “A” in the “IP4_” row and Column “B” in the “IP_5” row shaded and could be used in an IP45 application.

The NEMA Enclosure Type 3 not only meets the IP 45 Enclosure Rating, but also exceeds the IEC requirements because the NEMA Type requires an outdoor corrosion test; a gasket aging test; a dust test; an external icing test; and no water penetration in the rain test. Slight differences exist between the IEC and NEMA test methods, but the IEC rating permits the penetration of water if “it does not deposit on insulation parts, or reach live parts.” The IEC rating does not require a corrosion test; gasket aging test; dust test or external icing test. Because the NEMA ratings include additional test requirements, this table cannot be used to select IP Designations for NEMA rated enclosure specifications.

IEC 60529 specifies that an enclosure shall only be designated with a stated degree of protection indicated by the first characteristic numeral if it also complies with all lower degrees of protection. Furthermore IEC 60529 states that an enclosure shall only be designated with a degree of protection indicated by the second characteristic numeral if it also complies with all lower degrees of protection up to and including the second characteristic numeral 6. An enclosure designated with a second characteristic numeral 7 or 8 only is considered unsuitable for exposure to water jets (designated by second characteristic numeral 5 or 6) and need not comply with requirements for numeral 5 or 6 unless it is dual coded. Since the IEC protection requirements become more stringent with increasing IP character value up through 6, once a NEMA Type rating meets the requirements for an IP designation up through 6, it will also meet the requirements for all lower IP designations. This is apparent from the shaded areas shown in the table.

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