



Equipment Enclosure Classifications

White Paper 62
Revision 1

Life Is On



Equipment Enclosure Classifications

Similarities and Differences between Global Enclosure Standards

Transfer switches are available with various types of enclosures designed for indoor or outdoor use. Selecting the most appropriate enclosure type helps ensure that a transfer switch will provide reliable performance for its designed service life. This document summarizes the similarities and differences between global enclosure standards.

INDUSTRY STANDARDS

Three principle standards specify requirements for enclosures used with transfer switch equipment. International Electrotechnical Commission (IEC) *International Standard 60529 — Degrees of Protection Provided by Enclosures* sets forth design and test standards that are used in many regions of the world, including European, Mideastern, and Asian nations. National Electrical Manufacturers Association *NEMA 250 — Enclosures for Electrical Equipment (1000 Volts Maximum)* sets forth design and test standards that are used in North America, certain countries in Central and South America, and other select locations. Underwriters Laboratories *UL 50 — Enclosures for Electrical Equipment, Non-Environmental Considerations* and *UL50E — Enclosures for Electrical Equipment, Environmental Considerations* contains additional testing provisions, and is used in similar market regions. Certain topics are addressed by all three standards, including (1) protection of persons from hazards inside enclosures, (2) protection of equipment from ingress of objects including dust, and (3) protection from water ingress or its effects.

NEMA 250 and UL 50/50E both address environmental characteristics that are not covered by IEC 60529. The NEMA and UL standards have similar, although not identical, definitions and provisions. Each of the two documents also provides standards for enclosure construction, which IEC 60529 does not do. As a result, an IP code cannot be said to be equivalent to any NEMA 250 or UL 50/50E-type equipment. The scope of each standard is further compared in Table 1.

Table 1: Scope of Enclosure Standards

Characteristic	IEC 60529	NEMA 250	UL 50/UL 50E
Protection from Human Contact	X	X	X
Protection from Solids Ingress	X	X	X
Protection from Water Ingress	X	X	X
Environmental Requirements			
Design Requirements		X	X
Construction Requirements		X	X
Mechanical Impact		X	X
Sheet Metal Thickness		X	X
Gasket Aging		X	X
Oil Resistance		X	X
Materials/Finishes/Corrosion Resistance		X	X
Third-Party Oversight			
Third-Party Laboratory Testing			X
Third-Party Factory Inspection			X
Third-Party Field Inspection			X

While the scope of NEMA 250 and UL 50/50E are similar, they differ in application. NEMA 250, like IEC 60529, does not require equipment manufacturers to obtain independent testing services. This enables manufacturers to self-declare compliance. As a result, manufacturers may interpret and implement aspects of the standards differently.

UL 50/50E requires testing, factory inspection, and field inspection of equipment directly by UL or a UL-approved laboratory or representative. As a result, UL Listings may leave fewer matters to interpretation by manufacturers, and to the authorities that permit electrical projects and approve electrical installations. ASCO primarily supplies UL 50-Listed enclosures because they are subject to third-party testing and inspection requirements. Consequently, NEMA 250 standards will not be further assessed in this document.

IEC ENCLOSURE IP CODES

IEC 60529 addresses protection from ingress of solid objects and water. Classification codes are thus comprised of the letters “IP” (International Protection) plus two numerals. These numerals represent degrees of protection against entry of solid objects and water into an enclosure, as shown in Figure 1. Additional letters can be appended for specific characteristics.

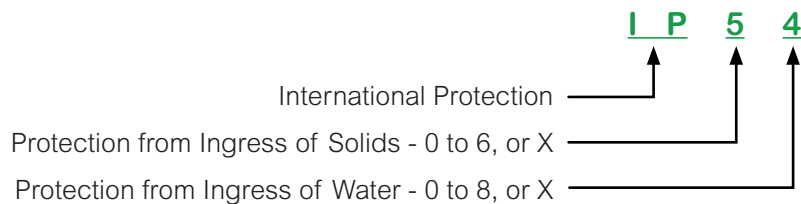


Figure 1: IP Code Key

First Numeral – Solids

The first IP code numeral indicates the extent to which the equipment is protected from both solid objects and persons. Where applicable, “X” can be used to designate that category as unassigned. Meanings and specifications for the first numeric position are shown in Table 2 below.

Table 2: Key to First IP Character		
Numeral	Protection of Equipment Against Ingress of Solid Foreign Objects and Hazardous Parts	
	Meaning	Specification
0	Not Protected	-
1	≥ 50 mm Dia.	An access probe sphere of 50 mm dia. shall not penetrate and shall have adequate clearance for hazardous parts
2	≥ 12.5 mm Dia.	An access probe sphere of 12.5 mm dia. shall not penetrate and shall have adequate clearance for hazardous parts
3	≥ 2.5 mm Dia.	An access probe sphere of 2.5 mm dia. shall not penetrate and shall have adequate clearance for hazardous parts
4	≥ 1 mm Dia.	An access probe sphere of 1 mm dia. shall not penetrate and shall have adequate clearance for hazardous parts
5	Dust-Protected	Ingress of dust not totally prevented, but dust shall not interfere with operation or impair safety
6	Dust-Tight	No ingress of dust

Second Numeral – Water

The second numeral indicates the extent to which the equipment is protected from water ingress. Meanings and specifications for the second IP numeric position are shown in Table 3 below.

Table 3: Key to Second IP Character		
Numeral	Protection of Equipment Against Ingress of Water	
	Meaning	Specification
0	Not Protected	-
1	Vertically Dripping	Vertically falling drops shall have no harmful effects
2	Dripping (15 Degrees Tilted)	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15 degrees on either side of vertical
3	Spraying	Water sprayed at an angle of up to 60 degrees on either side of vertical shall have no harmful effects
4	Splashing	Water splashed against the enclosure from any direction shall have no harmful effects
5	Jetting	Water projected in jets from any direction against the enclosure shall have no harmful effects
6	Powerful Jetting	Water projected in powerful jets from any direction against the enclosure shall have no harmful effects
7	Temporary Immersion	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time
8	Continuous Immersion	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions that shall be agreed to between the manufacturer and user but which are more severe than numeral 7

The IEC standard further provides test methods and conditions. Manufacturers may use the results to declare an IP code for an enclosure, indicating distinct first and second characters to describe protections from solids and water, respectively.



UL 50 ENCLOSURE TYPES

UL 50 uses “Types” to define and classify the protective characteristics of enclosures. These are described as follows.

Definitions and Uses

Every UL Type provides a degree of protection against inadvertent human contact with hazardous equipment components. The differing attributes of UL 50/50E enclosure types for indoor and outdoor applications are shown in Table 4 below. A type is assigned following testing by UL or in a UL-authorized laboratory.

Table 4: UL Types		
Type	Provides a degree of protection against:	Useful for:
1	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt) 	Primarily prevents incidental human contact with enclosed equipment in indoor environments.
2	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt) Ingress of water (dripping and light splashing) 	Drip tight. Useful where water condensation may be present in indoor environments.
3, 3X*	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and windblown dust) Ingress of water (rain, sleet, and snow) External ice formation 	Weather-resistant indoor or outdoor enclosures that protect against windblown, rain, sleet, snows, and dust and is undamaged by ice formation. Useful for UL 508 industrial control panels, lighting controls, and power distribution equipment and switchgear
3R, 3RX	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt) Ingress of water (rain, sleet, and snow) External ice formation 	Similar to 3 above, but <i>without</i> protection for windblown dust
3S, 3SX	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and windblown dust) Ingress of water (rain, sleet, and snow) External mechanism(s) remain operable when ice-laden 	Similar to 3 above. Operable when ice-laden
4, 4X	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and windblown dust) Harmful effects to equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose-directed water) External ice formation 	Watertight indoor enclosures for use where equipment is cleaned using water spray
5	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and settling airborne dust, lint, fibers, and flyings) Harmful effects to equipment due to the ingress of water (dripping and splashing) 	Dust-tight. Provides gaskets or other features to exclude dust
6, 6P	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt) Ingress of water (rain, sleet, snow, hose-directed water, and submersion at a limited depth) External ice formation 	Submersible in water or oil for temporary (6) or occasional prolonged (6P) durations
12**/ 12K***	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and settling airborne dust, lint, fibers, and flyings) Harmful effects to equipment due to the ingress of water (dripping and light splashing) Light splashing and consequent seepage of oil and noncorrosive coolants 	General purpose, dust and oil-resistant, indoor enclosures that pass tests for dripping noncorrosive liquids, dust and corrosion resistance
13	<ul style="list-style-type: none"> Ingress of solid foreign objects (falling dirt and circulating dust, lint, fibers, and flyings) Harmful effects to equipment due to the ingress of water (dripping and light splashing) Spraying, splashing, and seepage of oil and non-corrosive coolants 	General purpose indoor enclosures that pass tests for spraying noncorrosive liquids, including coolants, oil exclusion, and corrosion resistance

*X indicates added corrosion resistance ** With knockouts *** Without knockouts



Of the various UL 50 types, Type 1 and Type 12 enclosures are used most often for indoor applications, and Types 3R, 3RX, 4, and 4X are prevalent in outdoor use. These are the enclosure types that ASCO offers for its UL 1008-listed transfer switches. Their key characteristics are summarized in Table 5.

Table 5: Attributes of Commonly Used UL 50 Types

Environmental Condition	1	3R	3RX	4	4X	12
Incidental Contact	X	X	X	X	X	X
Rain, Snow, Sleet	-	X	X	X	X	-
Falling Dirt	X	X	X	X	X	X
Windblown Dust	-	-	-	X	X	-
Falling Liquid, Light Splashing	-	X	X	X	X	X
Dust, Lint, Fibers, Flyings	-	-	-	X	X	X
Hose-Down	-	-	-	X	X	-
Hose-Down & Splashing Water	-	-	-	X	X	-
Oil and Coolant Seepage	-	-	-	-	-	X
Corrosive Agents	-	-	X	-	X	-

Comparing IP Codes to UL Types

A number of organizations have published information equating UL or NEMA types to prospective IP codes. Many of these equivalency documents are produced by equipment vendors and offer differing assessments. Manufacturers may have sufficient application expertise to produce equivalency information about their particular products. However, technical exceptions in the standards and potential differences in interpretation prevent ASCO from making broad generalizations about UL/IEC equivalencies for protection from soils and water. ASCO does, however, test certain of its products to IEC 60529 standards. In addition, transfer switches can be provided without enclosures so that users can mount them in enclosures of their own choosing.

Because UL 50 evaluates properties that are not addressed or tested under IEC 60529, it is not possible to equate an IP code to a particular UL Type. Comparing UL 50 types to IP ratings shows that Type 4 enclosures can equal or surpass the ingress protection rating requirement for IP30, IP43, IP51, IP54, IP55, and IP65. In addition, UL50 Type 12 enclosures can equal or surpass the ingress protection rating requirement for IP30, IP43, IP51, IP54, IP55, and IP65. Nevertheless, a manufacturer's authorized representative should always be consulted to confirm the suitability of enclosure classifications for specific applications.

APPLICATION NOTES

Materials

The above listed enclosure types address most applications. Nevertheless, manufacturers may offer enclosures in more than one material. While cold rolled steel is suited for several enclosure types, Type 3RX and Type 4X stainless steel enclosures are available in Type 304 or Type 316 grade steel. The less expensive Type 304 steel is suited for many outdoor applications. Type 316 stainless steel can provide the best protection when ATSs will be located in coastal marine environments, at sites near roadways where seasonal deicing salts are used, and at industrial facilities where corrosive chemicals are present.

Some enclosures are available in aluminum, fiberglass, or other materials. These offer various levels of resistance to solvents, alkalis, and acids, and may be suitable for facilities where such substances are used.

Ventilation

High-capacity transfer switches may generate heat in amounts that require ventilated enclosures. Providing ventilation can impact the selection of an enclosure type. In some instances, other provisions may become necessary, such as placing the equipment in a shed or other protective shelter. Consult a qualified manufacturer's representative when evaluating enclosures for high-amperage equipment.

Placement in Lineups

Some types of electrical equipment are placed in lineups of connected enclosures can impact the selection of an enclosure type. However, the holes and hardware necessary to connect adjacent enclosures offer potential pathways of water ingress. Without further protective measures, these connective features would render outdoor-rated enclosures noncompliant with their type definitions. Consequently, equipment lineups are typically constructed only where UL 50 Type 1 and 3R enclosures can be used.

Secure Enclosures

When transfer switches are deployed outdoors, exposure to sunlight and its associated heat gain are sometimes overlooked. For equipment with single-door construction, displays and controls can be degraded by ultraviolet radiation and other environmental elements. In addition, unprotected displays and controls that are accessible to passersby can present a security risk. Specifying locking "door-over-door" enclosures can limit environmental exposures and reduce risks of inadvertent contact, operation, and vandalism. Learn more in our white paper entitled [Selecting Secure Enclosures to Protect Equipment from Ultraviolet Radiation](#).



Figure 2: A three pole, 2000 Amp transfer switch in a ventilated Type 3R enclosure.



Figure 3: A four pole, 1000 Amp transfer switch in a Type 1 enclosure.

SUMMARY

IEC 60529 and UL 50 each address protection of persons from hazards inside enclosures and protection of equipment from ingress of objects and water. Because UL Types encompass characteristics that are not addressed by IP Codes, overall equivalencies are difficult to generalize. Only the UL standards require third-party testing or verification of products in laboratory, manufacturing, and field settings.

Of the available UL Types, six meet the needs of common ATS applications. Specifying particular materials and configurations can increase the suitability of an enclosure for a specific application and improve the durability and security of transfer switch equipment.

REFERENCES

International Electrotechnical Commission, *International Standard 60529 - Degrees of Protection Provided by Enclosures*, Edition 2.1, 2001-02

National Electrical Manufacturers Association, *NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)*, 2014

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