

Enclosure Types acc. to NEMA/UL

- Overview and Definitions
- Degrees of Protection and Rules
- Comparison of “IP” and “Enclosure Type Ratings”?
- Detailed “Enclosure Type Rating”

Overview and Definitions

IP vs. enclosure types

IP – degree of protection (IEC)

International Protection (DIN)

Ingress Protection (intl.)

1. Figure: protection against contact and foreign bodies
2. Figure: protection against water

Details

In principle:

The higher the digits, the higher the level of protection

Enclosure types (UL)

Sometimes also called “NEMA type”.
NEMA is, however manufacturer-dependent, whereas
UL is manufacturer-**in**dependent

Every degree of protection is characterized by special protective features

In principle:

A high enclosure type does not automatically mean a higher level of protection

Enclosure Types acc. to UL

The rating code of enclosure types cannot be systematically encoded. Instead, every digit/letter is assigned to a defined degree of protection.

Sub-categorization of the enclosure ratings for

- **non-hazardous locations:**

- Acc. to UL50 / UL50E
- Type Ratings for **Indoor use**: 1, 2, 5, 12, 12K, 13
- Type Ratings for **Outdoor use**: 3, 3R, 3S, 4, 4X, 6, 6P

- **hazardous locations (classified locations):**

- Type 7: Indoor -- Class I; Group A, B, C or D
- Type 8: Indoor / Outdoor -- Class I; Group A, B, C or D
- Type 9: Indoor -- Class II; Group E, F or G
- Type 10: Mine safety and Health administration (30 CFR, Part 18.)
- Classification acc. NEC 2011

Attention: A higher digit does not automatically mean a higher level of protection but implies other protective features !

Overview and Definitions

Enclosure types in acc. with NEC / NFPA

- Every component being mounted to an enclosure or through the enclosure sheet must have the same rating as the enclosure or a “better” rating
- If devices with “lower” ratings are used, the rating of the entire industrial control panel is identical to the “lowest” rating of all devices applied
- If devices are used which do not provide for an enclosure rating, the rating of the entire industrial control panel is type 1
- Some ratings can be compared to IP degrees of protection

Attention:

IP degrees of protection can never be converted to UL enclosure type ratings !

UL Enclosure Type Ratings may need further additional tests which are not covered by the possible IP degrees of protection

Degrees of Protection and Rules

Comparison of enclosure types versa IP-Degree

UL guideline, chapter 5.2

UL / NEMA		Installation site (typical application)	Comparable IP degree of protection
Type	Properties		
1	General use	Indoors	IP 20
2	Protection against dripping water	Indoors	IP 20
3R	Rain, hail, ice	Outdoors (starter for pump)	IP 54
4	Dust-tight, water-tight	Indoors outdoors (food industry)	IP 65
4x	Water-tight, corrosion-resistant	Indoors, outdoors (sewage plants, fertilizer production)	Not available
12	Drip-tight, dust-tight, oil- and cooling water-tight	Indoors (machine tools)	IP 54 (IP 55)
13	Drip-tight, dust-tight, oil- and cooling water-tight	Indoors (commanding devices on machine tools)	IP 54+

Attention: NEMA ratings may be converted to IP degrees of protection, however, IP degrees of protection cannot be converted to NEMA ratings!

Degrees of Protection and Rules

UL50E (UL50) Enclosure Type Rating for general applications



Provides a degree of protection against the following environmental conditions	Type of enclosure												
	1 ^a	2 ^a	3	3R ^a	3S	4	4X	5	6	6P	12	12K	13
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X	X	X	X
Dripping and light splashing of non-corrosive liquids		X	X	X	X	X	X	X	X	X	X	X	X
Rain, snow, and sleet ^b			X	X	X	X	X		X	X			
Rain, snow, and sleet ^c					X								
Circulating dust, lint, fibers, and flyings ^d			X		X	X	X		X	X	X	X	X
Settling airborne dust, lint, fibers, and flyings ^d			X		X	X	X	X	X	X	X	X	X
Windblown dust			X		X	X	X		X	X			
Hosedown and splashing water						X	X		X	X			
Oil and coolant seepage											X	X	X
Oil or coolant spraying and splashing													X
Corrosive agents							X			X			
Occasional temporary submersion									X	X			
Occasional prolonged submersion										X			

^a These enclosures may be ventilated.
^b External operating mechanisms are not required to be operable when the enclosure is ice covered.
^c External operating mechanisms are operable when the enclosure is ice covered. See 8.5.2.
^d These fibers and flyings are nonhazardous materials and are not considered Class III type ignitable fibers or combustible flyings. (For Class III type ignitable fibers or combustible flyings, see the Canadian Electrical Code, Part I, Section 18, the National Electrical Code, Article 500, or Mexico's NOM-001-SEDE, Electrical Installations (utility), Article 500.

UL 50E valid in the field of:

- CEC (CSA22.1) - NEC;
- NOM-001-SEDE

Valid for general applications at non-hazardous locations

Degrees of Protection and Rules

Openings in enclosures with enclosure type >1

Enclosure type (Column 1)	Openings are able to be closed by equipment marked (Column 2)
2 ^a	2, 3, 3R, 3RX, 3S, 3SX, 3X, 4, 4X, 5, 6, 6P, 12, 12K, 13, "Wet Location", or "Raintight"
3	3, 3S, 3SX, 3X, 4, 4X, 6, 6P
3R ^b	3, 3R, 3RX, 3S, 3SX, 3X, 4, 4X, 6, 6P, "Wet Location," or "Raintight"
3RX	3RX, 3SX, 3X, 4X
3S ^c	3, 3S, 3SX, 3X, 4, 4X, 6, 6P
3SX ^c	3SX, 3X, 4X
3X	3SX, 3X, 4X
4	4, 4X, 6, 6P
4X	4X
5	3, 3R, 3RX, 3S, 3SX, 3X, 4, 4X, 5, 6, 6P, 12, 12K, 13, "Wet Location," or "Raintight"
6	6, 6P
6P	6P
12, 12K	12, 12K, 13
13	13

^a Type 1 components, ventilation openings, or observation windows are able to be installed when their profile outside the enclosure is completely protected by the drip shield from water dripping vertically downward from above.

^b Components marked "Weatherproof" or "Rainproof" are able to be installed below all other live parts within the enclosure.

^c Components with external operating mechanisms shall be Type 3S or 3SX for use on a Type 3S enclosure, or Type 3SX for use on a Type 3SX enclosure.

Note:

Column 2 shows the required enclosure type for the device/component, which is provided for the opening.

Note: Table 19.2 acc. to UL508A

Degrees of Protection and Rules

Openings in enclosures with enclosure type >1



Table 19.3
Alternate enclosure ratings

Table 19.3 revised September 1, 2005

Existing Enclosure	Rating of an add. device	Resulting Enclosure Rating
Enclosure type (including components and fittings that comply with Tables 19.1/19.2) (Column 1)	Component/fittings ratings that do not comply with Tables 19.1/19.2 (Column 2)	Resulting enclosure rating (Column 3)
3, 3RX, 3S, 3SX, 3X,4, 4X, 6, 6P	3R, "Wet Location", "Raintight", "Weatherproof" ^c , "Rainproof" ^c	3R ^{a,b,c}
4X	3RX, 3SX, 3X, 4X	3RX ^{a, b}
4, 4X, 6, 6P	3, 3S	3 ^b
4X	3X, 3SX	3X ^b
6, 6P	4, 4X	4
6P	6	6
13	12, 12K	12
12, 12K, 13	3, 3S, 4, 4X, 5, 6, 6P, "Wet Location", "Raintight"	5 ^b
<p>^a When a drain is added.</p> <p>^b When provision is made for locking the door (such as loop for padlock, key-locking type handle or latch) or tools are required to open the enclosure.</p> <p>^c Components marked "Weatherproof" or "Rainproof" shall be installed below all other live parts within the enclosure. Openings for conduit or conduit fittings shall comply with note a, b, or c in Table 19.1 for type 3R enclosures.</p>		

- Appropriate degree of protection against the intrusion of solids and liquids in dependence of the ambient conditions (e.g. location, dust, cooling water, chips, etc.)
- Minimum degree of protection: **NEMA type 1**

Exception: Replaceable collection pieces with busbar systems or terminal strips; appropriate protection must be ensured (e.g. raised mounting, covers)

Recommendation:

Degrees of protection against the intrusion of water and other liquids are specified in NEMA250; NFPA79, Annex F

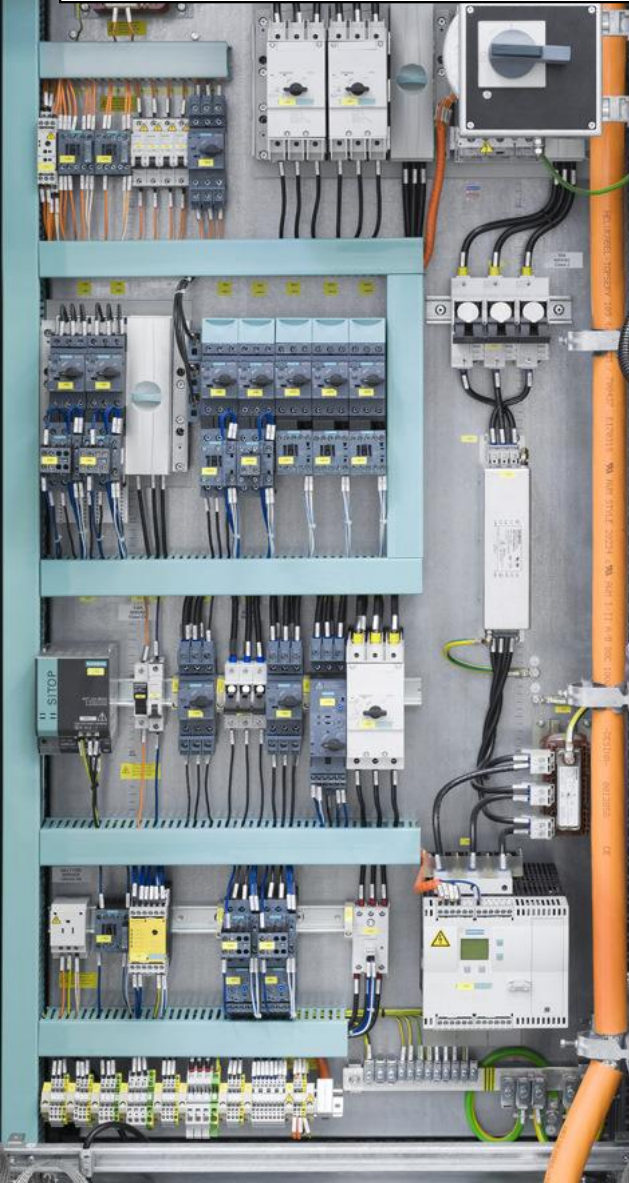
Table E.5.5 Assignment of IP-Ratings to Type-Rated Enclosures

A	NEMA Enclosure Type													B
IP First Character	1	2	3	3R	3S	4	4X	5	6	6P	12	12K	13	IP Second Character
IP0_	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	IP_0
IP1_	A	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	AB	IP_1
IP2_		B	AB	B	AB	AB	AB	AB	AB	AB	AB	AB	AB	IP_2
IP3_			AB	B	AB	AB	AB	AB	AB	AB	AB	AB	AB	IP_3
IP4_			AB	B	AB	AB	AB	AB	AB	AB	AB	AB	AB	IP_4
IP5_			AB		AB	AB	AB	A	AB	AB	A	A	A	IP_5
IP6_			A		A	AB	AB		AB	AB				IP_6
									B	B				IP_7
										B				IP_8

A: The first IP character designation is the protection against access to hazardous parts and solid foreign objects. The respective NEMA enclosure type meets the requirements for the IEC 60529 IP first character designation.
 B: The IP second character designation is the protection against ingress of water. The respective NEMA enclosure type meets the requirements for the IEC 60529 IP second character designation.

Notes:
 (1) Type-rated enclosures for hazardous locations and potentially explosive areas have been excluded from the table. The additional and supplementary letters for IP-ratings have also been excluded from the table. (See NEMA 250, ANSI/UL 508, and IEC 60529.)
 (2) This table should be used only to assign an IP-rating to a type-rated enclosure, and not to assign a type-rating to an IP-rated enclosure. This table assists in specifying enclosure ratings and should not be used as a definitive guide. For example, if the conditions of installation require an IP 55, this table indicates that a Type 3, 3S, 4, 4X, 6, or 6P enclosure can be utilized. However, if the conditions of installation require a NEMA Type 4, an enclosure that is only IP-rated cannot be used as a substitute.
 (3) Although the corresponding NEMA type-ratings meet or exceed the corresponding IP-ratings as indicated in the table, IEC does not currently accept these type-ratings without further IEC testing.

Questions?



Note / Disclaimer

The circuit examples and interpretations of the standard are non-binding and do not claim completeness concerning configuration, equipping and contingencies. They do not represent customized solutions but merely provide support for typical tasks.

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