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White Paper – IK code: Impact protection in line with the IEC 62 262 standard

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Contents

List of images

List of tables

List of figures

Introduction

Damage to enclosures may impair the proper functioning of installed equipment – e.g. machine control systems – or, in the worst case, even render it inoperative. As well as IP protection (protection against dust, contact and water), enclosures must therefore also have adequate protection against external mechanical impacts.

Image 1:
Deformed enclosure after impact

The relevant protection category that specifies an enclosure's resistance to impacts and shocks is the IK code. The IK code classification is established using a standardised testing method in line with IEC 62 262.

However, in laboratory testing it may not be possible to verify the level of an enclosure's tested impact resistance for all points on an enclosure – instead, this may only be possible for the explicitly tested points. In practice, critical points that are problematic for achieving a high IK code are often not tested. IK codes may vary depending on the manufacturer's understanding of quality and the criteria they themselves apply. The following sections offer basic information on the IK code, a description of IEC 62 262 and an insight into testing the IK code and the current testing practice of Rittal GmbH & Co. KG in Herborn.

Basic principles

Enclosures and control cabinets are used throughout the world in all kinds of conditions and need to meet the strictest possible safety requirements. Protection category tests that focus on the extent to which external influences such as foreign bodies and water can penetrate enclosures play a key role in this regard.

The IP protection category (**I**nternational **P**rotection) to IEC 60 529 and testing to NEMA (**N**ational **E**lectrical **M**anufacturers **A**ssociation), 250-2003, “Enclosures for Electrical Equipment (1000 Volts Maximum)”, which is significant for North America, are used in this area. The requirements for empty enclosures for low-voltage switchgear combinations are set out in the IEC 62 208 product standard.

Image 2: Stress on the enclosure

As well as the IP protection category, the IK code in line with IEC 62 262 is also significant. This standard specifies the classification of an enclosure’s impact resistance, i.e. the level of mechanical stress/effect of energy on the enclosure from outside. For empty enclosures to IEC 62 208, the IP protection category, insulation and functions of the enclosure and its inner workings must be maintained. The enclosure should be of a high quality, particularly in environments where a risk of damage from lifting and forklift trucks, for example, is to be expected.

However, when performing laboratory testing for the IK code, it is important to consider not just the conditions set out in the standard but also the latitude that the standard permits in testing.

Both stable and sensitive points on the enclosure can be tested. The IK code is met to a greater or lesser extent depending on the testing.

For an analysis of a practical laboratory test, see the section “Testing at Rittal”.

Description of the IEC 62 262 standard

The IEC 62 262 standard describes how impact protection tests on enclosures are conducted. It is used to determine the protection provided against external stresses (damage to or effect of impact/energy on the enclosure) for safeguarding equipment. The protected equipment must not exceed a rated voltage of 72.5 kV. IK codes are expressed from low to high on a scale of 00 to 10 and prefixed with “IK”. Example: “IK05”. If a higher level of protection than IK10 is reached, the code is IK10+, regardless of the additional energy effect, with the standard recommending a value of 50 J (joules).
The international IEC 62 262 standard is based on the European EN 50 102 standard, which has the same content. EN 50 102 is also the German standard VDE 0470, Part 100.
As shown in the following table, each digit of the IK code indicates a specific level of energy that impacts on the enclosure without impairing functions or dust/water protection:

Table 1: Classification of impact energy

IK code	IK00	IK01	IK02	IK03	IK04	IK05	IK06	IK07	IK08	IK09	IK10
Impact energy, J	a)	0.14	0.2	0.35	0.5	0.7	1	2	5	10	20
a) Not protected under this standard											

Among other things, the impact protection specified by the empty enclosure manufacturer must ensure the IP protection category (protection against contact/foreign bodies and water) specified by the manufacturer is maintained. It is possible to specify a lower IP protection category with a higher IK code. In contrast, it is not permitted to specify a high IK code if the IP protection category is impaired by this.

Example:
If, following impact protection testing of an enclosure with impact energy in line with IK08, IP protection of IP 66 is maintained, but only IP 54 for IK10, the specification must not read “IP 66 in testing to IK10”. The combined IP and IK protection category always applies. In this case, the correct designation would be “IP 66 in testing with IK08”.

The IK code refers to the entire enclosure. If individual sections such as the side panels of modular enclosures have a different IK code, this must be shown separately.

IP protection categories for foreign bodies and water protection in line with IEC 60 529 are identified using the first two digits. The first digit indicates protection against contact and foreign bodies, while the second indicates water protection.

Table 2: IP protection categories, protection against contact and foreign bodies[1]

Digit	Protection against contact	Protection against foreign bodies
0	No protection	No protection
1	Protection against large body parts (Ø from 50 mm)	Large foreign bodies (Ø from 50 mm)
2	Finger protection (Ø from 12 mm)	Medium-sized foreign bodies (Ø from 12.5 mm, length up to 80 mm)
3	Tools and wires (Ø from 2.5 mm)	Small foreign bodies (Ø from 2.5 mm)
4	Tools and wires (Ø from 1 mm)	Granular foreign bodies (Ø from 1 mm)
5	Wire protection (as for IP 5) protected against dust	Damaging dust deposits
6	Wire protection (as for IP 5) dust-tight	No dust ingress

Table 3: IP protection categories, water protection[1]

Digit	Protection against water
0	No protection
1	Protection against vertically dripping water
2	Protection against diagonally (up to 15°) dripping water
3	Protection against falling spray water up to 60° from the vertical
4	Protection against spray water on all sides
5	Protection against water jets (nozzle) from any angle
6	Protection against powerful water jets (flooding)
7	Protection against temporary immersion
8	Protection against continuous immersion
9	Protection against high-pressure water

[1] Source: Physikalisch-Technische Bundesanstalt

Performing impact protection laboratory tests

Impact protection tests (classification for protection category against external mechanical stress) for empty enclosures to IEC 62 208 are performed in line with the IEC 62 262 test standard. The following testing conditions must be observed:

1) Installation

During the test, the enclosure must be secured appropriately, as in everyday use. This means the enclosure must not be tested freely suspended, for example, as it is not secured appropriately and this is also not in line with normal usage. Mounting on the floor or wall is in line with the conventional place of use and the specification of the standard.

2) Performing the impact protection test

Image 3: Enclosure in the testing laboratory

An impact test is performed for every surface exposed in normal usage. Three stresses (damage to or effect of impact/energy on the enclosure) are applied to an enclosure with an area to be tested of less than 1 m in length, and a total of five for a length over 1 m. Stress must not be applied more than three times near the same point. However, all impacts must be distributed evenly over the object. In other words, the area must not be tested arbitrarily and must instead follow a certain symmetry.

3) Testing area on the enclosure:

Parts on the enclosure such as hinges, locks etc. are excluded from testing. Not only must the IP protection category be maintained after testing, but the insulation, opening and closing of the door and the installation and dismantling of the cover must also be ensured. The reliability of equipment (e.g. maintaining clearance and creepage distances) must continue to be ensured when testing (partially) configured enclosures as low-voltage switchgear and controlgear assemblies in line with IEC 61 439-1.
The test results vary depending on which points on the enclosure are subjected to impact testing. The most sensitive points on the enclosure can be tested most intensively by applying stress at up to a maximum of three neighbouring points. However, no regulation exists on this and the less critical impact- and shock-proof points can be tested equally effectively. A lower or higher IK code may result, as the case may be. In this variable framework, the result of impact protection testing may be influenced by the manufacturer. In principle, the relevant points can be selected and are subject only to the criteria under 2), i.e. no regulation exists stating that the enclosure needs to be subjected to impact protection testing at points that are particularly sensitive to impact.

4) Climatic conditions for testing

- Temperature range 15°C to 35°C
- Air pressure 86 kPa to 106 kPa (860 mbar to 1060 mbar)
- Altitude 0 to 2000 m

Conclusion:

A certain leeway is permitted in performing impact protection testing to IEC 62 262, which is why an IK code is not always 100% meaningful. The accuracy of laboratory testing and the points tested on an enclosure vary from case to case and are to some extent subject to the manufacturer’s discretion. Testing at more sensitive points has a completely different effect from testing at impact- and shock-proof points.

Test values and tools

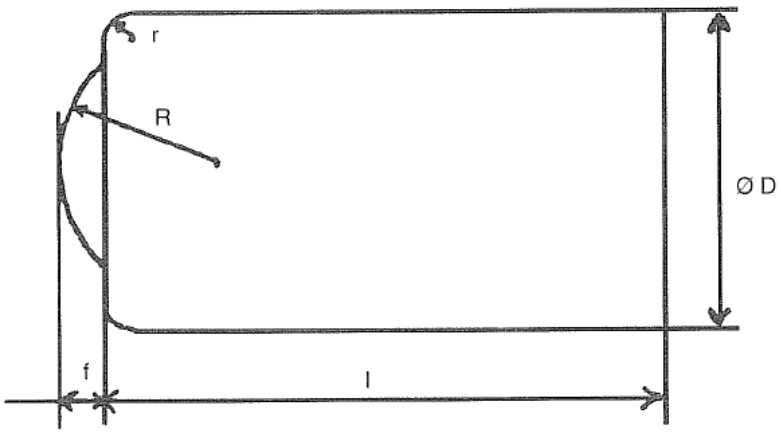
The following table shows the values for the various sources of energy that are required for the protection class being tested. The necessary testing tools and their features are also defined.

Table 4: Specifications relevant to testing

IK code	IK00	IK01 to IK05	IK06	IK07	IK08	IK09	IK10
Energy in joules	*	**< 1**	**1**	**2**	**5**	**10**	**20**
R in mm	*	10	10	25	25	50	50
Material	*	Polyamide (1)		Steel (2)			
Mass in kg	*	0.2	0.5	0.5	1.7	5	5
D in mm	*	20	25	35	60	80	100
f in mm	*	10	4	7	10	20	20
r in mm	*	-	2.5	-	6	-	10
l in mm	*	57.5	120	60	65	110	63
Pendulum hammer	*	Yes	Yes	Yes	Yes	Yes	Yes
Spring hammer	*	Yes	Yes	Yes	No	No	No
Free-fall hammer	*	No	No	Yes	Yes	Yes	Yes
Height of fall				0.408 m	0.300 m	0.204 m	0.408 m
* No protection							
1) R 100, Rockwell hardness to ISO 2039/2							
2) Fe 490-2, Rockwell hardness to ISO 10152							

As can be seen in the table, the IK code is tested with three different hammers. A specific hammer type may/must be selected depending on the type of stress.

Figure 1: Dimensions of testing tools



Testing at Rittal

Rittal has an accredited, in-house test laboratory. Here, the focus is on testing the impact-critical points on enclosures to determine the IK code, as a chain is only as strong as its weakest link. Testing is generally performed on the edge fold of an enclosure. Although the material in that location is the most stable, this is where the seal is situated, which may impair IP protection in the event of deformation of the enclosure edge due to an impact. It is not only important to achieve high impact resistance but also to maintain the proper functioning of the enclosure.

Image 4: Effects of an IK test

When testing (partially) configured enclosures as low-voltage switchgear and controlgear assemblies to IEC 61 439-1, the safety space – as for clearance and creepage distances, for example – must therefore also be maintained. Dents should be kept to a minimum/should not occur at all.
This highly intensive method of testing the IK code to IEC 62 262 is equivalent to testing the enclosure under worst-case conditions.

A high IK code for an enclosure may also quickly lead to misunderstandings, as performing a laboratory test is always subject to the subjectivity of the tester. Various levels of testing within an IK code may therefore be considered.

Sources

Rittal GmbH & Co. KG

IEC 62 262:2002 “Degrees of protection provided by enclosures for electrical equipment against external mechanical impact (IK code)”

IEC 62 208:2011 “Empty enclosures for low-voltage switchgear and controlgear assemblies”

IEC 60 529:2013 “Degrees of protection provided by enclosures (IP code)”

IEC 61 439-1:2011 “Low-voltage switchgear and controlgear assemblies”

Physikalisch-Technische Bundesanstalt (PTB): IP protection class designations http://www.ptb.de/cms/fachabteilungen/abt3/exschutz/ex-grundlagen/ip-schutzartkennzeichnung.html

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