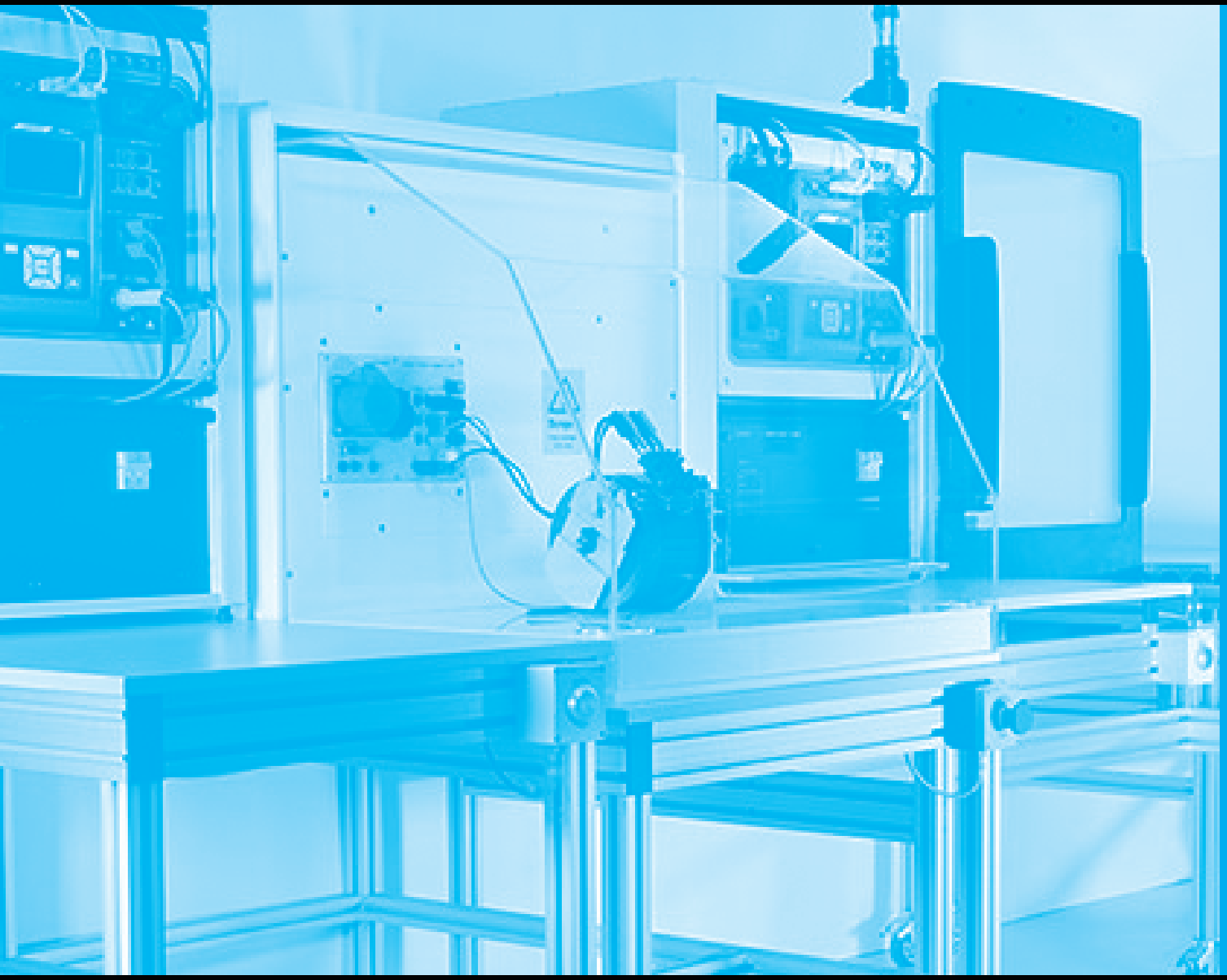


Electrical Equipment

Application catalogue

www.metrel.si

METREL®

End-of-line safety testing in production

Solutions by the Field of Use

Testing the electrical equipment at the end of the assembly line is a critical step in the production process. Defective products and even those not matching specification limits must be separated from the functional units. End-of-line testing assures quality, stability and yield of the production process.

The primary objective of the end-of-line test is detection of the non-functional units, but the ultimate goal is reducing the rejection rate of the manufactured electrical equipment. Testing of electrical equipment should be performed with high automation to shorten the production cycle, improve reproducibility and reduce risk of human error. Where automation isn't possible, it is necessary to prepare a safe environment for the test personnel.
Testing safety of electrical equipment on production lines or in laboratories usually includes tests with high voltages, currents and power. Special consideration must be taken to build safe workplaces in production process. The safety of work stations is covered in the standard EN 50191. Additionally, there are national guidelines like the German BGI 891. Requirements from the field of machine safety are also often considered.
The manufacturer is responsible for safety of manufactured electrical equipment. Responsibilities of the manufacturer include:

- That the electrical equipment is designed properly and fulfils requirements of product standards.
- That the production process is safe.
- That a thorough safety check of the produced equipment is performed.
- That all mentioned steps are carried out are, consequential and traceable.

ROUTINE TESTING

Other expressions used **are end-of-line testing** and **production testing**. These tests are carried out by the manufacturers to ensure that the produced equipment works properly and safely. The routine test is performed on each individual item during or after manufacture. Typical tests include insulation tests, high voltage tests, the continuity of protective conductors, leakage current and functional tests. Each piece of produced electrical equipment must be subjected to these tests.

The EN 50191 shall be considered if dangerous voltages can appear on live parts in the workplace. The limits are following:

- Voltages higher than 25 V AC (up to 500 Hz) or 60 V DC
- Touch current higher than 3 mA AC (up to 500 Hz) or 12 mA d.c.
- Discharge energy higher than 350mJ.
- At frequencies above 500 Hz, national regulations will be observed, or the Appendix A (Table A.1) in standard IEC 50191.

Other risks should also be considered. Possible dangers due to electric arcs, explosion, fire, formation of gases, etc. should be taken in account.

The risk is much higher if high voltages are involved in the testing. Because of this the standard includes additional demands if the test voltage exceeds 1000 V.

Many of Metrel test instruments generate high test voltages. We strongly recommend only users that are familiar with this standard operate them. For any questions regarding the safety of workplaces they can contact Metrel or their distributors.

GERMAN BGI 891

BGI 891 is a German guideline for erection and operation of electrical test installations. The guideline refers to EN 50191 (VDE 0104) and explains it in details. In addition, the guideline deals with some issues outside the scope of EN 50191. For example, it advises that work places should be also designed in accordance with standards for safety of machines (use of risk assessment, safety components, control circuits, safety categories etc., see chapter 3.1 in BGI 891).

The Metrel range covers testing on production lines with several different test station models. Operator safety is implemented through three different approaches.

1. Test station with automatic protection against direct contact according to EN 50191.
a) Safety is assured with a safety module designed in the RFID sensor.
b) Safety is assured with a safety module designed in the light barrier sensor.

2. Test station without automatic protection against direct contact according to EN 50191. Safety is assured with a safety module designed on the two-hand control device.

3. Test station where test current Itest does not exceed 3mA. Standard EN 50191 can be omitted.

Test station with automatic protection using RFID sensor safety module S 2109

End-of-line safety testing in production

Test stations built with enclosures, such as test cages or hoods, are the most commonly implemented option. This type of test station is typical in serial production lines, but is also preferred in workshops, repair, and service shops. Test stations with automatic protection against direct contact may be operated without the control and supervision of a skilled person. The safety system in a test cabinet provides automatic protection against direct contact as the testing sequence can only be started when the doors are securely closed. The 'cage closed' sensor is RFID coded, therefore malfunction or misuse is practically impossible.

IEC 60335-1 is one of the most widely recognized standards in the field of testing electrical equipment in production lines. Annex A of the IEC 60335-1 specifies that routine tests are to be carried out by the manufacturer on each appliance to detect production variations that could impair safety. They are normally carried out on the completed appliance after assembly, but the manufacturer may perform the tests at an appropriate stage during production, provided that later manufacturing processes do not affect the results.

The following tests are the minimum considered necessary to cover essential safety aspects. It is the manufacturer's responsibility to decide if additional routine tests are necessary. It may be determined from engineering considerations that some of the tests are impracticable or inappropriate and therefore need not be carried out.

- Earth continuity test
- Dielectric strength test
- Functional test

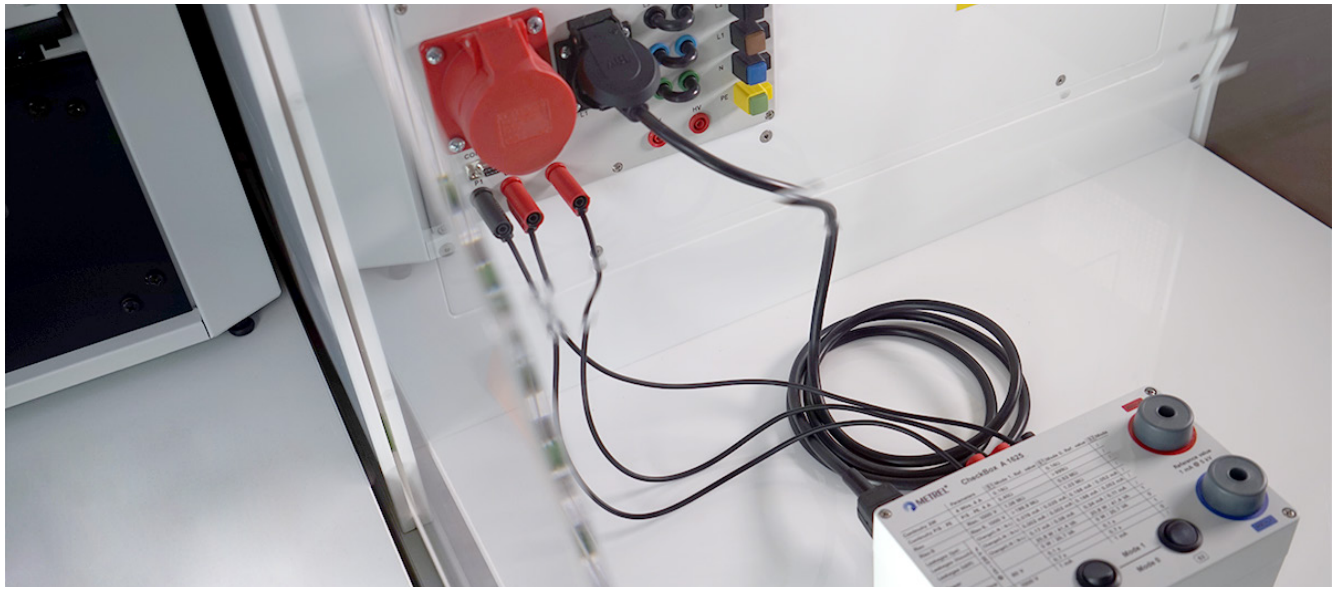
EASUREMENTS

MI 3394 XS (Extra Safety) is a specialised test instrument designed for integration into production lines. The instrument permits the connection of different safety sets for independent control of dangerous measuring circuits. It also supports user-created test sequences with comments, images, wiring diagrams, and other extra content.

The parameters and limits can be varied for all tests. The instrument can be remotely controlled via black-box protocol, which makes it ideal for integration into automated test systems.

Main features of the instrument:

- All features of MI 3394 CE MultiTesterXA.
- Control of measurement circuits with help of Safety sets.
- Perfectly suited for use in workplaces conforming to EN 50191.



Test station with automatic protection using light barrier sensor S 2110

End-of-line safety testing in production

Test station using enclosures such as test cages without doors is the preferred solution for production with very high frequency of testing. The safety of such system is assured with a light barrier sensor (light curtain). The light sensor monitors breaching of the prohibition zone by any object. If the light curtains detect a breach, the safety module will disconnect the measurement circuits from the mains. The testing sequence can only start when the light sensors are activated and the prohibition zone is not breached, making malfunction or misuse practically impossible.

Test stations which have automatic protection against direct contact may be operated without the control and supervision of a skilled person.

IEC 60335-1 is one of the most widely recognized standards in the field of testing electrical equipment in production lines. Annex A of the IEC 60335-1 specifies that routine tests are to be carried out by the manufacturer on each appliance to detect production variations that could impair safety. They are normally carried out on the completed appliance after assembly, but the manufacturer may perform the tests at an appropriate stage during production, provided that later manufacturing processes do not affect the results.

The following tests are the minimum considered necessary to cover essential safety aspects. It is the manufacturer's responsibility to decide if additional routine tests are necessary. It may be determined from engineering considerations that some of the tests are impracticable or inappropriate and therefore need not be carried out.

- Earth continuity test
- Dielectric strength test
- Functional test

MEASUREMENTS

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The parameters and limits can be adjusted for all tests. The instrument can be remotely controlled via black-box protocol, which makes it ideal for integration into automated test systems.

Main features of the instrument:

- All features of MI 3394 CE MultiTesterXA.
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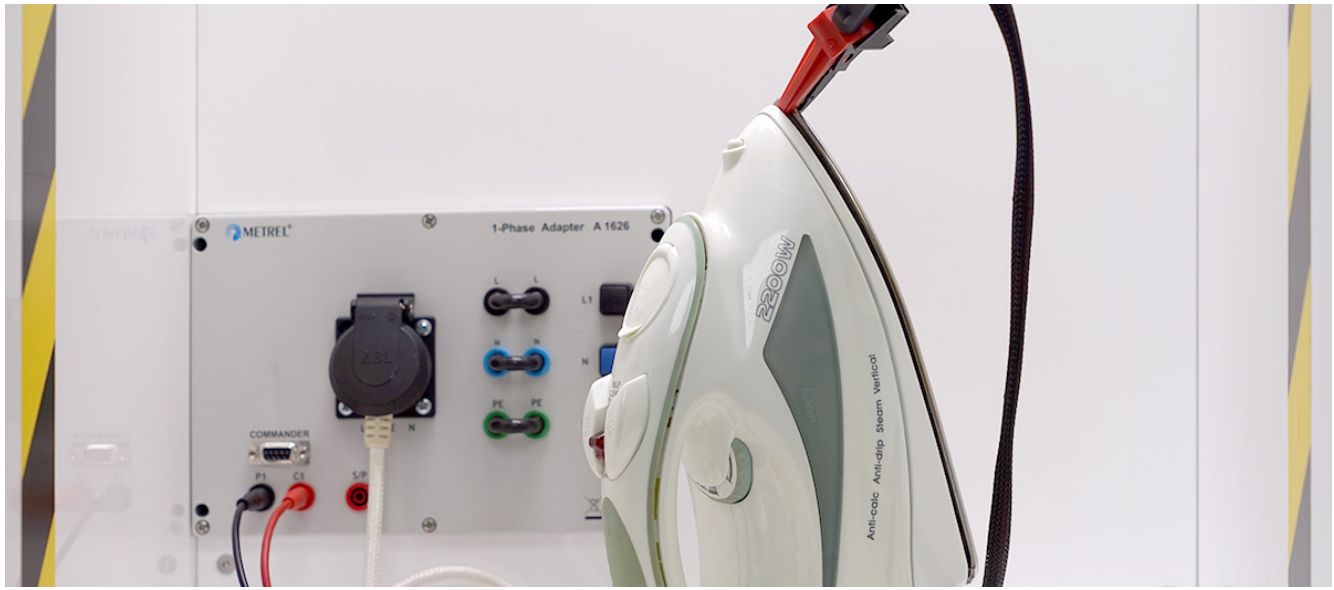
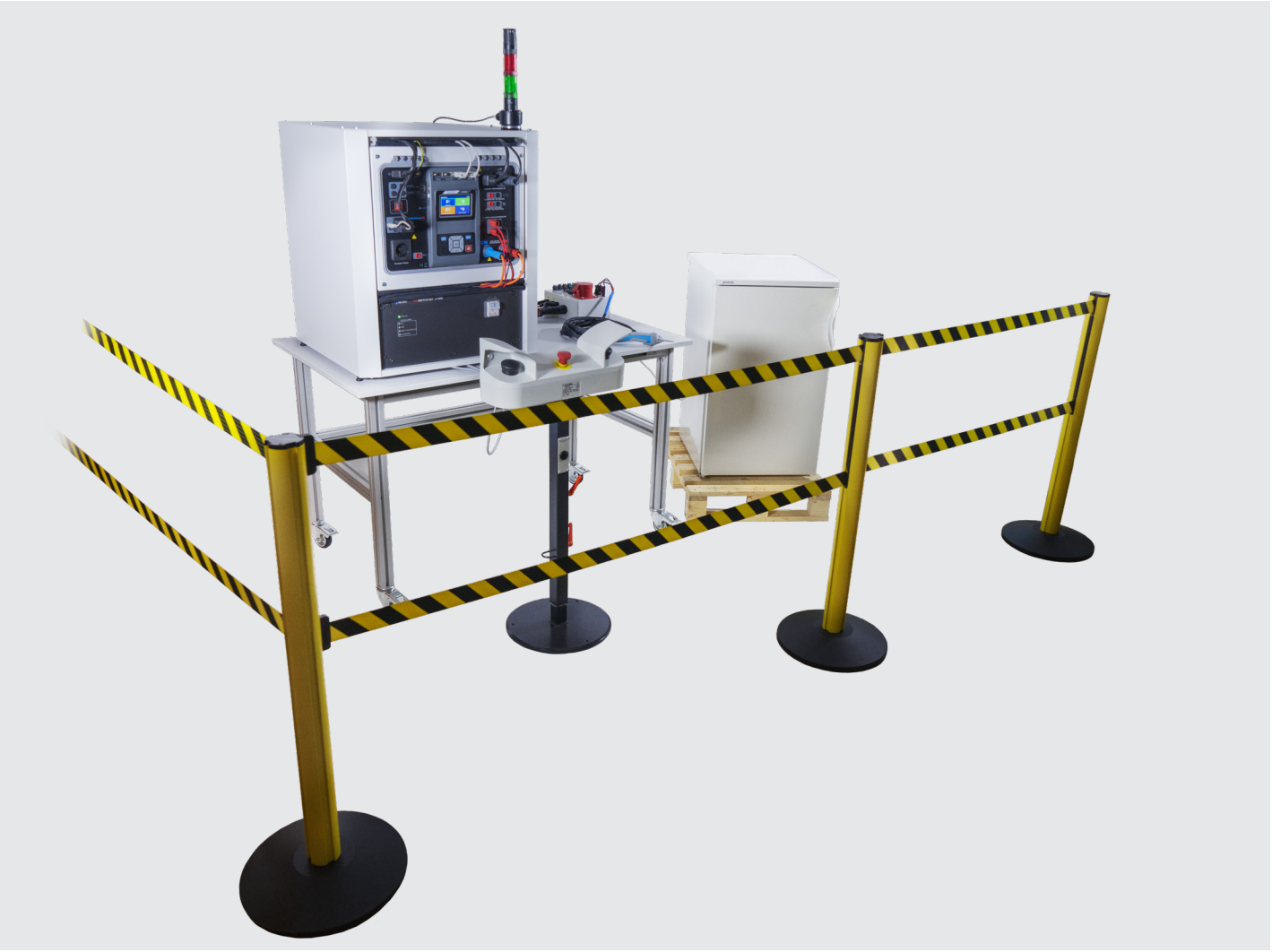
- Perfectly suited for use in workplaces conforming to EN 50191.



Test station without automatic protection using two hands control device S 2111

End-of-line safety testing in production



Test station built with a two-hand control safety system is the preferred solution for testing larger objects. When checking the electrical safety of larger electrical devices, PE continuity must be tested on all accessible metal parts. In practice this means checking the connection of multiple locations on the device. The operator must therefore have access to the device under test some stage during the electrical safety check to perform the test on every test point. The main job of the two-handed safety device at this type of safety station is to prevent the user from performing hazardous tests when exposed to the risk of electric shock. The device only allows the test to start when the user has both hands in contact with the safety set: both buttons on the pair of hand controls must be pressed during the test. This prevents the user from accidentally coming in to contact with the parts that become live during the test. If any of the buttons is released, the safety module disconnects the dangerous measurement circuits from the supply.

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- Earth continuity test
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MEASUREMENTS

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The parameters and limits can be adjusted for all tests. The instrument can be remotely controlled via black-box protocol, which makes it ideal for integration into automated test systems.

Main features of the instrument:

- All features of MI 3394 CE MultiTesterXA.
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- Perfectly suited for use in workplaces conforming to EN 50191.

Test station where test current for withstanding HV test does not exceed 3mA (S 2115)

End-of-line safety testing in production

Ensuring safety at work is a requirement of the association for employers' liability insurance. Safety requirements for execution of high voltage test are defined in the standard EN 50191.

Test stations with a current monitoring safety module are intended for production lines where withstanding test can be performed with low current output Itest < 3 mA. When such test station is used, the requirements of EN 50191 can be omitted.

The operator initiates the test sequence using the external start key. Despite the fact that safety is ensured by the current limit, the test station is additionally protected by a safety button for emergency shutdown.

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- Earth continuity test
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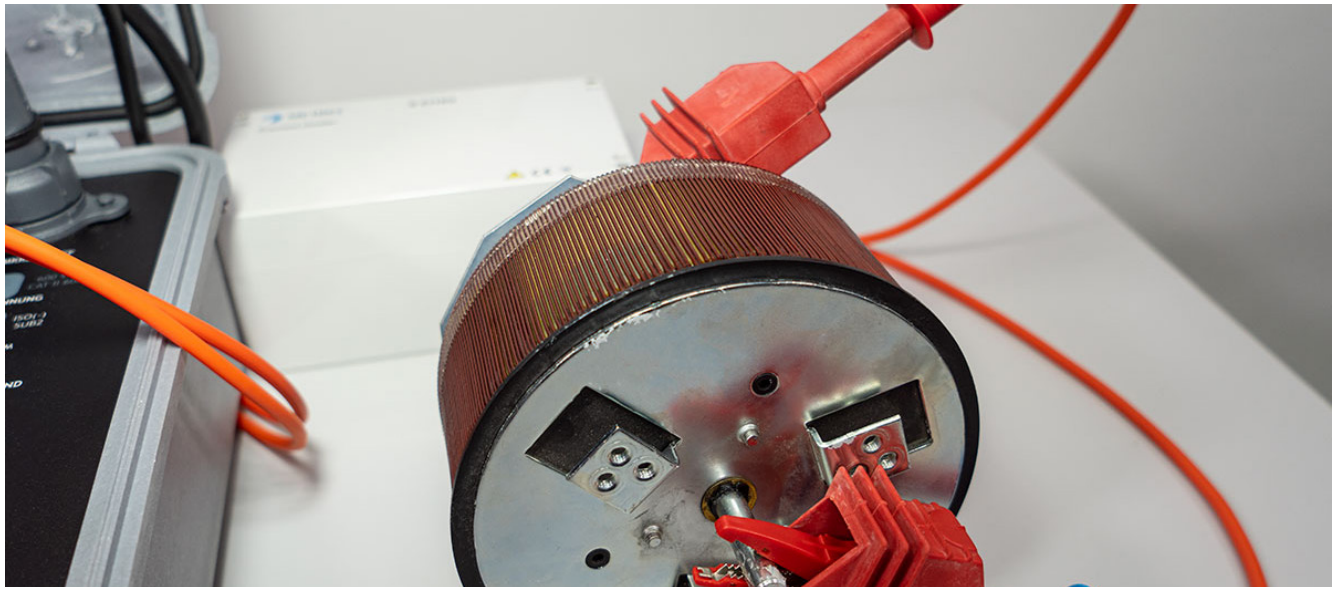

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