

# Measuring and Testing Safely – Guide

Test & Measureline | Test & Measurement



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## INTRODUCTION

# Introduction

Concerns about safety issues and usability of test accessories in compliance with applicable standards are brought up time and again. Therefore, there is a need for this matter to be explained, as it can be a bit difficult to understand. This brochure “Measuring and Testing Safely” gives you some useful information to make it easier for you to select and use the right test accessories.

Besides an overview of the most important applicable standards and directives, this brochure also addresses current changes to the industry standard IEC 61010-031, the most important standard for the safety of electro-technical test accessories.

We’ve also included in this brochure, a glossary with explanations of terms related to measurement and test accessories.

Every measurement situation presents a new challenge for the user and for the measurement and test accessories used. Every industry, every field of application, and every voltage environment are different. For that reason whether for test probes, test clips, or plug-in connectors, the crucial parameters are always the same: the safety, reliability, ease-of-use, precision, and resilience of the test accessories. To simplify the classification of the test accessories to be used in each application, the IEC 61010-031 standard has specified several categories that determine where in the grid power supply the work can take place and what sets the corresponding requirements for the respective voltage. What is crucial is the power available in the event of a fault (e.g. short circuit or overvoltage) in the corresponding measurement category.



There are various measurement categories, abbreviated “CAT” followed by a Roman numeral. In general, the higher the CAT number is, the stricter the safety requirements on the product are.

For the extra-low voltage range (up to 30 VAC / 60 VDC), it is assumed that contact with un-insulated live parts can be classified as harmless. However, if the extra-low voltage is supplied through a grid power adapter, there is always a connection to the grid power supply. People with pre-existing conditions (especially heart disease) should, in particular, avoid contact with electrical voltage, in general. Therefore, general use of touch-protected test accessories is recommended—consider what a

fault in the grid power supply or possible over-voltage on the grid could mean. If appropriate cautions are taken, tests can be performed safely in electronics laboratories and educational institutions, as well as by electronics hobbyists at home.

At the very least, touch-protected test accessories in accordance with IEC 61010-031 are essential when the user performs measurements on circuits that are directly connected to the low-voltage grid. Therefore, besides the measurement results, safety always plays a crucial role, whether for service technicians in repair shops (CAT II) or electricians and power supply company employees (CAT III and CAT IV).

## GENERAL INFORMATION ON OCCUPATIONAL SAFETY

## Occupational safety

**Obligatory: Specialist knowledge**

Maximum safety when working with electro-technical test accessories must be the highest priority—for you as a user and for us as a manufacturer. Working safely with electrical test accessories obviously requires trained or certified specialist knowledge.

**The selection of test accessories needs to be considered carefully**

However, to prevent accidents, it is just as important to consider in what situations the test accessories will be used, right from the selection stage.

**How is the measuring task arranged and how can the measuring point be accessed?**

The test accessory user should familiarize themselves with the issues listed on the following pages before beginning the work.

Practical considerations for performing the task: Shape of the tap, exclusive use of hand-

held test accessories (test clips, test probes, etc.) or installation of special adapters.

**What voltages and currents can occur? i.e. are the ratings of the test accessories sufficient for the planned applications?**

The test accessories should be designed for voltages and currents that are at least as high as the highest anticipated voltages and currents. As far as possible, our test accessories' ratings are mentioned in the catalogs and affixed to the products.

**Note the information on the product and, if applicable, in included documents (e.g., user information)!**

However, in certain cases, there is insufficient space on the products for technical information. You will then find the  $\triangle$  symbol, which refers to included documents. You can find the number of the associated document (user information **i000**) in the product description in the catalogs.

If the included information is lost, the documentation can also be viewed online at [www.staubli.com/electrical](http://www.staubli.com/electrical) and printed.

**At what point in the grid power supply is the measurement performed?**

The user must be clear where the work will take place in the installation (on the grid). The hazards that can arise in each particular case depend heavily on the position within the installation.

**What are the environmental conditions of the object being measured? What pollution is anticipated for the planned use?**

For use of electrical test accessories, it is important to know the environmental conditions. The user should note whether pollution or humidity are anticipated, for example.

**Proper use is a prerequisite for safe handling of test accessories.**

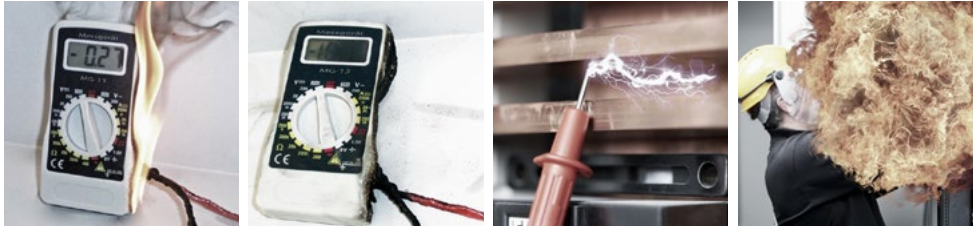
In a specific case, proper use means grasping a part of a test accessory where the handle area is provided or below the protective shroud, for example. Improper use or use of damaged products entails high, unforeseeable risks.

Furthermore, we would like to point out that on-site occupational safety ultimately remains the responsibility of test accessory users, since it depends on them actually using test accessories (properly) that are appropriate for their purposes. In brief:

**Test accessories + correct use = occupational safety**

## Hazards due to inadequate fuse protection

Measurements on circuits with a high energy content, e.g. on the power supply side of an installation, require the greatest degree of safety. The measuring instruments and accessories used should include effective protection against short circuit currents.



**Depending on the energy content of a measurement circuit, the consequences of a short circuit may be disastrous.**

## Use of high breaking capacity fuses

The use of high breaking capacity fuses is recommended in high-energy, low-voltage systems for preventing unforeseeable consequences in the event of a short circuit.

High breaking capacity fuses are able to disconnect even extremely high short circuit currents in the thousands (!) of amperes.

The high breaking capacity fuses can be integrated into test probes or test clips, connected to the measurement circuit with the help

of fuse adapters or integrated into the test lead, as in our new fused test leads. Besides being easy to handle, the latter have the advantage that standard test clips, test probes and adapters can be used for fused measurements.

When replacing the fuse, always ensure that the fuse is appropriate for the application.

The items we offer that can be equipped with high breaking capacity fuses are illustrated below.

**PF/S4-10x38-S**



**PF/S4-BS-10x38-S**



**GRIP-DI**



**FLU-11**



**XSM...-419**



**DMI...A**



**Test probes, test clips and adapters that can be equipped with high breaking capacity fuses and our XSM...-419 fused test lead.**



**STANDARDS AND DIRECTIVES**

# Overview of applicable standards and directives

## Local laws and standards

**Example: EU**

- EU Directive 2001/95/EC  
“General Product Safety”
- EU Directive 2014/35/EC  
“Low Voltage Directive” CE

**Example: USA and Canada**

- USA: National Electrical Code (NEC)
- Canada: Canadian Electrical Code (CEC)

## International standards

**Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use****IEC 61010-1**

- Part 1: General safety requirements

**IEC 61010-031**

- Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test

**IEC 61010-2-030**

- PART 2-030: Particular requirements for equipment having testing or measuring circuits


**IEC 61010-2-33**

- PART 2-033: Particular requirements for hand-held multimeters and other hand-held meters, for domestic and professional use, capable of measuring mains voltage

# Details of relevant standards

## Protection class

The definitions of the protection classes and their applicability relate to electrical devices of all kinds.

Since, depending on the category, a test accessory may be designed with reinforced or double insulation, but is not considered a device, marking with the  double insulation symbol is not required.

The requirements for the protection class for hand-held test accessories follow from IEC 61010-031.

## Overvoltage category

Transient overvoltages are taken into account for hand-held test accessories through the design of the test voltage as per IEC 61010-031. This ensures the safety of the user even if transient overvoltages occur while measurements are being taken.

## Pollution

The environment determines the influence of pollution on the insulation.

Any solid, liquid or gaseous foreign substance residues can reduce the dielectric strength or surface resistance of the insulation.

Small clearances can be bridged completely by solid parts, dust or water. Therefore, minimum clearances are required to the extent that pollution can occur in the micro-environment. For determining the creepage distances, the following four degrees of pollution are set for the micro-environment (see table below):

Degree of pollution	Definition
1	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
2	Only non-conductive pollution occurs, though occasionally temporary conductivity caused by condensation is to be expected.
3	Conductive pollution occurs or dry non-conductive pollution occurs that becomes conductive due to condensation, which is to be expected.
4	Pollution generating continuous conductivity occurs due to conductive dust, rain or snow.

With hand-held test accessories, it is not possible to meet the requirements of pollution degree 1, since even a small amount of hand sweat means pollution degree 2.

As a general rule, Stäubli test accessories are designed for pollution degree 2. Test accessories rated for 1000 V, CAT IV are an exception; they are also designed for pollution degree 3.

## **Clearances and creepage distances**

As essential protection, clearances and creepage distances contribute to ensuring that nothing happens even with aged insulation materials with reduced withstand voltage. Clearances and creepage distances can be determined if the following parameters are known:

- Rated voltage (rms of the voltage)
- Insulation material (insulation group)
- Form and type of insulation (basic, double or reinforced insulation)
- Degree of pollution
- Measurement category

# EU Directive 2001/95/EC “General Product Safety”

This directive applies to all goods that are put on the market in the EU.

The manufacturer or distributor of a product for the European Single Market is responsible for ensuring that only safe products are provided on the market.

In assessing the safety of a product, the following four issues, in particular, must be taken into account:

- The properties of the product (composition, packaging, instructions for assembly, installation, maintenance, duration of use),
- Possible influences on and interactions with other products (insofar as use with other products is anticipated),
- Product-specific information (presentation, labeling, warnings, instructions for use and operation, disposal information),
- The consumers and especially at-risk user groups.

# EU Directive 2014/35/EC “Low Voltage Directive” CE

The Low Voltage Directive serves to ensure a high level of protection of electrical devices with respect to the health of humans, pets, livestock, and goods.

In addition to the actual devices, it also applies to the connected (measurement) accessories. It applies to “electrical equipment designed for use with a voltage rating of between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current,” with some exceptions.

The Directive sets requirements for manufacturers, authorized representatives, importers and distributors of the equipment.

The name and address of the manufacturer must be provided for all products, either on the product itself or on the packaging. If the manufacturer is not established in the European Economic Area, this requirement is transferred to the authorized representative or importer.

Compliance of electrical equipment with the Low Voltage Directive is demonstrated by performing a conformity assessment procedure. For this purpose, the manufacturer prepares technical documents, includes operating instructions and safety information with the device and affixes the CE marking.

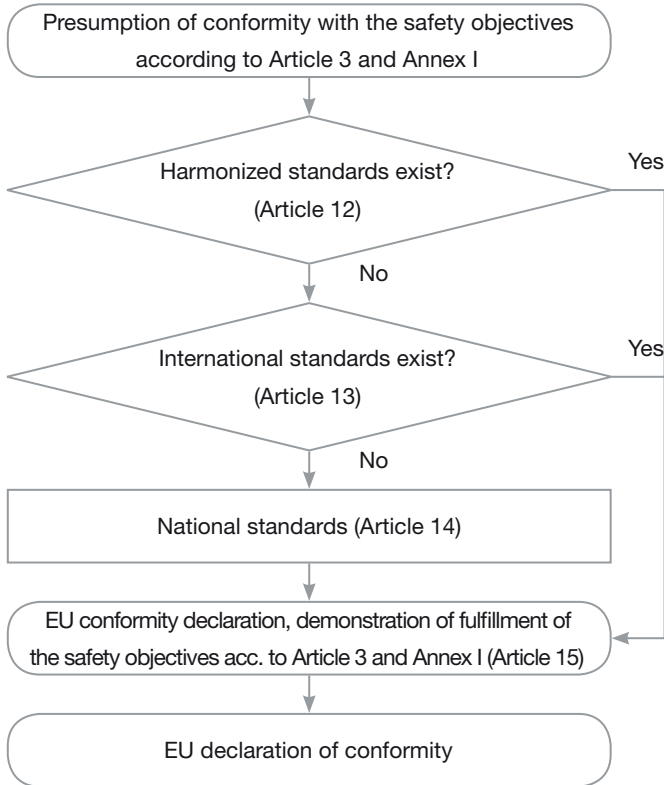
Therefore, the CE marking is a declaration of the manufacturer, which does not have to be reviewed by external institutes.

Harmonized standards, which are published in the Official Journal of the European Union as “Harmonised Standards,” must be used first as “valid” (applicable) standards.

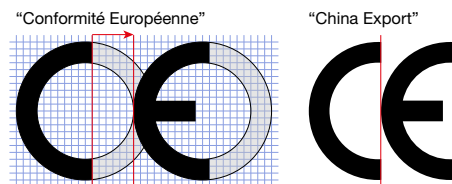
If no harmonized standards in the sense of the directive are set, international or national standards can be used to demonstrate fulfillment of safety requirements.

EN 61010-031 “Safety requirements for hand-held probe assemblies for electrical measurement and test” has been published in the Official Journal of the European Union as harmonized standards for the Low Voltage Directive.

Therefore, hand-held test accessories within the scope of application of this Directive must meet all requirements of EN 61010-031.



Repeatedly, products are appearing with CE marking that is not meant to guarantee that they meet the applicable directives of the European Union. Instead, CE stands for “China Export.”



The abbreviation CE standing for “China Export” is barely different from the usual CE marking; the “C” and “E” are merely a bit closer together. This difference in letter spacing is scarcely noticeable to consumers.

Please pay attention to where you obtain your test accessories.

# IEC 61010-1

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.

This standard, Part 1 of IEC 61010, sets the general safety requirements for the following types of electrical devices and their accessories, regardless of where use of the device is intended.

- Electrical testing and measuring instruments
- Electrical control and regulation devices for industrial process control technology
- Electronic laboratory devices

The purpose of the requirements of this standard is to ensure that hazards to the user and the environment are reduced to an acceptable degree.

For hand-held test accessories for measurement and testing, the separate IEC 61010-031 standard must be followed.

# IEC 61010-031

## Overview

Part of 031 of the IEC 61010 series of standards contains safety requirements for hand-held and hand-operated test accessories and accessory parts.

These test accessories serve as the interface between an electrical phenomenon and a testing or measuring instrument. They can be permanently connected to the measuring instrument or be plug-in accessories for instruments.

The purpose of the requirements of this standard is to ensure that hazards to the user and the environment are reduced to an acceptable level.

Requirements for protection against special hazards are handled as follows:

- Electric shock and burns
- Mechanical hazards
- Excessive temperatures
- Spread of fire originating from the test accessories
- Arc flash

## Classification and subdivision of test accessories

To simplify the classification of the test accessories to be used in each case, the IEC 61010-031 standard has specified several categories that determine where in the grid power supply the work can take place and set the requirements that apply to the respective category.

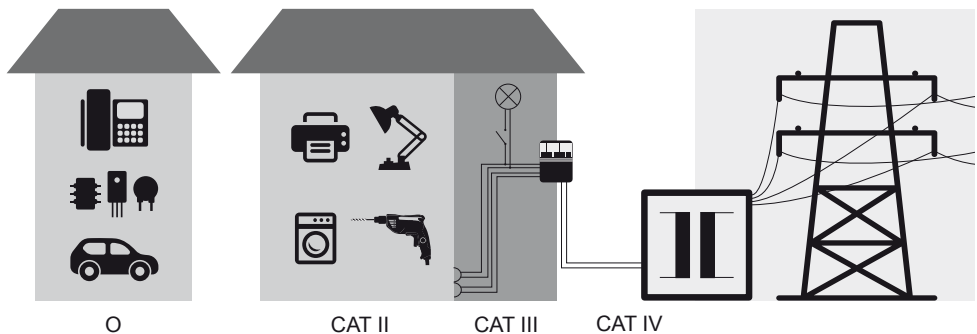
The measurement categories currently specified in the standards used (until 2002) to be called overvoltage categories. The term was based on the fact that the classification primarily focused on the overvoltages (transients) anticipated on a power grid.

The measurement categories now no longer differ so much in the level of the anticipated transients, but rather in the power available in the respective measurement category in the event of a short circuit.

More energy can be released in a higher measurement category than in a lower one, all the way up to explosive results, with very serious consequences for the user.

There are three different measurement categories in the standard, abbreviated "CAT." You will find CAT followed by a number indicated in our catalogs for the rated voltage and on the products.

In general, the higher the CAT number is, the stricter the safety requirements on the product are. Other circuits that are not directly connected to the grid are an exception; see page 17.



### Overview of measurement categories according to IEC 61010-031



### **Devices without a rated measurement category**

Many types of testing and measuring circuits are not intended for direct connection to the power grid. Some of these measuring circuits are only appropriate for low-voltage power applications. However, others of these mea-

suring circuits can be exposed to very large quantities of available energy due to high short circuit currents or high open-circuit voltages. Therefore, in order to set the requirements for these applications, it is necessary to know what overvoltages can arise.

**Within electronic battery-operated devices or within devices in which voltages are generated.**



**Measurement in motor vehicles**

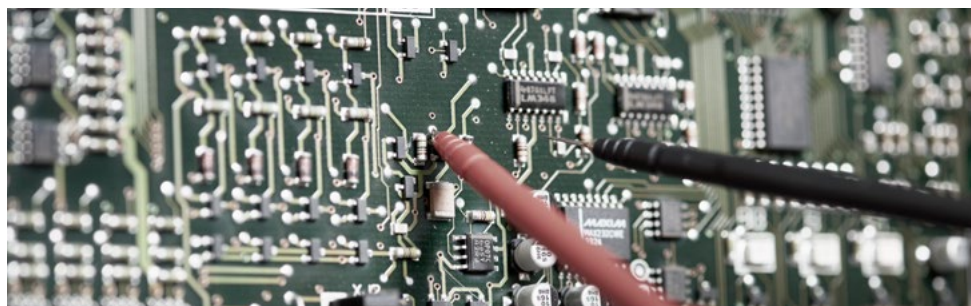
## Measurement category II (CAT II)

Applies to testing and measuring circuits that are directly connected to user terminals (outlets and similar terminals) of the low-voltage grid installation.

Example: Measurements on supply circuits of household appliances, portable tools and similar devices and exclusively on the load side the fixed installation's outlets.

Measurement category	Short circuit current (typical)	Area of the building installation
CAT II	< 10 kA	Circuits connected to power outlets and similar points within the grid installation

**Electrical equipment between the device and outlet within electrical devices like household appliances (repair shops).**



**Electrical laboratory in educational institutions and measurement taps in electronic devices**

### Measurement category III (CAT III)

Applies to testing and measuring circuits that are directly connected to the distributor circuit of the building installation of the low-voltage grid installation.

In order to avoid risks arising from hazards caused by these higher short circuit currents, additional insulation and other measures are required.

Example: Measurements on distribution boards (including outgoing meter circuits), on photovoltaic modules, on circuit breakers, in cabling, on busbars, circuit breaker panels, switches and outlets of the permanent installation, on devices for industrial use and some other devices such as stationary motors with a fixed terminal.

Measurement category	Short circuit current (typical)	Area of the building installation
CAT III	< 50 kA	Power distributors in buildings

**Permanent installations in buildings, contactors, protective devices, switches, outlets (installers).**



**Measurements in fuse boxes and switch cabinets**

### Measurement category IV (CAT IV)

Applies to testing and measuring circuits that are connected to the supply point of the building's low-voltage grid installation.

Due to the high short circuit currents that can result from the high energy levels, measure-

ments here are very dangerous. Extensive precautionary measures must be taken to prevent a possible short circuit.

Example: Measurements on devices that are installed before the main fuse or circuit breaker in the building installation.

Measurement category	Short circuit current (typical)	Area of the building installation
CAT IV	> 50 kA	Grid installation supply in the building

**Secondary circuit of medium voltage transformers, electricity meters, connection to overhead lines (power supply company employees).**



**House junction box and examples of test accessories for CAT IV.**

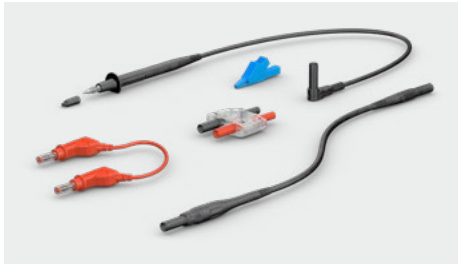
## Examples for specific requirements on insulation for hand-held test accessories

The IEC 61010-031 standard classifies test accessories and accessories into type classes:

### Type A

Test accessories without an attenuator, rated for direct connection to voltages higher than 30 VAC rms, 42.4 V peak or 60 VDC, but not greater than 63 kV. They may contain passive non-signal-attenuating components such as fuses.

Products from Stäubli's portfolio of test accessories (formerly T&Mline) for categories CAT II, III and IV are usually of this type.



### Type B

Attenuating or divider test accessories for direct connection to secondary voltages greater than 1 kVAC rms or 1.5 kVDC, but no greater than 63 kVAC or kVDC. The dividing function may be performed entirely within the test accessories or partially within the testing or measuring instruments connected to them.

This usually concerns high-voltage test probes, which Stäubli does not offer.

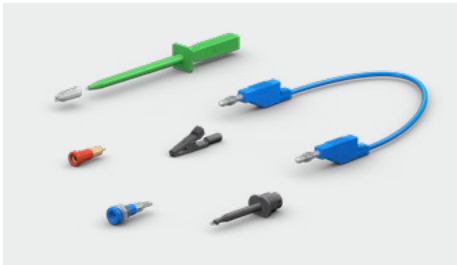
### Type C

Test accessories with an attenuating, dividing or signal conditioning function for direct connection to voltages not greater than 1 kVAC rms or 1.5 kVDC. The signal conditioning function may be performed entirely within the test accessories or partially within the testing or measuring instruments connected to them. Stäubli test accessories for HF measurement technology (formerly HFline) are usually of this type



**Type D**

Low-voltage test accessories with and without an attenuator that are rated for direct connection to voltages below 30 VAC rms, 42.4 V peak or 60 VDC and for currents above 8 A. Products from Stäubli's portfolio of test accessories (formerly T&Mline) for category O are usually of this type

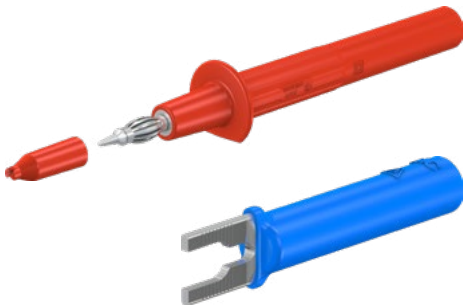


## Requirements on markings and documentation

Every test accessory and, if possible, detachable part of a test accessory must be labeled with:

- The name or registered trademark of the manufacturer or supplier and, in addition, for types B and C, with a designation to identify the test accessory or part,
- The ratings of the test accessory and, if applicable, the measurement category,
- Warnings and, if necessary, a reference ( $\Delta$ ) to the operating instructions.

If necessary for safety reasons, the test accessories must be provided with documentation.



## Requirements on insulation

Plug-in connectors, that serve exclusively for connecting the test accessory to testing or measuring instruments and are not intended to be touched by hand after the connection is established, must be insulated with at least basic insulation against hazardous live parts.

Plug-in connectors intended to be held in hand during measurement or testing and connectors that can be swapped between test accessories and testing or measuring instruments, must be insulated with double or reinforced insulation against hazardous live parts.

Parts of a test accessory that are held in hand or operated by hand by the user during measurement or testing must be insulated with double or reinforced insulation from parts that could become hazardous live parts.

Below we show examples of specific applications of the requirements of the standard for the classification of our own products:

## Examples of some of our products

### Unmated plug-in connectors

#### ... Connector

“... (c) Unmated plug-in connectors:

The following requirements do not apply to unmated plug-in connectors if voltage to ground is present on one side of the test accessory:

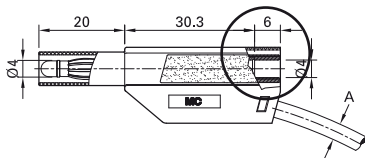
- Live parts of lockable or screwable plug-in connectors, including connectors that do not require tools in order to be unlocked or loosened, may be touchable
- Unmated, integrated connections of stackable plug-in connectors must be protected with basic insulation
- Live parts of other unmated plug-in connectors with a rated voltage up to 1000 VAC or 1500 VDC must contain the applicable offset dimensions (see page 27). For rated voltages above 1000 VAC or

1500 VDC, these distances cannot be less than 2.8 mm.

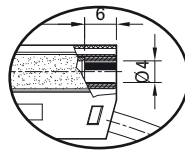
One product range affected by these stricter requirements is the SLK4...-E... range of measurement leads with stackable plugs.

The reason for this is to comply with the minimum clearance for the tap socket. For 1000 V, CAT III, this socket would have to have an offset of 8 mm from the test finger, so it would be practically impossible to properly establish a contact with an additional inserted plug. Therefore, it is downgraded to **1000 V, CAT II and 600 V, CAT III**.

**1000 V, CAT II**  
**600 V, CAT III**



CE



■ Creepage distance



... protection against electric shock

For all touchable parts of test accessories, one or more of the following measures must be taken to ensure that these do not represent a hazard for the user.

- Maintaining minimum distances from hazardous live parts
- Double insulation consisting of basic insulation and supplementary insulation
- Basic insulation and enclosures or protective shrouds
- Basic insulation and impedance
- Reinforced insulation
- Protective impedance

Insulation covers or sleeves over plugs that are held in hand or operated by hand by the

user during measurement or testing and that can be removed or adjusted by the user without the use of tools do not offer sufficient protection against electric shock.

For example, retractable insulating sheaths are not considered sufficient protection. The only acceptable use is cases in which they are required for connecting to devices for testing and measurement that are equipped with terminals that cannot accommodate fully enclosed plugs.

### Retractable sleeve plugs

Retractable sleeve plugs can no longer be exposed to hazardous voltages during hand-held use. Therefore, the rated voltages of such

items have been downgraded to 30 VAC ~ 60 VDC.



**30 VAC / 60 VDC**

**SLS425-ZL  
SLS425-ZL/M3**

Only leads that serve as adapter leads for connection to devices that are not (yet) equipped with safety sockets can still be equipped with retractable sleeve plugs on the device side. On the other side, where hand-held test

probes or test clips are applied, these leads must be equipped with a safety system plug with a rigid insulating ferrule.



**Never attach hand-held test probes or taps to retractable sleeve plugs!**

The rated voltage of the device-side plug is then also determined again through the possible creepage distances and clearances. In order to increase these and thus make the adapter leads usable for higher voltages, we

have provided our retractable sleeve plugs with a protective shroud. This allows us to increase the nominal voltage up to 600 V, CAT II.



**600 V, CAT II**

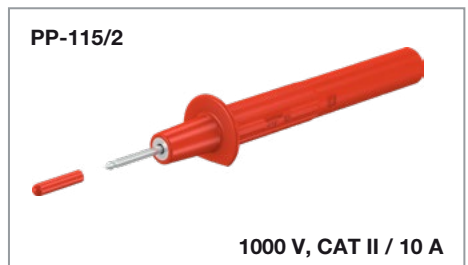
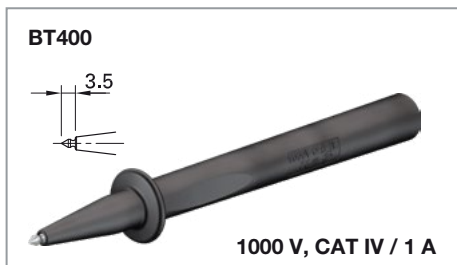
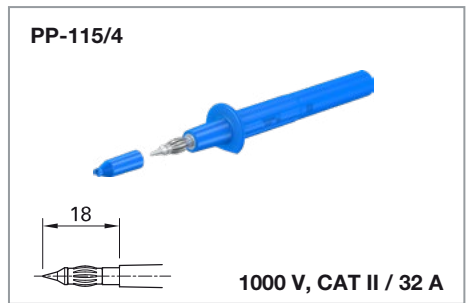
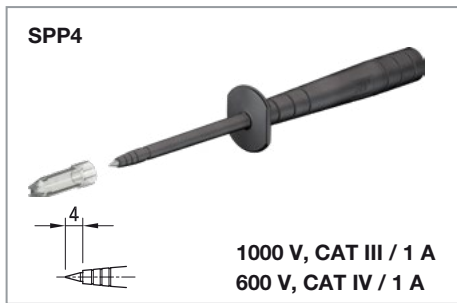
■ Creepage distance



## Bare test probes

Lengths of the bare test probes are limited to:

- Max. 19 mm for other circuits that are not directly connected to the power grid and in measurement category II (exception: for use in special cases outside of power grid applications and at low energy levels, the protruding conductive part of the contact probe can be max. 80 mm).
- Max. 4 mm in CAT III and CAT IV (background: short circuits between bus-bars should be avoided).



## Test probes and their rated voltages

### Touchable parts of test clips

The following applies in measurement categories CAT II, CAT III and CAT IV: When closed, it must be impossible to touch the live parts of test clips.

**XKK-1001**



1000 V, CAT II / 32 A

**XDK-1033/I-2**



1000 V, CAT III / 19 A  
600 V, CAT IV / 19 A

**SAGK4-K**



300 V, CAT II / 15 A

**AB200**



1000 V, CAT IV / 16 A

Examples of test clips and their rated voltages

### Not permitted!



~~CAT II~~  
~~CAT III~~  
~~CAT IV~~

Standard test finger (here a jointed test finger) comes into contact with parts of the terminal when closed: Use in CAT II, III and IV not permitted!

The clearances are designed according to the following table. The measurement categories and voltages influence the design:

		Basic or supplementary insulation			Reinforced insulation		
		CAT II	CAT III	CAT IV	CAT II	CAT III	CAT IV
	V	mm	mm	mm	mm	mm	mm
Highest nominal DC or AC voltage of a grid power supply for the connection of which the test accessory is designed	≤ 50	0.04	0.1	0.5	0.1	0.3	1.5
	> 50 ≤ 100	0.1	0.5	1.5	0.3	1.5	3.0
	> 100 ≤ 150	0.5	1.5	3.0	1.5	3.0	6.0
	> 150 ≤ 300	1.5	3.0	5.5	3.0	5.9	10.5
	> 300 ≤ 600	3.0	5.5	8	5.9	10.5	14.3
	> 600 ≤ 1000	5.5	8	14	10.5	14.3	24.3
	> 1000 ≤ 1500	8	11	18	16	22	36
	> 1500 ≤ 2000	14	18	22	28	36	44
	> 2000 ≤ 3000 <sup>1</sup>	18	22	25	36	44	50

<sup>1</sup> Only for DC voltage

Example of basic insulation with 5.5 mm clearance:

Possible information on the test accessory:  
300 V, CAT IV / 600 V, CAT III / 1000 V, CAT II  
Clearance of 10.5 mm is required for reinforced insulation.

It is important to note that test accessories of a lower category can generally be used with downgraded voltage in a higher category, BUT not vice versa, since the withstand voltage, creepage distances and offset dimensions must be retested at a higher voltage!

## Changes in IEC 61010-031 Ed. 2

### **Voltage levels for “Extra-Low Voltage” have been reduced**

The previous voltage limit of 33 VAC/70 VDC has been reduced to 30 VAC/60 VDC.

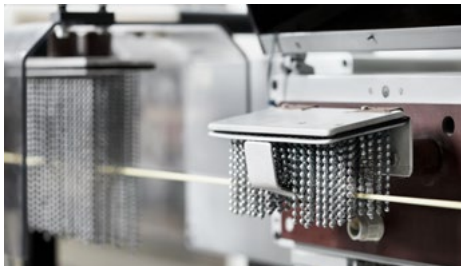
### **Extended environmental conditions**

It is now possible for the manufacturer to permit extended environmental conditions for the test accessories:

- Outdoor use
- Use at altitudes above 2000 m
- Ambient temperatures below +5°C and/or above +40°C
- Relative humidity above the maximum (80% for temperatures up to 31°C, decreasing linearly to 50% at 40°C)
- Wet environmental conditions

### **High-voltage testing on the stranded wire**

A 100% test must be performed on all stranded wires during production.



### **Additional requirements on examination of foreseeable misuse**

Examination of foreseeable misuse has been incorporated into the standard through a risk assessment and taking it into account in product design and documentation.

As a specific example, a warning against the influence of pacemakers has been incorporated into the documentation for magnetic adapters.

Furthermore, for category “O” non-touch-protected test accessories, the sentence “item not appropriate for use in supply circuits” has been included.

### **Incorporation of servicing conditions**

Information on the servicing type and intervals for the product must be formulated clearly. Due to the design, this does not apply to Stäubli test accessories.

### The offset dimension of plug-in connectors has been increased.

This serves as extended touch protection.

All products of the Stäubli Test & Measurement portfolio have been reviewed and adapted to the new standard.

Voltage on the live part of the plug-in connector	Offset dimension
VAC or VDC	mm
$> 30 \leq 300$	0.8
$> 300 \leq 600$	1.0
$> 600 \leq 1000$	2.6
$> 1000 \leq 1500^1$	2.8

<sup>1</sup> Only for DC voltage

### Adaptation of the test probes that can be used as plug-in connectors

Test probes that can be used as plug-in connectors must now meet the same requirements as plug-in connectors:

- Partially inserted: Basic insulation
- Fully inserted: Double insulation

### New requirements on protective shrouds

The dimensions on the protective shrouds have been increased:

- The side that the finger is supposed to grip during normal use must have a height of at least 2 mm



### Modified requirements on test probes and spring-loaded clips

For spring-loaded clips rated for measurement category III or IV:

When closed,

- the protruding touchable conductive part of a contact probe must not be longer than 4 mm (in all directions).

When open,

- the length of the protruding touchable conductive part of the spring-loaded clip with a hook must not exceed 10 mm,
- the exterior surfaces of spring-loaded clips with more than one hook or jaw must not be live.

Except for spring-loaded clips rated for measurement category III or IV:

- for test accessories rated for measurement category III or IV, the protruding live part of a contact probe must not be longer than 4 mm,
- for test accessories not rated for measurement category II, III or IV, and for use in special cases where the energy level cannot cause arcing, the protruding conductive part of the contact probe must not be longer than 80 mm,
- for test accessories that are rated for measurement category II and for miscellaneous test accessories that are not covered by the two above, the protruding conductive part of a contact probe must not be longer than 19 mm.

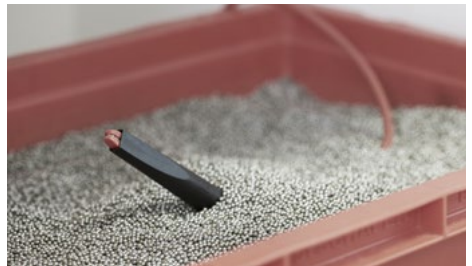
## Product tests according to IEC 61010-031

The following section is meant to give an idea of the tests that must be performed as part of the IEC 61010-031 conformity testing.

### Power-frequency withstand voltage test

Withstand voltage test in which the required insulation strength is tested.

No flashover or breakdown is permitted to occur during the test.



**Voltage test in shot bath**



### Impulse voltage test

Impulse voltages are generated to emulate quickly or slowly rising transient overvoltages, which ultimately means lightning or switching overvoltages.

Breakdowns may occur as possible faults after the voltage test!

#### One-minute DC voltage test

The test voltage is increased smoothly for 5 s from 0 V to the specified value and held at this value for at least 1 min.



No flashover or breakdown is permitted to occur during the test.



**Breakdown with non-compliant plug-in connector**

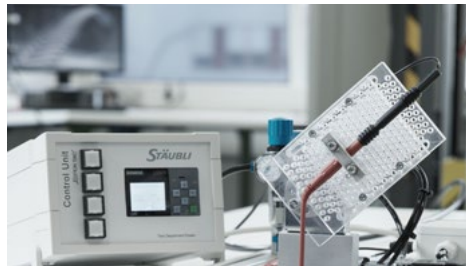
### Tensile test

The objective is to test the strain relief of the cable. For this purpose, the cable is subjected to a constant axial tensile force for one minute. The tensile force depends on the cross-section of the conductor.



### Tensile flexing and rotational flexing test

The goal of both of these tests is to test kink protection. The contact probe enclosure or the plug-in connector is clamped so that it cannot let go and a mass is attached with a force and flexed or rotated.



### **Testing the probe wires**

Previously, probe wires were not addressed separately in the standard. Section 12.3 now sets requirements for demonstrating the conformity of the probe wires. For this purpose, the following tests are performed on the probe wires:

- Pressure test at high temperature for insulation
- Tests for resistance of insulation to cracking
- Voltage test
- Tensile test

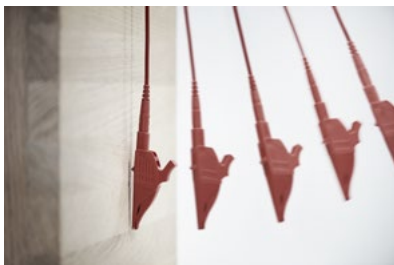
### **Mechanical strength against falls, shocks and impacts**

#### **Drop test**

Test objects are dropped three times from a height of 1 m onto a 50 mm thick hardwood panel.

#### **Impact swing test**

The test probe enclosure is subjected to an impact against a hardwood board mounted on a solid wall by swinging on its cable like a pendulum



### **Temperature limits and protection against the spread of fire**

Under normal conditions, warming must neither cause a hazard nor spread fire outside of the test accessory. Under normal conditions, easily touched surfaces must not exceed the following temperatures:

- Metal: 55°C
- Non-metallic materials: 70°C
- Probe wires: 75°C

The test is performed at the rated voltage indicated by the manufacturer at room temperature or higher, if indicated. The current must be applied until temperature stability is achieved.

# IEC 61010-2-030

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-030: Particular requirements for equipment having testing or measuring circuits

- This part must be applied in connection with the newest edition of IEC 61010-1. Special requirements for testing and measurement circuits have been removed from Part 1 and form the basis for the requirements in Part 2-030
- This part sets safety requirements for test and measurement circuits that are

connected to devices or circuits outside of the measuring instrument for testing or measurement purposes. These circuits are components of electrical equipment for measurement, control and laboratory use.

- Conductive parts of uncoated connections of measurement circuits (e.g., panel sockets) that can accept hazardous live voltages from other connections must be separated from the test finger at least by clearances and creepage distances.

Voltages on conductive parts of the connection	Clearances and creepage distances
Rms of the ACV	mm
$\geq 30 \leq 300$	0.8
$> 300 \leq 600$	1.0
$> 600 \leq 1000$	2.6
$> 1000 \leq 1500^1$	2.8

<sup>1</sup> Only for DC voltage

Note: The values in this table are not applicable to voltages that are lower than “hazardous live voltages.” These values are determined through calculation for reinforced insulation. Transient voltages are not taken into account. Stäubli plugs and sockets are tested on the basis of the standard.

# IEC 61010-2-33

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-033: Particular requirements for hand-held multimeters and other hand-held meters, for domestic and professional use, capable of measuring mains voltage

This part of IEC 61010 sets safety requirements for measuring instruments.

Measuring instruments, the primary purpose of which is to measure voltages on a power grid circuit, fall within the scope of this standard. They have different names, but all are appropriate for measuring voltages in a live power grid circuit. Some of the names of these devices are:

- Multimeter
- Digital multimeter
- Voltmeter
- Clamp measuring instrument (see also Part 2-032).

The term “measuring instrument” is used for these hand-held measuring devices for the purpose of this standard.

The standard stipulates that

- test accessories within the scope of application of IEC 61010-031 must meet these requirements,
- the documentation must indicate that test accessories that are used for measurements on the power grid must be rated according to IEC 61010-031 for measurement category III or IV, depending on what applies, and must have a rated value for the voltage that corresponds to at least the voltage of the circuit in which the measurement is performed.

Test accessories and accessories within the scope of application of IEC 61010-031 must meet these requirements.

# UL

UL stands for “Underwriters Laboratory.” This is a testing institute headquartered in the USA that handles approval and verification of the safety of devices and components for use in the USA.

For test accessories, UL has adapted IEC 61010 with national additions and conducts testing according to the applicable requirements.

## GLOSSARY

# Glossary

## Accepted rules of technology

The (generally) accepted rules of technology are technical rules or technical clauses for the design and implementation of structural or technical objects. These are rules that are scientifically acknowledged as theoretically correct and fixed, which are thoroughly familiar in practice to technicians with state-of-the-art training and proven through ongoing practical experience. The generally accepted rules of technology are not identical to standards.

## Adjustment

Adjustment, setting, calibration or trimming are work processes for establishing and maintaining the operational state of technical devices and systems. For testing equipment, we speak of calibration or, where legal authority exists, of official calibration, where the reference value is concerned.

## Assembly instructions

For all items in the catalog requiring assembly, we provide assembly instructions in which you can find information on completing assembly yourself and on any tools that may be required. We provide the assembly instructions upon request. With all requests, please always include the corresponding

number that you find with the item in the catalog (e.g., MA106 for item SLS425-SL). You can also download the assembly instructions from our website in PDF format:  
[www.staubli.com/electrical](http://www.staubli.com/electrical).

## Basic insulation

Basic insulation is the insulation of parts that are hazardous to touch in order to ensure basic protection against hazardous shock currents. This means that failure of the basic insulation can lead to a risk of electric shock. ⚠ Basic insulation can also serve functional purposes.

## Breakdown voltage

The breakdown voltage refers to the voltage that is necessary in order for current to flow through an insulator. An insulation breakdown then occurs.

See also “Dielectric strength,” page 42

See also “Flashover voltage,” page 43

## CE mark

According to EU Directive 765/2008, the manufacturer, distributor or EU authorized representative uses the CE mark to declare that the product meets the applicable requirements that are set in the regulations of the harmo-

nization law of the Community concerning affixing this mark.

All items in our product ranges for testing and measurement technology with a rated voltage greater than 30 VAC / 60 VDC follow the Low Voltage Directive 2014/35/EU of the European Union and, insofar as they are ready-to-use items, are labeled with the CE mark.

### **CEN**

The European Committee for Standardization (abbreviation: CEN, derived from the French name **Comité Européen de Normalisation**) is responsible for the European standardization in all technical areas except for electrical engineering and telecommunications.

### **CENELEC**

The European Committee for Electrotechnical Standardization (abbreviation: CENELEC, derived from the French name **Comité Européen de Normalisation Électrotechnique**) is responsible for the European standardization in the area of electrical engineering.

### **Clearance (according to IEC 61010-031)**

The clearance is the shortest distance through the air between two live parts.

For test accessories, the clearance means the shortest distance through the air between a part that is hazardous to touch and a body part of the user during proper use.

### **Color deviations**

Due to use of various high-quality insulation materials, our product ranges contain items for which certain color deviations can occur for the same color code (e.g., a silicon-insulated stranded cable, pre-assembled with TPE-insulated plugs).

### **Contact carrier**

The contact carrier is a part made of insulation material for attaching and positioning the contact elements in the plug connector.

### **Contact probe**

#### **(according to IEC 61010-031)**

Part of a test accessory that establishes a direct connection to the point to be tested or measured.

### **Contact resistance**

Contact resistance is the resistance that arises at the point where two contact surfaces touch. Its value is calculated through the measured voltage drop at the rated current of the plug-in connector in new condition.

### **Contact surfaces**

Since solid surfaces in the physical sense are always rough, a pure-metal contact surface that has been made as even as possible with many bearing contact surfaces is important. The condition of the contact surfaces has a crucial influence on the contact resistance.

**Creepage currents**

Creepage currents run along the surface of an insulation material (creepage distance). They arise due to sweat, condensed ambient humidity, contamination or the minimum conductivity of even highly insulating plastics as soon as voltage is present.

**Creepage distance  
(according to IEC 61010-031)**

The creepage distance is the shortest distance on the surface of a solid insulation material between two conductive parts.

For test accessories, the creepage distance means the shortest distance along the surface of an insulation material between a part that is hazardous to touch and a body part of the user during proper use.

**Cu cable**

Copper cable.



### Degree of protection, electrical

Systematic classification of the protection of electrical equipment for access to hazardous live parts (touch protection) and against penetration of solid and liquid materials into the interior of the equipment (protection from foreign bodies and water). The degree of protection is indicated with two code numbers in the form IPxy.

An X in place of one of the two code numbers means that the corresponding code number is not required. The code can optionally be extended with letters to add additional information. The degrees of protection and IP codes are specified in IEC 60529 with the title “degree of protection of enclosure” (IP code).

1st code number x (protection against solid foreign bodies and touch protection)		2nd code number y (degree of water protection)	
0	No protection	0	No protection
1	Protection against solid bodies with Ø 50 mm and above	1	Protection against dripping water (vertically falling drops)
2	Protection against solid bodies with Ø 12.5 mm and above	2	Protection against dripping water (vertically falling drops when the enclosure is tilted at an angle of 15°)
3	Protection against solid bodies with Ø 2.5 mm and above	3	Protection against spraying water
4	Protection against solid bodies with Ø 1 mm and above	4	Protection against splashing water
5	Dust protection	5	Protection against jets of water
6	Dust tight	6	Protection against powerful jets of water
		7	Protection against the effects of temporary immersion in water
		8	Protection against the effects of continuous immersion in water
		9	Protection against water in high-pressure and steam jet cleaning

### **Dielectric strength**

The dielectric strength (usually given in kV/mm) of an insulator is the maximum electrical field strength that can exist in the material without a breakdown occurring (arc or spark).

### **DIN**

The German Standards Institute, DIN – “**D**eutsches **I**nstitut für **N**ormung e. V.” – represents German interests on international/European standards committees (ISO and CEN, as well as the electrical engineering organizations IEC and CENELEC). The manner in which the standards are developed should ensure that the content and process technology meet the generally accepted rules of technology.



### **DKE**

DKE, **D**eutsche **K**ommission **E**lektrotechnik **E**lektronik Informationstechnik im DIN (the German Commission for Electrical Engineering, Electronics and Information Technology in DIN), is the organization responsible in Germany for developing standards and safety requirements in the areas of electrical engineering, electronics and information technology. It is the German member of IEC, CENELEC and ETSI.

### **Double insulation**

#### **(according to EN 61010-031)**

Insulation consisting of basic insulation and supplementary insulation.

⚠ The intent is that, in the event of damage to one of the two layers, the second layer should continue to ensure the full insulation capacity against the rated voltage. For double insulation and the equivalent reinforced insulation, the creepage distances and clearances are twice as large as for basic insulation. In older Stäubli catalogs, doubly insulated items are still labeled with . The  symbol will be eliminated for test accessories in the future.

### **EN**

European Standards (EN) are rules that have been ratified by one of the three European committees for standardization: the “European Committee Standardization” (CEN), the “European Committee for Electrotechnical Standardization” (CENELEC) or the “European Telecommunications Standards Institute” (ETSI). All EN standards have come into being through a public standardization process.

### **Enclosure (according to IEC 61010-031)**

Part that provides protection of a test accessory against certain external influences and against direct contact from all directions of access.

## **ETSI**

The **E**uropean **T**elecommunications **S**tandards **I**nstitute, ETSI, is responsible for European standardization in the area of telecommunications.

## **Extra-high voltage**

In electrical power engineering, the term “extra-high voltage” is used for the upper range of high voltages (typically 220 kV and up). Extra-high voltages serve the purposes of large area supply, wide area synchronous grids for interregional energy exchange and the connection of large power plants.

## **Extra-low voltage**

Extra-low voltage (ELV) is a voltage in electrical engineering that does not exceed the limit values for voltage range I according to IEC 60449. The limit values are  $\leq 50$  V for AC voltage and  $\leq 120$  V for DC voltage. These values correspond to the limits for the continuously permitted touch voltage that is classified as non-life-threatening for adults and normal applications.

A further distinction is made between the terms “Protective Extra-Low Voltage” and “Functional Extra-Low Voltage,” which are usually abbreviated by their initials:

SELV = **S**afety **E**xtra-**L**ow **V**oltage

PELV = **P**rotective **E**xtra-**L**ow **V**oltage

FELV = **F**unctional **E**xtra-**L**ow **V**oltage

see also “Low voltage” page 46

## **Failsafe**

Built in such a way that faults that could cause the risk of a hazard are not anticipated; for testing a device under fault conditions, a fail-safe component is considered not prone to failure.

## **FELV**

Functional Extra-Low Voltage, FELV (formerly “functional extra low voltage without protective separation”) is a low electrical voltage that itself represents no danger when touched; however, its generation includes no protective measures that would rule out hazards in the event of fault.

## **Flashover voltage**

“Flashover voltage” refers to the voltage at which flashover occurs along the insulating surface of electrical equipment.

See also “Breakdown voltage,” page 38

## **Gold plating**

Gold has good electrical conductivity and the best resistance to corrosion. The contact resistance is low and constant. Nickel or copper layers serve as diffusion barriers.

## **Hand-held and hand-operated test accessories**

Special safety requirements should be set for test accessories with which the user comes into direct contact. IEC/EN 61010-031 meets this important standardization need and addresses hand-held and hand-operated test

accessories, in particular. Among other things, the standard requires parts that can conduct voltage greater than 30 VAC or 60 VDC to be classified as hazardous as a general rule and thus to be sufficiently insulated so that no energized parts can be touched.

### **Hazard (according to EN 61010-031)**

Potential source of damage.

### **Hazardous live (according to EN 61010-031)**

Capable of causing an electric shock or electrical burns under normal conditions or under a single fault condition.

### **High breaking capacity fuse**

High breaking capacity fuses can disconnect currents of several thousand amperes. Our fused measurement leads and test probes can be equipped with high breaking capacity fuses.

### **High voltage**

An electrical voltage over 1000 VAC / 1500 VDC is generally described as high voltage. In VDE requirements, voltages up to 1 kV are consistently described as low voltage and those over 1 kV as high voltage. In electrical power engineering, further terminological distinctions are usual within the high voltage range among “medium voltage,” “high voltage” and “extra-high voltage,” but the limits are not set uniformly. In this context, “high voltage” refers to the range of 60 kV and 110 kV for the supply of smaller cities,

overland transmission and the connection of smaller power plants.

### **IEC**

The **I**nternational **E**lectrotechnical **C**ommission, IEC, is an international standardization committee in the areas of electrical engineering and electronics.

Some standards are developed together with the ISO (International Organization for Standardization).

### **IEV**

The IEV is the IEC 60050 series of standards of the IEC and has also been available online since 2007 as Electropedia. It consists of numerous chapters that are divided into parts and sections. The German edition of the IEV contains English and French designations and definitions of IEV terms and their translation into German.

### **Insertion force and withdrawal force**

The forces used to insert or withdraw a plug-in connector without having an impact on the coupling or locking device. The insertion force is normally greater than the withdrawal force due to the spring tension. Both forces are determined with polished steel sockets and steel plugs.

### **Insulated conductor structure**

Our highly flexible stranded wires consist of many thin individual copper strands. The number, diameter and stranding of these determine a wire's connector structure.

## Insulation coordination

Concept for determining creepage distances, clearances and installation distances for electrical equipment, taking into account the conditions of use, e.g. the occurrence of overvoltages.

The following must be taken into account for insulation coordination:

- Voltages that can occur in the system (overvoltages)
- Voltages that can be generated by the operating equipment (system voltage)
- The protection of persons and objects (protection classes)
- Environmental conditions (degree of pollution)
- Insulation properties (material groups)

The IEC 60664 series applies as applicable standards in the low-voltage range up to a rated AC voltage of 1000 V or a rated DC voltage of 1500 V. A procedure for rating the insulating clearances and creepage distances for electrical equipment in low-voltage systems is described here.

The values given for the anticipated overvoltages are based on the overvoltages actually occurring in power grids, which can be determined with long-term measurements. In the IEC/EN 61010-031, the values underlie this standard for the determination of the necessary clearances and creepage distances for the respective application.

## Insulation materials

In our catalogs, we indicate the material of the wire insulation for the respective item. You can find comprehensive information on the materials used, namely silicon, PVC and TPE, in the main catalog “Cables & Multistrand Wires.”

If you have questions on these or other insulation materials we use (e.g. for plug-in connectors, etc.), please contact us.

## ISO

The International Organization for Standardization (abbreviation: ISO) is the international association of standardization organizations and develops international standards in all areas with the exception of electrical engineering, electronics and telecommunications.

## Lead length

The lead length indicated in our catalogs for pre-assembled leads defines the minimum visible lead length. The plug-in connectors are included with the Ø 6 mm test leads.

## Live working

“Live working” refers to work on or near energized electrical equipment. Insofar as this concerns voltages that are hazardous to touch, work under voltage requires specially trained employees, special work equipment (e.g., insulated tools) and special organizational measures (e.g., written instructions from the responsible parties).

The method of working on energized parts for the purposes of cleaning, maintenance, repair

and expansion of electrical power supply systems was introduced decades ago, is common worldwide, has significant advantages and is very safe when performed correctly.

### **Low voltage**

AC voltages up to 1000 V and DC voltages up to 1500 V are referred to as low voltage. Higher voltages are referred to as high voltage.

### **Low voltage equipment**

This is electrical equipment operated with low voltage. The Low Voltage Directive defines low voltages as between 50 and 1000 V for AC current and between 120 and 1500 V for DC current.

However, the Low Voltage Directive does not apply to special equipment and areas.

Low-voltage equipment consists of equipment for generation, conversion, storage, transmission, distribution and consumption of electrical energy for the purpose of performing work (for example, in the form of mechanical work, to generate heat and light or in electro-chemical processes).

The standards that are important for the set-up, operation and maintenance of low-voltage equipment are set in Part 1 of the DIN VDE standards.

The low-voltage power grid represents distributed low-voltage equipment for public power supply; in Europe, this is usually operated with three-phase AC power.

### **Mating cycles**

Mechanical actuation of plug-in connectors and plug-in devices through insertion and withdrawal. Each mating cycle consists of one insertion operation and one withdrawal operation.

### **Medium voltage**

In electrical power engineering, the term “medium voltage” is used for the lower range of high voltages (typically up to about 30 kV). Application areas of medium voltages are large consumers like industrial plants and the power supply to individual urban districts or multiple localities.

### **MULTILAM plug**

Our MULTILAM plugs consist of a metal pin (a turned brass part) with an attached contact louver made of a hard copper alloy. The metal pin and contact louver are nickel-plated or gold-plated. The contact louver is under internal tension in the groove provided for it around the metal pin. The geometry and material of the contact louver provide optimal mechanical and electrical properties for the plug-in connection: It is sturdy and durable (thanks to the solid metal pin), vibration resistant when inserted, can be subjected to high currents and exhibits low contact resistance and low self-heating. The MULTILAM plugs are generally designed as a plug-socket part, so the pre-assembled connection cables can be connected one after another any number of times.

⚠ You can find extensive technical information on our contact lovers in our “MULTILAM Technical Overview” brochure, which you can download from [www.staubli.com/electrical](http://www.staubli.com/electrical).

### **Neutral conductor**

Conductor that is electrically connected to the neutral point of a power supply system. The conductor is marked with the letter N and preferably uses light blue (formerly: gray) as the color coding. A neutral conductor is often inaccurately referred to as a zero conductor. Since neutral conductors are intended to carry current during regular operation, they, like the line conductors, are referred to as active conductors.

### **NH fuse**

Low-voltage high-power fuses, known as NH fuses, have a higher volume than screw fuses and have solid contact blades on both ends. Therefore, they can conduct and disconnect higher currents. NH fuses are used in house junction boxes, for example.

### **Nickel plating**

Where requirements on electrical properties are less strict, our contact elements are nickel-plated. Nickel plating is also primarily used for intermediate layers (diffusion barriers) for a gold layer above.

### **Nominal voltage**

The nominal voltage of an electrical load or a voltage source (battery, generator or power

grid) is the value of the electrical voltage under normal operations, as specified by the manufacturer or supplier. A tolerance range is usually added to the indicated nominal voltage; it is the maximum permissible range. The “rated voltage” must be distinguished from the nominal voltage. This indicates the maximum voltage for which the insulation of switchgears, etc., must be designed. The rated voltage is always greater than the nominal voltage.

### **Normal conditions**

#### **(according to EN 61010-031)**

Condition in which all protective measures against hazards function.

### **Occupational safety**

see page 5 – 8

### **Operator (according to EN 61010-031)**

Individual or group responsible for the use and maintenance of the device.

### **Overvoltage**

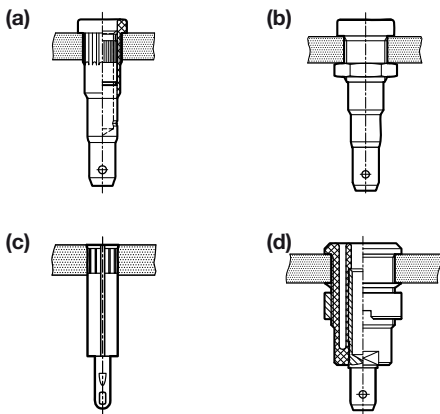
“Overvoltage” refers to the situation where the nominal voltage of an electrical system is exceeded. The anticipated overvoltages on and in electrical devices are crucially dependent on the point in the grid at which the device in question is located.

Temporary overvoltage, page 52

Transient overvoltage, page 53

### Panel sockets and press-in sockets

Our sockets are offered in various designs; panel sockets and press-in sockets, insulated or uninsulated and with various connection options. The sockets mostly have rigid designs; some are also spring-loaded with the proven contact louver.



- (a) Insulated press-in sockets (rigid and with spring-loaded contact louvers)
- (b) Insulated panel sockets (rigid and with spring-loaded contact louvers)
- (c) Uninsulated press-in sockets (rigid)
- (d) Safety sockets (rigid), appropriate for accepting spring-loaded plugs with a rigid insulating ferrule.

### PE conductor

See “Protective conductor,” page 49

### PELV

Protective Extra-Low Voltage, PELV, (formerly: “Functional Extra-Low Voltage with Protective Separation”) also offers protection against electric shock.

PELV is used when extra-low voltage live conductors or the body of equipment must be grounded. For example, this is the case if equipotential bonding has to be implemented to prevent sparking in containers and explosive spaces.

### Plug-in connection

The electrical connection between two plug-in connectors, i.e. consisting of at least two contact parts.

### Plug-in connector (according to IEC 61010-031)

A component that is connected to the probe wire in order to be connected to the terminal on the device or the plug-in connector of another test accessory.

### Plug-in devices

Equipment that can be inserted or disconnected under load during proper use.



### **Pollution (according to IEC 61010-031)**

Deposits of solid, liquid or gaseous (ionized gases) foreign substances that can lead to a reduction of the dielectric withstand voltage or specific surface resistance.

### **Primary current**

See “Primary winding,” page 49

### **Primary voltage**

See “Primary winding,” page 49

### **Primary winding**

Winding from which the electrical power is drawn. For example, in a transformer, this is the side facing the grid. The voltage present on this winding is called primary voltage; the current flowing through it is called primary current.

### **Proper operation**

Operation, including readiness for operation, according to the user information or the clearly intended purpose.

⚠ In most cases, proper operation presupposes normal conditions, since the user information warns against operation of the device under abnormal conditions.

### **Protective conductor**

A protective conductor is an electrical conductor that serves to provide protection. The abbreviation for protective conductor is PE (Protective Earth). The task of the protective conductor in electrical systems is protection

of humans and animals against hazardous contact voltage and electric shock in the event of a fault (e.g., failure of the enclosure’s insulation). A protective conductor is often included in electrical equipment and cables and is identified by the color combination green/yellow.

### **Protective impedance**

#### **(according to EN 61010-031)**

Component, component assembly or combination of basic insulation and a voltage or current limiter that offers protection in the sense of this standard due to its impedance, design and reliability when it is connected between touchable conductive parts and hazardous live parts, under normal conditions or a single fault condition.

### **Protective shroud**

#### **(according to EN 61010-031)**

Part that ensures protection against direct contact from all usual directions of access.

### **Rated current**

The rated current is the current that our items can carry continuously without exceeding an upper temperature limit.

### **Rated value**

A value of a quantity valid for a previously specified operating condition, which is generally determined by the manufacturer for a component, device or instrument.

### **Rated voltage**

The rated voltage is the voltage for which our item is rated and to which the specified operating properties relate. The rated voltage also includes the indication of the measurement category insofar as this concerns voltage indications greater than 30 VAC / 60 VDC.

The rated voltage in our catalogs always relates to pollution degree 2 (exception: CAT IV items are designed for pollution degree 3).

### **Rating (according to EN 61010-031)**

Totality of the rated values and operating conditions.

### **Reach**

Regulation (EC) No. 1907/2006 – Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

### **Reference connection**

#### **(according to IEC 61010-031)**

A device that serves to connect a reference point in the measuring instrument or test device (usually the functional ground connection) to a reference point in the electrical circuit to be measured or tested.

### **Reference ground**

Part of the ground outside of the range of influence of ground electrodes in which no measurable voltages occur between any two points on the surface of the ground. The electrical potential of the reference ground is equated to zero by convention. The voltage to

this zero potential is what is meant when the voltage indication  $U_0$  occurs in multiple-phase power grids or multiple-strand cables, for example.

### **Reinforced insulation**

#### **(according to IEC 61010-031)**

Insulation that offers protection against electric shock and the protection of which is not less than the protection provided by double insulation.

Reinforced insulation may consist of multiple layers that cannot be tested individually as basic insulation or supplementary insulation.

### **Responsibility / duty of care of the user**

The user is responsible for verifying that the products shown in the catalog meet regulations other than those indicated in application areas we cannot foresee.

This also includes observing the user information and inspecting the test accessories for defects before use.

### **RoHS conformity (RoHS ready)**

EC Directive 2011/65/EU restricts the use of certain hazardous materials for electrical and electronic devices (RoHS conformity). Although electrical test accessories do not currently fall within the scope of this directive, we use materials that meet the RoHS criteria exclusively for all items in our product ranges.

### **Safety Extra-Low Voltage**

Safety Extra-Low Voltage (SELV) is a low electrical voltage that offers special protection against electric shock due to its low value and insulation from higher voltage circuits (Safety **Extra-Low Voltage**). Extra-low voltage protection with SELV is a safety measure allowing circuits with nominal voltages up to 50 VAC / 120 VDC to be operated ungrounded. The power is supplied from higher voltage circuits in such a way that safe insulation from them is ensured.

See also “Extra-low voltage,” page 43

### **Safety of components**

For components that are installed in devices (e.g., panel sockets or adapters), protection against hazardous electrical voltage must be ensured by the end product. The ratings we indicate are only valid if these parts are used and installed properly. You can find more information on this in the respective assembly instructions, which you can download as PDF files from our website, [www.staebli.com/electrical](http://www.staebli.com/electrical), under Downloads – Assembly Instructions – Test & Measurement, or request directly from us. You can find the corresponding assembly instruction number in the product description.

### **Safety plug-in connectors**

Special plug-in connectors in which all live parts are insulated in such a way that they cannot be touched during normal operation, regardless of whether or not they are inserted.

Rigid insulating ferrules are one such example. Safety plug-in connectors meet all common safety requirements and standards, e.g. IEC/EN 61010-031.

### **Secondary current**

See “Secondary winding,” page 51

### **Secondary voltage**

See “Secondary winding,” page 51

### **Secondary winding**

Winding—of a transformer, for example—into which the electrical energy from the primary winding is transmitted inductively. The voltage induced in the secondary winding is called secondary voltage; the current flowing through it is called secondary current.

### **Single fault condition**

#### **(according to EN 61010-031)**

Condition in which a protective measure against hazards is defective or a fault exists that could cause a hazard.

⚠ If the single fault condition inevitably leads to a further single fault condition, the two are also jointly considered one “single fault condition.”

### **Solid insulation**

#### **(according to IEC 61010-031)**

Solid insulation must withstand the electrical and mechanical stresses that can arise under normal conditions under all rated environment conditions.

The manufacturer should take the anticipated lifespan of the test accessory into account when selecting insulation materials.

**Standard test finger**

The test finger serves the purpose of simulating the (un)touchability of active parts by the human finger. The dimensions are specified in EN 61010-031. A distinction is made between rigid test fingers and jointed test fingers.

Also see the illustration of a jointed test finger on page 28

**Supplementary insulation  
(according to  
IEC 61010-031)**

Independent insulation that is used in addition to basic insulation in order to ensure protection against electric shock in the event of failure of the basic insulation.

**Surface treatment**

For protection against corrosion, our contact elements are provided with a protective layer (a precious-metal layer in some cases).

**Technical changes and  
catalog information**

We reserve the right to make technical changes that serve the purpose of technical progress and safety, even without prior consultation with users. No liability is assumed for any catalog information.

**Temporary overvoltage**

Temporary overvoltages are caused by load fluctuations or grounding faults, for example.

**Terminal (according to EN 61010-031)**

Component of a device that is provided for connecting the device to external electrical cables.

**Test accessory  
(according to EN 61010-031)**

Device for temporary contact between the measuring instrument or test device and a point in an electrical circuit to be measured or tested. It includes the lead and all additional equipment used to establish the connection to the measuring instruments or test devices.

**Test finger (according to EN 61010-031)**

See “Standard test finger,” page 52

**Test voltage**

The voltage that a plug-in connector can withstand under the specified conditions without breakdown or flashover. In the catalog, we do not indicate test voltage, in order to prevent any confusion with the significantly lower rated voltage.

**Thermoelectric voltage**

On the contact points between different metals, a contact voltage develops (according to the thermoelectric series), the amount of which depends on the temperature. Between two like contacts of different temperatures in

a circuit, a thermoelectric voltage arises, as a consequence of which thermoelectric current flows that can have a disruptive influence on measurements.

### **Tool (according to IEC 61010-031)**

A device separate from the part, including keys or coins, that allow a person to perform mechanical functions.

### **Touch protection**

Design precautions on electrical equipment such as test accessories that serve to protect against accidentally touching energized parts (e.g., insulation or protective shrouds).

The term “touch protection” is associated with a voltage indication, which provides an upper limit on the electrical voltage at which this test accessory can be operated safely. This upper limited (rated voltage) is also based on the environment of use of the test accessory.

See also “Measurement categories,” pages 16 – 20

### **Touchable (with respect to a part – according to EN 61010-031)**

Built in such a way that it can be touched with a standard test finger or test probe.

### **Transient overvoltage**

refers to voltage spikes caused by switching actions in electrical circuits or electrostatic discharge, persisting for a period of nano/microseconds. The effects of lightning during thunderstorms also cause transient overvoltages.

### **User (according to EN 61010-031)**

Person who uses the device properly.

⚠ The user should be properly instructed for this purpose.

### **User information **i**000**

As a general rule, information on the max. rated voltage and maximum rated current is provided on each of our items. However, for some items, this may not be possible for reasons of space, among other things. Therefore, we supply these items with the corresponding user information **i**000, which is referred to in the catalog.

### **VDE**

VDE, originally the Verband Deutscher Elektrotechniker (Association of German Engineers) and, since 1998, the Verband der Elektrotechnik, Elektronik und Informationstechnik (Association of Electrical Engineering, Electronics and Information Technology), campaigns for these scientific fields and the technology building on them. The focus of VDE’s work is on ensuring safety in electrical engineering, developing accepted rules of technology as well as national and international standards as well as testing and certifying devices and systems.

### **Wet environment**

#### **(according to IEC 61010-031)**

Environment in which water or another conductive liquid may be present and in which it is likely that the resistance of the human body will be reduced by wetting of the contact be-

tween the human body and the device and by wetting of the contact between the human body and its environment.

**Withstand voltage**

For cables and passive and active components, the withstand voltage parameter indicates the voltage at which the corresponding component can still be operated.

**Working voltage****(according to EN 61010-031)**

Highest rms of the direct or alternating current that can be present continuously on insulation under observation during proper operation if the device is supplied with the rated voltage.

**Note:**

The glossary covers definitions and explanations of terms and abbreviations that are used in Stäubli's webpages and documents. The terms in it contain generally valid explanations, with both European and international scope, which correspond in full or in part to excerpts from currently applicable standards.



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