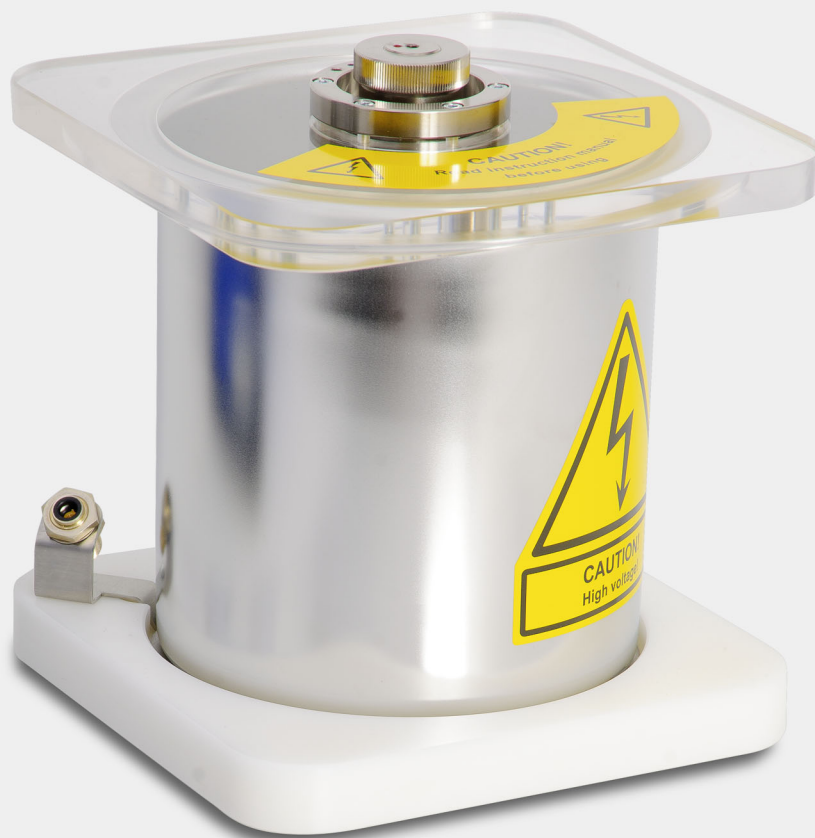


CP TC12

Reference Manual



Manual Version: ENU 1034 04 02

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The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing and are subject to change without prior notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present.

The user is responsible for every application that makes use of an OMICRON product.

OMICRON translates this manual from the source language English into a number of other languages. Any translation of this manual is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this manual shall govern.

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About this manual

This User Manual provides information on how to use the *CP TC12* test system safely, properly and efficiently. The CP TC12 Reference Manual contains important safety rules for working with the *CP TC12* and gets you familiar with operating the *CP TC12*. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The CP TC12 Reference Manual always has to be available on the site where the *CP TC12* is used. The users of the *CP TC12* must read this manual before operating the *CP TC12* and observe the safety, installation, and operation instructions therein.

Reading the CP TC12 Reference Manual alone does not release you from the duty to comply with all national and international safety regulations relevant to working on high-voltage equipment.

Safety symbols used

In this manual, the following symbols indicate safety instructions for avoiding hazards.



DANGER

Death or severe injury will occur if the appropriate safety instructions are not observed.



WARNING

Death or severe injury can occur if the appropriate safety instructions are not observed.



CAUTION

Minor or moderate injury may occur if the appropriate safety instructions are not observed.

NOTICE

Equipment damage or loss of data possible.

1 Safety instructions

1.1 Operator qualifications

Working on high-voltage assets can be extremely dangerous. Testing with the *CP TD1* must be carried out only by qualified, skilled and authorized personnel. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on the *CP TD1* must be under constant supervision of an experienced operator while working with the equipment. The operator is responsible for the safety requirements during the whole test.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with the *CP TC12* must comply with the internal safety instructions and additional safety-relevant documents.

In addition, observe the following safety standards, if applicable:

- EN 50191 (VDE 0104) "Erection and Operation of Electrical Test Equipment"
- EN 50110-1 (VDE 0105 Part 100) "Operation of Electrical Installations"
- IEEE 510 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing"

Moreover, observe all applicable regulations for accident prevention in the country and at the site of operation.

Before operating the *CP TC12* and its accessories, read the safety instructions in this User Manual carefully.

Do not turn on the *CP TC12* and do not operate the *CP TC12* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of the *CP TC12* and its accessories is only permitted by qualified experts at OMICRON service centers (see "Support" on page 17).

1.2.2 Safety rules

Always observe the five safety rules:

- ▶ Disconnect completely.
- ▶ Secure against re-connection.
- ▶ Verify that the installation is dead.
- ▶ Carry out grounding and short-circuiting.
- ▶ Provide protection against adjacent live parts.

1.3 Operating the measurement setup

The metallic container of the *CP TC12* represents the high-voltage electrode. During the test, this part carries a voltage of up to 12 kV.

- ▶ Treat the area around the *CP TC12* as "prohibition zone" according to EN 50191.
- ▶ Make sure that nobody can enter this zone during the test. Use walls or barriers for protection as shown in Figure 4-1: on page 14.
- ▶ Always obey the five safety rules and follow the detailed safety instructions.
- ▶ Before switching on the high voltage, leave the high-voltage area.

Before performing tests by using high voltage, observe the following instructions:

- ▶ Do not use the test equipment without a steady connection to substation ground.
- ▶ Do not connect any cable to the test object without a visible grounding of the test object.
- ▶ Never remove any cables from the *CP TC12* or the test object during a test.
- ▶ Do not use inadequately rated supply cords.
- ▶ Do not insert objects (for example, screwdrivers, and so on) into any input/output socket.
- ▶ Check your additional equipment (computer) for environmental conditions before use.
- ▶ Do not operate the *CP TC12* and its accessories in the presence of explosives, gas or vapors.
- ▶ If the *CP TC12* or its accessories do not seem to function properly (for example, in case of cable damages, or overheating of components), stop using them and contact your regional OMICRON service center (see "Support" on page 17).
- ▶ Observe the dangerous areas.
- ▶ Always obey the internal safety instructions for working in areas with high voltage to avoid injury.

1.4 Orderly measures

The *CP TC12* Reference Manual or alternatively the e-book has always to be available on the site where the *CP TC12* is operated.

The users of the *CP TC12* must read this manual before operating the *CP TC12* and observe the safety, installation, and operation instructions therein.

The *CP TC12* and its accessories may be used only as described in this User Manual. Any other use is not in accordance with the regulations. The manufacturer and the distributor are not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

Following the instructions provided in this User Manual is also considered part of being in accordance with the regulations.

Opening enclosed components of the *CP TC12* or its accessories invalidates all warranty claims. This of course does not include opening the *CP TC12*'s container (high-voltage electrode) which is necessary during operation of the *CP TC12*.

1.5 Disclaimer

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.6 Recycling



This test set (including all accessories) is not intended for household use. At the end of its service life, do not dispose of the test set with household waste!

For customers in EU countries (incl. European Economic Area)

OMICRON test sets are subject to the EU Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE directive). As part of our legal obligations under this legislation, OMICRON offers to take back the test set and ensure that it is disposed of by authorized recycling agents.

For customers outside the European Economic Area

Please contact the authorities in charge for the relevant environmental regulations in your country and dispose the OMICRON test set only in accordance with your local legal requirements.

2 Introduction

Capacitance (C) and Dissipation Factor (DF) measurement is an established and important insulation diagnosis method. It can detect:

- Aging of insulation liquids
- Contamination of insulation liquids with particles
- Water in liquid insulation

In an ideal capacitor without any dielectric losses, the insulation current is exactly 90° leading according to the applied voltage. For a real insulation with dielectric losses this angle is less than 90° . The angle $\delta = 90^\circ - \varphi$ is called loss angle. In a simplified diagram of the insulation, C_p represents the loss-free capacitance and R_p the losses (see Figure 2-1).

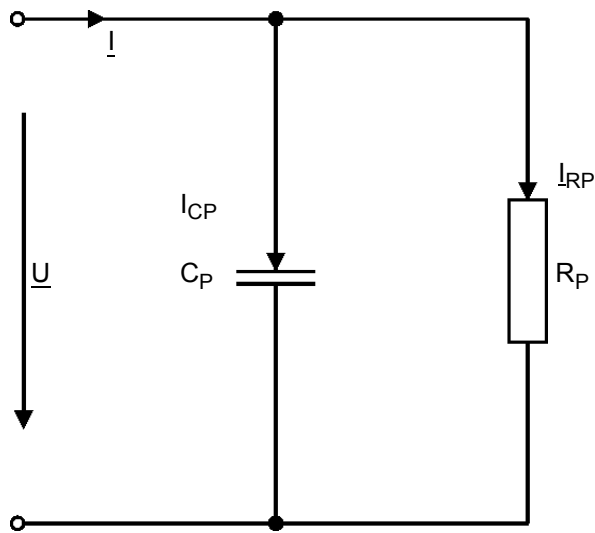


Figure 2-1: Simplified circuit diagram of a capacitor

The definition of the dissipation factor and the vector diagram are shown in Figure2-2.

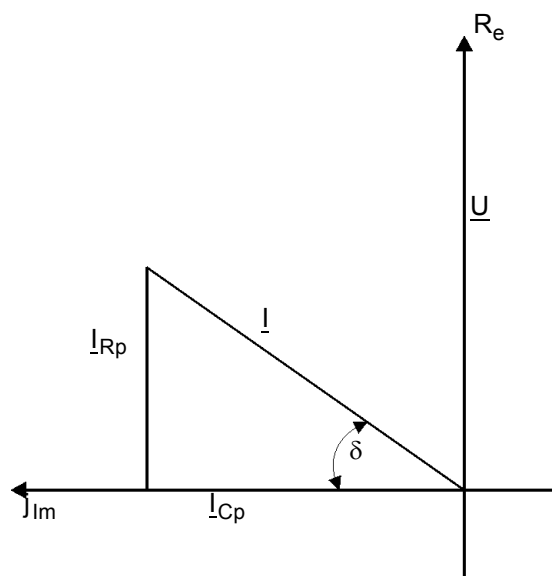


Figure 2-2: Definition of dissipation factor ($\tan \delta$) and the vector diagram

The correlation between the Dissipation Factor and Power Factor ($\text{PF} = \cos \varphi$) and the vector diagram are shown in Figure 2-3.

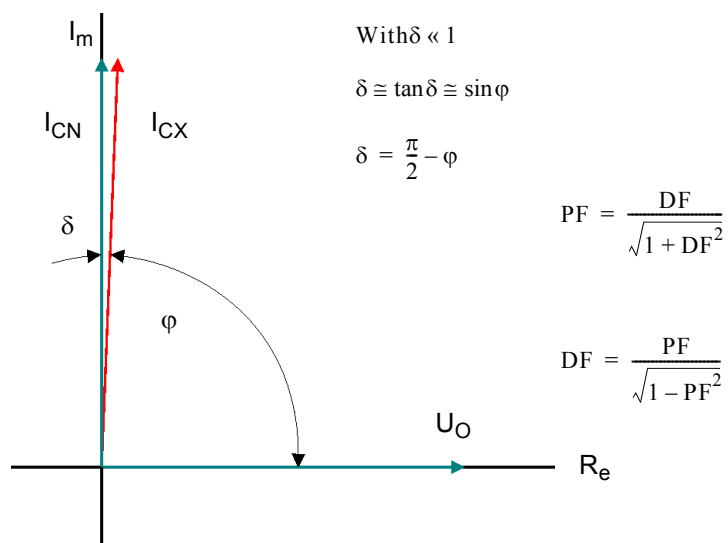


Figure 2-3: Correlation between DF and PF

Figure 2-4 shows the breakdown voltage and DF in oil, dependent on the water content. With low water content, the breakdown voltage is very sensitive; with higher water content, the DF is a good indicator.

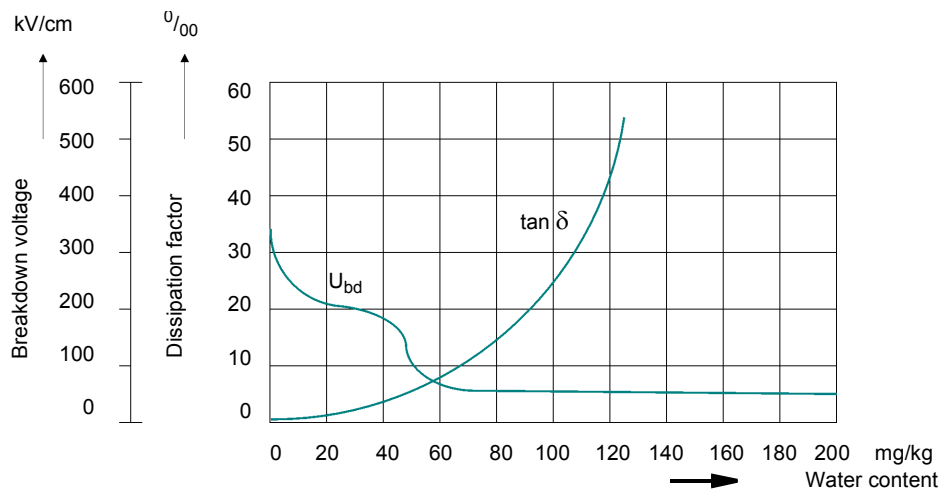


Figure 2-4: Breakdown voltage and DF in oil, dependent on the water content

Figure 2-5 shows the DF of new and used oil, dependent on the temperature. With higher temperatures, the viscosity of the oil decreases. The particles, ions, and electrons can move easier and faster. Thus, the DF increases with temperature.

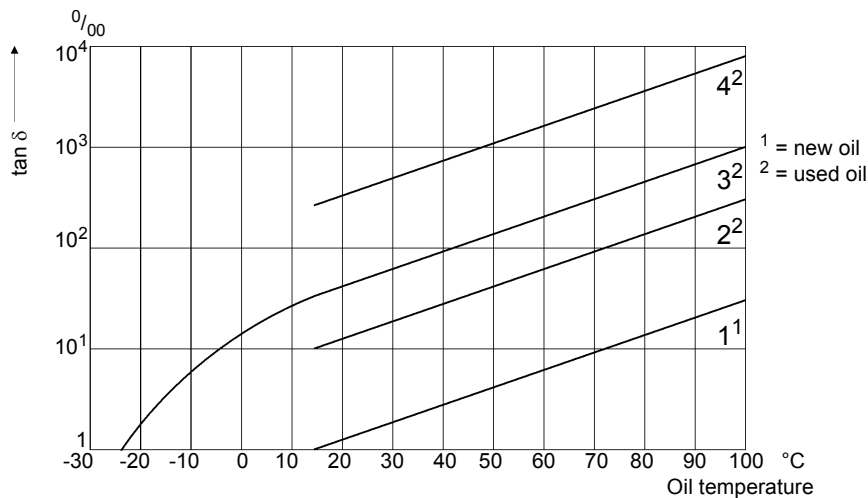


Figure 2-5: DF of new and aged oil, dependent on the temperature

For mineral oil, the dissipation factor is generally measured at 90° C according to IEC.

When the dissipation factor is measured at 20° C, the values are about $\frac{1}{10}$ to $\frac{1}{20}$ of the 90° C values.

3 Measuring Principle

In the measuring schematic in Figure 3-1, the guard (ring) is shown as cut surface.

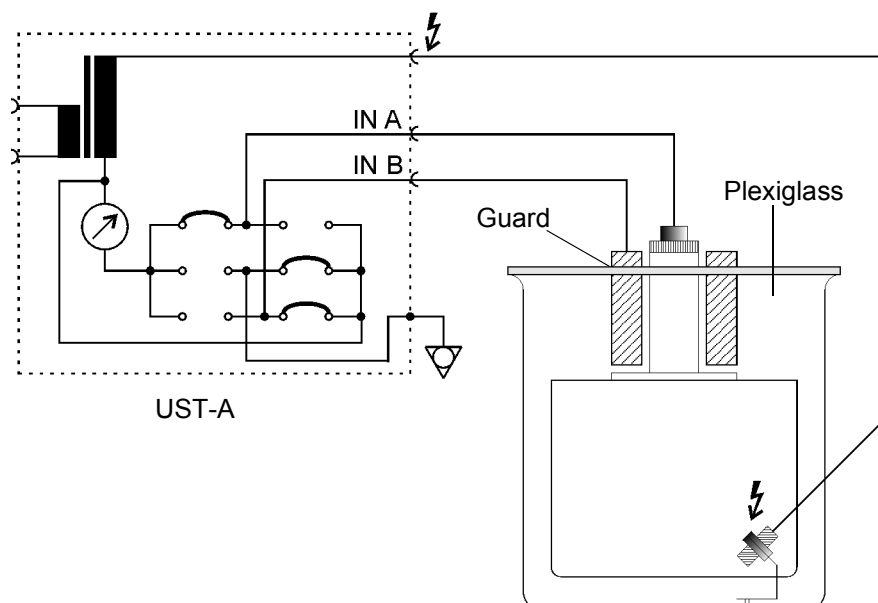


Figure 3-1: Measuring schematic

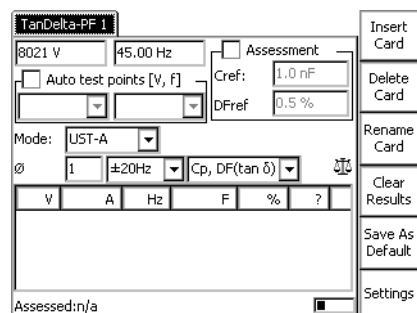


Figure 3-2: Measurement settings

Note: Whereas the 8 kV measuring voltage in Figure 3-2 is just an example, we recommend to use the averaging factor (number of measurements) setting of $\emptyset = 10$ at any rate.

Figure 3-3 shows the oil test cell's minimum oil level, which should be slightly above the lower edge of the guard.

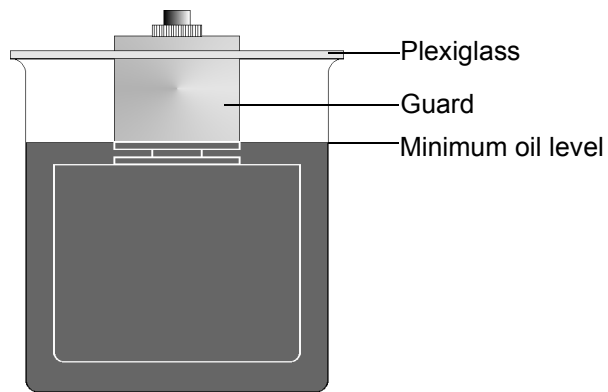


Figure 3-3: Minimum oil level

4 Connecting the *CP TC12*

WARNING



Death or severe injury caused by high voltage possible!

The metallic container of the *CP TC12* represents the high-voltage electrode. During the test, this part carries a voltage of up to 12 kV.

- ▶ Treat the area around the *CP TC12* as "prohibition zone" according to EN 50191.
- ▶ Make sure that nobody can enter this zone during the test. Use walls or barriers for protection as shown in Figure 4-1 below. Keep a minimum of 150 cm (59 inches) from the test cell to the barriers in all directions, and make sure that high-voltage warning signs are well visible.
- ▶ To avoid electrical spark-over between the two *CP TD1* connecting cables and the housing, keep the cables at least 10 cm (4 inches) away from the *CP TC12* housing.

Figure 4-1 shows a typical test setup with the *CP TC12* connected to the *CP TD1*. For a more detailed view, also see Figure 4-2 on the next page.

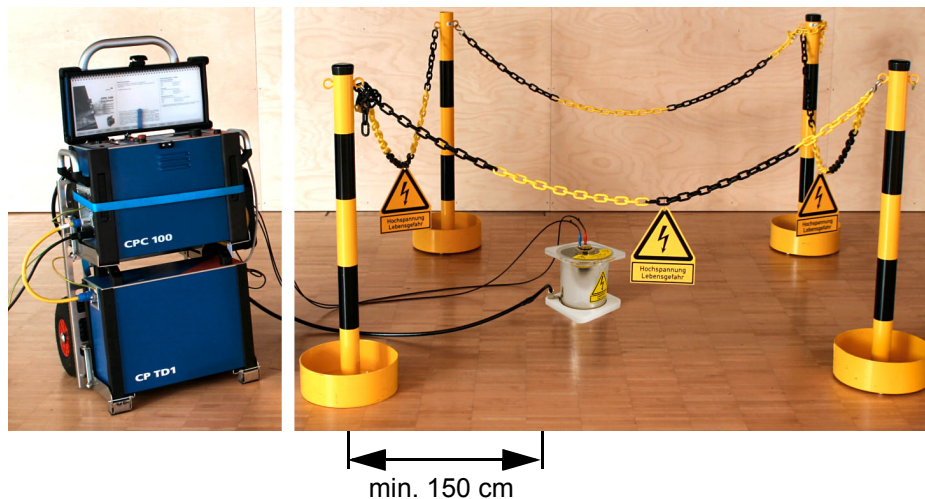


Figure 4-1: Typical test setup

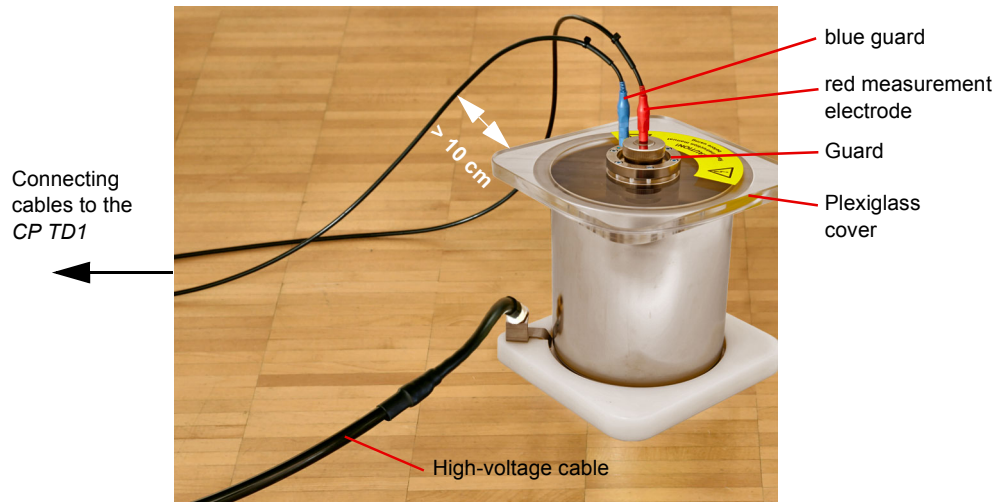


Figure 4-2: Oil test cell CP TC12

4.1 Components of the CP TC12

Figure 4-3 shows the disassembled oil test cell.

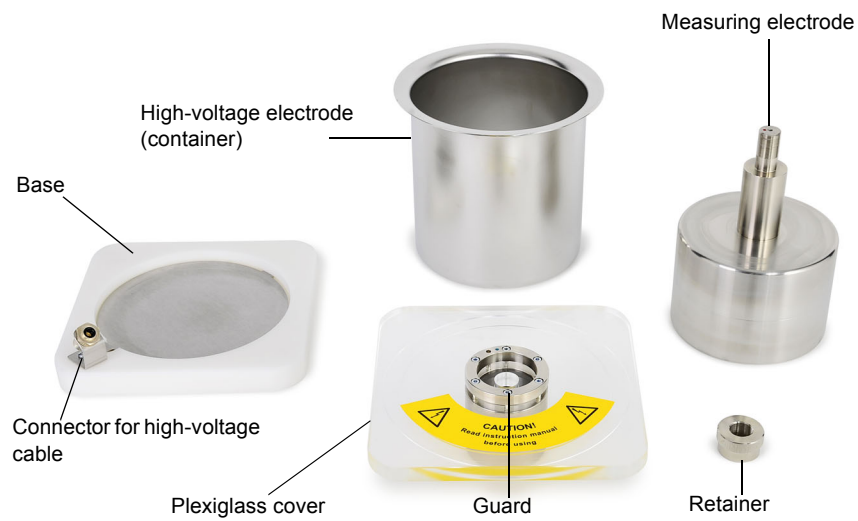


Figure 4-3: Disassembled oil test cell CP TC12

5 Technical data

Three-electrode design with guard for precise measurement, especially of small losses, electrodes made of stainless steel.

Table 5-1: CP TC12 Specifications

Characteristic	Rating
Test gap	11 mm / 0.43 inch
Capacitance of empty cell (air)	approx. 65 pF $\pm$ 10 %
Sample volume	1.2 - 2 l / 41 - 68 fl.oz.
Max. RMS test voltage	12 kV
Inner dimensions (diameter x height)	172 mm x 180.8 mm / 6.8 x 7.1 inches
Weight	approx. 9.2 kg / 20 lb
Dimensions of case (L x W x H)	390 mm x 390 mm x 400 mm / 15.35 x 15.35 x 15.75 inches
Weight with case	approx. 12 kg / 26 lb

5.1 Cleaning

Clean the cell with warm water and a dishwashing detergent. The plexiglass cover may not be exposed to temperatures higher than 60° C. Do not use alcohol for cleaning the plexiglass cover.

Support

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