♦ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ♦

RDC-1

Rigid Dielectric Cell
User Manual

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RDC-1 IM January 2025

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WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Revision	Description
January 2025	Initial Release

WARNING

OBSERVE ALL SAFETY RULES
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

Dangerous voltages may be present inside this instrument. Do not open the case
Refer servicing to qualified personnel

HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE CONDUCTORS WHEN USING THIS INSTRUMENT.

Use extreme caution when working with bare conductors or bus bars.

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND KEEP UNREQUIRED PERSONNEL SAFELY AWAY.

CAUTION

DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

Contents

SAFETY PRECAUTIONS

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. Such noncompliance would also violate safety standards of design, manufacture, and intended use of the instrument.

IET Labs assumes no liability for the customer's failure to comply with these precautions.

The RDC-1 complies with INSTALLATION CATEGORY I as well as POLLUTION DEGREE 2 in IEC61010-1.

If an instrument is marked CAT I (IEC Measurement Category I), or it is not marked with a measurement category, its measurement terminals must not be connected to line-voltage mains.

The RDC-1 is an indoor use product.

 DANGEROUS PROCEDURE WARNINGS 

Comply with all WARNINGS - Procedures throughout in this manual and instructions on the instrument prevent you from potential hazard. These instructions contained in the warnings must be followed.

BEFORE APPLYING POWER

Verify that all safety precautions are taken. Make all connections to the instrument before applying power. Note the instrument's external markings described under "Safety Symbols".

GROUND THE INSTRUMENT

This is a Safety Class I instrument. To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

 **WARNING** 

Although the RDC-1 is designed with full attention to operator safety, serious hazards could occur if the Rigid Dielectric Cell is used improperly and these safety instructions are not followed.

- DO NOT Operate in an Explosive Atmosphere
- Do not operate in the presence of inflammable gasses or fumes
- Operation of any electrical instrument in such an environment clearly constitutes a safety hazard
- Use Caution around live circuits and whenever hazardous voltages > 45 V are present

Safety Symbols

General definitions of safety symbols used on the instrument or in manuals are listed below.

Caution symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.

Hazardous voltage symbol: the product is marked with this symbol when high voltage maybe present on the product and an electrical shock hazard can exist.

Indicates the grounding protect terminal, which is used to prevent electric shock from the leakage on chassis. The ground terminal must connect to earth before using the product

Direct current.

Alternating current.

Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

On supply.

Off supply.

Hot surface. Avoid contact. Surfaces are hot and may cause personal injury if touched.

Disposal

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC
This product complies with the WEEE Directive (2002/96/EC) marking requirements.
The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.
Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities.

Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being.

When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal.

Proposition 65 Warning for California Residents

WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

This product may contain chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm

Chapter 1

INTRODUCTION

1.1 Introduction

The RDC-1 Rigid Dielectric Cell is designed for measurement of dielectric constant and dissipation factor on a wide range of materials according to ASTM D150 Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation.

The dielectric cell is made up of two electrodes. One electrode is fixed and the other is movable via a micrometer.

The RDC-1 does use a guard ring and is designed for routine measurement of dielectric constant and dissipation factor.

Key Features of the RDC-1 Rigid Dielectric Cell:

- **Designed for rigid flat materials up to 38 mm (1.50 inches) in diameter and 10 mm (0.40 inches) thick.**
- **Precision micrometer adjustment for exact electrode spacing.**
- **Dual-electrode design with a guard for accurate high-frequency testing.**
- **Includes 5 mm and 38 mm interchangeable electrodes to accommodate different sample sizes.**
- **Comes with a PTFE Calibration Standard for system verification before testing.**

A Calibration Standard is provided to verify operation of the RDC-1 with an LCR Meter.

The PTFE Calibration standard should have a calibrated value for dielectric constant of 2.02 and a Df of 0.0001.

The Calibration Standard is used as well to compensate for any error to improve measurement results.

Chapter 2

SPECIFICATIONS

SPECIFICATIONS

Terminals: 4-terminal connection via BNC connector on 2.2 cm (0.866”) spacing for direction connection to an LCR meter

Electrodes: 2-terminal connection via 38 mm or 5 mm electrodes

Applicable LCR Meters: 1920 and 7660 Precision LCR Meters

Frequency: < 30 MHz for direct connection

Maximum Voltage: 42 V peak

DUT Thickness: 10 mm Max.

Temperature: 0°C to 55°C

Dimensions: 15.5 cm H x 11.5 cm W x12.6 cm D

Weight: 1 kg (2.2 lb)

ORDERING INFORMATION

RDC-1 Rigid Dielectric Cell
Includes:
Instruction Manual

Chapter 3

OPERATION

3.1 Initial Inspection and Setup

The RDC-1 was carefully inspected before shipment. It should be in proper electrical and mechanical order upon receipt.

Contents:

1 Dielectric Test Cell
2 Type B 5 mm Electrode Plate
3 Type A 38 mm Electrode Plate
4 Open / Short Calibration Kit
5 Open Calibration
6 Calibration Standard
7 Zero Spanner
8 Adjustment Wrench
9 and 10 Foam Bottom and Top

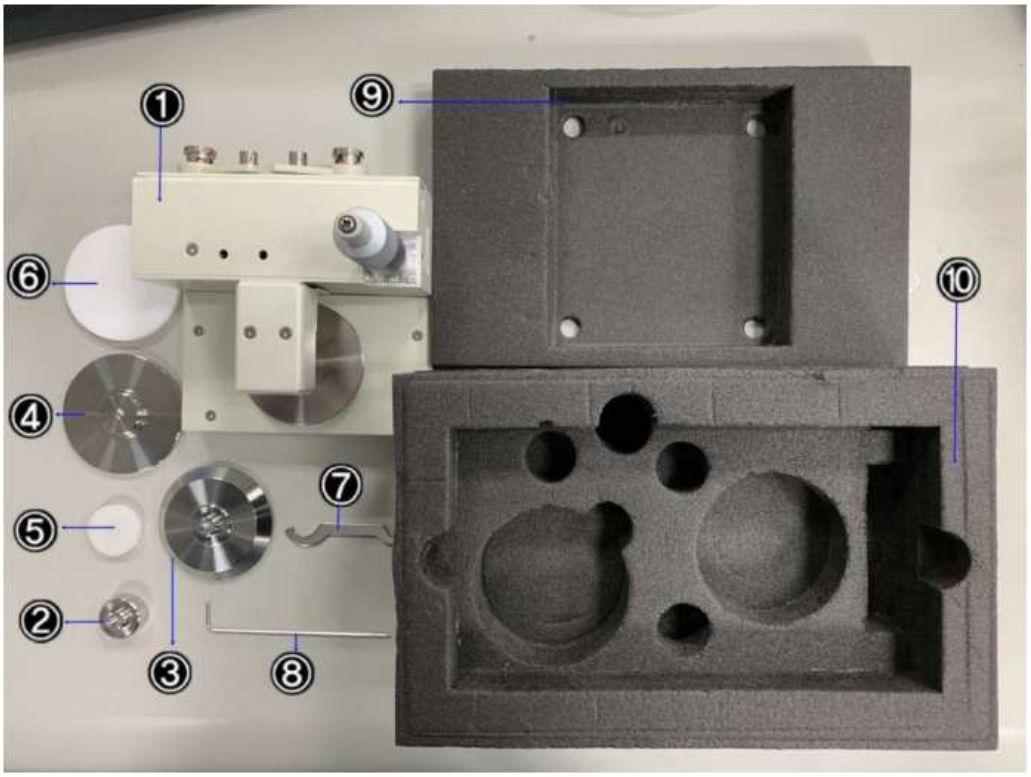

Figure 1-1 Contents of RDC-1

3.2 RDC-1 Main Fixture Parts

The main cell parts of the RDC-1 consists of:

1 Cell Body - Main support for connection to the LCR meter
2 Cell Base - Supports the fixed electrode
3 Fixed Electrode - Where the sample is placed. This is one of the measurement electrodes.
4 Electrode Holder - The holder accepts the 5 mm or 38 mm electrode
5 Moveable Body - Moves the top electrode up or down by rotating the micrometer
6 Micrometer - Micrometer is used to move the top electrode up or down and provides an indication of the spacing between the electrodes.
7 - 4 x BNC connectors for connection to the LCR meter.
8 Lever - Allows the user to lock the BNC connectors to the LCR meter.

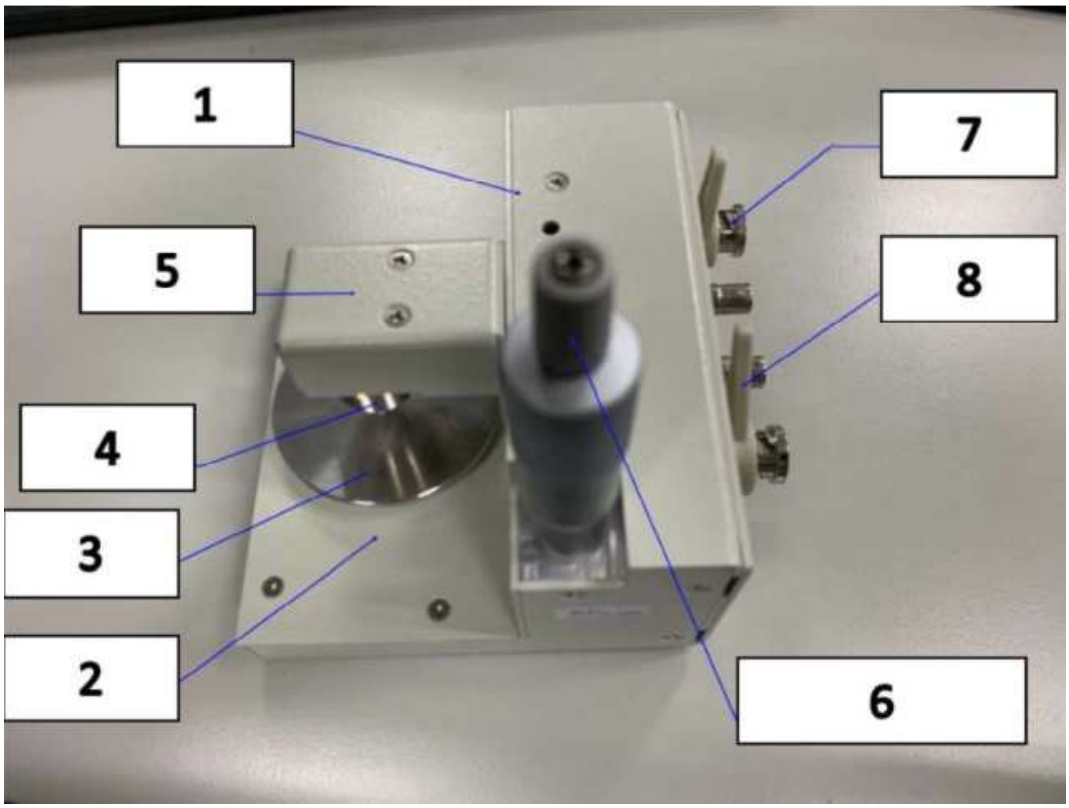

Figure 1-2 Fixture Parts

3.3 RDC-1 Accessories

The RDC-1 is delivered with the following accessories:

1 Open Calibration Cover - For open circuit compensation
2 Open / Short Compensation Plate - For open and short compensation
3 Calibration Standard - To determine correction
4 Type B 5 mm Electrode - Small electrode for smaller samples
5 Type A 38 mm Electrode - Larger electrode for larger samples
6 Zero Spanner
7 Allen Wrench

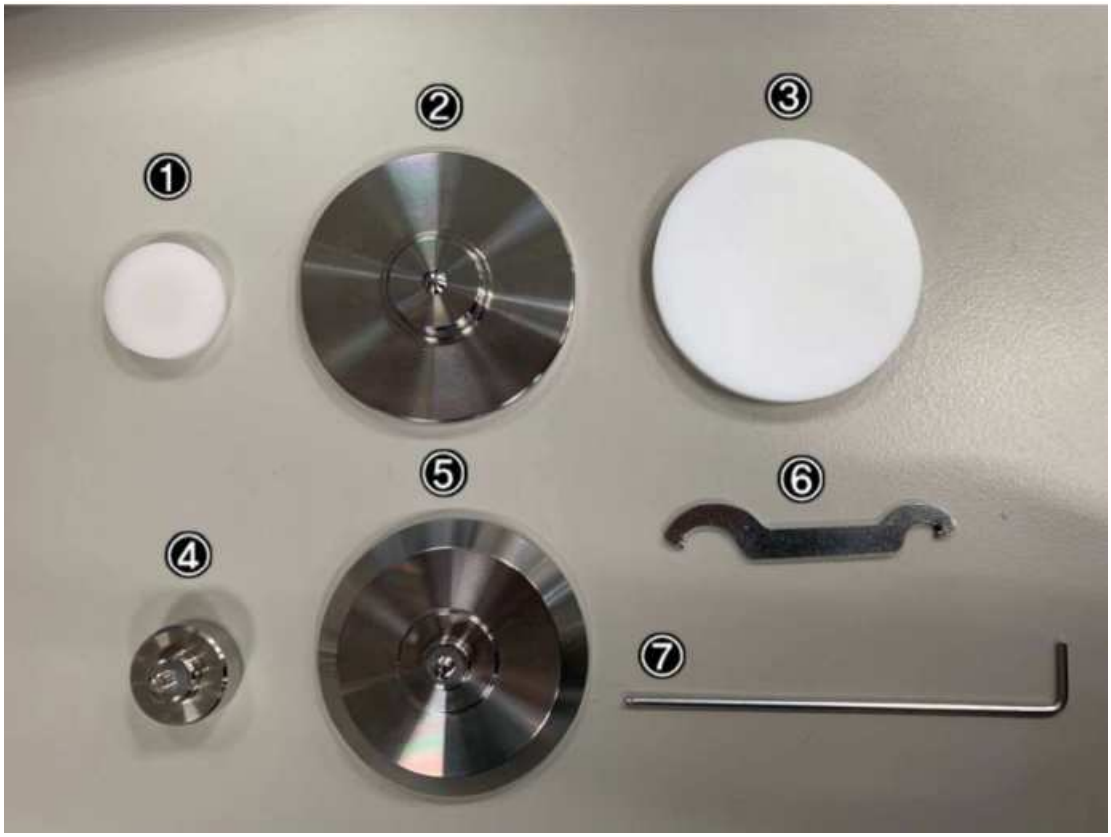

Figure 1-3 Accessories

3.4 General Considerations

The RDC-1 should be directly connected to the 1920 or 7660 Precision LCR Meter.

Cable length selection in the LCR meter should be set to 0 meter as the RDC-1 is directly connected to the front panel.

3.4.1 Basic measurement method

- Connect RDC-1 to BNC terminals on front of LCR Meter
- Set desired: frequency, voltage, Cp and Df, average, speed etc on the LCR meter
- Attach the required electrode per 3.4.2
- Perform Short Compensation 3.4.3
- Perform Open Compensation 3.4.4
- Determine Fixture Correction (if needed) 3.4.5
- Perform measurements per 3.5

3.4.2 Attached the required electrode

Notice: The electrode plate spacing adjustment is performed using the micrometer. It is important to rotate the micrometer using the small knob which has clutch to prevent overtightening and damage to the cell.

The 5 mm or 38 mm electrode screws onto the Electrode Holder.

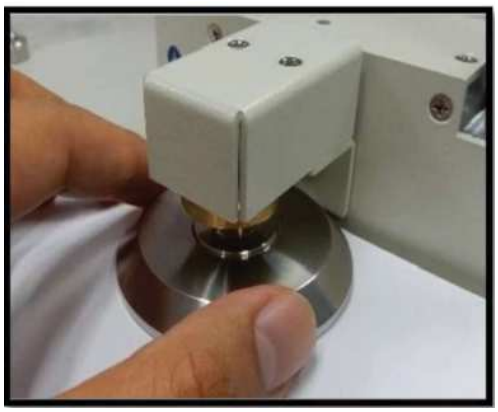

Figure 1-4 Attaching 38 mm Electrode

The electrode is chosen so that the entire piece of material being tested is larger than the electrode by at least 2 times the thickness of the material.

This means the material being tested must be at least 5 mm in diameter + 2 x thickness of the sample in mm.

If the material being measured is greater than 5 mm and < 38 mm use the 5 mm electrode.

If the material is larger than 38 mm then use the 38 mm electrode.

It is recommend to place a piece of paper over the fixed electrode on the bottom to prevent scratching the electrode.

Screw the electrode on to the Electrode Holder only finger tight do not over tighten.

3.4.3 Short Circuit Compensation

- Attach the 5 mm or 38 mm electrode onto the Electrode Holder.
- Place the Open/Short Compensation Plate onto the bottom electrode
- Do not use the Open Calibration Cover
- Rotate small knob on the micrometer until the top electrode contacts with the Open/Short Compensation Plate
- On the LCR meter perform a Short Compensation
- After the short has been performed measurement of Rs or Z should be very close to 0 Ω.

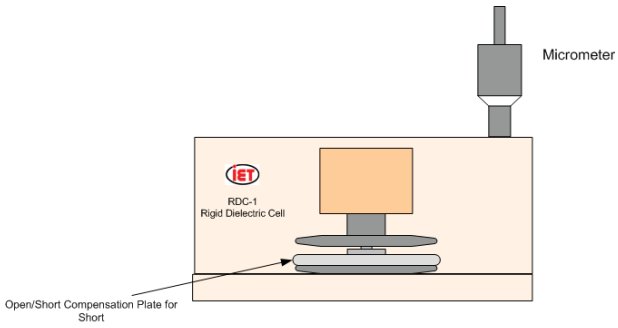

Figure 1-5 Open/Short Calibration Plate on Bottom Electrode with no Cover

3.4.4 Open Circuit Compensation

- Attach the 5 mm or 38 mm electrode onto the Electrode Holder.
- Install Open Calibration Cover onto the Open/Short Compensation Plate
- Place the Open/Short Compensation Plate and cover onto the top electrode
- Rotate small knob on the micrometer until the top electrode contacts with the Open/Short Compensation Plate and Cover
- On the LCR meter perform a Open Compensation
- After the open has been performed measurement of Cp should be less than 0.1 pF.

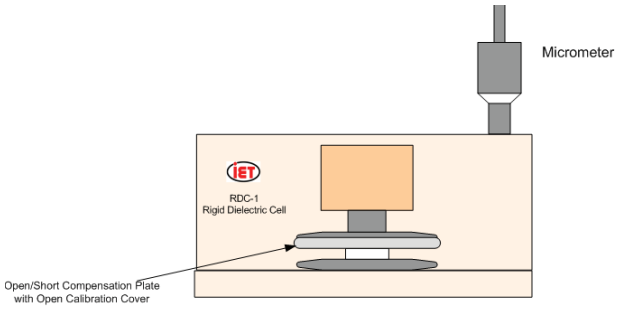

Figure 1-6 Open/Short Calibration Plate on top Electrode with Open Cover

3.4.5 Fixture Correction

- Attach the 5 mm or 38 mm electrode onto the Electrode Holder.
- Place the PTFE Calibration Standard onto the bottom electrode
- Rotate small knob on the micrometer until the top electrode contacts with the Calibration Standard.
- Note micrometer reading
- Perform a measurement of Cp and note as Csample
- Rotate small knob on the micrometer so that the Calibration Standard can be removed.
- Rotate small knob on the micrometer back to the micrometer reading that Csample was measured at.
- Perform a measurement of Cp and note as Cair
- Dielectric constant of the Calibration Standard is suppose to be 2.000
- Calculate dielectric constant correction as

kcorrection = (Csample / Cair) - 2.000

- The Correction Factor kcorrection should be subtracted from any measured Dielectric Constant k.

3.5 Dielectric Constant Measurements

- Attach the 5 mm or 38 mm electrode onto the Electrode Holder.
- Place the sample to be tested onto the bottom electrode
- Rotate small knob on the micrometer until the top electrode contacts with the sample.
- Note micrometer reading
- Perform a measurement of Cp and Df and note as Csample and Dfsample
- Rotate small knob on the micrometer so that the sample can be removed.
- Rotate small knob on the micrometer back to the micrometer reading that Csample was measured at.
- Perform a measurement of Cp and Df and note as Cair and Dfair
- Dielectric constant of the sample is calculated as

k = (Csample / Cair) - kcorrection

- Dissipation factor of the sample is calculated as

Df = Dfsample - Dfair

More information on measurements can be found in the application note below.

https://www.ietlabs.com/pdf/application_notes/035222_7660_LCR_Meter_with_RDC-1_Cell_ASTMD150.pdf

3.6 Environmental Conditions

For optimal accuracy, the RDC-1 should be used in an environment of 0°C to 55°C.

Humidity should be maintained at laboratory conditions.

3.7 Cleaning

The electrodes and other parts of the cell can be cleaned using a soft cloth and denatured alcohol.