Application Note

7660 Precision LCR Meter and the RDC-1 Rigid Dielectric Cell

The IET Labs 7660 Precision LCR Meter in combination with the RDC-1 Rigid Dielectric Cell is ideal for performing accurate and rapid measurements of Dielectric Constant and Dissipation Factor on materials according to ASTM D150, and IEC-60250.

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.

Figure 1 shows the RDC-1 Rigid Dielectric Cell connected to the 7660 Precision LCR Meter.

The **7660 Precision LCR Meter** is ideal for repeatable and precise measurements of dielectric properties by:

- Supports a broad frequency range for dielectric property measurements from 20 Hz to 2 MHz.
- Accurate and repeatable measurements of low capacitance and dissipation factor
- Simple to use and high reliability make the 7660 the choice for dielectric constant and dissipation factor measurements in accordance with ASTM D150.
- Excellent sales and applications support at IET Labs and sales@ietlabs.com .

Figure 1: Connection RDC-1 Cell to 7660 Precision LCR Meter

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The electrical connections are made via 4 BNC connectors on the base of the RDC-1. The 2.2 cm spacing allows direct connection to most LCR meters including the 7660 Precision LCR Meter and 1920 Precision LCR Meters. This minimizes errors due to cables at higher frequencies.

The RDC-1 Rigid Dielectric Cell comes with all the accessories needed to connect to the LCR Meter, perform open and short compensation and verify the system.

The RDC-1 is delivered with the following accessories shown in Figure 2:

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

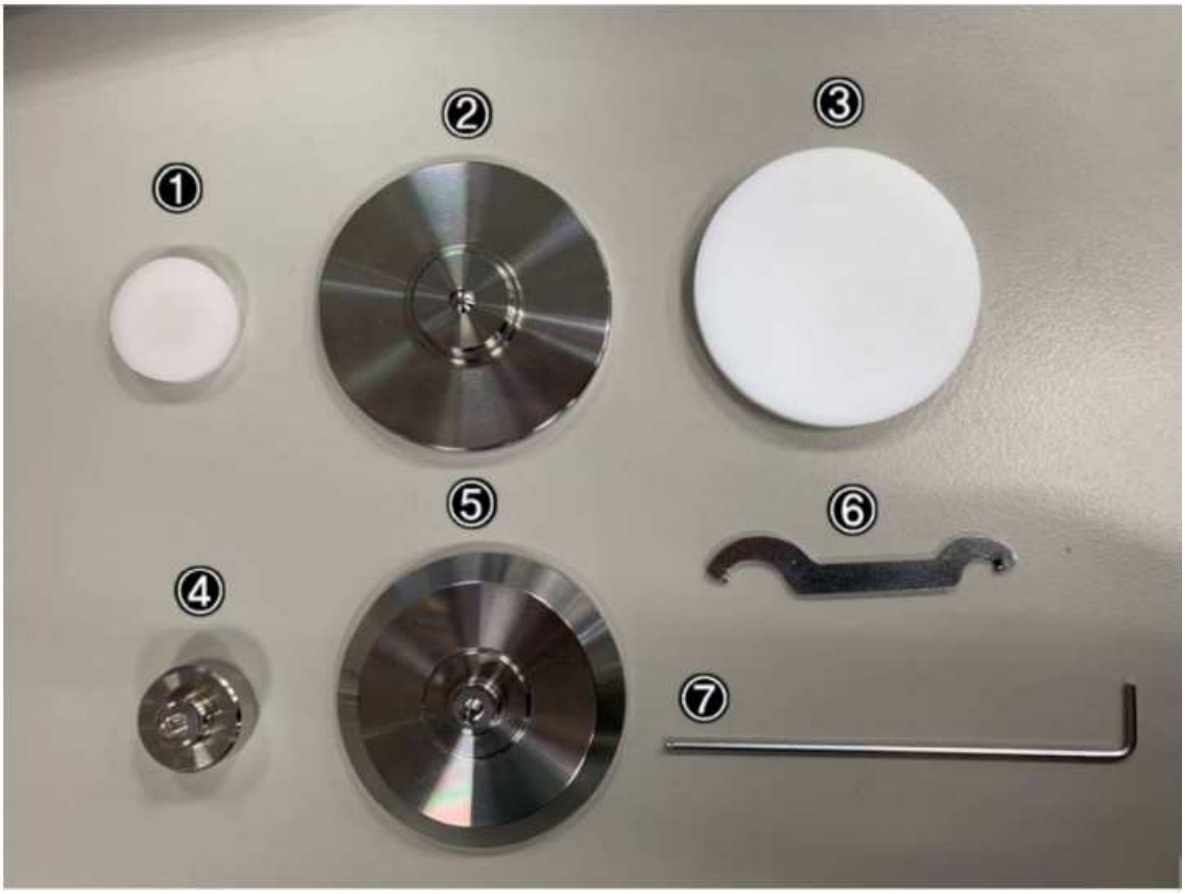

Figure 2 Parts Included with RDC-1

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Step-by-Step Dielectric Measurement Process:

1. **Compensation**
   - Conduct open and short circuit compensation to eliminate system errors.

2. **Sample measurement and verification**
   - Verify performance using the PTFE Calibration Standard with a known dielectric constant of 2.02.
   - Insert the material sample into the RDC-1 cell and adjust the micrometer-controlled electrode.
   - Measure capacitance (Cp) and dissipation factor (Df) of the material using the 7660 LCR Meter.
   - Remove the sample, return the micrometer to the previous setting and measure capacitance (Cp) and dissipation factor (Df) of air using the 7660 LCR Meter.

3. **Data calculation (per ASTM D150 Standard)**
   - Use the measured capacitance values to calculate the dielectric constant (k) and dissipation factor (Df) of the material using standard formulas.

Compensation

It is very important to perform an OPEN and SHORT circuit zero with the system before making measurements.

Short Compensation

Figure 3 illustrates the preferred method to accomplish short.

The Open/Short Compensation Plate without the Open Cover should be placed on the bottom electrode.

The top electrode can then be moved downward until it contacts the tip of the Open/Short Compensation Plate. This ensures the bottom electrode contacts just the center of the top electrode. Do not force the electrodes against the Open/Short Compensation Plate as this can damage the cell.

Perform a measurement with the LCR meter to make sure the resistance is low. If low, then perform a short compensation using the LCR Meter.

Once the short compensation is complete, a measurement should be made to make sure the resistance is << 1 Ω.

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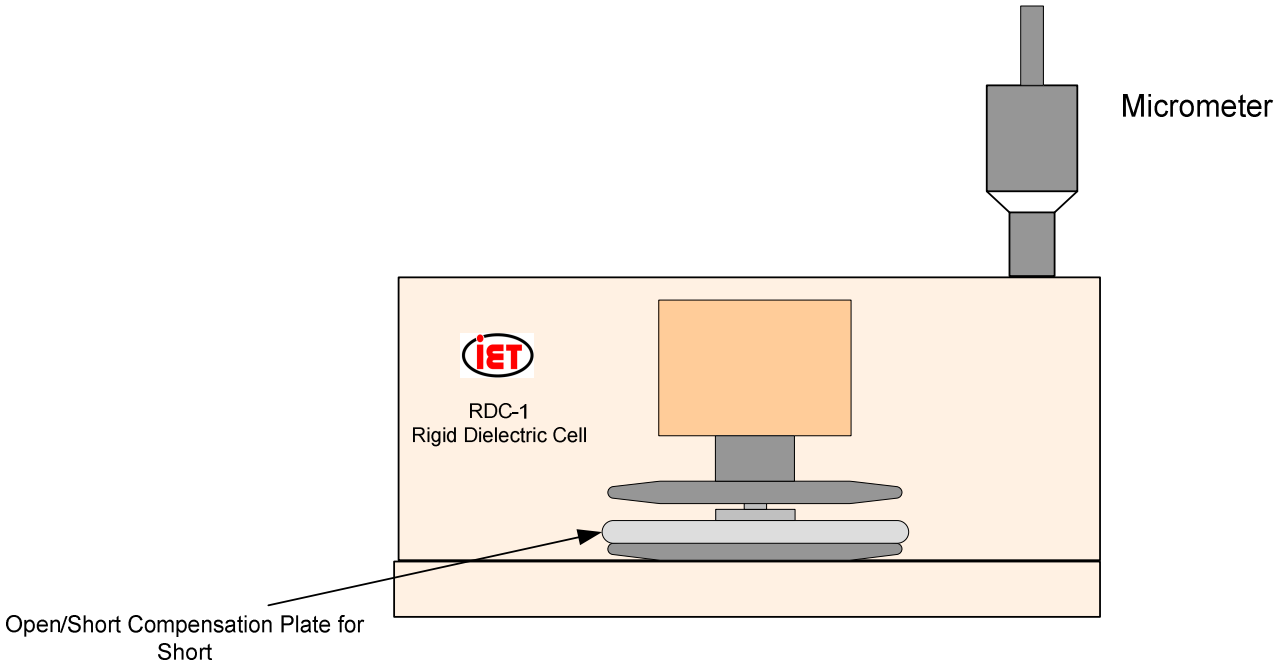

Figure 3: Position for Short Compensation

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Open Compensation
Figure 4 illustrates the preferred method to accomplish open compensation.

The Open Compensation Cover should be placed on the Open/Short Compensation Plate. The Open/Short Compensation Plate is then placed on the upper electrode. The upper electrode is moved downward until the Open Compensation Cover contacts the bottom electrode.

Perform a measurement with the LCR meter to make sure capacitance is low. If low, then perform open compensation using the LCR Meter.

Once the open compensation is complete, a measurement should be made to make sure the capacitance is << 1 pF.

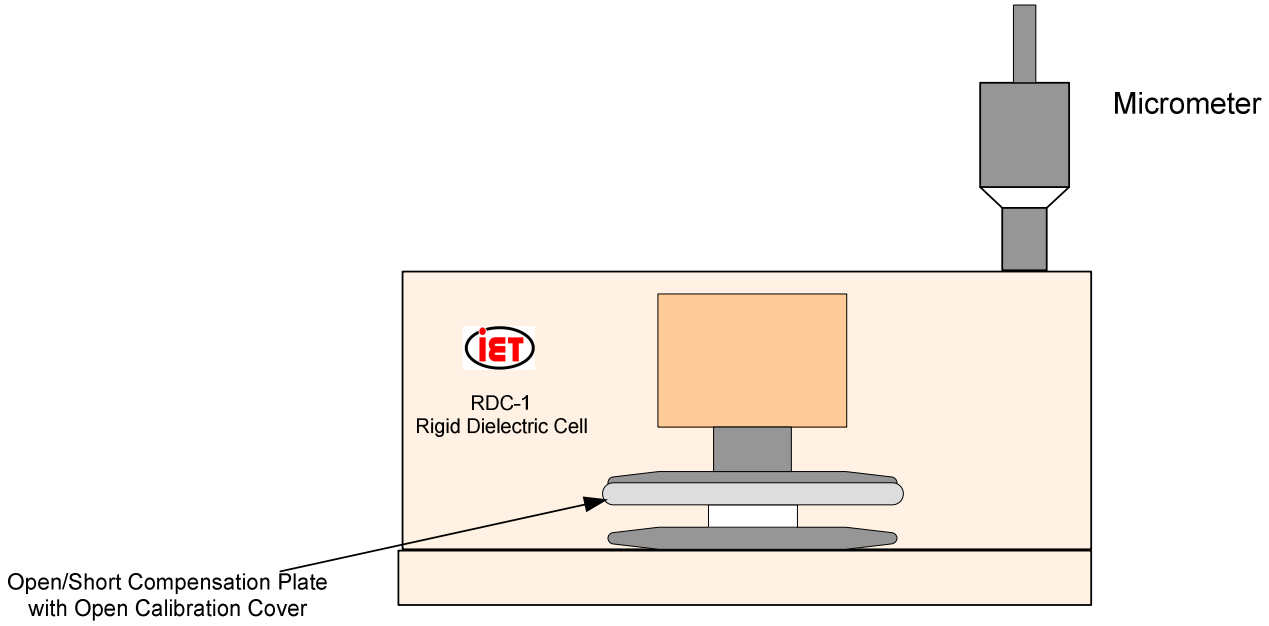

Figure 4: Position for Open Compensation

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Verification and Sample Measurements

Set the 7660 to the desired frequency, signal level and primary and secondary parameters of Cp and Df.

Verification
It is recommended that you make a measurement on the PTFE Calibration Standard that is included with the RDC-1.

The PTFE Calibration standard should have a calibrated value for dielectric constant of 2.02 and a Df of 0.0001. Verification is performed in the same way as the sample measurement below to determine k and Df.

Any error can be compensated for as a percentage error for dielectric constant and a subtraction for Df.

Sample Measurement
The sample is inserted in the cell and the top electrode is moved downward with the micrometer until the top electrode touches the sample.

Do not force the electrodes against the sample as this can damage the cell. Turn the micrometer with a light finger touch and only by the very top of the micrometer.

Record the micrometer setting as hm. Set the instrument to measure parallel capacitance and and dissipation factor of the sample as Cxm and Dxm.

Open the electrodes and remove the sample. Then close the electrodes to the same micrometer reading hm. Measure C (parallel) and D of empty cell as Ca and Da.

Calculate Kx and Dx of the sample from:

$Kx = (1.0005)\ Cxm/Ca$ and $Dx = |Dxm| - |Da|$

The factor 1.0005 in the formula for Kx corrects for the dielectric constant of (dry) air. Subtracting Da from Dxm removes any constant phase error in the instrument.

For even better D accuracy, adjust the electrode spacing until the measured capacitance is approximately equal to Cxm and then measure Da.

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Why Choose the IET Labs 7660 Precision LCR Meter in combination with the RDC-1 Rigid Dielectric Cell for ASTM D150 Testing?

- **Industry-Leading Accuracy** – The **7660 LCR Meter** and **RDC-1 Dielectric Cell** ensure precise measurements across a range of dielectric materials.
- **Comprehensive Testing Accessories** – Includes **electrodes, calibration tools, and compensation plates** for streamlined testing.
- **Trusted by Engineers & Researchers** – Ideal for **material science, electronics, and insulation testing**.

IET Labs offers a wide range of accessories including:

LDC-1 Liquid Dielectric Cell for dielectric constant and dissipation factor measurements on liquids and pastes.

For complete product specifications on the 7660 Precision LCR Meter or any of IET's products, visit us at https://www.ietlabs.com/ or email your questions to sales@ietlabs.com .

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