

# 2.5 kV and 12 kV Capacitance and Dissipation Factor Test Sets



- Interference suppression circuits for testing in high-voltage switchyards
- Automatic balancing of dissipation factor
- Direct readout of capacitance, dissipation factor and watts dissipated
- Lightweight, compact design

## DESCRIPTION

Capacitance and Dissipation Factor (C&DF) Test Sets are used for evaluating the nature and quality of electrical insulation materials and systems.

By measuring dissipation factor losses in electrical insulation, these units can indicate the presence of contaminants, fractures and punctures.

As part of a routine maintenance program, capacitance and dissipation factor testing can aid in predicting potential failure of deteriorating insulation.

The C&DF Test Sets include interference suppression circuits that assure accurate measurements even under severe interference or noise conditions such as those found in switchyards.

They are the lightest test sets on the market, making them extremely easy to transport to the testing locations. Automatic balancing of dissipation factor (power factor) significantly reduces the required testing time and provides higher resolution.

Two types of C&DF Test Sets are available: one for measuring dissipation factor losses at test voltages up to 2.5 kV; the other up to 12 kV.

The 12 kV version consists of two units, a measuring bridge and a high-voltage power source. The 2.5 kV version combines both units in one self-contained test set.

An extended-range version of the 12 kV test set is available for testing high-capacitance items. This unit is capable of testing capacitances of up to 1  $\mu$ F at 10 kV when used with the Biddle Resonating Inductor.

## APPLICATIONS

The test sets are used for testing high-voltage electrical insulation systems at the power frequency by applying test voltages up to 12 kV.

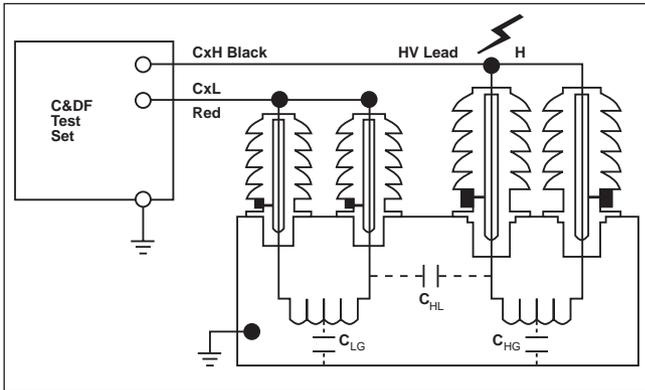
The purpose of the dissipation factor measurement of high-voltage insulation is to find early signs of weakness in the high-voltage insulation.

Typical high-voltage equipment tested includes: high-voltage circuit breakers, transformers, cables and potheads, bushings, windings of rotating machines and protective surge arresters.

Dissipation factor tests on high-voltage insulation are frequently made in manufacturing facilities, repair shops and in the field.

By measuring dissipation factor of the specimen plus capacitance, undesirable conditions are found. They include conditions caused by moisture on or in the insulation; shorts or opens in windings or insulation; and conductive contaminants in insulating oil, gas or solid materials.

The test sets also detect the presence of internal partial discharges that occur up to the level of the applied test voltage.



**Two-winding transformer tests**

The most important benefit to be gained from a typical dissipation factor test program is obtaining a benchmark reference reading on costly and vital high-voltage apparatus.

Whenever possible, these initial readings should be taken when the equipment is new and when the insulation is clean and dry.

Later readings taken during the service life of the apparatus can be compared to the benchmark. Increasing values of dissipation factor can represent deteriorating insulation and the need for remedial action.

Intervals of one to three years between routine diagnostic tests are usually observed for high-voltage transmission and distribution apparatus.

The Capacitance and Dissipation Factor (C&DF) Test Sets can perform the following standard tests:

**Ungrounded Specimen Test (UST)**

This test is made when both specimen terminals can be insulated from ground. The test is often used to reduce the effect of stray capacitance losses to ground and to reduce the effect of interference pickup from nearby energized apparatus.

Typical test specimens include the capacitive grading foils used in high-voltage bushings and the interwinding insulation used in high-voltage transformers.

**Grounded Specimen Test (GST)**

This is the most frequently used test connection and involves all insulation between the high-voltage conductor and ground. Typical test specimens include transformer windings to tank and core, circuit-breaker assemblies, coils of rotating machines, etc.

**Grounded Specimen Test with Guard Connection (GST-G)**

This test is used to separate the total values of a GST into separate parts for better analysis. Often this test is used with the GST to confirm the test readings made using the UST.

The C&DF Test Sets can perform excitation-current tests on transformer windings or other insulated coil windings. A maximum of 400 mA can be used up to 6 kV when testing large windings.

Changes in transformer excitation-current measurements can indicate internal faults caused by shorted turns in the windings. This type of measurement has gained wide acceptance in the utility industry.

These test sets make a direct measurement of test specimen capacitance, dissipation factor and watts dissipated. The terms “power factor” and “dissipation factor” have the same numerical values for the usual operating range of insulation materials, so generally either term may be used.

Some simple conversions may be needed when higher values (above 10%) are encountered. Because most nameplate values are given as power factor (dissipation factor) by the manufacturer, this test set provides quick, easy and direct test comparisons.

**FEATURES AND BENEFITS**

- Interference suppression circuits allow for accurate measurements under severe interference or noise conditions.
- Automatic balancing of dissipation factor allows the operator to perform tests quickly and with higher resolution.
- Lightweight, compact design makes the test sets extremely portable. These are the lightest test sets on the market.
- Fully shielded and guarded circuits eliminate the influence of stray capacitances to ground.
- Extended-range test set is capable of testing capacitances of up to 1 μF at 10 kV when used with the Resonating Inductor.

**SPECIFICATIONS****Instrumentation**

Common to All Test Sets

**Voltmeter and Ammeter**

Digital readout with LED display

**Ammeter**

**Accuracy:**  $\pm$ (1% of reading + 0.1 mA)

**Resolution:** 0.1 mA up to 200 mA; 1 mA above 200 mA

Ammeter reads specimen current only.

**Voltmeter Accuracy:**  $\pm$ (1% of reading + 1 digit)

**Resolution:** 10 V

**Dissipation Factor and Watts/Milliwatts****0 to 20% DF Range**

**Accuracy:**  $\pm$ (2% of reading 0.05% DF)

**Resolution:** 0.01% DF

**0 to 200% DF Range**

**Accuracy:**  $\pm$ (2% of reading + 0.05% DF)

**Resolution:** 0.1% DF

Both positive and negative DF values are indicated automatically.

Values up to 1200% DF can be measured by indirect methods.

LO/HI equivalent milliwatts/watts dissipated in specimen.

**Capacitance****Range**

0 to 220,000 pF in eight ranges;

110/220/1100/2200/11,000/22,000/110,000/220,000 pF full scale

**Accuracy**

$\pm$ (1% of reading + 2 pF) for ungrounded specimen test

$\pm$ (1% of reading + 6 pF) for grounded specimen test

**Resolution:** 0.01% of range selected

Decade readout using three dials with eight-range multiplier switch.

Extended-range test set capable of testing capacitances of up to 1  $\mu$ F when used with the Resonating Inductor.

**Capacitance Null Detector:** Phase-sensitive, zero-center analog meter with sensitivity selector switch providing six steps of gain control from MIN to MAX. Automatic synchronization of null detector to test set output current over entire operating range  
Test Selector Switch

**UST:** Three switch positions. Two or three terminals of specimen are insulated from ground.

**GST L-GROUND:** One switch position. Test specimen has one insulated terminal and one grounded terminal.

**GST L-GUARD:** Three switch positions. Test specimen has one insulated terminal, one grounded terminal and one terminal raised to guard potential.

**Note:** These test switch positions are defined in IEEE Standard 62, "Guide for Field Testing Power Apparatus Insulation."

**Dimensions (each unit)**

12.5 H x 19.5 W x 15 D in.

(310 H X 510 W x 380 D mm)

**Weight**

**2.5 kV Unit:** 51 lb (23 kg)

**12 kV Measuring Unit:** 48 lb (22 kg)

**12 kV HV Power Unit:** 63 lb (29 kg)

**Cables Only:** 34 lb (15 kg)

**2.5 kV Test Set****Input (specify one)**

120 V, 60 Hz, 3 A continuous

120 V, 50 Hz, 3 A continuous

240 V, 60 Hz, 1.5 A continuous

240 V, 50 Hz, 1.5 A continuous

**Output**

**Voltage:** 0 to 2.5 kV ac, digital readout

**Current:** 0 to 100 mA continuous

**Dissipation Factor (or equivalent watts/milliwatts)**

Automatic, direct readout on digital LED at test voltages of 0.25, 0.5, 1.0, 1.5, 2.0 and 2.5 kV. Indirect at intermediate test voltages

**Interference Suppression**

Separate capacitance and dissipation factor gain controls with three-position selector switch (LOW/HIGH/OFF)

**12 kV Test Set****Input (specify one)**

120 V, 60 Hz, 10 A continuous

120 V, 50 Hz, 10 A continuous

240 V, 60 Hz, 5 A continuous

240 V, 50 Hz, 5 A continuous

**Output**

**Voltage:** 0 to 12 kV ac, digital readout

**Current:** High Range to 5 kV: 0 to 200 mA continuous; 0 to 400 mA for 10 min

Low Range to 10 kV: 0 to 100 mA continuous; 0 to 200 mA for 10 min

**Dissipation Factor (or equivalent watts/milliwatts)**

Automatic, direct readout on digital LED at test voltages of 1, 2, 2.5, 4, 5, 6, 8, 10 and 12 kV

**Interference Suppression**

Separate capacitance and dissipation factor gain controls with seven position selector switches (a/b/c/d/e/f/OFF)

**ORDERING INFORMATION**

| Item (Qty)  | Cat. No.    | Item (Qty)                                | Cat. No.     |
|---|-------------|---|--------------|
| <b>2.5 kV Capacitance and Dissipation Factor Test Set</b>               |             | <b>120 volt input</b>                     |              |
| 120 Vac, 60 Hz  | 670025      | 240 volt input                            | 17032-2      |
| 120 Vac, 50 Hz  | 670025-44   | Cable assembly                            |              |
| 240 Vac, 60 Hz  | 670025-45   | C:H high voltage, 70 ft (15 m)            | 30012-5      |
| 240 Vac, 50 Hz  | 670025-47   | C:L high voltage (red), 70 ft (15 m)      | 25572-1      |
| <b>12 kV Capacitance and Dissipation Factor Test Set</b>                |             | C:L high voltage (blue), 50 ft (15 m)     | 25572-2      |
| 120 Vac, 60 Hz  | 670065      | Cable carrying bag, canvas                | 18313        |
| 120 Vac, 50 Hz  | 670065-44   | Instruction manual                        | AVTM670065JA |
| 240 Vac, 60 Hz  | 670065-45   | <b>12 kV Unit - 670070</b>                |              |
| 240 Vac, 50 Hz  | 670065-47   | Cable assembly                            |              |
| <b>12 kV Extended Range Capacitance and Dissipation Factor Test Set</b> |             | External interlock, 10 ft (3 m)           | 10229-5      |
| 120 Vac, 60 Hz  | 670070      | Interconnection, five-pin                 | 27978        |
| 120 Vac, 50 Hz  | 670070-44   | Interconnection, eight-pin                | 27979        |
| 240 Vac, 60 Hz  | 670070-45   | Ground, 15 ft (4.5 m)                     | 4702-6       |
| 240 Vac, 50 Hz  | 670070-47   | Line cord                                 |              |
| <b>Included Accessories</b>   |             | 120 volt input                            | 17032-4      |
| <b>2.5 kV Unit - 670025</b>   |             | 240 volt input                            | 17032-2      |
| Line cord   |             | Cable assembly                            |              |
| 120 volt input  | 17032-4     | C:H high voltage, 70 ft (21.3 m)          | 30012-5      |
| 240 volt input  | 17032-2     | C:L high voltage (red), 70 ft (21.3 m)    | 25572-1      |
| Cable assembly  |             | C:L high voltage (blue), 50 ft (15 m)     | 25572-2      |
| C:H high voltage, 50 ft (15 m)  | 30012-1     | Cable carrying bag, canvas                | 18313        |
| C:L high voltage (red), 50 ft (15 m)                                    | 25572-3     | Instruction manual                        | AVTM670065JA |
| C:L high voltage (blue), 50 ft (15 m)                                   | 25572-4     | <b>Optional Accessories</b>               |              |
| External interlock, 10 ft (3 m)   | 10229-3     | <b>All Units</b>                          |              |
| Ground, 15 ft (4.5 m)   | 4702-5      | Hot collar straps [3]                     | 670505       |
| Cable carrying bag, canvas  | 18313       | Tap connectors [2]                        | 670506       |
| Instruction manual  | AVTM670025J | Calibration standard                      | 670500-1     |
| <b>12 kV Unit - 670065</b>  |             | Oil test cell                             | 670511       |
| Cable assembly  |             | Foam-padded case for calibration standard | 670635       |
| Interconnection, four-conductor   | 30015       | Transit case, test set                    | 670626       |
| Interconnection, eight-conductor  | 30016       | Transit case, cables                      | 218744-1     |
| External interlock, 10 ft (3 m)   | 10229-3     | <b>12 kV Extended-Range Unit Only</b>     |              |
| Ground, 15 ft (4.5 m)   | 4702-5      | Resonating inductor                       | 670600       |
| Line cord   |             |   |              |