

1. Scope of Test

$$3.0 \leq V_{fs} \leq 7.9$$

2. Definitions of Technical Codes

- 1) V_{fs} : Nominal Formation Voltage
- 2) V_t : Dielectric Withstanding Voltage
- 3) V_r : 90% of V_{fs}
- 4) T_r : Rise Time
- 5) T_{r60} : Rise Time after Hydration Process (60 min.)

3. Test Procedure

- 1) The following tests and measurements shall be performed on the same test specimen.
- 2) Procedure
 - ① V_t Measurement
 - ② Capacitance Measurement
 - ③ Hydration Resistance Test

4. Test Equipment for V_t Measurement

- 1) DC Power Supply
 - Ripple Content : 2% or less for 50,60Hz
1% or less for 100,120Hz
 - DC Voltage Stability : $\pm 3\%$
- 2) DC Voltmeter
 - Internal Resistance : $1M\Omega$ or higher
 - Accuracy : $\pm 0.5\%$
- 3) DC Ammeter
 - Internal Resistance shall be sufficiently small compared to Load Resistance (10Ω or less)
- 4) Measurement Vessel
 - Material : SUS304
 - Volume : $500 \pm 50\text{ml}$
 - Depth : $100 \pm 20\text{mm}$
- 5) Counter Electrode
 - Measurement Vessel : SUS304
- 6) Referential Electrode
 - Material : Platinum Plate
 - Purity : 99.99% or more
 - Dimensions : $10 \times 20 \times 0.1\text{mm}$
- 7) Volt Recorder
 - Internal Resistance : $1M\Omega$ or higher
 - Accuracy : $\pm 0.5\%$
- 8) Vessel for Hydration Process
 - Material : SUS304
 - Volume : $600 \pm 60\text{ml}$
 - Temperature Control : Capable of maintaining the temperature of approx. 500ml of deionized water at 95°C or higher

5. Test Equipment for Capacitance Measurement

- 1) Capacitance Measurement Device
 - Capacitance Meter in accordance with JIS C 5101-1,4.7
 - Measurement Frequency : $120\text{Hz} \pm 5\%$
 - Measurement Voltage : $0.5V_{rms}$ or less
- 2) Measurement Vessel
 - Material : Glass
 - Volume : 200ml or 300ml
- 3) Counter Electrode : Test Specimens

6. Test Specimen

Test Specimen : In accordance with 8-1 *Selecting Test Specimens for Electrical Characteristics Measurements.*

7. V_t Measurement

- 1) Electrolyte for V_t Measurement
 - Ammonium Adipate : 150g
 - Deionized Water : 1,000ml
 - Specific Resistance : $6.5(+2.0 -1.5)\Omega\text{cm}/70 \pm 2^\circ\text{C}$
 - pH : $6.7(+0.5 -1.5) / 50 \pm 2^\circ\text{C}$
- 2) Conditions for V_t Measurement
 - Measurement Temperature : $85 \pm 2^\circ\text{C}$
 - Current Density : $0.5 \pm 0.05\text{mA}/1\text{ Test Specimen } 5\text{cm}^2$

3) Measurement Circuit

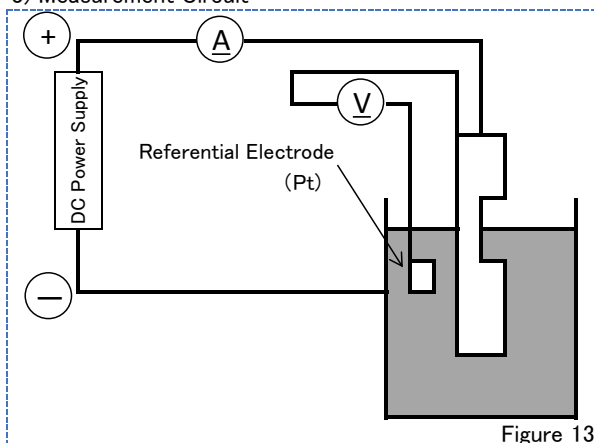


Figure 13

4) Measurement Method

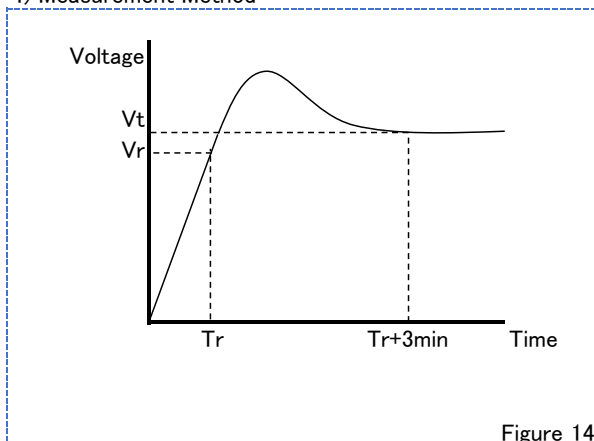


Figure 14

- ① The test specimen shall be immersed in the measuring electrolyte so that the top edge of the Projected Area (area to be measured) is 6-8mm below the surface.
- ② The increase in voltage shall be measured after applying constant DC current.
- ③ Rise Time (T_r) is measured when the voltage reaches 90% of Nominal Formation Voltage (V_{fs}).
- ④ Dielectric Withstanding Voltage (V_t) shall be the voltage measured 3 minutes after T_r .

8. Capacitance Measurement

1) Electrolyte for Capacitance Measurement

Ammonium Adipate	: 150g
Deionized Water	: 1,000ml
Specific Resistance	: $6.5(+2.0 -1.5)\Omega \text{ cm}/70\pm 2^{\circ}\text{C}$
pH	: $6.7(+0.5 -1.5) /50\pm 2^{\circ}\text{C}$

2) Condition for Capacitance Measurement

Measurement Temperature	: $30\pm 2^{\circ}\text{C}$
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3) Measurement Circuit

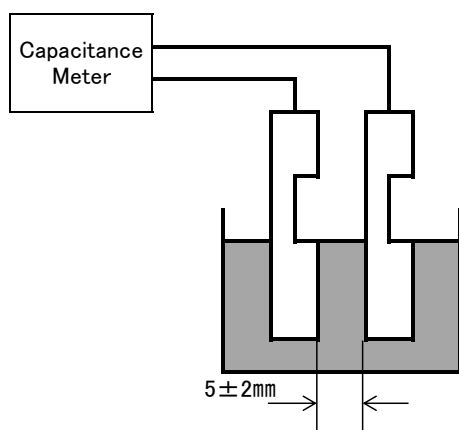


Figure 15

The test specimen shall be immersed in the measuring electrolyte so that the top edge of the Projected Area (area to be measured) is level with the surface.

4) Measurement Calculation

Capacitance per 1cm^2 is calculated by the following formula

$$C = \frac{C_m \times 2}{5}$$

Where : C_m = Measured Value (μF)

: C = Capacitance ($\mu\text{F}/\text{cm}^2$) per 1cm^2

9. Hydration Resistance Test

1) Electrolyte for Vt Measurement

Ammonium Adipate	: 150g
Deionized Water	: 1,000ml
Specific Resistance	: $6.5(+2.0 -1.5)\Omega \text{ cm}/70\pm 2^{\circ}\text{C}$
pH	: $6.7(+0.5 -1.5) /50\pm 2^{\circ}\text{C}$

2) Conditions for Vt Measurement

Measurement Temperature	: $85\pm 2^{\circ}\text{C}$
Current Density	: $0.5\pm 0.05\text{mA}/1 \text{ Test Specimen } 5\text{cm}^2$

3) Hydration Process

Test Specimen : Use the same specimen already measured by the Vt test process for dielectric withstanding voltage.

Hydration Process Time : $60\pm 1\text{min}$

Hydration Temperature : 95°C or higher

Number of Specimen : 6 or less per hydration process

Deionized Water Change : Change deionized water for every hydration process.

4) Measurement Circuit

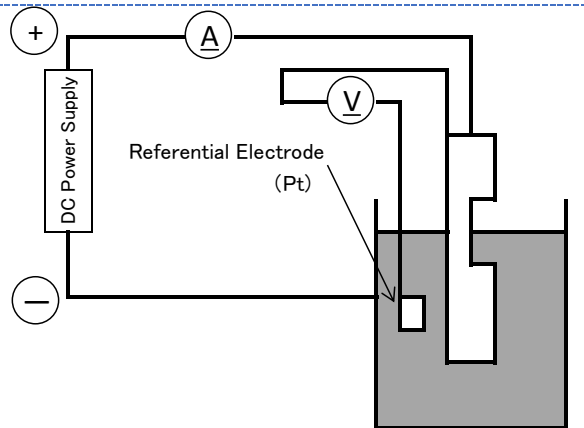


Figure 16

5) Measurement Method

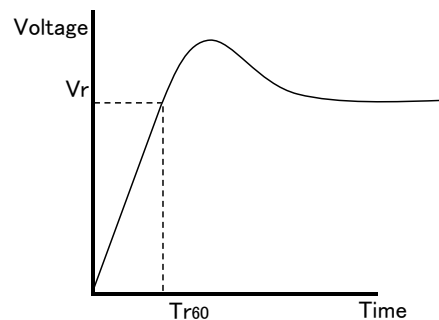


Figure 17

① The test specimen shall be immersed in the measuring electrolyte so that the top edge of the Projected Area (area to be measured) is below the place that measured by the Vt test process.

② The increase in voltage shall be measured after applying constant DC current.

③ Rise Time (Tr_{60}) is measured when the voltage reaches 90% of Nominal Formation Voltage (V_f s).