

FOIL TESTING

METHODOLOGY FOR TESTING THE ELECTRICAL PARAMETERS OF LOW-VOLTAGE FOIL

Measuring capacitance

- ✓ Place the molded foil sample in a measuring cell with electrolyte in such a way that only the working part of the sample (without the terminal) is immersed in the electrolyte;
- ✓ Keep the sample for 1 minute, then measure the capacity;
- ✓ The capacitance value obtained from the device is divided by 10 to obtain the specific capacitance value in $\mu\text{F}/\text{dm}^2$.

METHODOLOGY FOR TESTING ELECTRICAL PARAMETERS OF HIGH-VOLTAGE FOIL

1.1 FORMING ETCHED FOIL SAMPLES FOR SUBSEQUENT FORMING IN ELECTROLYTE NO. 4

1.2 FORMING ETCHED FOIL SAMPLES FOR SUBSEQUENT FORMING IN ELECTROLYTE NO. 1

Hydration

- ✓ Time: 15 ± 1 minute;
- ✓ Temperature: $\geq 95^\circ\text{C}$;
- ✓ Number of samples: ≤ 6 ;
- ✓ Replace deionized water: after each hydration process.

Forming electrolyte

Forming stage 1:

- ✓ Boric acid - 100 g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S}/\text{cm}$) – 900 ml.

Forming stage 2:

- ✓ Boric acid - 100 g;
- ✓ Ammonium pentaborate, tetrahydrate – 0.7 g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S}/\text{cm}$) – 900 ml;

Forming parameters

- ✓ Forming current - 0.5 A/sample;
- ✓ Electrolyte temperature is $90 \pm 2^\circ\text{C}$.

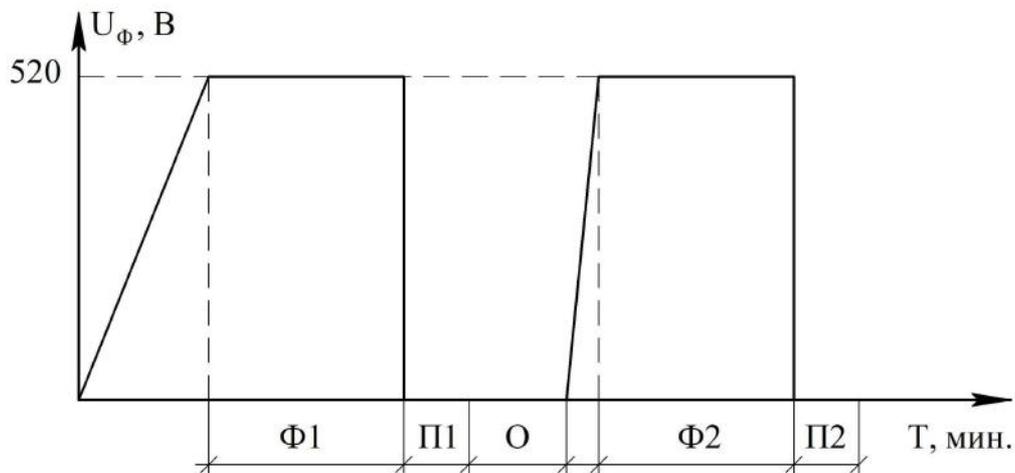
Forming parameters

The test sample should be immersed in the electrolyte so that the top of the measured sample is 10-15 mm below the surface of the solution.

Forming electrolyte

- ✓ Citric acid - 2 g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S}/\text{cm}$) - 1000 ml;
- ✓ Electrolyte resistance at $+ 30^\circ\text{C}$ is $1000 \pm 50 \text{ Ohm}\times\text{cm}$.

Molding scheme



- Forming cycle F1 – 10 minutes;
- Rinse (P1) – 1 minute;
- Annealing from $+510$ to $+530^\circ\text{C}$ (O) – 2 minutes;
- Forming cycle (F2) – until the forming current drops to 0.03 A;
- Rinse (P2) – 1 minute.

Flushing

Samples are washed in deionized water at room temperature.

Drying

Drying of samples is carried out at a temperature of $< 100^\circ\text{C}$.

2. MEASURING FORMING STRESS

Test equipment

- ✓ DC power supply
 - ripple $\leq 1\%$;
 - voltage stability $\pm 3\%$;
- ✓ DC voltmeter - accuracy $\pm 0.5\%$;
- ✓ DC ammeter - accuracy $\pm 1.0\%$;
- ✓ Stainless steel bath, temperature control.

Electrolyte for voltage measurement

Forming voltage from 200V to 620V:

- ✓ Boric acid - 70g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at $+ 70^\circ\text{C}$ – $7,500 \pm 300 \text{ Ohm}\times\text{cm}$.

Forming voltage from 621V to 700V:

- ✓ Boric acid - 40g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at $+ 70^\circ\text{C}$ – $19,000 \pm 1,000 \text{ Ohm}\times\text{cm}$.

Forming voltage from 701V to 800V:

- ✓ Boric acid - 30g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at $+70^\circ\text{C}$ – $28,900 \pm 1,500 \text{ Ohm}\times\text{cm}$.

Forming voltage above 800 V:

- ✓ Boric acid - 20g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at $+ 70^\circ\text{C}$ – $46,500 \pm 2,500 \text{ Ohm}\times\text{cm}$.

Measuring capacitance

- ✓ Place the molded foil sample in a measuring cell with electrolyte so that only the working part of the sample (without the terminal) is immersed in the electrolyte;
- ✓ Keep the sample for 1 minute, then measure the capacity;
- ✓ Multiply the capacitance value obtained from the device by 10 to obtain the specific capacitance value in $\mu\text{F}/\text{dm}^2$.

4. CONTROL OF OXIDE LAYER STABILITY

Electrolyte for voltage measurement

Forming voltage from 200V to 620V:

- ✓ Boric acid - 70g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at + 70°C – $7,500 \pm 300 \text{ Ohm}\times\text{cm}$.

Forming voltage from 621V to 700V:

- ✓ Boric acid - 40g;
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- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) - 1000 ml;
- ✓ Electrolyte conductivity at + 70°C – $46,500 \pm 2,500 \text{ Ohm}\times\text{cm}$.

METHODOLOGY FOR TESTING THE ELECTRICAL PARAMETERS OF CATHODE FOIL

Electrolyte for measuring capacity

- ✓ Ammonium adipate - 150 g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) – 1000 ml;
- ✓ Сопротивление электролита, при + 70°C – 5,0 ... 8,5 Ом×см.

Multiply the capacitance value obtained from the device by 20 to obtain the specific capacitance value in $\mu\text{F}/\text{dm}^2$

STABILIZATION QUALITY CONTROL

Electrolyte for measuring capacity

- ✓ Ammonium adipate - 150 g;
- ✓ Deionized water ($\leq 0.1 \mu\text{S/cm}$) – 1000 ml;
- ✓ Electrolyte resistance at + 70°C is 5.0 ... 8.5 Ohm×cm.

BENDING TEST METHOD

Test conditions

Foil type	Bending radius, mm
Etched anode high voltage	$0,5 \pm 0,05$
Molded anode low voltage	$0,5 \pm 0,05$
Molded anode high voltage	$0,5 \pm 0,05$
	$3,5 \pm 0,35$
Cathodic etched	$1,0 \pm 0,10$
Cathode annealed	