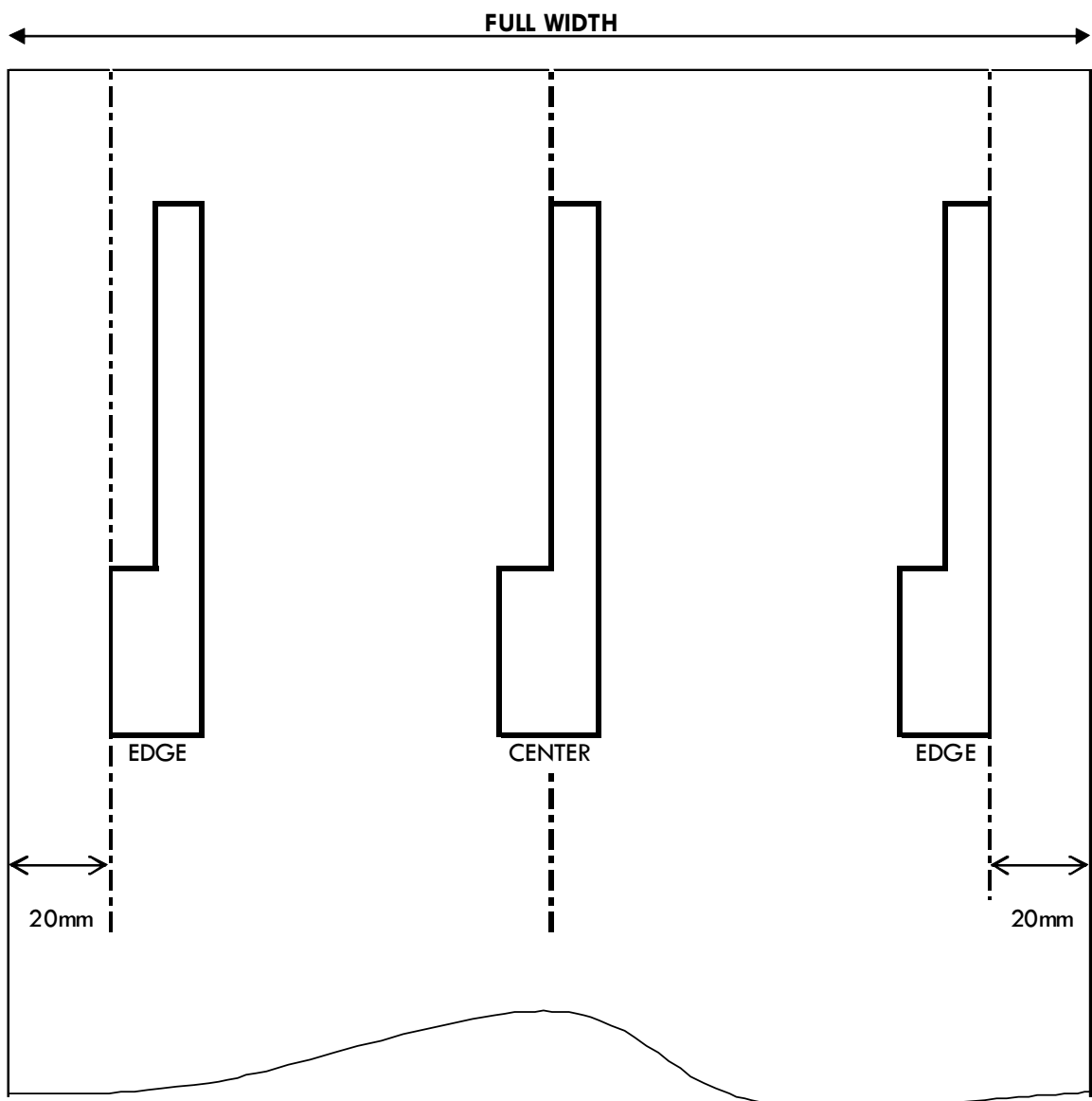


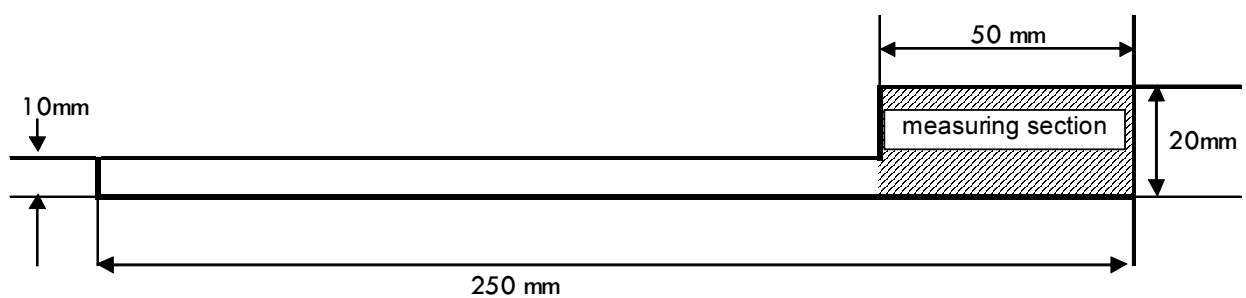
7. TEST METHODS

7.1 - TEST PIECES LOCATION

Test pieces used to carry out various tests should be taken in top and tail sample sheets of each standard size roll according to the following diagram:



Test piece dimensions



7.2 - BURSTING TEST (EC1)

Equipment

Testing machine LHOMARGY type EC 05.

Method

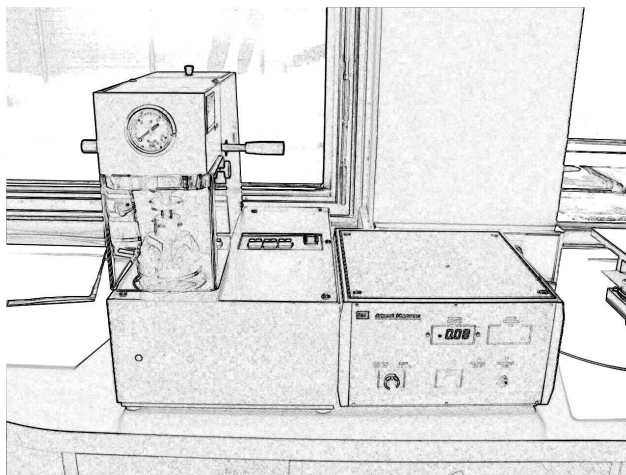
The sample to be tested is tightened down over the test surface. An evenly distributed hydraulic pressure is applied under the test piece by means of a rubber membrane and is increased until the foil bursts. The pressure measured when the foil bursts is recorded.

Expression of results

Bursting resistance values are expressed in kg/cm².

Advantages of the method

It is possible to detect material weaknesses in a multidirectional manner. The speed of the operation (four to five seconds per test) allows a great number of measurements to be carried out. No test piece preparation is needed.



7.3 - BENDING TEST (PL3)

Bending test PL3 (EIAJ RC-2364)

Equipment

MIT Automatic tester

The test piece is strained by a weight.

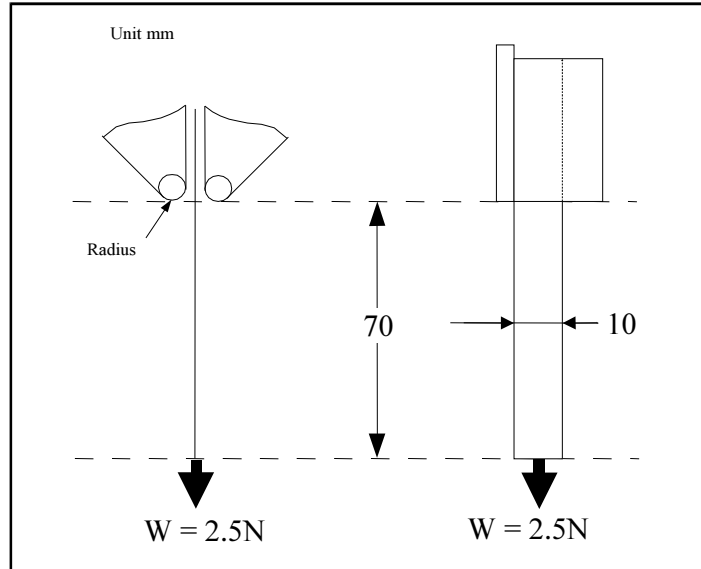
The clamp holding the piece is turned both ways

with 90° angle and the cycle is repeated until the

test piece breaks.

Clamp mandrel radius: according to following table

Type of foil	Radius (mm)
MV or HV anode foil (previously formed at 450V in case of etched foil)	3.5 ± 0.35
Cathode foil	0.5 ± 0.05



Bending Angle : $90 \pm 2^\circ$

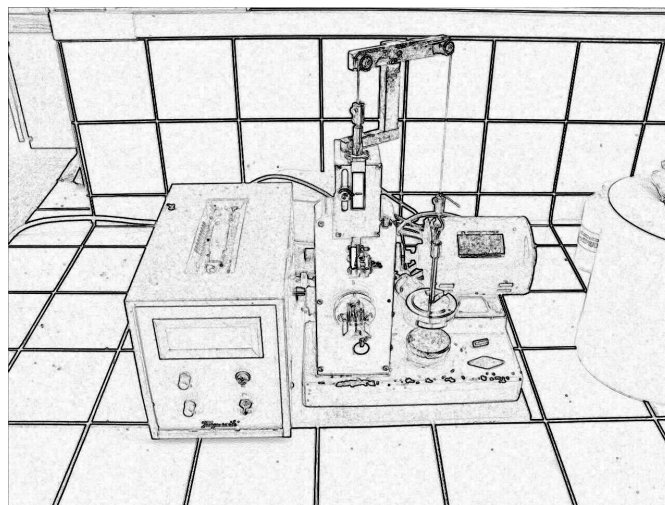
Bending Speed :

6 times / sec.

6 times / min. for cathode foil

Load : 2.5 ± 0.05 N

Unit of Measurement : number of bends before the test piece breaks.



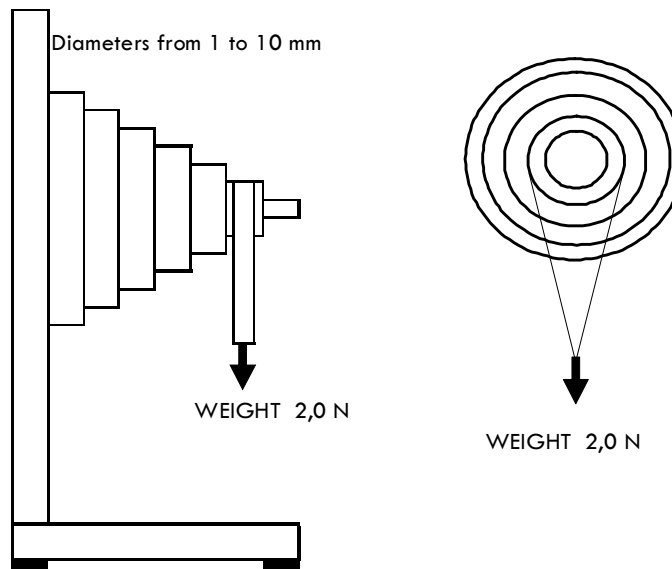
7.4 - HANGING BAR (HB1)

This test is used to evaluate the winding ability of heavy duty motor start foils (thick amorphous oxide). The test is carried out by carefully hanging a test piece around the 10mm diameter rod bar. A clamped load strains the test piece. The process is repeated on rod bars with descending diameters, until the test piece breaks.

Test piece size: 150x10 mm.

Load: 2N

Unit of Measure: The hanging bar strength of the foil is expressed as the diameter of the last rod bar on which the piece doesn't break.



7.5 - MEASUREMENT OF CHLORIDE CONTENT (S1)

Reagents

- Pure water (Resistivity higher than 2 MW. cm)
- Oxalic acid in powder form A.R. grade
- Nitric Acid 52.5% A.R. grade
- Silver nitrate solution 0.1N

Equipment

- Photoelectric nephelometer
- Temperature controlled water-bath
- Beakers, flasks, burettes, pipettes as required

Method

- A 600cm² area of foil is treated by a boiling solution of 0.24% nitric acid during 5 min for etched foil, or 7% oxalic acid during 30 min for formed foil.
- 6 ml of 52.5% nitric acid is added to the extract.
- Put two samples of 25ml of the extract solution in volumetric flasks (A and B).
- 0.5 ml of silver nitrate solution is added to flask A. Flask B without any silver nitrate is used as reference.
- The two flasks are left at 92°C for 5 minutes and then are cooled in cold water during 10 minutes.

- Turbidity is measured by nephelometric method. The nephelometer is standardised with a solution of known turbidity. A blank is made with the flask B. The test therefore takes into account any quantity of chloride, which may be in the reagents and also any residual opalescence of the extraction solution. The solution is tested at 20°C. The reading of the galvanometer for flask A is directly proportional to chloride concentration in the solution and therefore to surface concentration of the foil. The difference between A and B readings provides the surface concentration according to the calibrated curve.

7.6 - HYDRATION RESISTANCE TEST (ST3)

Principle

Hydration resistance is tested through the difference of electrical characteristics of formed foils before and after 4h immersion in pure boiling water.

Remark : this test is not applicable to S 249 series.

Equipment

- Equipment specified for M6D test method.
- Pyrex beaker
- Heater.

Method

- Measure the electrical characteristics of the test-piece according to M6D test method. Rinse test pieces with pure water.
- Immerse test-piece in pure boiling water for 4 hours, ten pieces maximum in the same beaker. Test pieces must remain inside boiling water during the 4 hours immersion time.
- Measure rise time to forming voltage again according to test M6D.

7.7 - MEASUREMENT OF CATHODE CAPACITANCE

Equipment

JIS C5102-7.8.1 Capacitance meter

Measuring electrolyte

150g/l ammonium adipate solution at $30 \pm 2^\circ\text{C}$

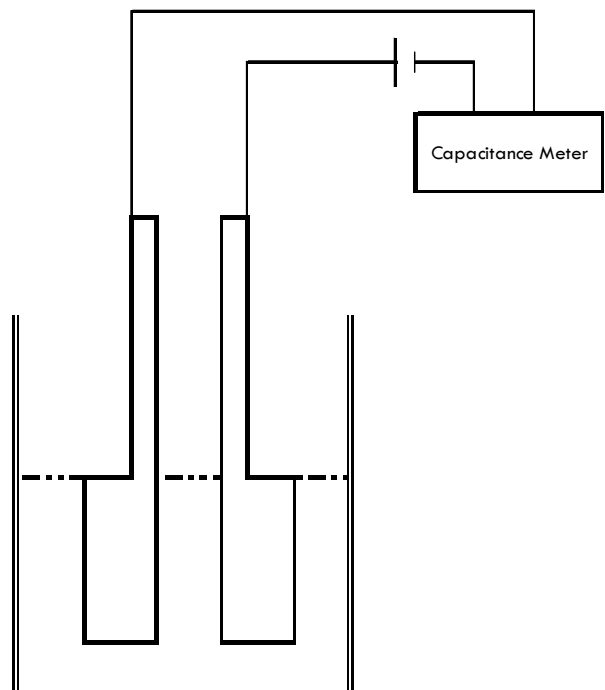
$6.5 \Omega\cdot\text{cm}$ (70°C)

pH: 6.7

Measuring section: 50 *10 mm

Operating procedure

- Take two test pieces.
- Immerse the two test pieces so that the test-piece upper edge is just flush with electrolyte level.
- Connect the test pieces to the capacitance meter and take the reading at $120 \text{ Hz} \pm 5\%$.
- The foil specific capacitance per cm^2 is equal to $[\text{Cm}^*2]/5$ where Cm is the measured value (μF).



7.8 - HV ETCHED FOIL CAPACITANCE MEASUREMENT (M4D)

This operation is carried out in four stages:

1 - Hydration

Test pieces are cut to dimensions shown in page 16, then immersed in pure boiling water during 2.5 minutes.

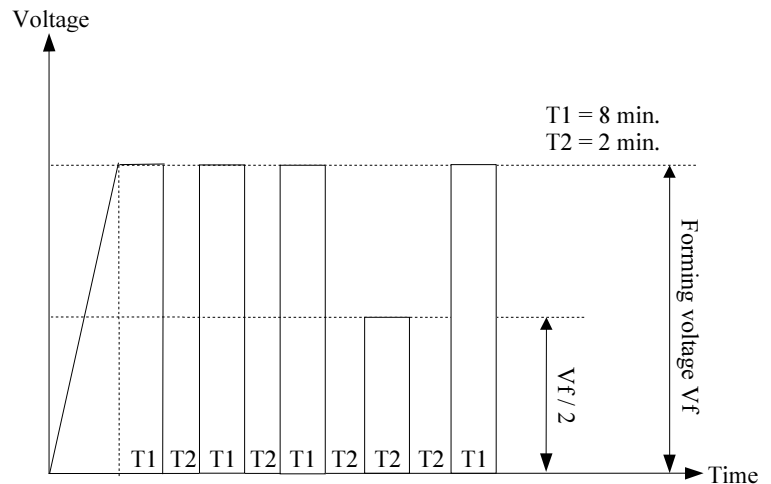
2 - Formation

Equipment

- Pure aluminium tank which acting as the cathode.
- Variable D.C. Power Supply rated at 600 V and 30Amp. Ripple Voltage not to exceed 1 %.

Method

- The forming solution is made of 9% Boric Acid in pure water at 90°C. Resistivity is adjusted between 2000-3000 W.cm at 70°C by adding ammonia.
- The test-pieces are placed in the forming bath.
- A part of the connection tab must always remained below the solution level.
- Test pieces are then formed according to the cycle shown in Figure 1.



3 - Test for formation quality

Equipment

- A beaker containing a lining of pure aluminium as cathode.
- Variable D. C. Power Supply rated at 600 V and 1Amp. Ripple Voltage not to exceed 1 %.

Method

- The testing electrolyte is made of 7% Boric Acid in pure water at 90°C. This electrolyte must be electrically cleaned by applying a 600V voltage on a plain aluminium sample until the current decreases down to 0.10A.
- The formed test-piece is immersed in the beaker so that the upper edge is flush with electrolyte level.
- The test piece is connected to the positive output of the power supply and a 2mA (0.2 mA/cm²) constant current is applied.
- The maximum voltage is checked. It must exceed the rated forming voltages (250 V, 450 V or 600 V).
- The rise time to reach this voltage must be less than 30seconds. If these conditions are not met, a second forming sequence is required.

4 - Measuring the foil capacitance

Measuring electrolyte

- 100 g/l ammonium adipate in pure water at room temperature
- Specific resistivity between 16 and 20 W.cm at room temperature

Testing apparatus

- Measuring cell : copper cylinder (F65 x h 140 mm) electrolytically covered with silver
- Support of inert material with a vertically adjustable stand equipped with a crocodile clip to connect the test-piece
- Capacitance meter

Operating procedure

- Put the formed test-piece in the middle of the cell and attach its riser to the crocodile clip.
- Adjust the stand for height so that the test-piece upper edge is just flush with electrolyte level.

- Connect the crocodile clip and the cell to the capacitance meter device.
- Measure the capacitance at 100 Hz frequency. The capacitance per cm^2 equals 0.1 time the reading obtained.

7.9 - FORMED FOIL CAPACITANCE MEASUREMENT (M6D)

This operation is carried out in two stages:

1-Testing forming quality

Equipment

- Beaker containing a SUS cylinder as a cathode
- Variable D.C. Power Supply rated at 1000 V and 50mA with voltage and current control. Ripple voltage not to exceed 1 %.

Method

- For VF 200 to 600 V the testing solution is 7% Boric Acid in pure water at 90°C .
For VF 601 to 800 V the testing solution is 5% Boric Acid in pure water at 90°C .
- Test-pieces are cut to dimensions shown in page 16.
- Each test-piece is immersed in the testing electrolyte, so that the top edge of the measuring section is just below the electrolyte level.
- The test-piece is connected to the positive output of the power supply and the cathode is connected to the negative output. Apply a 4 mA (0.4 mA/cm^2) current
- Record the time (T) to reach the rated forming voltage (V_n).
- Record the stabilized voltage (V_m) one minute after V_n has been reached (figure below).

2-Measuring the foil capacitance

Measuring electrolyte

- 100 g/l ammonium adipate in pure water at room temperature
- Specific resistivity between 16 and 20 W.cm at room temperature

Testing apparatus

- Measuring cell: copper cylinder (F65 x h 140 mm) electrolytically covered with silver
- Support of inert material with a vertically adjustable stand equipped with a crocodile clip to connect the test-piece
- Capacitance meter

Operating procedure

- Put the formed test-piece in the middle of the cell and attach its riser to the crocodile clip.
- Adjust the stand for height so that the test-piece upper edge is just flush with electrolyte level.
- Connect the crocodile clip and the cell to the capacitance meter device.
- Measure the capacitance at 100 Hz frequency. The capacitance per cm^2 equals 0.1 time the reading obtained.

