

DIRECTIONS FOR TEST NO. 14-36-41

SUBJECT: Dielectric Constant of Liquid Aroclor

METHOD: _____

Scope

This method applies to mineral oils and oil substitute used for insulating purposes.

Apparatus

Capacitance Bridge	General Radio Co., Type 716-AM
Cathode Ray Null Detector	" " " Type 707-A
Oscillator	" " " Type 606-A
Constant Temperature Oven	Cenco-DeKhotinsky #95050
Variable Air Condenser	General Radio Co., Type 334-F
1500 cc. Pyrex Beaker	

Procedure

Electrode and beaker must be cleaned as directed under "Cleaning Apparatus for Dielectric Constant", and be at 100°C.

Heat Aroclor in the can to 105°C. Pour over electrode until plates and ceramic insulation is covered. Connect leads. Stir with thermometer outside oven until temperature reaches 101°; place in oven which has been carefully adjusted to 100°C. At the time sample is placed in oven its temperature should not have fallen below 90°C.

Connect leads to capacitance bridge, observing that the lead from insulated side of condenser goes to insulated terminal on bridge. Balance bridge carefully according to direction under "Balancing Capacitance Bridge". Until Aroclor and oven temperatures have become identical the bridge balance will constantly shift. After oven temperature reaches 100°C., maintain bridge balance until no pronounced shift is evident. Record reading of capacitance scale multiplied by multiplier setting.

$$\text{Dielectric Constant} = \frac{\text{Capacitance in Aroclor at } 100^{\circ}\text{C.}}{\text{Capacitance in air at } 100^{\circ}\text{C.}}$$

Balancing Capacitance Bridge

Condensed procedure. Operator should read operating instruction for Null Detector for complete details.

1. Connect to power supply leads to oscillator and null detector. Ground the oscillator.

2. Turn on oscillator by pushing 5000 ohm, 10 multiplier, 100 cycle frequency buttons. Adjust harmonic control until oscillation begins as shown by closing of sector in cathode ray tube.

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3. On null detector turn brilliance knob to extreme left, the focus knob to extreme right, gain control to extreme left, sweep amplitude at mid-scale position, the sweep frequency switch on line side.
4. Turn on power switch, lighting pilot light.
5. Wait fifteen seconds, turn brilliance knob to extreme right.
6. Adjust focus and brilliance knobs until sharp fine line.
7. Connect external terminals on detector to output terminals on oscillator. Switch sweep frequency to external side.
8. Connect detector terminals of bridge to input terminals of detector, taking care that the black wire (ground wire) of the lead goes to grounded terminal on both ends of lead.
9. Set gain control at mid-scale and selectivity to extreme left. Turn sweep amplitude to extreme left, obtaining vertical line. With
10. With turning control knob obtain the maximum length of this line, keeping it always under $1/4$ inch with gain knob.
11. Set sweep amplitude to extreme left.
12. Set gain control to give vertical straight line of about $3/8$ inch.
13. Balance bridge by adjusting power factor and capacitance dials until only a dot remains on the screen when the gain control is at extreme right.
14. Set sweep amplitude beyond mid-point, and slightly displace the power-factor dial to obtain a tilted ellipse.
15. Adjust phase control until this ellipse closes into a straight line inclined to the horizontal.
16. Bring power-factor dial back to balance position, which should restore the horizontal straight line. Displace this control the same amount in the opposite direction. This should again tilt the straight line but in the opposite direction. Adjust phase control until there is no tendency for this line to open up when it is swung 30 degrees from horizontal in both directions.
17. Throughout these adjustments the other bridge control (the

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capacitance Dial) must be in balance position. If the ellipse gradually opens when the line is horizontal it may be brought back to the line again by making slight changes in this control. If confusion results, balance both controls again as in (13) and repeat the succeeding adjustments.

This is the position of bridge balance: An alteration of the power-factor control will tilt the line which does not open appreciable thru an angle of 30° to the horizontal both ways; an alteration of the capacitance dial opens the ellipse but does not change the inclination of the major axis.

The apparatus may be left in this balanced condition, turned off by switching off first the brilliance knob of the detector, then the power switch, then turning off the oscillator.

For successive measurements the controls are not changed, the apparatus left in adjustment. Then the following steps define the procedure:

1. Connect all leads as previously directed including that from null detector to bridge.
2. Turn on oscillator by pushing 100 cycle frequency button.
3. Turn on null detector, wait 15 seconds then turn on cathode ray tube. Turn sweep amplitude to extreme left and adjust brilliance to obtain a fine vertical line on screen.
4. Bring this line to a dot by adjusting the two bridge controls. Initial adjustment is facilitated by having "Gain" control to left. When final adjustment is obtained this knob must be at extreme right.
5. This dot remaining unchanged shows condition of bridge balance.

Cleaning Apparatus for Dielectric Constant

The condenser is removed from Aroclor while still hot by suspending it from the plate attached to the frame and allowed to drain. Never handle condenser by the insulated terminal. After allowing to cool somewhat a 50-50 mixture of benzene-carbon tetrachloride is poured over condenser into the beaker used in the test. After draining it is washed in a mixture of equal parts benzene-tetrachloride. It is then washed successively in three different mixtures of benzene-tetrachloride, draining thoroughly between washes. Finally the electrode is placed on clean paper and brought to 100° in constant temperature oven.

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The beaker is rinsed with the cleaning mixture originally poured over the condenser, then washed with T.S.P. and hot water. After draining thoroughly it is dried at 100° in the oven.

When handling the condenser the operator should never suspend it by the terminal to the insulated plates.

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