3-45. Measuring Distributed Capacitance (Preferred Method).

3-46. The impedance of a coil at its self-resonant frequency is resistive and usually high. This characteristic may be utilized for measuring distributed capacitance. Proceed as follows:

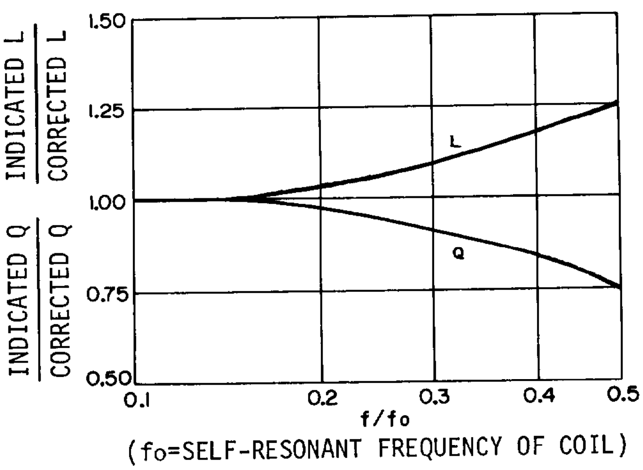

Figure 3-9. Typical Variation of Effective Q and Inductance with Frequency.

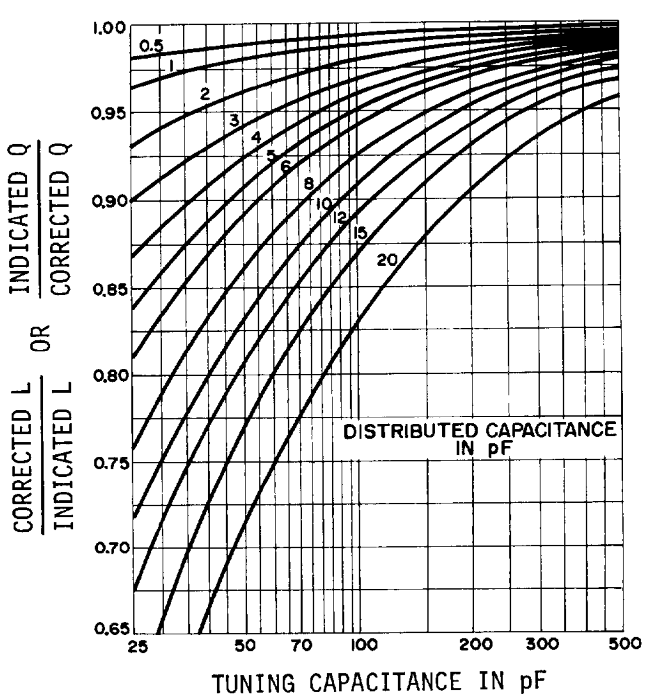

Figure 3-10. Correction Chart for Distributed Capacitance.

a. Connect inductor sample to be tested to the 4342A measurement COIL (HI and LO) terminals.

b. Set L/C dial control to approximately 400pF and ΔC dial control to 0pF. Note C dial reading as C_1.

c. Depress a trial FREQUENCY RANGE button and rotate FREQUENCY dial to search for the frequency at which panel Q meter shows a maximum deflection. If no peak deflection can be observed, change FREQUENCY RANGE setting and repeat the procedure.

d. Adjust FREQUENCY dial control for maximum Q meter deflection. Note the dial frequency reading as f_1.

e. Set measurement frequency to approximately ten times the frequency f_1 noted in step d.

f. Replace the inductor sample with a stable coil (16470 series supplemental inductor) capable of resonating in the measuring circuit at this higher frequency.

g. Adjust the L/C dial control for maximum Q meter deflection.

h. Connect the test inductor to the measurement CAPACITOR (HI and GND) terminals.

i. Adjust the L/C dial control for again obtaining maximum Q meter deflection. If the L/C dial control has to be rotated in the direction of higher capacitance, increase the measurement frequency. If it has to be rotated towards a lower capacitance, decrease the frequency.

j. Alternately connect and disconnect the test inductor to/from the CAPACITOR terminals and adjust the FREQUENCY dial control (if necessary, change FREQUENCY RANGE setting) until the influence of the test inductor to tuning conditions is non-existent (indicated Q value may change). Note dial frequency reading as fo. This frequency is identical with the self resonant frequency of the inductor.

k. Distributed capacitance of the inductor sample is given by the following equation. Substitute measured values of C_1, fo, and f_1 in the equation:

$$Cd = \frac{C_1}{\left(\frac{f_0}{f_1}\right)^2 - 1} \quad \text{.......... (eq. 3-7)}$$

Where, Cd: distributed capacitance in farads.
C_1: C dial reading (farads) noted in step b.
f_0: measurement frequency (hertz) noted in step j.
f_1: measurement frequency (hertz) noted in step d.

Note

If $f_0 \gg f_1$, the eq. 3-7 is simplified as follows:

$$Cd = \left(\frac{f_1}{f_0}\right)^2 C_1 \quad \text{........... (eq. 3-7)}$$

3-47. Measuring Distributed Capacitance (Approximate Method, Cd≥10pF).

3-48. A distributed capacitance more than approximately 10pF may be measured with the simplified procedure described below (this procedure is useful for obtaining approximate values of distributed capacitance with an accuracy which serves practical purposes):

a. Connect inductor sample to the measurement COIL (HI and LO) terminals.

b. Set L/C dial control to approximately 50pF and ΔC dial control to 0pF. Note the C dial reading as C_1.

c. Depress a trial FREQUENCY RANGE button and rotate FREQUENCY dial control to search for the frequency at which panel Q meter shows a maximum deflection. If no peak deflection can be observed, change FREQUENCY RANGE setting and repeat the procedure.

d. Adjust FREQUENCY dial control for maximum panel Q meter deflection. Note this frequency as f_1.

e. Change FREQUENCY dial setting to f_2 equal to f_1/n (n should be a selected integer, e.g. 2 or 3).

f. Adjust L/C dial and ΔC dial controls for again obtaining maximum meter deflection. Note the sum of C dial and ΔC dial readings as C_2.

g. Distributed capacitance is given by the following equation. Substitute measured values of C_1, C_2, f_1 and f_2 in the equation:

$$Cd = \frac{(C_2 - n^2 C_1)}{n^2 - 1} \quad \text{........ (eq. 3-9)}$$

$$n = \frac{f_1}{f_2}$$

Where, Cd: distributed capacitance in farads.
C_1: C dial reading (farads) noted in step b.
C_2: C dial reading (farads) noted in step f.
f_1: measurement frequency (hertz) noted in step d.
f_2: measurement frequency (hertz) given in step e.

Note

If f_2 is exactly one half of f_1, then

$$Cd = \frac{C_2 - 4C_1}{3} \quad \text{........... (eq. 3-10)}$$

An average of several measurements using different values of C_1 will improve the results of this measurement. The best accuracy to be expected with this method, however, is in the range of ±2pF.

3-49. CORRECTION FOR Q.

3-50. To use the indicated Q for the purpose of calculating L and Rs (in determining the actual equivalent circuit), it must be corrected for the effects of the distributed capacitance. The corrected Q and the Q value measured by the Q meter can be obtained from the following equation:

$$Qt = Qi \frac{C + Cd}{C} \quad \text{........... (eq. 3-11)}$$

Then,

$$\text{Correction factor} = \frac{C + Cd}{C} = 1 + \frac{Cd}{C} \quad \text{........... (eq. 3-12)}$$

Where, Qt: corrected Q value.
Qi: indicated Q value.
C: sum of C and ΔC dial readings.
Cd: distributed capacitance of sample.