Charakteristic impedance in coaxial line (book "Electromagnetics" by John D. Kraus)

If a cross-section of the coaxial line is drawn to scale with conducting paint on a sheet of space paper, 69 Ω is measured directly on an ohmmeter connected between the inner and outer conductors.

When this resistance-measurement method is applied to open types of line such as a two-wire line, the sheet of resistance material should extend out to a distance that is large compared with the line cross-section if accurate results are to be obtained.

Although graphical, analog-computer, and digital-computer methods can be applied to two-conductor lines of any shape, some configurations yield to a simple calculation. Thus, for the *coaxial line* of Fig. 12-13 we have from (6-10-8) for L and (4-12-2) for C that its characteristic impedance

$$\boxed{Z_0 = \sqrt{\frac{L}{C}} = \frac{1}{2\pi}\sqrt{\frac{\mu}{\epsilon}}\ln\frac{b}{a}} = 0.367\sqrt{\frac{\mu}{\epsilon}}\log\frac{b}{a} \qquad (\Omega) \tag{21}$$

If there is no ferromagnetic material present, $\mu = \mu_0$ and (21) reduces to

$$\boxed{Z_0 = \frac{138}{\sqrt{\epsilon_r}}\log\frac{b}{a} \qquad (\Omega)} \qquad \text{Coaxial line impedance} \tag{22}$$

where ϵ_r = relative permittivity of medium filling line, dimensionless
a = outside radius of inner conductor
b = inside radius of outer conductor, same units as a

For an air-filled line $\epsilon_r = 1$, and (22) becomes

$$Z_0 = 138\log\frac{b}{a} \qquad (\Omega) \tag{23}$$

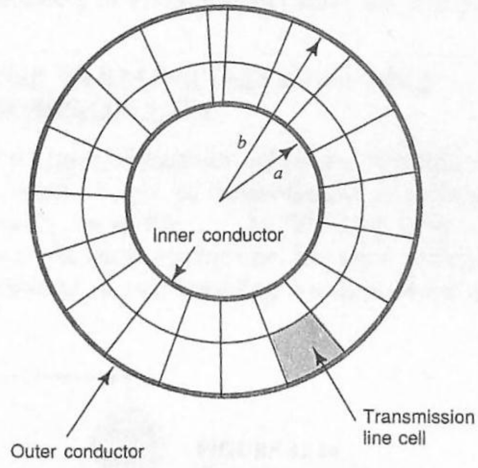

FIGURE 12-13
Coaxial transmission line with 18.3 transmission-line cells in parallel and 2 in series.