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Details of the two-wattmeter method.

Assuming connections as shown on the right, and assuming no neutral connection, then the total power is given by the equation

$$P_{3f} = I_a V_a + I_b V_b + I_c V_c$$

where we have taken the "in-phase" components of the currents (i.e. the power factor is included in the current quantities above.) The reading of the wattmeters P_2 can be expressed as follows:

$P_2 = I_c V_{cb} + I_a V_{ab}$ (where again, the power factors are included in the current quantities.) It is noted that $V_{ab} = V_a - V_b$ and $V_{cb} = V_c - V_b$, hence the total power read by the two wattmeters is:

$$\begin{aligned} P_2 &= I_c V_{cb} + I_a V_{ab} = I_c (V_c - V_b) + I_a (V_a - V_b) \\ &= I_c V_c + I_a V_a + V_b (-I_a - I_c) \\ &= I_c V_c + I_a V_a + V_b I_b \\ &= P_{3f} \end{aligned}$$

This is the normal way to measure three phase power when there is no neutral connection. If the three phase circuits are "balanced" then the neutral would carry no current, and this method will work for a three phase circuit with neutral (as long as the circuit is balanced.)

