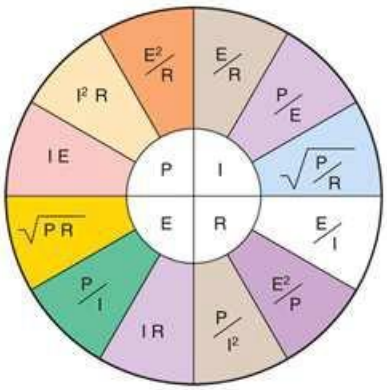
Instrumentation Formulas

For use with the following assessments:

- **Instrumentation Fitter**
- **Instrumentation Technician**
- **Industrial Maintenance Electrical & Instrumentation Technician**

Power Formulas



Resistance Formulas

TR = R1 + R2 + R3...

$$TR = \frac{1}{(1/R1) + (1/R2) + (1/R3)}$$

Temperature Formulas

°C = $^{5}/_{9}$ (°F - 32)
°F = (1.8 x °C) + 32

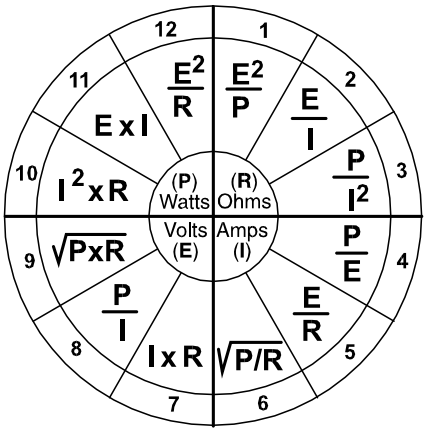
Pressure Formulas

"H20 = PSI x 27.68
PSIA = PSIG + 14.7 PSI
Absolute vacuum pressure = Barometric pressure – vacuum gauge reading

Electrical Formulas

General Formulas

The following formula wheel can be used for all direct current circuits and alternating current circuits with unity power factor.



Voltage Drop Formulas

Voltage Drop (1∅) = $\frac{2 \times L \times K \times I}{CM}$

Voltage Drop (3∅) = $\frac{1.732 \times L \times K \times I}{CM}$

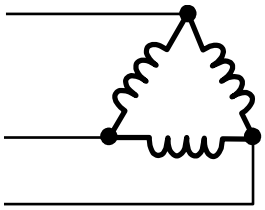
K = direct current resistance for a 1,000 circular mil conductor 1,000 feet long operating at 75°C
K = 12.9 ohms for copper
K = 21.2 ohms for aluminum
(From NEC - Chapter 9, Table 8)

L = One way length of circuit in feet
I = Current in conductor in amperes

Voltage Drop (1∅) = R x I
R = Resistance of both conductors

Voltage Drop (3∅) = R x I x 1.732
R = Resistance of one conductor

DELTA

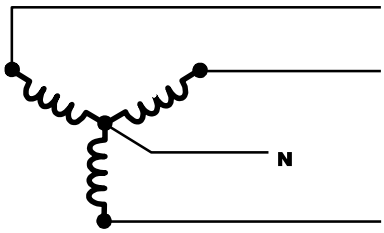


V_L = V Line = Source Voltage
V_P = V Phase = Phase Voltage
$V_L = V_P$

I_L = I Line = Line Current
I_P = I Phase = Phase Current
$I_L = I_P \times 1.732$
$I_P = I_L / 1.732$

Power = W = $\sqrt{3} \times V_L I_L \cos \theta$
$= 3 I_p^2 R$
$= 3 V_p I_p \cos \theta$

WYE



V_L = V Line = Source Voltage
V_P = V Phase = Phase Voltage
$V_L = V_P \times 1.732$

I_L = I Line = Line Current
I_P = I Phase = Phase Current
$I_L = I_P$

Power = W = $\sqrt{3} \times V_L I_L \cos \theta$
$= 3 I_p^2 R$
$= 3 V_p I_p \cos \theta$

Power Factor = $\frac{\text{True Power}}{\text{Apparent Power}}$

Note 1 - Use copper conductors for all problems, unless otherwise specified.
Note 2 - One horse power is equal to 746 watts.
Note 3 - Power factor (P.F.) = cos θ = R/Z, Z = Impedance.
Note 4 - Efficiency = Output/Input