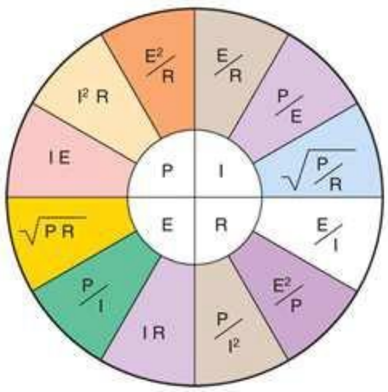
Instrumentation Formulas

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

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

Pressure Formulas

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

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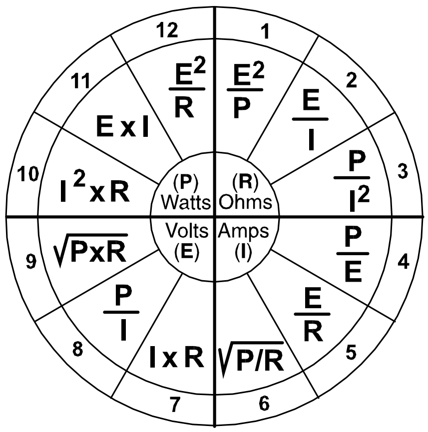
Electrical Formulas

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∅) = $\frac{1.732 \times L \times K \times I}{CM}$

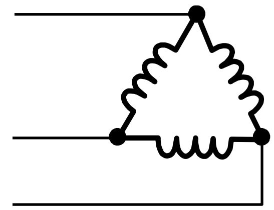
K = direct current resistance for a 1,000 circular mil conductor 1,000 feet long operating at 75°C
K = 12.9 ohms for copper
K = 21.2 ohms for aluminum
(From NEC - Chapter 9, Table 8)

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

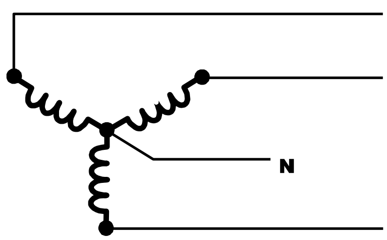


V_L = V Line = Source Voltage
V_P = V Phase = Phase Voltage
$V_L = V_P$

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