MARINE ELECTRIC

Electrical Equations

Capacitors

Capacitive Reactance in Ohms = $X_C = 1/(2 \times 3.14 \times f \times C)$

Parallel Impedance in Ohms = $Z = X_{C1} + X_{C2} + X_{C3}...$

Series Impedance in Ohms = $Z = 1/(1/X_{C1}) + (1/X_{C2})...$

Current, Amperes (I)

Single-Phase = $I = P/E$

Three-Phase = $I = P/(\ E_{L\text{-}L} \times 1.732)$

Efficiency

Efficiency = Output/Input

Input = Output/Efficiency

Output = Input × Efficiency

Inductors

Inductive Reactance in Ohms = $X_L = 2 \times 3.14 \times f \times L$

Parallel Impedance in Ohms = $Z = 1/(1/X_{L1}) + (1/X_{L2}) + (1/X_{L3})$

Series Impedance in Ohms = $Z = X_{L1} + X_{L2} + X_{L3}$

Impedance (Z)

Impedance in Ohms = $Z = \sqrt{[R^2 + (X_L{}^2 - X_C{}^2)]}$

Electrical Equations

Motor FLA/Watts

FLA, Single-Phase = (hp × 746W)/(E × Eff × PF)

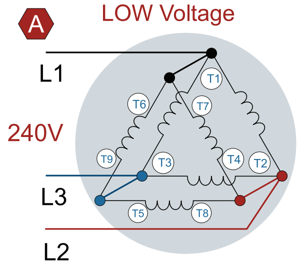
FLA, Three-Phase = (hp × 746W)/(E × 1.732 × Eff × PF)

Watts = Horsepower × 746W

Motors, Dual-Voltage

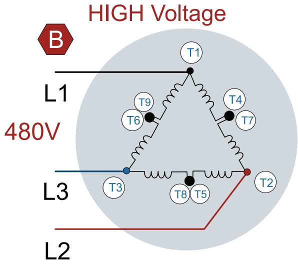
Dual-Voltage Motor Windings - Delta, Three-Phase

Parallel-Connected LOW Voltage



L1 = T1,6,7 L2 = T2,4,8 L3 = T3,5,9	Tie Together None

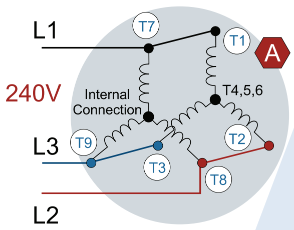
Series-Connected HIGH Voltage



L1 = T1 L2 = T2 L3 = T3	Tie Together T4,7 T5,8 T6,9

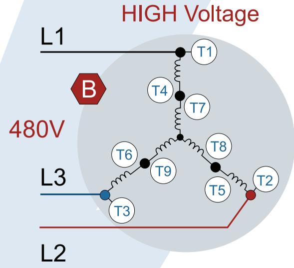
Dual-Voltage Motor Windings - Wye, Three-Phase

Parallel-Connected LOW Voltage



L1 = T1,7 L2 = T2,8 L3 = T3,9	Tie Together T4,5,6

Series-Connected HIGH Voltage



L1 = T1 L2 = T2 L3 = T3	Tie Together T4,7 T5,8 T6,9

Neutral Current

Single-Phase, 120/240V System: $I_{Neutral} = \text{Line 1} - \text{Line 2}$

Three-Phase, 120/208V, 4-wire Wye Connected System:

$$I_{Neutral} = \sqrt{(I_{L1}^2 + I_{L2}^2 + I_{L3}^2) - ((I_{L1} \times I_{L2} +) - (I_{L2} \times I_{L3}) - (I_{L1} \times I_{L3})}$$

Electrical Equations

Parallel Circuit Resistance

R_T = Resistance/Number of Resistors

$R_T = (R_1 \times R_2)/(R_1+R_2)$

$R_T = 1/(1/R_1 + 1/R_2 + 1/R_3)$

Power Factor

PF = W/VA

VA = W/PF

W = VA × PF

Series Circuit Resistance

$R_T = R_1 + R_2 + R_3 \ldots$

$E_T = E_1 + E_2 + E_3 \ldots$

Short-Circuit Calculation

Short-Circuit Current = Secondary Amperes/Transformer Z%

Temperature Conversions

C° = 5/9 × (Temp F° – 32°)

F° = (9/5 × Temp C°) + 32°

Transformers, Single-Phase

$I_{Primary}$ = Transformer VA/$E_{L\text{-}L}$

$I_{Secondary}$ = Transformer VA/$E_{L\text{-}L}$

Transformer VA = $E_{L\text{-}L} \times I_{Secondary}$

MARINE ELECTRIC

Electrical Equations

Transformers, Three-Phase

$I_{Primary}$ = Transformer VA/(E_{L-L} × 1.732)

$I_{Secondary}$ = Transformer VA/(E_{L-L} × 1.732)

Transformer VA = (E_{L-L} × 1.732) × $I_{Secondary}$

Turns Ratio

Turns Ratio = Primary Volts:Secondary Volts

Secondary Volts = Primary Volts/Turns Ratio

Primary Volts = Secondary Volts × Turns Ratio

Volt-Amperes

Single-Phase = VA = E × I

Three-Phase = VA = (E_{L-L} × 1.732) × I

Voltages

Peak Voltage = Effective (RMS) Voltage × 1.414

Effective (RMS) Voltage = Peak Voltage × 0.707

High-Leg Voltage = $V_{L\text{-}to\text{-}N}$ × 1.732

Electrical Equations

Voltage Drop, Single-Phase

Voltage Drop = $(2 \times K \times I \times D)/Cmil$

Wire Size = $(2 \times K \times I \times D)/VD$

Distance = $Cmil \times VD/(2 \times K \times I)$

K = Cu, 12.90Ω – Al, 21.20Ω

Voltage Drop, Three-Phase

Voltage Drop = $(1.732 \times K \times I \times D)/Cmil$

Wire Size = $(1.732 \times K \times I \times D)/VD$

Distance = $Cmil \times VD/(1.732 \times K \times I)$

K = Cu, 12.90Ω – Al, 21.20Ω

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