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AC Machines Formulas

Calculators! Examples! Conversions!

List of 28 AC Machines Formulas

AC Machines

Electrical Parameters

1) Apparent Power

Open Calculator

fx $$S = \frac{P_{rated}}{PF}$$

ex $$48.01556kVA = \frac{21.607kW}{0.45}$$

2) Current in Conductor

Open Calculator

fx $$I_z = \frac{I_{ph}}{n_{||}}$$

ex $$10A = \frac{20A}{2}$$

3) Current per Phase

Open Calculator

fx $$I_{ph} = \frac{S \cdot 1000}{E_{ph} \cdot 3}$$

ex $$20A = \frac{48kVA \cdot 1000}{800kV \cdot 3}$$

4) Field Coil Voltage

Open Calculator

fx $$E_f = I_f \cdot R_f$$

ex $$42.4983\text{V} = 83.33\text{A} \cdot 0.51\Omega$$

5) Field Current

Open Calculator

fx $$I_f = \frac{E_f}{R_f}$$

ex $$83.33333\text{A} = \frac{42.5\text{V}}{0.51\Omega}$$

6) Field Resistance

Open Calculator

fx $$R_f = \frac{T_c \cdot \rho \cdot L_{mt}}{A_f}$$

ex $$0.51\Omega = \frac{204 \cdot 2.5\text{e-}5\Omega^*\text{m} \cdot 0.25\text{m}}{0.0025\text{m}^2}$$

7) Output Coefficient using Output Equation

Open Calculator

fx $$C_{o(ac)} = \frac{P_o}{L_a \cdot D_a^2 \cdot N_s \cdot 1000}$$

ex $$0.848826 = \frac{600\text{kW}}{0.3\text{m} \cdot (0.5\text{m})^2 \cdot 1500\text{rev/s} \cdot 1000}$$

8) Output Power of Synchronous Machine

Open Calculator

fx $$P_o = C_{o(ac)} \cdot 1000 \cdot D_a^2 \cdot L_a \cdot N_s$$

ex $$600.8296\text{kW} = 0.85 \cdot 1000 \cdot (0.5\text{m})^2 \cdot 0.3\text{m} \cdot 1500\text{rev/s}$$

9) Short Circuit Ratio

Open Calculator

fx $$SCR = \frac{1}{X_s}$$

ex $$2.5 = \frac{1}{0.4\Omega}$$

10) Specific Electric Loading

Open Calculator

fx $$q_{av} = \frac{I_a \cdot Z}{\pi \cdot n_{||} \cdot D_a}$$

ex $$187.4845\text{Ac/m} = \frac{1.178\text{A} \cdot 500}{\pi \cdot 2 \cdot 0.5\text{m}}$$

11) Specific Electric Loading using Output Coefficient AC

Open Calculator

fx $$q_{av} = \frac{C_{o(ac)} \cdot 1000}{11 \cdot B_{av} \cdot K_w}$$

ex $$187.4642\text{Ac/m} = \frac{0.85 \cdot 1000}{11 \cdot 0.458\text{Wb/m}^2 \cdot 0.9}$$

12) Synchronous Speed using Output Equation

Open Calculator

fx $$N_s = \frac{P_o}{C_{o(ac)} \cdot 1000 \cdot D_a^2 \cdot L_a}$$

ex $$1497.929\text{rev/s} = \frac{600\text{kW}}{0.85 \cdot 1000 \cdot (0.5\text{m})^2 \cdot 0.3\text{m}}$$

13) Winding Factor using Output Coefficient AC

Open Calculator

fx $$K_w = \frac{C_{o(ac)} \cdot 1000}{11 \cdot B_{av} \cdot q_{av}}$$

ex $$0.900001 = \frac{0.85 \cdot 1000}{11 \cdot 0.458\text{Wb/m}^2 \cdot 187.464\text{Ac/m}}$$

Magnetic Parameters

14) Flux per Pole using Pole Pitch

Open Calculator

fx $$\Phi = B_{av} \cdot Y_p \cdot L_{limit}$$

ex $$0.054004\text{Wb} = 0.458\text{Wb/m}^2 \cdot 0.392\text{m} \cdot 0.3008\text{m}$$

15) Full Load Field MMF

Open Calculator

fx $$MMF_f = I_f \cdot T_c$$

ex $$16999.32\text{AT} = 83.33\text{A} \cdot 204$$

16) Magnetic Loading

Open Calculator

fx $$B = n \cdot \Phi$$

ex $$0.216\text{Wb} = 4 \cdot 0.054\text{Wb}$$

17) MMF of Damper Winding

Open Calculator

fx $$MMF_d = 0.143 \cdot q_{av} \cdot Y_p$$

ex $$10.50848\text{AT} = 0.143 \cdot 187.464\text{Ac/m} \cdot 0.392\text{m}$$

18) Pole Arc

Open Calculator

fx $$\theta = n_d \cdot 0.8 \cdot Y_s$$

ex $$257.6\text{m} = 10 \cdot 0.8 \cdot 32.2\text{m}$$

19) Pole Pitch

Open Calculator

fx $$Y_p = \frac{\pi \cdot D_a}{n}$$

ex $$0.392699\text{m} = \frac{\pi \cdot 0.5\text{m}}{4}$$

20) Specific Magnetic Loading

Open Calculator

fx $$B_{av} = \frac{n \cdot \Phi}{\pi \cdot D_a \cdot L_a}$$

ex $$0.458366\text{Wb/m}^2 = \frac{4 \cdot 0.054\text{Wb}}{\pi \cdot 0.5\text{m} \cdot 0.3\text{m}}$$

21) Specific Magnetic Loading using Output Coefficient AC

Open Calculator

fx $$B_{av} = \frac{C_{o(ac)} \cdot 1000}{11 \cdot q_{av} \cdot K_w}$$

ex $$0.458 \text{Wb/m}^2 = \frac{0.85 \cdot 1000}{11 \cdot 187.464 \text{Ac/m} \cdot 0.9}$$

Mechanical Parameters

22) Area of Field Conductor

Open Calculator

fx $$A_f = \frac{MMF_f \cdot \rho \cdot L_{mt}}{E_f}$$

ex $$0.0025 \text{m}^2 = \frac{17000 \text{AT} \cdot 2.5\text{e-}5 \Omega^* \text{m} \cdot 0.25 \text{m}}{42.5 \text{V}}$$

23) Armature Core Length using Output Equation

Open Calculator

fx $$L_a = \frac{P_o}{C_{o(ac)} \cdot 1000 \cdot D_a^2 \cdot N_s}$$

ex $$0.299586 \text{m} = \frac{600 \text{kW}}{0.85 \cdot 1000 \cdot (0.5 \text{m})^2 \cdot 1500 \text{rev/s}}$$

24) Armature Diameter using Output Equation

Open Calculator

$$fx\quad D_a = \sqrt{\frac{P_o}{C_{o(ac)} \cdot 1000 \cdot N_s \cdot L_a}}$$

$$ex\quad 0.499655\text{m} = \sqrt{\frac{600\text{kW}}{0.85 \cdot 1000 \cdot 1500\text{rev/s} \cdot 0.3\text{m}}}$$

25) Cross Sectional Area of Damper Winding

Open Calculator

$$fx\quad \sigma_d = \frac{A_d}{n_d}$$

$$ex\quad 0.565\text{m}^2 = \frac{5.65\text{m}^2}{10}$$

26) Diameter of Damper Bar

Open Calculator

$$fx\quad D_d = \sqrt{\frac{4 \cdot A_d}{\pi}}$$

$$ex\quad 2.682127\text{m} = \sqrt{\frac{4 \cdot 5.65\text{m}^2}{\pi}}$$

27) Length of Damper Bar

Open Calculator

$$fx\quad L_d = 1.1 \cdot L_a$$

$$ex\quad 0.33\text{m} = 1.1 \cdot 0.3\text{m}$$

28) Number of Damper Bars

Open Calculator

$$n_d = \frac{\theta}{0.8 \cdot Y_s}$$

$$10 = \frac{257.6\text{m}}{0.8 \cdot 32.2\text{m}}$$

Variables Used

- A_d Area of Damper Winding *(Square Meter)*
- A_f Area of Field Conductor *(Square Meter)*
- B Magnetic Loading *(Weber)*
- B_{av} Specific Magnetic Loading *(Weber per Square Meter)*
- $C_{o(ac)}$ Output Coefficient AC
- D_a Armature Diameter *(Meter)*
- D_d Diameter of Damper Bar *(Meter)*
- E_f Field Coil Voltage *(Volt)*
- E_{ph} Induced Emf per Phase *(Kilovolt)*
- I_a Armature Current *(Ampere)*
- I_f Field Current *(Ampere)*
- I_{ph} Current per Phase *(Ampere)*
- I_z Current in Conductor *(Ampere)*
- K_w Winding Factor
- L_a Armature Core Length *(Meter)*
- L_d Length of Damper Bar *(Meter)*
- L_{limit} Limiting Value of Core Length *(Meter)*
- L_{mt} Length of Mean Turn *(Meter)*
- MMF_d MMF of Damper Winding *(Ampere-Turn)*
- MMF_f Full Load Field MMF *(Ampere-Turn)*
- n Number of Poles

- **$n_{||}$** Number of Parallel Paths
- **n_d** Number of Damper Bar
- **N_s** Synchronous Speed *(Revolution per Second)*
- **P_o** Output Power *(Kilowatt)*
- **P_{rated}** Rated Real Power *(Kilowatt)*
- **PF** Power Factor
- **q_{av}** Specific Electric Loading *(Ampere Conductor per Meter)*
- **R_f** Field Resistance *(Ohm)*
- **S** Apparent Power *(Kilovolt Ampere)*
- **SCR** Short Circuit Ratio
- **T_c** Turns per Coil
- **X_s** Synchronous Reactance *(Ohm)*
- **Y_p** Pole Pitch *(Meter)*
- **Y_s** Slot Pitch *(Meter)*
- **Z** Number of Conductors
- **θ** Pole Arc *(Meter)*
- **ρ** Resistivity *(Ohm Meter)*
- **σ_d** Cross-Sectional Area of Damper Winding *(Square Meter)*
- **Φ** Flux per Pole *(Weber)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Power** in Kilovolt Ampere (kVA), Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Magnetic Flux** in Weber (Wb)
  Magnetic Flux Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Magnetic Flux Density** in Weber per Square Meter (Wb/m²)
  Magnetic Flux Density Unit Conversion
- Measurement: **Magnetomotive Force** in Ampere-Turn (AT)
  Magnetomotive Force Unit Conversion
- Measurement: **Electric Potential** in Kilovolt (kV), Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Electric Resistivity** in Ohm Meter (Ω*m)
  Electric Resistivity Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Second (rev/s)
  Angular Velocity Unit Conversion

- Measurement: **Specific Electrical Loading** in Ampere Conductor per Meter (Ac/m)
  Specific Electrical Loading Unit Conversion

Check other formula lists

- AC Machines Formulas
- DC Machines Formulas

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