Power Loss Formula

7 Solved Examples - Free Reference Sheet

Key Formulas

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P = I^2 x R        (copper / resistive loss)
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P = V^2 / R
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P = V x I
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Three-phase loss:  P = 3 x I^2 x R   (per-phase values)
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Energy loss = Power loss x Time
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Where: P = power loss (watts), I = current (amperes), R = resistance (ohms), V = voltage (volts). Power loss rises with the SQUARE of current: doubling the current makes the loss FOUR times greater.

Solved Examples

Example 1: Basic DC circuit

Given: Current I = 10 A, Resistance R = 2 ohm.

Solution: P = I^2 x R = (10)^2 x 2 = 100 x 2.

Answer: P = 200 W lost as heat in the conductor.

Example 2: Using voltage and resistance

Given: Voltage V = 220 V, Resistance R = 48.4 ohm.

Solution: P = V^2 / R = (220)^2 / 48.4 = 48400 / 48.4.

Answer: P = 1000 W = 1 kW.

Example 3: Using voltage drop and current

Given: Voltage drop across cable Vd = 20 V, Current I = 10 A.

Solution: P = Vd x I = 20 x 10.

Answer: P = 200 W.

Example 4: Three-phase system

Given: Per-phase current I = 50 A, per-phase resistance R = 0.1 ohm.

Solution: P = 3 x I^2 x R = 3 x (50)^2 x 0.1 = 3 x 2500 x 0.1.

Answer: P = 750 W total three-phase copper loss.

Example 5: Transmission line percentage loss

Given: Power transmitted = 100 kW at 11 kV, line resistance R = 5 ohm.

Solution: Current I = 100000 / 11000 = 9.09 A. P = I^2 x R = (9.09)^2 x 5 = 413 W. % loss = 413 / 100000 x

100.

Answer: Power loss = 413 W (only 0.41% of transmitted power).

Example 6: Effect of doubling the current

Given: R = 4 ohm. Case A: I = 5 A. Case B: I = 10 A.

Solution: Case A: P = (5)^2 x 4 = 100 W. Case B: P = (10)^2 x 4 = 400 W.

Answer: Doubling the current makes power loss FOUR times greater (100 W -> 400 W).

Example 7: Energy lost over time

Given: A conductor continuously loses 200 W for 5 hours.

Solution: Energy loss = Power loss x Time = 200 x 5 = 1000 Wh.

Answer: Energy loss = 1 kWh.