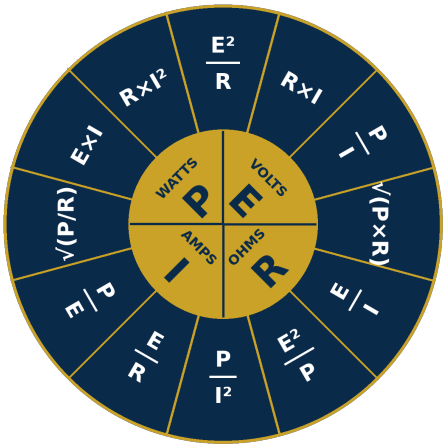
SPARKY FORMULA SHEET

FORMULAS TO MEMORIZE

Burn these in. Everything else lives in your code book.



MEMORIZE THESE TABLE LOCATIONS

240.4(D) — small conductor limits
250.66 — grounding electrode conductor
250.122 — equipment grounding conductor
310.16 — conductor ampacity
314.16 — box fill
430.52 — motor breaker / fuse max
430.250 — 3-phase motor full-load amps
Ch. 9 Tbl 1/4/5 — conduit fill
Ch. 9 Tbl 8 — circular mils (voltage drop)

POWER — SINGLE PHASE

Volts × Amps = **Watts** (VA)

Ex: a 120V circuit drawing 10A uses 120 × 10 = **1,200W** (flip it: 1,200 ÷ 120 = 10A)

POWER — THREE PHASE

3-phase Watts = Volts × Amps × **1.732** (× power factor)

Ex: a 208V 3-phase load at 30A: 208 × 30 × 1.732 = **10,808 VA**

AMPS — THREE PHASE

3-phase Amps = Watts ÷ (Volts × **1.732)**

Ex: a 15,000W 3-phase load on 208V draws 15,000 ÷ (208 × 1.732) = **41.6A**

KILOVOLT-AMPERES

kVA = Volts × Amps ÷ **1,000** (× 1.732 for 3-phase)

Ex: a 480V 3-phase transformer loaded to 50A: 480 × 50 × 1.732 ÷ 1,000 = **41.6 kVA**

MOTOR CONDUCTORS

Motor wire size = **125%** of **table** amps (not nameplate)

Ex: a 10 HP, 230V 3-phase motor — the table says 28A: 28 × 1.25 = **35A** conductors (430.22)

MOTOR OVERLOADS

Motor overloads = **115%** of **nameplate** amps **(125%** if SF ≥ 1.15 or temp rise ≤ 40°C)

Ex: a 10A nameplate motor with 1.15 service factor: 10 × 1.25 = **12.5A** max trip (430.32)

MOTOR FEEDER

Motor feeder = **125%** of biggest motor + **100%** of the rest

Ex: a feeder for 28A + 14A motors (table amps): (28 × 1.25) + 14 = **49A** (430.24)

DWELLING SERVICE WIRE

House service wire = **83%** of the service size

Ex: a 200A house service: 200 × 0.83 = **166A** → 2/0 copper is enough (310.12)

DWELLING LOAD CALC

House load: first 10,000 VA at **100%,** the rest at **40%**

Ex: a house with a 14,000 VA calculated load: 10,000 + (4,000 × 0.40) = **11,600 VA** (220.82)

VOLTAGE DROP

Voltage drop = (2 × K × Amps × Feet) ÷ Circular mils **(K** = 12.9 Cu / 21.2 Al)

Ex: a 10A load 90 ft away on 12 AWG copper (6,530 CM): (2 × 12.9 × 10 × 90) ÷ 6,530 = **3.56V** → 2.96% (under the 3% rule)

CONTINUOUS LOADS

Continuous loads (3+ hrs): wire + breaker = **125%**

Ex: a 40A load that runs all day: 40 × 1.25 = **50A** → 50A breaker and wire (210.19(A))

CONDUIT FILL

Conduit fill: 1 wire **53%** · 2 wires **31%** · 3+ wires **40%**

Ex: pulling four 12 AWG THHN through ½" EMT: 4 × 0.0133 = 0.0532 sq in. — fits in 0.122 (Ch. 9 Tbl 1)