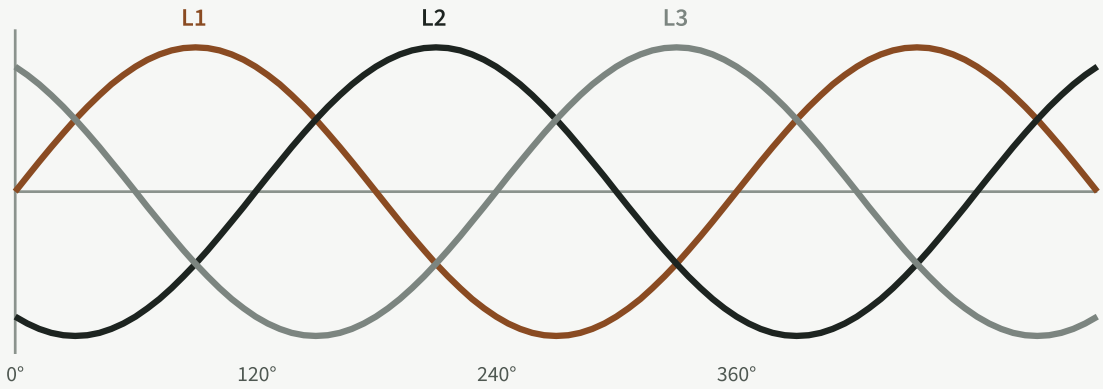
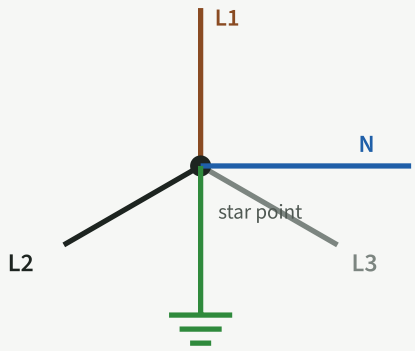
THREE-PHASE SUPPLY, STAR AND DELTA

TWO 230 VOLT LINES. WHY IS IT 400 BETWEEN THEM, NOT 460?

A generator has **three sets of windings**, each creating an EMF set **120° apart**. So a three-phase supply is effectively three supplies all rising and falling at different times.

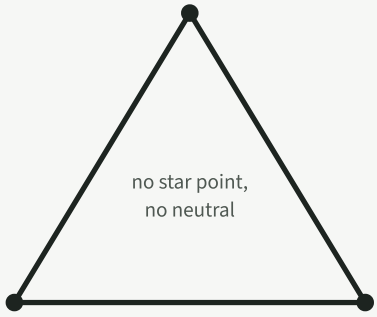


L1 (brown), L2 (black) and L3 (grey) each peak 120° after the one before.



STAR (secondary)

Star: 4 wires (3 lines + neutral). Line to neutral = **230 V**, line to line = **400 V**.



DELTA (primary)

Delta: 3 wires. The distribution transformer's primary is delta and its secondary is star, which gives you a neutral.

- The star system produces **230 V and 400 V**. 230 V × $\sqrt{3}$ (1.732) ≈ 400 V.
- **Single-phase** houses on a street are each connected to one line plus neutral, spread across L1, L2 and L3 to keep the load balanced. Any line to neutral = 230 V.
- **Three-phase** commercial and industrial supplies use all three lines. Any line to line = 400 V.
- The phases are 120° apart because 360° ÷ 3 = 120°.

- **Why 400 V and not 460 V (230 + 230)?** Two phases never reach their peaks at the same moment. They cross before either one peaks, so the difference between them tops out at 400 V, not double. (415 V is the old figure and no longer used.)
- **Delta** (the primary side) has its three windings joined end to end, so there is no star point and no neutral. On a distribution transformer the delta primary is fed at 11 kV; the star secondary gives the 230/400 V supply.
- **Star** (the secondary side) has a neutral. Houses put different loads on each phase, so the phases become **unbalanced**, and the neutral carries that out-of-balance current back.
- Two-phase supplies (two lines plus neutral) exist but are rare, only for very large properties.

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