Load Calculations - Branch and Feeder Circuits Review

Magic numbers: 125%, 80%, 3VA, 175%, 250%, 1.732, 115%, 140%, 12.9, 21.1

Read NEC 110.14(C)

Volt Amps, or VA
Amps X Volt = VA (Volt Amperes, Single Phase), 35 X 230 = 8050 VA
Amps X Volt X 1.732 = (Volt Amperes, 3 Phase), 35 X 480 X 1.732 = 29,098 VA

Min Circuit Size (Read NEC 210.19 and 210.20A)
Amps X 1.25 = Amps X 125% = 25A X 1.25 = 31.25A

Max Continuous Load
Amps X 0.80 = Amps X 80% = 75A X 0.80 = 60A

NEC Table 310.15(B)(16)

Temperature Derating (See NEC Table 310.15(B)(2)(a))
Adjustment Factors for more than 3 current carrying conductors (See NEC Table 310.15(B)(3)(a))
Amps X 0.70 = Amps X 70% = 80A X 0.80 = 64A
Amps / 0.70 = Amps / 70% = 80 / 0.70 = 114A

Voltage Drop
Constant for copper = 12.9
Constant for aluminum = 21.2
VD = 2 X K X I X L / CM
VD = 1.732 X K X I X L / CM

http://www.risingedgeservices.com/voltageDrop.html

Motor Calculations
FLC X 125% = MCA (Min. Circuit Ampacity)
Round
Temp Adjustment
Number of Wires Adjustment
MCA / (Temp Adjustment X Number of Wires Adjustment) = MCA after Adjustments
Check your termination temps
Choose your conductors

Branch Circuit Ampacity
Single Phase = VA / V = Amps

3 Phase = VA / (V X 1.732)

What's the ampacity of three, 5.6 kW, 3 phase, 480VAC, immersion heaters?
What's the Min. Circuit Ampacity?

(5.6 x 1000) / (480 x 1.732) = 6.74A
6.74A x 3 fixtures = 20.22A
20.22A x 1.25 = 25A

Lighting Loads

What's the minimum lighting load for a 4,200 sq/ft home?

4200 x 3VA = 12600W = 12600W/240VAC = 52.5A

What's the minimum lighting load for a 30,000 sq/ft armory?

30000 x 1VA = 30,000VA = 30,000 / (480 *1.732) = 36A

How many 250 watt lighting fixtures, with a power factor of 90%, can can be placed on a 20A, 277V, lighting circuit?

20A x 0.80 = Max amps on a 20 amp circuit (Due to continuous loading) = 16A
250W / 0.90 = 278W
278W / 277V = 1A per fixture
This make math easy. If each fixture take 1A, then you can put 16 fixtures on the circuit.

Practical Application #3
You are an electrician installing the wiring in a new home. The homeowner desires that a ceiling fan with light kits be installed in five different rooms. Each fan contains a light kit that can accommodate four 60 watt lamps. Each fan motor draws a current of 1.8 amps when operated on high speed.
It is assumed that each fan can operate more than three hours at a time. The fans are to be connected to a 15 amp circuit. How many fans can be connected to the 15 amp circuit? How many circuits will be required to supply power to all the fans?

(4 x 60) / 120 = 2A = Lighting load on each circuit.
1.8A = motor load on each circuit.
2A + 1.8A = 3.8A = Total load for each fan and light kit.

15 x 0.80 = Max amps on a 15 amp circuit (Due to continuous loading) = 12A

12A / 3.8A = 3.16 fans on each circuit? No, only 3 fans can go on the circuit.

19A / 12A = 1.58 Circuits are needed to power all the fans and light kits.

Practical Application #4

A homeowner is installing a swimming pool. You have been asked to install a circuit to operate a 600 watt underwater light and a circulating pump. The motor nameplate reveals that the pump has a current draw of 8.5 amps. The devices are considered continuous duty. Can the power to operate these devices be supplied by a single 20 amp circuit?

600W / 120VAC = 5A
Motor Amps = 8.5A
Total Amps = 5A + 8.5A = 13.5A
Total Amps x 1.25 = 16.88 = 17A
20A x 0.80 = Max amps on a 20 amp circuit (Due to continuous loading) = 16A
So, you can connect all that to the 20A circuit. 17A is greater than the 16A continuous load allowed on on 20A circuit.

NEC 110.3
NEC 430.51
NEC 430.122(A) and (B)

Motor Application

Design the installation of a 230VAC, 15HP, 3 Phase Motor, running a water pump for a commercial cooling system. The motor and pump will be installed 520' from the control panel. The conduit passes through a room where they are using hydrochloric acid as part of the water treatment system. The owner asked that you use XHHW conductors, since that is what is being used on site. The owner also wants the motor to be protected by current limiting time delay fuses, since she is considering adding a Danfoss 15HP FC-302 VFD in the future. Assume 75C connections.

15HP FLC = 42A
42A x 1.25 = 52.5A = #6 AWG, CU
42A x 1.75 = 73.5A = 80A Fuse
HP x 0.7457 kW = 15HP x 0.7457 = 11.19 kW = 11 kW
15HP FC-302 VFD continuous load = See page 59 in the FC-302 Manual = 46.2A
46.2 x 1.25 = 57.75A = #6 AWG, CU
46.2 x 1.75 = 80.85 = 90A Fuse
What size fused disconnect do you need? 100A
VD = (1.732 x K x I x L) / Cmils = (1.732 x 12.9 x 46.2 x 520) / 26240 = 20.46 VD
VD / Voltage = %VD = 20.46 / 230 = 8.9% VD = Too much %VD!

CM = (1.732 x K x I x D) / VD = (1.732 x 12.9 x 46.2 x 520) / (230 x 0.05) = 46675 Cmils = #3 AWG