ENGINEERING WHITE PAPER

Internal use only

AirReps™

October 26, 2020

Electrical System Sizing & Protections

While we are not electrical engineers or electricians there is a baseline knowledge required of us to ensure our equipment interfaces properly with the buildings electrical system. This white paper is meant to make you aware of these electrical characteristics, explain why they matter, and to show you how to do the calculates to ensure a proper application to the building electrical system.

FLA, MCA, & MOP:

- **Full Load Amps (FLA)** is current equipment draws while producing its rated load at its rated voltage. Note that an individual motor's full load amps will always be shown on the motor nameplate.
  - You derive this value from this equation: **motor amps x motor qty + heater amps**
- **Minimum Circuit Ampacity (MCA)** is the minimum wire size required for a field wired product. It is chosen to guarantee that the wiring will not overheat under expected operating conditions.
  - You derive this value from this equation: **1.25 x [motor FLA x motor qty + heater amps]**
- **Maximum Overcurrent Protection (MOP)** is the maximum circuit breaker or fuse size required to properly protect the equipment under anticipated fault conditions. MOP takes into account startup surges and component aging.
  - You derive this value from this equation: **2.25 x largest motor FLA + other motors FLA+ heaters**
  - Fuse and circuit breaker sizes are finite. So if the MOP does not match up with a standard rating, it is rounded down to the next lower standard rating.
  - In the rare case that the calculated MOP is less than the calculated MCA, the MOP is adjusted up to the next higher standard circuit breaker rating above the MCA.

AFC, AIC, & SCCR:

- **The National Electric Code (NEC)** requires equipment manufacturers to label the short circuit current rating (SCCR) on their equipment.
- **Available Fault Current (AFC)** is NOT an equipment rating but is instead the maximum amount of objectionable (unwanted) current that will flow through that equipment, should a fault occur. AFC is determined by the voltage and impedance of the supply system, so it will be different at different points in a building.
  - On new jobs you can find the AFC on the electrical engineering one-line diagrams in the plan set. If it is not there, then contact the Electrical Engineer to get the answer.
  - Recent NEC code revision now requires marking the panels and switchboards with the calculated AFC for that point in the building wiring.
  - Confirm the AFC for the point in the electrical system where your equipment is being installed and ensure that the equipment SCCR is same or higher than the AFC for compliance. **See SCCR example image on p3.**
  - Below is an image showing an electrical one line diagram and a corresponding table to points along the wiring system. You will note that AFC decreases as current moves through the building and away from the electrical utilities point of connection to the building.

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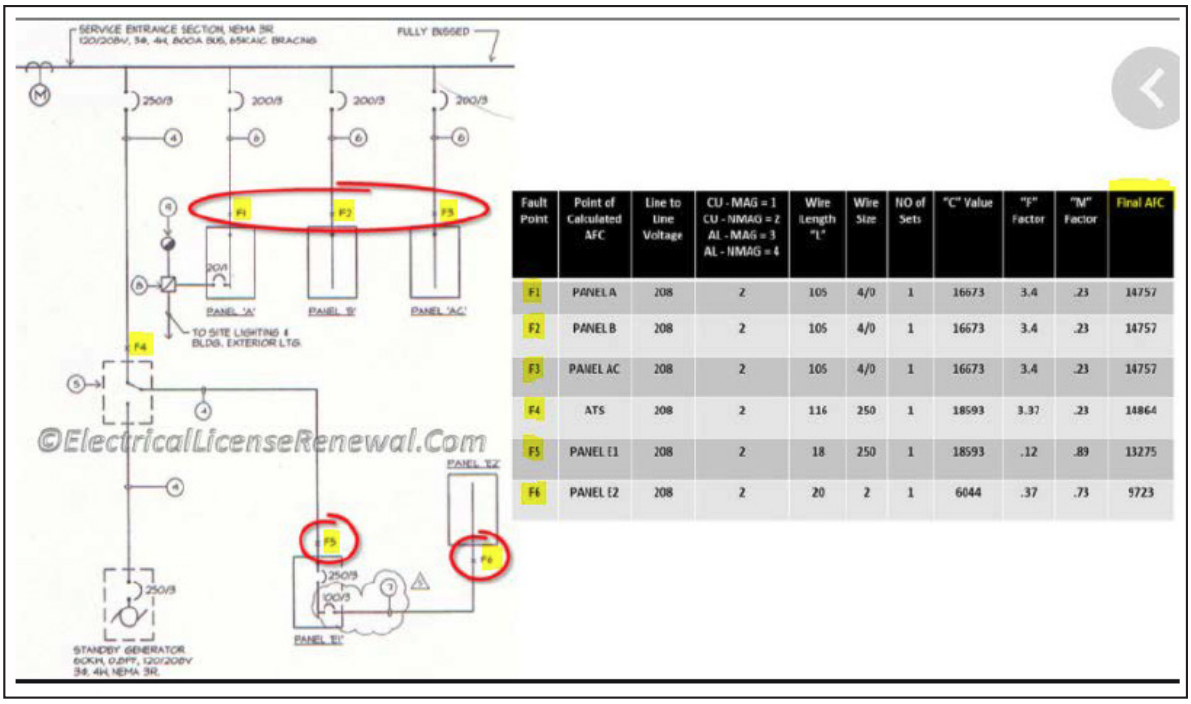

Fault Point	Point of Calculated AFC	Line to Line Voltage	CU - MAG = 1 CU - NMAG = 2 AL - MAG = 3 AL - NMAG = 4	Wire Length "L"	Wire Size	NO of Sets	"C" Value	"E" Factor	"M" Factor	Final AFC
F1	PANEL A	208	2	105	4/0	1	16673	3.4	.23	14757
F2	PANEL B	208	2	105	4/0	1	16673	3.4	.23	14757
F3	PANEL AC	208	2	105	4/0	1	16673	3.4	.23	14757
F4	ATS	208	2	116	250	1	18593	3.37	.23	14864
F5	PANEL E1	208	2	18	250	1	18593	.12	.89	13275
F6	PANEL E2	208	2	20	2	1	6044	.37	.73	5723

- **Amps Interrupting Current (AIC)** is the highest current at a rated voltage that a device can interrupt under standard test conditions. AIC is only applied to an individual device that is designed to interrupt current flow (ie: a fuse or circuit breaker).
- **Short Circuit Current Rating (SCCR)** is the short circuit current an electrical panel, component, or group of components can withstand without causing a shock, fire hazard, or sustaining excessive damage.
  - SCCR is required to be listed on the equipment name plate
  - Typically listing looks like this: Short Circuit 10kA
  - Common values are: 5kA, 10kA, 22kA, 35kA, 42kA, 65kA, 100kA
  - Note that the higher kAIC rating of a fuse (200 kAIC being typical) does NOT then mean the rest of the panel or piece of equipment downstream of the fuse is then at 200kA SCCR.
    The panel must be tested to successfully withstand its rated SCCR, or alternatively the lowest-rated component in the panel will determine the overall SCCR.

As you can imagine, the higher the SCCR the more costly your equipment. Furthermore, some equipment cannot accommodate the higher SCCR values. So when selecting & pricing equipment be sure to know the AFC on site rather than just complying with what the mechanical notes call out or you may grossly oversize the SCCR and add a lot of unnecessary cost to your equipment.

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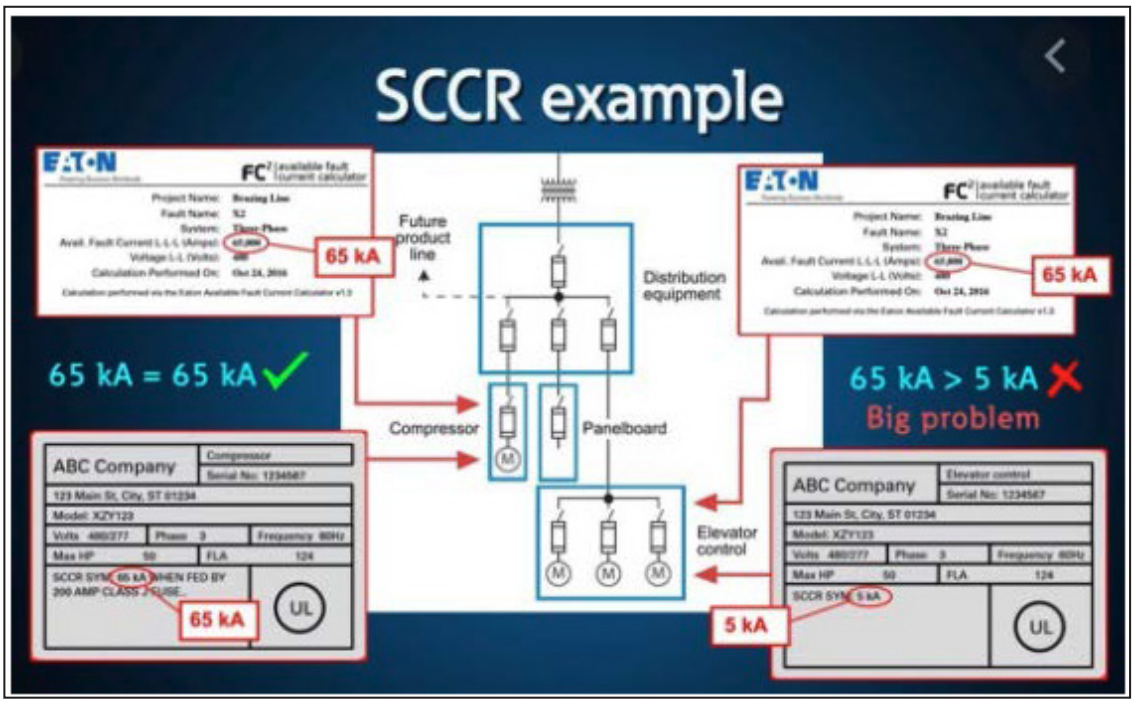

Other useful equations:

- Power (KW) = Volts (V) x Amps (I)
- Watts= volts x amps (single phase), Watts= volts x amps x 1.73 (3 phase)
- KW= 3413 btuh
- Motors: KW= bhp x 0.746 / efficiency

There are also online calculators you can source. Below is a useful sight for engineering calculators (including electric) you should check out.

Online assistance with electrical calculations can be found at https://www.engineeringtoolbox.com/

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