



### Understanding Wire Temperature Ratings, Dimmer Racks, and Conduit Fill

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We often get asked about wire temperature ratings and how they relate to dimmer rack wiring and the allowable number of circuits in a conduit or wireway. While the ultimate authority on wire size, temperature ratings, and conduit fill is the project electrical engineer, and then the local inspector, we thought it would be useful to present some key points to help explain wire temperature ratings.

- NEC Table 310.16 defines the ampacities of different gauge wires, in aluminum and copper, for wire temperature ratings of 60°, 75°, and 90° C. The higher the temperature rating, the greater the ampacity for a given AWG size (gauge) of conductor. This table also lists the wire types for each temperature rating (THHN, THHW, etc). It covers conditions where up to three current-carrying conductors are installed in a pipe or wireway.
- NEC table 310.15(B)(2)(a) gives the derating factors for ampacity when more than three current-carrying conductors are installed in a pipe or conduit. This is the table of “normal” derating factors.
- For many theatrical installations where diversity is common—where many loads are not connected at all or not turned on all at once—NEC Table B310.11 (in Annex B at the back of the Code) lists the ampacity derating factors for up to 85 wires in a pipe or wireway. This section defines diversity, and offers less ampacity derating for a given conduit fill under the assumption that not all circuits are fully loaded or turned on simultaneously.
- As part of their UL listing, ETC Sensor and Unison dimmer racks require use of 90° C copper conductors, but used at not more than the 75° C ampacity rating of the conductor. This is because normal wire ratings are based on an ambient temperature of 30° C (86° F), and it is assumed that the interior of a dimmer rack will be hotter than that, requiring additional derating. In practical terms, this does not impose more restriction on a typical installation, and here’s why:

Example: Ten 20 amp circuits in a conduit connected to a Sensor Rack - 20 current-carrying conductors.

1. Ampacity of #10AWG 90° C copper conductor from table 310-16: 40 amps
2. Derating for 20 conductors from Table 310.15(B)(2)(a): 50%
3. Resulting ampacity of #10AWG 90° C conductor: 20 amps
4. Compared to 75° C Ampacity of #10AWG conductor: 35 amps

You can see that in a typical installation, using 90° C wire and a larger conductor size to gain additional ampacity and conduit fill puts the actual ampacity (20 amps) far below the 75° C rating of the wire (35 amps), thus automatically complying with the Sensor UL listing requirement for use of the 75° C ampacity rating and 90° C wire. This also applies to typical rack feeder conductors, where there are generally at least four current-carrying conductors in the pipe or wireway, causing 80% ampacity derating of conductors.

- With a phase-control dimmer system like Sensor or Unison, neutrals are always considered current-carrying conductors for the purpose of conduit fill and derating. This is because phase-control dimmers generate harmonics.