Power Quality Guidelines

What can be done about poor power quality? Plenty, beginning with thinking beyond the NEC. The Code's purpose is to ensure safety. It has only recently begun to address power quality issues. To avoid power quality problems, the recommended practices for Sensitive Electronic Equipment, published in IEEE 1100 *(The Emerald Book)* and IEEE 142 *(The Green Book),* are good starting points. Other worthwhile recommendations can be found in TIA/EIA 607. The recommendations aren't complicated, and they make sense.

Based on those sources, along with proven field experiences, the following guidelines should pay off in more ways than one:

- Install no more than four to six outlets per branch circuit in those branch circuits that serve computers and other sensitive electronic equipment. Segregate outlets that serve computer equipment from those used for general service. (Separate panel boards and feeders are also recommended.)

- Use oversized conductors to account for peak loads, since these loads may be up to three times that of rms current levels when power is severely distorted. This smart practice also reduces energy (I^2R) losses.

- Specify oversized neutrals in three-phase circuits feeding nonlinear-load branch circuits. Better still, use separate full-sized neutrals for each phase leg.

- Don't rely on conduit or raceways as equipment-grounding conductors. Instead, include a separate copper-grounding conductor (green wire) for each circuit. Follow recommendations spelled out in IEEE 1100 and TIA/EIA 607. Above all, make sure all systems are properly bonded to a common grounding electrode system. We especially recommend this for workstations in dental operatories.

- Verify that the grounding electrode system indicates a resistance no greater than 10 ohms, less in installations that contain computers and other sensitive electronic equipment. (Most computer equipment manufacturers now recommend 2 ohms maximum ground resistance.) Install a heavy-gauge copper ring ground and multiple vertical grounding electrodes wherever practical.

- Use only copper grounding electrode conductors, preferably 250 kcmil or larger, and copper or copper-alloy connectors. Copper resists corrosion, and copper connectors remain tight.

- Specify copper-wound harmonic-canceling isolation transformers between nonlinear loads and upstream circuits, or depending on your engineer's advice, call for shielded isolation transformers. If standard transformers are acceptable, specify copper-wound K-rated transformers to accommodate high neutral currents.

In addition, consider the benefits of a high quality UPS. As power fluctuates, electronics expand and contract. Eventually, failures occur. Also, when the lights go out, you lose your data, then when they flicker, this causes extreme stress on electronic components. In order to protect your equipment, be sure and select an on-line UPS, one that doesn't switch between utility and battery power.

These recommendations may increase the initial cost of a system a few percent, but they will return tremendous reliability rewards. Life-cycle costs should decrease as a result of lower maintenance, repair and downtime costs.