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2. Do different types of non-linear loads generate different harmonics?

By far the majority of today's non-linear loads are rectifiers with DC smoothing capacitors. These rectifiers typically come in 3 types – (i) single phase, line-to-neutral, (ii) single phase, phase-to-phase and (iii) three-phase.

Single-phase line-to-neutral rectifier loads, such as switch-mode power supplies in computer equipment, generate current harmonics 3rd, 5th, 7th, 9th and higher. The 3rd will be the most predominant and typically the most troublesome. 3rd, 9th and other odd multiples of the 3rd harmonic are often referred to as triplen harmonics and because they add arithmetically in the neutral are also considered zero sequence currents. Line-to-neutral non-linear loads can be found in computer data centers, telecom rooms, broadcasting studios, schools, financial institutions, etc.

208V single-phase rectifier loads can also produce 3rd, 5th, 7th, 9th and higher harmonic currents but if they are reasonably balanced across the 3 phases, the amplitude of 3rd and 9th will be small. Because they are connected line-line, these loads cannot contribute to the neutral current. The largest current and voltage harmonics will generally be the 5th followed by the 7th. Typical single phase, 208V rectifier loads include the switch-mode power supplies in computer equipment and peripherals.

Three-phase rectifier loads are inherently balanced and therefore generally produce very little 3rd and 9th harmonic currents unless their voltage supply is unbalanced. Their principle harmonics are the 5th and 7th with 11th and 13th also present. They cannot produce neutral current because they are not connected to the neutral conductor. The rectifiers of variable speed drives and Uninterruptible Power Supplies (UPS) are typical examples of three-phase rectifier loads.

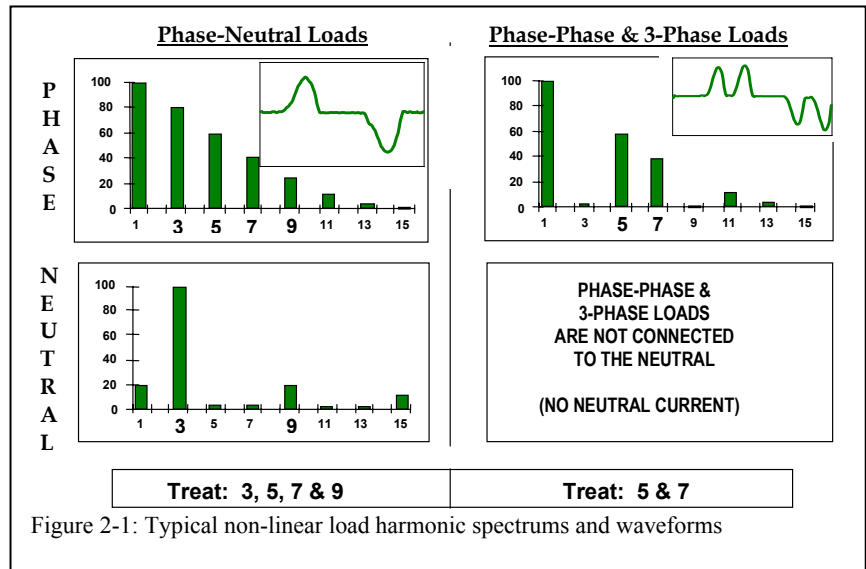


Figure 2-1: Typical non-linear load harmonic spectrums and waveforms