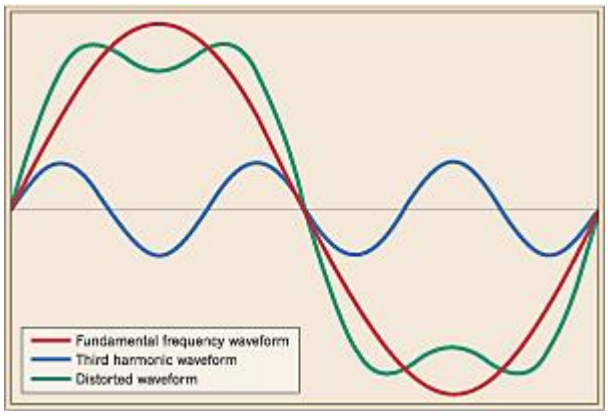
Over view of harmonics distortion in electrical system and applicable standard.

In any industry, there are linear loads and nonlinear loads. Linear load consists of elements like resistor, capacitor, inductor and combination there- of. Here impedance is constant. Power Factor=KW/KVA. Current and voltage waveforms are sinusoidal and hence there are no harmonics.

Nonlinear load consists of power electronic switching devices like THYRISTOR, MOSFET,IGBT and Diodes Here impedance varies with voltage. Industries extensively use VFDs which are basically nonlinear loads. In these cases, voltage and current waveforms are not pure sinusoidal. Non sinusoidal waveform is made up of sine waves of different frequencies, which is explained by Fourier theorem. They consist of fundamental frequency component and higher frequency (multiples of fundamental frequency) components Such waveforms are said to have harmonics add they offer harmonic distortion. Finding out amplitudes of fundamental and nth multiple of fundamental frequency is generally done by harmonic analysis. Power factor has to be calculated based on contribution from fundamental waveform and contribution by individual harmonics. Figure showing fundamental waveform , third harmonic waveform and the resultant waveform is given below. (Picture courtesy: ecmweb.com)



Harmonics Distortion in voltage and current in any electrical system leads to;

- Excessive heating
- Unwanted tripping of circuit breaker
- Capacitor bank failure
- Transformer overheating
- Burning of motor windings
- Neutral over loading
- EMI (Electromagnetic Interference) to sensitive equipment.
  Above harmful effects lead to
    - Increased maintenance and replacement costs
    - Downtime cost
    - Reduction of system capacity, as equipment is to be underrated to reduce the harmful effects of harmonic distortion.

Industries are striving hard to introduce suitable filters (Active/Passive types) to reduce the harmonic content. Some companies recommend 12 pulse VFD s instead of 6 pulse VFDs but cost and complexities are high. Foretec engineers provide cost effective and reliable passive filter system to reduce harmonic distortion to mitigate the problems created by harmonics.

STANDARDS

Over the years, IEEE standard 519 has evolved as a guideline to limit the harmonics levels in the industry, so as to protect the utility and consumer installation .Industries all over the world, have to follow IEEE std. 519 guidelines, as insisted by electrical authorities in their respective countries. This standard was introduced in 1981. In 1992, it was revised, based on the experience gained. In 2014, it was further revised. IEEE std.519/2014 guidelines are to be followed now.

Major changes in IEEE Std. 519-2014 compared to IEEE Std. 519-1992 have been briefly given below for better understanding

	IEEE std. 519-1992	IEEE std. 519-2014
1	Recommended practices and requirements for harmonic control standard was sponsored byTransmission &Distribution committee of the IEEE PES,IEEE IAS, SPCC.	Sponsored by Transmission and Distribution committee of the IEEE Power engineering society
2	Equipments needed for measurement and analysis of non sinusoidal voltage and currents are specified.	Reference is directly given to IEC (International Eectro Technical Commission). Required equipments have to be selected as per IEC standard
3	Limits for THD (Total Harmonics Distortion) for system voltage from 120V to 69KV have been specified uniformly as 3% for individual harmonics and 5% for total harmonics.	Limits for THD have been separately defined for voltage <=1000 and voltage from 1001 to 69KV. For voltage less than 1000V, limits are 5% for individual harmonics and 8% for total harmonics . For voltage levels,1001 to 69KV, old limits of 3% for individual harmonics and 5%for total harmonics are retained.

4	Special loads like hospital, airports were defined with various harmonics distortion limits.	Classification of loads have been dispensed with. All loads have to follow the same limits, variation in limits are based on supply voltage only.
5	Point of Common Coupling (PCC) is defined as point of metering or point at which utility company as well as consumer can access the point for measurements. Usually this point is on the HT side. (Draw a figure for PCC)	Point of common coupling is redefined as point on public supply system, electrically near to a load, at which other loads are connected. For large industries, this point is secondary side of HT transformer. For commercial users, this point is at the low voltage side.(Draw a figure for PCC)
6	Individual's responsibility in harmonics control, parameters like Total Demand Distortion for shorter periods & longer periods are defined.	Certain modifications are introduced.