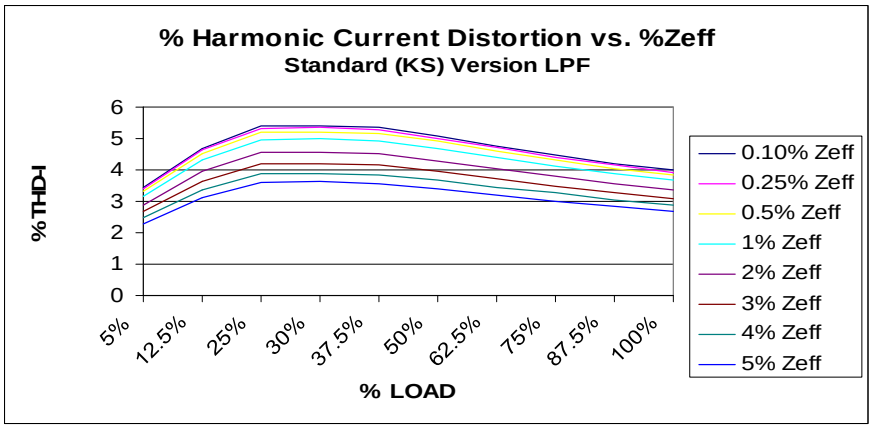
Why do APQ,LLC. Low Pass Harmonic Filters Perform better than others?

There are three basic reasons why APQ Low Pass Filters (LPF) consistently out-perform similar filters as offered by competitors. APQ filters are better by design, plus they include uniquely designed reactors and capacitors that are better suited for harmonic filter environments.

Basic Filter Design Philosophy:

APQ,LLC. filters are optimized with the precise inductance and capacitance so that you don't need to add more reactors. Some manufacturers may state that you must increase source impedance (add another reactor) or insert an extra reactor between the filter and drive, in order to obtain the published benefits from their filters. APQ low pass harmonic filters include the right amounts of inductance and capacitance so that they perform on any system, regardless of the source impedance. Our 5% THD-I filter does not require any additional reactors.



APQ Low Pass Harmonic Filters include three stages of anti-resonant filtering to achieve maximum harmonic attenuation. Some filters attempt to meet the IEEE-519 requirements using only a two stage filter. By excluding the output stage, more harmonic stress is placed on the shunt stage elements and higher peak current may flow in the VFD input rectifiers and bus capacitor. Higher stress and higher peak current can result in reduced operating life. APQ Low Pass Harmonic Filters include three full stages of filtering and are designed to achieve the lowest component stress levels, both in the filter and in the drive.

Reactor Design Improves Filter Performance

Reactors are the predominant element of the low pass harmonic filter. In order to achieve superior performance from the LPF, the reactors must have superior balance between all three phases and must deliver an accurate amount of inductance over a wide range of harmonic frequencies. Some reactor manufacturers don't even bother testing the reactor's center coil inductance, because they simply accept that it will be 10% to 12% higher than the outside two phases. This is common with single air gap construction. When the series reactors have unbalanced inductance, then the voltage drop across each coil can differ, resulting in unbalanced load currents. Unbalanced currents can cause 3rd (and other triplen) harmonics to flow, resulting in higher harmonic current distortion levels.

Likewise, when the shunt reactor inductances are not accurately balance, then the rms voltage can be boosted unequally on the phase conductors, again resulting in unbalanced current flow and production of triplen harmonics. Inaccurate, or unbalanced inductance, will also detune the shunt leg degrading the filtering performance in one or more phases. APQ reactors are constructed with PolyGap® core construction to achieve accurate per phase inductance values and extremely well balanced inductance between all phases. Reactors utilized in APQ harmonic filters are specially designed and constructed to deliver optimum performance in applications where high harmonic levels are present. They consistently provide tolerance of as little as +/- 1% to 3% maximum over a wide range of harmonic frequencies.

PolyGap® Core Construction

PolyGap® core construction achieves the desirable characteristic of a good saturation curve (linear inductance over a wide range of current) without the undesirable effects associated with large air gaps. Large air gaps are common in those cores using only 1, 2 or even a few distributed air gaps. As the name implies, reactors having PolyGap® core construction incorporate many air gaps of very short length. This minimizes the fringing flux across the air gaps, which can otherwise cause excessive heating in conductors and core structural members, as well as power losses.

Partially assembled reactor with PolyGap™ core

The direct benefits of PolyGap® core construction include:

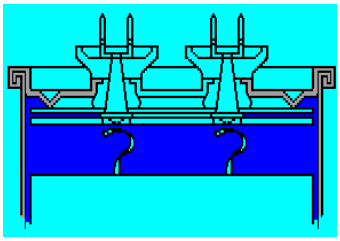
- Constant inductance over a wide range of current and frequency
- Accurate and balanced inductance in all three phases
- Virtually eliminates stray magnetic fields
- Superior saturation characteristics
- Minimum total losses
- Optimum performance in the presence of harmonics

All APQ Low Pass Harmonic Filters utilize reactors with PolyGap® core construction. The reactor is a key component in our filter which has a very positive impact on the filter's outstanding performance.

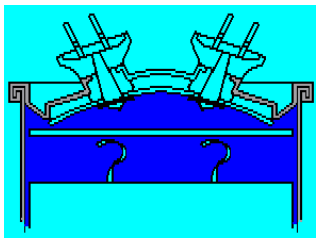
Capacitor Design Improves Filter Performance

APQ, LLC. has decades of experience in the manufacture and application of capacitors, especially for harmonic filter applications. From this extensive experience along with a vast knowledge of capacitor design and construction, they generated a specification for the capacitors to be used in all low voltage APQ harmonic filters. With an understanding of exactly how capacitor geometry and construction techniques can have a major impact on capacitor heating and thus life expectancy, they developed a capacitor with extremely low ESR (equivalent series resistance).

Low ESR means lower losses, lower temperature rise in the capacitor winding itself, and improved capability to withstand higher ambient temperatures. The result is a capacitor with lower than the industry average losses, and a nameplate rated operating temperature limit of 80°C. That is not to say that a capacitor will experience operating temperatures like this, but what it means for the user is extremely long life expectancy in normal applications. For operation at 40°C, capacitor life expectancy is nearly 1,000,000 hours! APQ products typically have internal temperature rises of only 10-20 degrees Celcius, so long capacitor life is assured. Our capacitors have a tolerance of only +/- 4%. Our capacitors start out with accurate capacitance and due to construction, low ESR and low internal temperature, they are able to maintain accurate capacitance far longer than typical capacitors. This assures long term proper operation of our filters.



Normal: Contacts Closed



Failed: Contacts Open (capacitor is bulging)

For high reliability, APQ uses Metallized Polypropylene (MPP) type capacitors which are specially designed to carry the necessary harmonic currents. The use of single phase capacitors is our preferred method of construction because it offers lower ESR and reduced internal heating as discussed above. APQ low voltage capacitors are self healing and include internal short circuit protection that disconnects the capacitor when a failure occurs.
Capacitor failure can be visually detected by a bulge at the terminal end of the capacitor.