

(This is NOT an instructional explanation of the actual work involved to complete a Power Factor corrected and Harmonics free facility)

An Explanation of Power Factor

There must always be a supply of energy to operate an electrical device. With electric motors, you have to supply more power than is actually necessary to just rotate the shaft. This is due to the fact that a certain amount of power is essential just to uphold the magnetic field of a motor.

This essential energy is known as reactive power or magnetizing power. Your utility will only deliver a certain amount of reactive power at no cost. You will be charged extra for the additional power if you are a customer who runs high reactive power loads.

The additional charge is called a power factor surcharge or power factor penalty.

Precisely what is Power Factor?

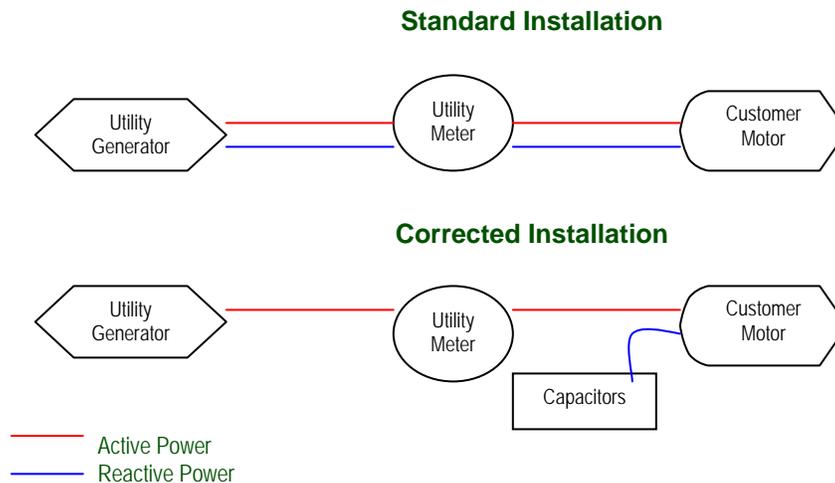
Power factor (pf) is the ratio of the active power measured in kilowatts (kW), to the total, active and reactive, power measured in kilovolt amps (kVA). It is calculated as $kW / kVA = pf$.

The power factor is generally referred to in percent form, with 100% being the ideal power factor, or unity. At unity power factor, the $kVA = kW$, therefore, the utility company isn't supplying any reactive power.

What is Power Factor Correction Equipment?

PFC equipment offers a way to reduce the reactive power being supplied by your utility. Lowering the reactive power supplied by your utility will result in a cost reduction in your electrical bills, because the kVA "demand" is also reduced.

Capacitors are the main component in PFC equipment. Their size is most often referred to in kVAr. This diagram illustrates how a PFC capacitor works when installed on the line side of a motor.



Just how does all this Work?

Reactive Power Generation is achieved with PFC capacitors. They are designed to provide the magnetizing power motors need to operate, instead of getting it directly from the utility company. When you improve your power factor, you reduce your demand on your utility company. This reduction is measurable and saves you money.

Occasionally, the installation of PFC equipment will be easy, as revealed in the above diagram. Nevertheless, when the complete electrical distribution system, or multiple systems on the same premises, necessitates correction, deciding on the best technological and reasonably priced solution is more complex.

How is Your Target Power Factor Determined?

To avoid paying a power factor penalty, your company, as a utility customer, should try to attain the utility's target power factor. The target power factors are set by the utility company. Depending upon your utility company, it will be between 90% and 100% and have a specified rate structure set by that company.

It is not always a good thing to achieve a unity power factor. Raising your power factor is not a one-to-one equation with your savings. The accountability for this falls to your PFC equipment designer to guarantee that you obtain the best possible combination.

With Power Factor Correction are the Dollar Savings Real?

Your actual achieved annual savings will be based upon these variables:

- Your existing power factor,
- Your target power factor,
- Your existing kVA demand,
- Your utility's rate structure.

Given that energy costs vary so widely on customers' energy invoices, linking dollars saved to PFC equipment installed might be deceptive; so we'll use payback periods. Somewhere between 18 and 24 months is the average payback period, with shorter payback periods possible.

Harmonics

Some actually believe that "harmonics" is a mystical problem, leading many people to believe that they will never comprehend what they are, what they do to their electrical systems, why they occur, and how to defeat them. Let's change that here.

Harmonics come in varying sizes and shapes and are all related to the standard 60Hz North American electrical frequency. The harmonics that shape your electrical systems are multiples of this base frequency.

An example: a measured frequency of 120Hz on your electrical system would be a 2nd order harmonic ($120 / 60 = 2$), and a measured frequency of 300Hz would be a 5th order harmonic ($300 / 60 = 5$).

Just What is Harmonics?

Harmonics is distortion of the electrical sine wave. Most often referred to as the THD (total harmonic distortion), it is displayed in percent.

THD is split into an ITHD (for current) and VTHD (for voltage).

How is Harmonics Generated?

Harmonics start with non-linear loads on your electrical systems. Variable frequency/speed drives (VFD/VSD) are the most common offenders. Arc welders, DC rectifiers and soft start motors (on start up only) are also contributors.

To complicate this further, harmonics can also be introduced into your electrical systems from your utility company. A welding shop down the street might very well be the source of your motor's early retirement!

At what Point should Harmonics Concern You?

When the non-linear load on your electrical system surpasses 15% of your total load, you will likely suffer from a harmonics contaminated distribution. Utilities across North America have started to implement guidelines as to the levels of harmonic distortion that any utility customer is allowed to export; because just as your neighbor's equipment is sharing harmonic distortion with you, you may also be exporting harmonics into theirs or any other facility.

Are there Risks Operating with a Harmonics Contaminated Distribution?

Because they increase the operating current and voltage on the system, harmonics cause serious damage to your electrical systems. In addition to motors and other components on the system being overloaded, the increase to the current and voltage results in the generation of enormous amounts of heat.

Heat losses result in using and paying for many more kWh than necessary. Consequently, operating with a harmonics contaminated distribution system quickly shortens the life expectancy of your electrical equipment and costs you money.

Can You Eliminate Harmonics Distortion Significantly?

Considerable levels of harmonics distortion can be simply and effectively reduced or eliminated with harmonics filters. A harmonics filter is a capacitor and reactor working together.

Manufacturing harmonics filters are not a difficult task. The design and proper application of these filters is the difficult part, and this is where we come in.

Summary

How much can your facility save with PFC equipment? If you'd like to know, call Globus Electric to get a [Preliminary Evaluation](#). There is no charge or obligation. In order for us to start the evaluation, we only require your last 12 months power bills. Calculations can be done with fewer bills, though it's most accurate with 12 months. This evaluation will provide an estimated annual savings, along with an estimated equipment cost. We will also let you know whether a power factor study and harmonic analysis is required to finalize a design.

Globus Electric will provide you with all your PFC and harmonics filtering needs: preliminary evaluations, power factor studies and harmonics analysis designed to meet the requirements of your electrical systems, and after sale support.