



# Electrical Connections

For regulatory authorities in the electrical inspection community.



## Power Factor Correction Equipment

by Jeff Fecteau

With the high cost of energy, many individuals and companies are becoming more conscientious of wasteful spending and are looking for ways to cut expenses. One of the ways to cut expenses is by using less energy. A number of manufacturers have been promoting the use of power factor correction equipment as a way of reducing electricity use and saving money.

Claims of up to 50 percent savings can be found with a routine internet search. As is generally true with such product claims, one should be cautious when considering products that claim to save money by reducing electric consumption. The purpose of this article is to describe how power factor correction equipment functions, and how this relates to reducing energy consumption and expenses.

### UL does not verify a manufacturer's claims of energy consumption

UL Lists products that can be used in residential, commercial, and industrial applications that claim to reduce the consumption of electricity. It is important to note that most electrical equipment that has been Listed by UL has only been evaluated to comply with the applicable UL Standard with respect to the risks of fire, electric shock and injury to persons. Performance claims (efficacy) by the equipment manufacturers are not normally part of the UL evaluation.

### What is power factor?

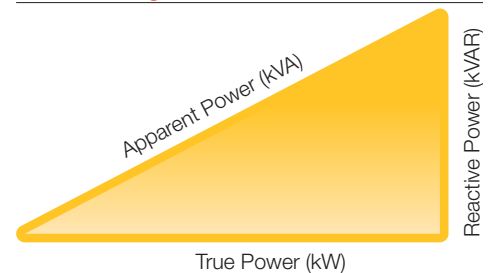
Power factor is a term that expresses the relationship between true power (the power actually consumed — also known as real power) and the apparent power (the power that must be supplied by the electric utility to have this true power available). This ratio is a number between 0 and 1, and is expressed as a percentage (e.g. 0.75 = 75% pf).

True power is expressed in kilowatts (kW), and represents the ability of the circuit to perform useful work. Apparent power required is expressed in kilovolt-amperes (kVA). Electrical equipment, such as generators and transformers, are usually rated in kVA. See the power triangle shown to the right for a graphical representation of this relationship.

Many types of machines, motors, transformers, relays or contactor coils, and ballasted lighting are examples of equipment that may have lagging power factor, requiring reactive power due to magnetic fields and energy storage in the loads. Non-linear loads may

also contribute to low power factor. For these types of loads, and in the absence of power factor correction, reactive power is required to be provided by the utility in addition to true power, resulting in the need for larger generators, transformers, and other utility distribution components.

### Power Triangle



$$\text{Power Factor} = \frac{\text{True Power (kW)}}{\text{Apparent Power (kVA)}}$$

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## Power Factor Correction Equipment (continued from page 1)



Power factor correction equipment

### Electric utility-imposed penalties

Use of power factor correction equipment could result in significant cost savings for a mid- or large-size primary-metered service customer, depending on electric utility penalties imposed due to lagging power factor. Electric utilities contacted confirmed that they have rate structures that take low power factor into account. One utility indicated that if the customer's power factor is less than 90 percent, they are permitted to substitute the kVA reading (apparent power) for the kW reading (true power) for billing purposes.

Another called for penalties ranging from 1 to 3 percent when power factor drops below 85 percent but not less than 70 percent. Power factors below 70 percent are not permitted, and customers are required to invest in power factor correction equipment to improve the power factor above this level. Until corrections are made, a 25 percent penalty is applied after two consecutive months below 70 percent and continues until corrections are completed.

### UL Listed power factor correction equipment

You can find UL Listings for power factor correction equipment under 2 different UL product categories. The details covering UL's certifications are as follows:

### Capacitors

Capacitors are one of the options that can be used to improve power factor. UL Lists these devices under the product category for Capacitors (CYWT). UL Guide Information for this category is located on page 86 of the 2008 UL White Book and can also be found on UL's Online Certifications Directory at [www.ul.com/database](http://www.ul.com/database). This category covers general-use power factor correction units rated 600 V maximum. These assemblies employ integrally protected capacitors, and are intended for indoor use, unless otherwise indicated.

The guide information, together with other restrictions of use, such as mounting means and special electrical connections, are detailed in the manufacturer's installation instructions furnished with the product. The Listing Mark for these products includes the product name "Power Factor Correction Unit" or "Capacitor Bank," or other appropriate product name as shown in the individual Listings. This equipment is investigated in accordance with UL 810, the UL Standard for Safety for Capacitors.

UL 810 includes requirements applicable to general-use power factor correction units, consisting of one or more capacitors either with or without protective fusing or other overload protection, with or without a switch or other disconnect device, all housed within a protective enclosure. These units are intended for installation in circuits in accordance with the National Electrical Code® (NEC®), and intended for installation in ordinary locations, where the ambient temperature does not exceed 40°C (104°F) maximum.

### Industrial control equipment

Power factor correction equipment is also Listed under the Power Circuit and Motor-mounted Apparatus (NMTR) product cat-

egory. UL Guide Information for this product category is located on page 215 of the 2008 UL White Book and can also be found on UL's Online Certifications Directory at [www.ul.com/database](http://www.ul.com/database). While this category covers numerous product types, most unrelated to this subject matter, certain types of power factor correction equipment are included.

The requirements of UL 810 (Capacitors) do not apply to power factor correction units containing automatic or other circuit monitoring/conditioning controls or automatic systems of multiple connected power factor correction units. Power factor correction units with these additional features are evaluated in accordance with the requirements in UL 508, the Standard for Safety for Industrial Control Equipment. The Listing Mark for these products includes the product name "Industrial Control Equipment" (or "Ind. Cont. Eq.").

### Summary of key points

- Low power factor is generally associated with industrial machinery, but can also result from ballasted lighting or the current wave shape of non-linear loads.
- Some utilities impose low power factor penalties for mid- and large-size primary-metered service customers.
- UL does not evaluate or validate any manufacturer's claims of energy usage reduction or energy cost reduction due to the use of power factor correction equipment.
- UL evaluates and Lists power factor correction equipment only for the risks of fire, electric shock, or injury to persons.
- UL Listed equipment that may be used in power factor correction applications is covered under the UL product categories for Capacitors (CYWT) and Power Circuit and Motor-Mounted Apparatus (NMTR).

For more information about UL Listed equipment used in power factor correction applications, please contact Jeff Fecteau at +1.952.838.5453; or at [Jeffrey.Fecteau@us.ul.com](mailto:Jeffrey.Fecteau@us.ul.com)