POWER FACTOR CORRECTION EXPLANATION

2.1 INTRODUCTION

In commercial/industrial life, most AC apparatus (e.g. lifts, lights, machinery, air conditioning, motors and so on) take more from the Regional Electricity supply than they actually need. The power factor is the relationship between working **(active)** power and total power consumed **(apparent).**

The higher the power factor, the more effectively electrical power is being used and vice versa.

A distribution system's operating power is composed of two parts: **Active** (working) power and **reactive** (non-working) magnetising power. The **ACTIVE** power performs the useful work while the **REACTIVE** power does not, as its only function is to develop magnetic fields by inductive devices. Generally, power factor decreases with increased motor loads.

Power Factor is the ratio of true power to apparent power

$$\textbf{POWER FACTOR} = \frac{\textbf{KW}}{\textbf{KVA}}$$

Therefore, it can be seen that to reduce the total current to the actual current required would result in greater efficiency. Power Factor values are in the range of 0-1, hence an electrical system with a power factor of 1 (unity) is using 100% useful current with no inefficiency. However, an electrical system with a power factor of 0.5 (50%) is using twice as much current as it needs.

Where this is the case, improvement in power factor (i.e. moving closer to unity), can in most instances, be achieved by connecting a power factor correction capacitor to the electrical supply, resulting in energy efficiency.

Typical Power Factors of Electrical Systems

SAWMILLS	0.5
FREEZER SHOPS	0.65
ENGINEERING WORKS	0.7
QUARRIES	0.7
FOOD STORES	0.8
OFFICE BLOCKS	0.8

2.2 WHY CORRECT LOW POWER FACTOR

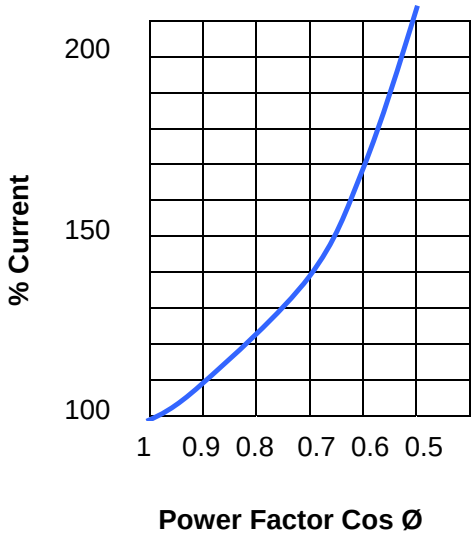
Low power factor means poor electrical efficiency

The lower the power factor, the higher the apparent power drawn from the distribution network. When low power factor is not corrected, the utility must provide the non-working reactive power, **in addition to** the working active power. This results in the use of larger generators, transformers, bus bars, cables and other distribution systems devices, which would otherwise be unnecessary.

As the utility's capital expenditures and operating costs are going to be higher, they are going to pass these higher expenses down the line to industrial users in the form of power factor penalties.

2.3 THE RELATIONSHIP OF POWER FACTOR TO TOTAL CURRENT CONSUMED

With a power factor of 1.0, given a constant power load, the 100% figure represents the required useful current. As the power drops from 1.0 to 0.9 power is used less effectively. Therefore, 11% more current is required than when the power factor was 1.0 to handle the same load. A power factor of 0.7 requires approximately 43% more current, while a power factor of 0.5 requires approximately 100% more (twice as much) as when the power factor was 1.0 to handle the same load. The graph below illustrates the relationship between power factor and total current consumed.



It can therefore be seen that there are genuine reasons for improving the power factor of commercial/industrial premises by installing power factor correction capacitors.

2.4 BENEFITS OF POWER FACTOR CORRECTION

- A reduction in electricity charges, which depending on the individual premises, can range from £100's to £10,000's.
- High power factor eliminates utility power factor penalties, which may be applied to consumers with poor power factors. Such penalties can result in electricity bills for consumers being increased by anything up to 20%, depending on individual electricity companies.
- High power factor reduces the I^2R losses of transformers and distribution equipment.
- A reduction in the heat in cables, switchgear, transformers, and alternators will also prolong the life of such equipment.
- Reduced voltage drop in cables, allowing the same cable to supply a larger motor and improving the starting of motors at the end of long cable runs.
- A return on investment for power factor correction is typically between 12 to 24 months.

2.5 HOW POWER FACTOR CORRECTION CAPACITORS RESOLVE THE PROBLEM OF LOW POWER FACTOR

Low power factor is a problem, which can be resolved by adding power factor correction capacitors to the plant distribution system. Capacitors work as reactive current generators "providing" needed reactive power (KVAr) into the power supply. By supplying their own source of reactive power, the industrial user frees the utility from having to supply it, and therefore the total amount of apparent power supplied by the utility will be less.

Power factor correction capacitors reduce the total current drawn from the distribution system and subsequently increase the system's capacity by raising the power factor level.

Sawmill Case Study

A sawmill purchased power at 415V, 50Hz, from a Regional Electricity Company. The tariff terms included a charge for KVA capacity/availability and excess reactive hours.

The sawmill registered a demand of 420KVA at a power factor of 0.5 lagging. The cost per KVA per month was £1.30, hence the company decided to have a free power factor survey carried out by SDC Industries.

After a full on-site survey we recommended that the power factor be improved to unity, reducing the demand to 210KVA.

The financial saving was £3276 per annum (£1.30*210*12)

Sawmill Case Study (continued)

The usage was 46200 kWh per month and 80020 reactive hours. The local Regional Electricity Company penalised for excess reactive hours greater than 50% of the Kilowatt hours used. Hence, a charge was levied for 56920 excess reactive hours at 0.4 pence per reactive hour, resulting in a cost of £2731 (56920*0.4 pence).

Our qualified engineer recommended an installation of 360KVAr power factor correction capacitance, comprising capacitors connected to motors and an automatic bank. The payback period on the equipment in this instance was only 12 months.

2.6 SDC INDUSTRIES - A COMPLETE SERVICE PACKAGE

SDC Industries have been in the power factor correction business since 1978 and are the premier manufacturer of such equipment. Furthermore, our service includes full "on-site", free of charge, power factor correction surveys (in most instances on the UK mainland), in order to determine the power factor requirements of the customer. Such surveys vary from being a short visit and test for a small electrical load, to an involved exercise using sophisticated test instrumentation and harmonic analysers, for the larger sites.

It is the data from these surveys that allows our in-house applications engineers to recommend and design equipment to meet the individual needs of any client.

All of our capacitors are assembled in SDC Industries own manufacturing complex using only the finest quality materials. Furthermore, SDC maintains a strict quality control system, with all equipment being 100% tested, prior to despatch, in order to guarantee quality when it reaches the customer.

In addition, SDC are able to provide on-site supervision and start up assistance to all clients, in order to ensure that all power factor correction equipment is installed and commissioned properly, resulting in maximum benefit to the client.