Electrical Terms & your Electricity Supply

Introduction

Electrical terms can be confusing to anyone who has little experience of them. This information sheet is an attempt to clarify some of the basic points.

Kilo (k)

Kilo is a prefix used with many electrical terms and means "thousand". For example, one kilowatt is one thousand watts.

Current (A)

Current is a flow of electricity and is measured in amps (A). It is analogous to flow in a water circuit measured in - say, litres per second.

Voltage (V)

The electrical pressure at which current is delivered is termed voltage and is usually measured in volts (V) or kilovolts (kV).

Using the water analogy again, voltage is equivalent to water pressure in - say, newtons per square metre.

Electrical loading/power (W)

The electrical loading of a piece of equipment gives the rate at which it will take power from the electricity supply. Loading is commonly measured in watts (W) or kilowatts (kW). For a given machine the product of voltage and current ratings (V x A) will give an approximate figure for loading in watts. Most electrical equipment has a rating plate which gives its electical loading. If the loading is not given in W or kW then this can be calculated by multiplying the voltage by the current, both of which should appear on the plate.

Usually the mechanical output of a motor is put on the plate and quoted in either Wo, kWo, or horsepower (hp). The 'o' following W or kW, in this instance, indicates that mechanical 'output' is being quoted.

In the case of electric motors the electrical input rating of the machine will always be greater than mechanical output. When sizing cables to supply a motor, or when calculating running costs the following approximation can be used:

RULE OF THUMB 1hp = 1kW (input)

Units

By taking the electrical loading (kilowatts) of a machine, and multiplying this by the length of time it operates (in hours), the electrical consumption in kilowatt hours (kWh) or units can be determined. For example:

15 kW (input) motor used for 30 mins (0.5 hr)

15 kW x 0.5 = 7.5 kWh or 7.5 units

250 W infra-red bulb used for 12 hours

0.25 kW x 12 = 3 kWh or 3 units

Tariffs

All electricity companies make a charge through tariffs for units used. The simplest tariffs consist of a fixed charge (to cover fixed costs which the Electricity Company incurs whether or not energy is used eg transformer, meters, meter reading, supply cables, generator) plus a charge for each unit used.

Maximum Demand (MD)

The maximum demand of an electrical installation, so far as tariff purposes are concerned, is the maximum rate at which the supply is being used during *any complete half-hour period,* and is measured in kilovolt-Amperes (kVA). kVA is similar in value to kW, but is usually, in the case of motive power, 10-20% higher. For instance, if a 20 kW motor and a 6 kW heater are on for a half hour period then the maximum demand would be in the order of 28 kVA (assuming kVA to be 10% higher than kW on the motor). The ratio of kW:kVA is called power factor.

Maximum Demand Tariffs

Larger users of electricity are charged on maximum demand tariffs. With a maximum demand tariff, as

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well as having a normal unit meter a device is installed to monitor maximum demand (in kVA), and a charge may be made each month in relation to the highest maximum demand figure recorded. The monthly maximum demand charges normally vary according to the season and are generally more expensive in the winter months.

This reflects the cost of production of electricity. As previously mentioned, kVA is usually slightly more than kW but it is possible to correct the kVA figure to something nearer the kW figure by using a power factor correction capacitor. The cost of fitting a capacitor has to be considered against possible savings. Unit charges on maximum demand tariffs are generally lower than unit charges on standard tariffs.

To make the most of a maximum demand tariff avoid simultaneous use of large pieces of electrical equipment, especially in the months of October - March when MD charges are always at their highest.

Two-rate (Economy 7 or White Meter Day/ Night) and Off-peak Tariffs

There is often some confusion about the differences between these two types of tariff. They can be explained as follows:

a) With two-rate tariffs, equipment can be switched on at any time. Electricity consumption is recorded and billed at two different unit rates, depending on time of day or night - the cheap (low) rate is usually for 7-8 hours during the night period.

b) Off-peak tariffs supply electricity at pre-determined off-peak times only - during other periods equipment connected to these types of meter cannot be used. Other equipment works on throughout the 24 hours at normal rate.

In many Electricity Companies, two-rate tariffs have almost completely superseded off-peak tariffs. However, many people still have off-peak and will continue to use it for many years to come.

There are other tariffs that the Electricity Companies offer that may suit your business better. It is well worth discussing the different tariff options with your Electricity Company's customer services.

If you use, or can arrange to use, some electricity during the period 12 midnight to 8 am GMT, ask your Electricity Company if an Economy 7 two-rate tariff will save you money.

Voltage Drop

When a curent flows through a cable, a voltage reduction occurs such that the voltage at the terminals of the load is less than the voltage at the supply. This phenomenon is termed voltage drop. In cases where short runs of cable are used voltage drop is usually insignificant, but when runs are longer it may be necessary to install larger cables to reduce the effect. Tables which give current carrying capacities and voltage drops for different types and sizes of cable are produced by the Institution of Electrical Engineers.

Load Factor

In any given period, the relationship between the average rate and the maximum rate at which electricity is used is termed 'load factor'. This is best illustrated in the following example.

If, over a 24 hour period, a 2 kW heater is used for a total of 4 hours, then it could be said that the average usage over that period would be:

$$\frac{4 \times 2}{24} = 0.33 \text{ units per hour}$$

The maximum rate of consumption possible would be 2 units per hour. The load factor in this case is therefore:

$$\frac{0.33}{2} \times 100 = 16.5\%$$

On maximum demand and two-rate tariffs, customers with high load factors tend to have lower average unit costs.

Starting Current

When motors start they take more current than they do at normal running speed, in some cases up to 12 times as much. This sudden inrush of current depresses the voltage of the supply, and can cause unacceptable flicker (lights dimming) and sometimes damage. The size of the transformer supplying the load has an important bearing on the maximum allowable starting current. It's quite often necessary therefore to restrict the starting current. Star-Delta starters reduce the starting current to about seven times the running current. However where this is still not acceptable a soft start device can often be

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used to typically reduce the starting current to twice the running current.

Diversity

When the maximum demand of a supply is being assessed it is not sufficient to simply add together the ratings of all electrical equipment that could be connected to that supply. If this is done, a figure somewhat higher than the true maximum demand will be produced. This is because it is unlikely that all the electrical equipment on a supply will be used simultaneously.

For example, on a pig unit where heating and ventilation equipment is being used, the ventilation systems will not be operating at their full capacity when the maximum amount of heating is required. Furthermore, if the heating systems are on thermostatic control then it is unlikely that all the heating will be working flat-out at the same time.

The concept of being able to de-rate a potential maximum load to an actual maximum demand is known as the application of a diversity factor.

Diversity can be quantified as a decimal fraction or a percentage in the following manner:

About The Electricity Network

Electricity is distributed around the country using high voltage lines and cables and is, thereafter, reduced in voltage through transformers. Many farms are serviced by their own transformer which is usually mounted on a high voltage overhead line pole.

The transformer size is the main limiting factor on how much electricity can be taken by the farm and, therefore, must be considered when new electrical equipment is to be installed. The local Electricity Company should be notified of any additional loads that are to be connected to the supply.

Single and Three-Phase

The British Electricity Supply Industry's supply network is based on a three-phase system. Customers who require three-phase supplies must have a cable or line with three phase conductors installed. However, many rural areas are not equipped with 3 phase transmission lines and in these cases only single-phase or split single-phase (two-phase) is available. Any conversion from single-phase to three-phase involves work by the Electricity Company in uprating lines, cables, transformers, meters, etc, and often this work is chargeable to the customer.

To obtain a single-phase supply from three-phase so that single-phase equipment can be run, one of the phases is used together with neutral. Just to confuse matters, however, there are parts of the country that have a 480 V split single phase supply. Split single-phase equipment designed to run on 480 V cannot be run from three-phase. Like-for-like, three-phase motors are cheaper to buy than single-phase motors because of their simple construction. However, three-phase equipment is not necessarily cheaper to run than equivalent single-phase equipment.

Single to three-phase converters are available and may be suitable where a three-phase motor is a cheaper alternative. It should be noted that converters only change the single-phase to three-phase and do not increase the amount of power available from the supply. The intention to increase load on the electricity supply should be notified to your local electricity company to ensure that the transformer and cables can carry the extra power.

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