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# The impact of the 18th Edition (BS 7671:2018) – New Part 8, Section 801 Energy Efficiency

*Mark Coles, Head of Technical Regulations – IET, looks at a proposed new area for BS 7671 – Part 8, Section 801 Energy Efficiency.*

***Note: the following are draft proposals only at this stage and may or may not be included in the 18th Edition (BS 7671:2018), depending on the decision of the national committee, JPEL/64. This article is based on the DPC that is now available (on the BSI website) to anyone to view and to comment on.***

It's nothing out of the ordinary to see new requirements coming into the Regulations but energy efficiency takes a different approach.

Traditionally, BS 7671 has had requirements for "the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of electrical installations" and this stance, of course, will continue. The introduction of the concept of energy efficiency breaks from tradition but, don't worry, it's nothing really new to us.

Like all British Standards, BS 7671 is not a statutory document but, as cited in the Electricity at Work Regulations 1989 (EWR), by following the requirements of BS 7671 you are likely to meet the requirements of the law. The requirements of the proposed new section, Section 801 Energy Efficiency, is not safety related so it doesn't sit conventionally under EWR but, however, it aids in the meeting of requirements of Part L (Conservation of fuel and power) of the Building Regulations of England and of Wales and the conservation requirements of Scotland and of Northern Ireland. Irrespective of one's political stance or opinions on climate change and global warming, it is fundamentally important that we conserve energy. International and European standards on energy efficiency, such as IEC 60364-8-801 and HD 60364-8-801, have already been published and, regardless the inclusion in BS 7671, the UK still has to implement the requirements.

## Design and installation practice

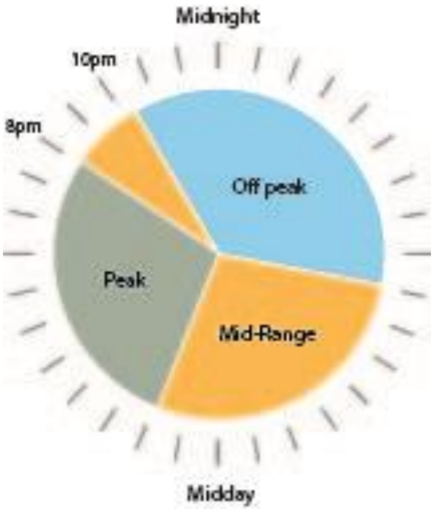
From a design and installation point of view, energy efficiency can be applied to all installations, i.e. domestic, commercial and industrial. The main question is – how does it affect the designer or the installer? The good news is that most of the principles within are common parlance already. Let's look at the concepts.

**I. Consumer demand**

At design stage, particularly for larger installations, it's important to know the consumer (or maximum) demand, for example, in kWh. With the application of diversity, the consumer demand can be assessed. This will help determine the size of the electrical supply required for a new building; larger supplies, of course, cost more to install and tariffs are generally higher.

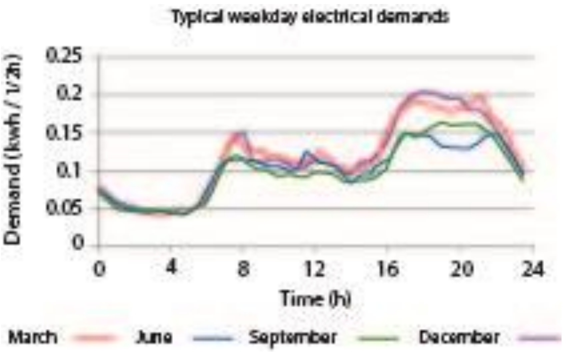
**II. Tariff structure**

The tariff structure will need to be agreed with the supplier. Based on the maximum demand, a tariff structure will set the parameters in which the installation is expected to operate. This could include on- and off-peak tariffs. If the client exceeds the maximum demand, even for a very short period of time, they will be financially penalised for the whole period, i.e. a month.



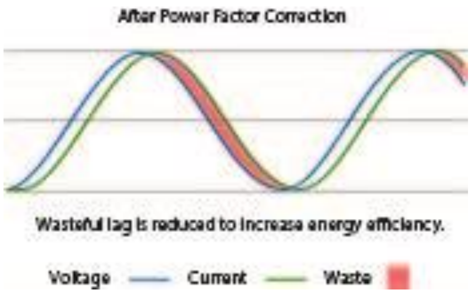

**III. Load profile**

As the graph shows, knowledge of the load profile allows us to identify when peak loads can occur and if particular loads can be operated during quieter periods. Keeping the graph as 'flat' as possible means that peaks are avoided and consumer demand is kept low.



## IV. Power factor correction

When the power factor is at unity, all the energy supplied by the source is consumed by the load. Power factors are usually stated as ‘leading’ or ‘lagging’. Capacitive loads are leading (current leads voltage) and inductive loads are lagging (current lags voltage). When power factor is poor, the client will be heavily penalised by the electrical supplier on larger commercial installations. Modern equipment is likely to have its power factor corrected within but if, for example, older equipment without internal power factor correction is used, such as relocated industrial equipment, it would be beneficial to install suitable correction equipment. Conversely, as a point of note, altered circumstances may mean that, where power factor correction is already in operation in an older installation, the equipment is ineffectual and the operator may be regularly penalised by the supplier for operating at a poor power factor.




## V. Location of equipment

Often on large sites HV/LV transformers are located on the outskirts or periphery of a large building. In order to distribute electricity across the site, large low voltage distribution cables are run to feed distribution boards, etc. Theses cables will be sized to allow for volt drop but there will be losses in the cables. Now consider the same site with the HV/LV transformer sited in the centre of a large building. Low voltage distribution cables that are run to feed distribution boards, etc. are far shorter than the previous example. Applying this logic to the positioning of heavy and frequently used loads will result in a more efficient distribution system.

## VI. Lighting and controls


It’s well established that newer ‘low energy’ light sources, such as LED, are far more efficient than incandescent lamps, however, colour rendering may not be equivalent but that’s another issue. Efficient lighting systems will ‘harvest’ natural light wherever possible and will dim or increase the illuminance when natural light is low. Occupancy detectors will switch off the lighting when a room is not occupied. Part L of the Building Regulations of England and of Wales has specific statutory requirements for lighting controls, luminous efficacy and/or W/sq m/year that are well in advance of the requirements of the proposed Section 801. Note that you wouldn't comply with UK lighting energy conservation requirements if you followed the content of Section 801 alone.

## VII. Harmonic reduction

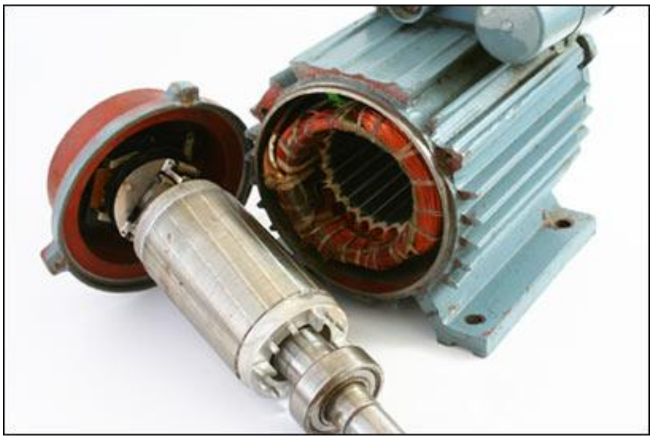
Where harmonics occur in the electrical system, it means that non-linear loads are being supplied. A linear load could be something as simple and straightforward as an incandescent lamp. When the incandescent lamp is supplied, current is drawn at the same frequency as the supply voltage.

Non-linear loads, such as rectifiers, switch mode power supplies and variable speed drives result in a non-sinusoidal waveform, which can cause many problems – typically overheating waveforms and overloading of neutral conductors. Where triplen harmonics are present, currents add in the neutral conductor because part of the waveform is at a peak at the same time as the fundamental; this image is a simplification of how triplen harmonics add in the neutral conductor:


Harmonic reduction is therefore of great importance in achieving an energy efficient installation.

## VIII. Motor control

When motors start they can draw a very large current. Drawing a large current for even a very short period of time could mean a breach of the tariff structure agreement. Using energy-efficient soft starters dramatically reduces the starting current.



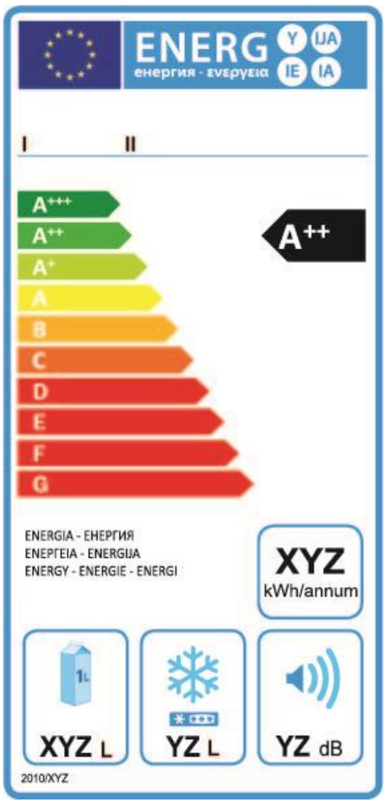
**IX. Cable sizing**

When we design circuits, we tend to use conductors with the smallest cross-sectional area (csa) possible to keep initial costs down. By using the smallest csa conductor, however, the cable may be close to its maximum running temperature, which for PVC/PVC, is 70 ˚C. When a cable runs hot, the heat generated is lost energy, which has to be paid for. Choosing a larger csa conductor would mean the cables run cooler so there are fewer losses.

Choosing a larger csa cable at the point of installation puts the initial cost of the installation up but it can be demonstrated over time, say the twenty year lifecycle of a building, that the increased installation costs can be recouped over a period of time as less energy is lost.

## Strategic approach

So, as you can see, much of this is not new and by putting it all together we can achieve an energy efficient installation. We're all familiar with energy ratings (shown below) on appliances, such as ovens and fridges:




We can approach energy efficient electrical installations in a similar way, i.e. design an installation to a particular energy rating. Energy efficiency measures are classified according to five levels (from 0 to 4). Level 4 is considered to be the highest attainable level and the requirements for each level include requirements for the preceding ones.

Consider the following table is from Section 801 of the DPC of BS 7671:2018:

**Lighting, required optimization analysis**

| Sector of activity | EM0 | EM1 | EM2 | EM3 | EM4 |
|---|---|---|---|---|---|
| Residential buildings (dwellings) | No consideration | No consideration | To consider lamp type and position | To consider lamp type and position with natural lighting control according to natural lighting source or building use or lamp type | Control according to natural lighting source and building use and to consider lamp type |
| Commercial, Industrial, and Infrastructure | No consideration | To consider lamp type and position | To consider lamp type and position with natural lighting | Control according to natural lighting source or building use or lamp type | Control according to natural lighting source and building use and to consider lamp type |

This approach, across all aspects of an electrical installation, allows us to describe an electrical installation in terms of efficiency and to design to a particular efficiency level.

## Summary

Part 8, Section 801 Energy Efficiency of DPC BS 7671:2018 takes a different approach to electrical installations and is a result of the need to use energy more efficiently. The concepts within the section are nothing new to electrical designers and installers but this section pulls the relevant aspects together and allows us to describe an electrical installation in terms of efficiency and to design to a particular efficiency level.

This article only gives an overview of draft proposals, which may or may not be included in the 18th Edition (BS 7671:2018), depending on the decision of the national committee, JPEL/64.

The DPC (draft for public comment) is now available to the public for comment at this url: https://standardsdevelopment.bsigroup.com/