8.12 Energy efficiency considerations

Most of the electrical power consumed by a luminaire is due to the lamp and its control gear. However this power consumption may be modified slightly by the operating conditions inside the luminaire (i.e. thermal conditions altering the operation of the lamp/ballast system). Additionally minor luminaire losses may occur due to parasitic losses from electronic control or emergency lighting capabilities of the luminaire.

The energy efficiency index (EEI) classifies fluorescent lamp ballasts into seven categories as shown in Table 8.6 and is used by the industry in ballast labelling.

Class	Ballasts
A1	Dimmable electronic ballasts
A2	Reduced-loss electronic ballasts
A3	Electronic ballasts
B1	Magnetic ballasts, very low loss (low loss ballast)
B2	Magnetic ballasts, low loss (low loss ballast)
C	Magnetic ballasts, moderate loss (conventional ballast) **Prohibited from sale since 21st November 2005**
D	Magnetic ballasts, very high loss (conventional ballast) **Prohibited from sale since 21st May 2002**

Table 8.5 Fluorescent lamp ballast classifications

8.13 Circuits

The circuits shown in this section are generic, in that they are not specific to any manufacturer or make of control gear but serve to illustrate the principles. They are split into fluorescent and sodium/metal halide lamp circuits as these have distinct wiring and control techniques.

Lamps, LEDs and Circuits

Definitions

Ballast

The general term for control gear inserted between the mains supply and one or more discharge lamps or fluorescent lamps, which by means of inductance, capacitance or resistance, singly or in combination, serves mainly to limit the current to the lamp(s) to the required value. A ballast may also incorporate means of:

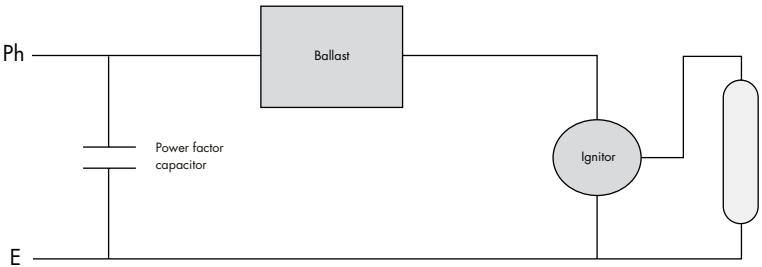
Transforming the supply voltage,
Providing a starting voltage,
Providing a pre-heating current,
Improving cold starting,
Reducing stroboscopic effects,
Correcting power factor,
Suppressing radio interference.

Ignitor

A starting device, intended to generate voltage pulses to start discharge lamps, which does not provide for the pre-heating of electrodes. A basic ignitor will do this until the lamp strikes, which means that if there is a problem with the lamp or circuit that prevents the lamp starting the ignitor will continue to try to start the lamp until the circuit is turned off or potentially the ballast is damaged. Modern ignitors therefore normally incorporate anti-cycling control that can sense the normal end-of–life mode of a lamp and disables the ignitor. This normally happens after the ignitor has tried to start the lamp a few times, and for metal halide lamps this is generally after approximately 15 minutes. (For high pressure sodium lamps this will be after approximately five minutes)

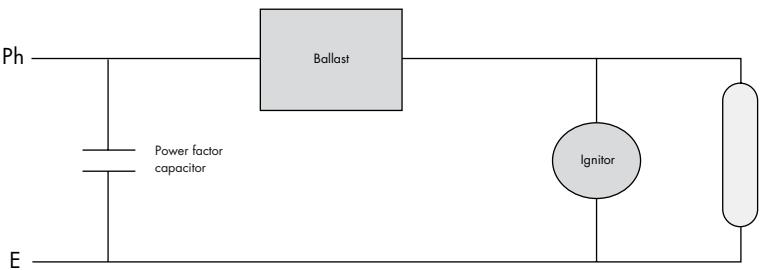
Starter switch
A device which initiates a surge of high voltage across the lamp.

Sodium/metal halide lamp circuits



A series ignitor circuit. Here the lamp is wired across the ignitor and the neutral. This type of circuit is common when using high-pressure sodium and metal halide lamps.

Fig. 8.18 Series ignitor circuit



A parallel ignitor circuit. Here the lamp is wired across the ballast and the neutral in parallel with the ignitor. This type of circuit is common when using low-pressure sodium lamps.

Fig. 8.19 Parallel ignitor circuit

Lamps, LEDs and Circuits

Fluorescent lamp circuits

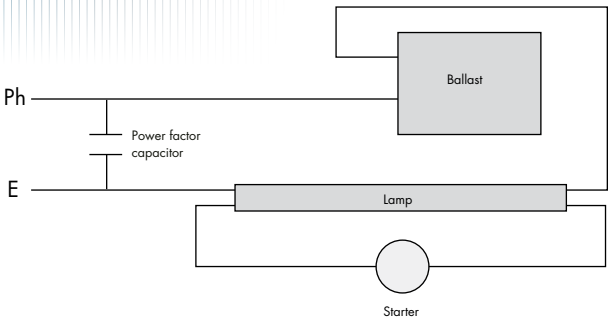


Fig. 8.20 Typical magnetic ballast circuit

A circuit typical of magnetic ballast, incorporating a power factor correction capacitor and a starter. The circuit is essentially a series circuit, from the input phase through the ballast, through one end of the lamp, through the starter, through the second end of the lamp and out to neutral.

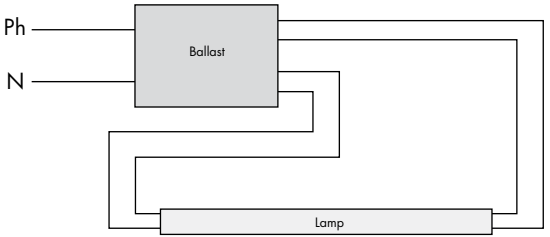


Fig. 8.21 Electronic circuit

A circuit typical of electronic control gear. Here no power factor capacitor or starter is required as this is dealt with by the electronics. Wiring is according to the connector designations on the ballast with the lamp being wired across the ballast. Additional control lines may be used for ballasts incorporating dimming functionality.

Figure 8.22 shows a typical emergency lighting circuit for a maintained luminaire. Two additional components are required, an inverter and a battery pack, and the inverter controls the circuit. Under normal conditions with a mains supply present the inverter supplies the ballast with a phase supply from the mains, and the lamp is driven from the ballast, via the inverter. When the mains supply fails the lamp is driven from the inverter, which receives power from the battery pack.

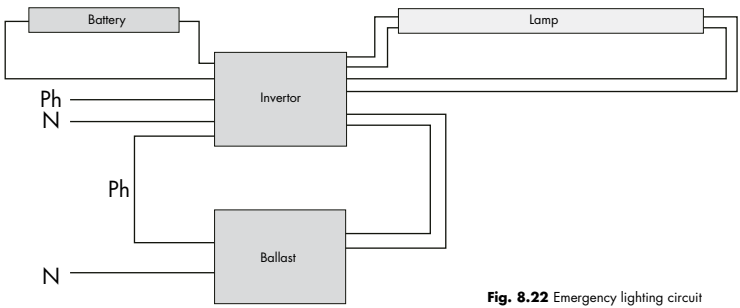


Fig. 8.22 Emergency lighting circuit

For circuits with more than one lamp only the lamp used in emergency mode is connected to the inverter, additional lamps being connected directly to the ballast. As the ballast receives no power supply during mains failure these lamps are extinguished and again the emergency lamp is lit using a supply from the batteries via the inverter.

8.14 Properties of electronic ballasts

With the implementation of European Directive 2000/55/EC on energy efficiency requirements for ballasts for fluorescent lighting and the Energy using Products Directive 2005/32/EC type C and D magnetic ballasts are banned for sale within the European Union. The benefits of using electronic technology over magnetic ballasts are:

- Energy savings 1. Energy costs are cut by using electronic control gear, and further savings may be made using presence detection and dimming technology to ensure that light is not wasted by lighting empty spaces or over lighting an area.