8 Automatic test systems for emergency lighting (BS EN 62034 and other standards)

Testing of emergency lighting is essential to provide confidence that the system will operate correctly when an emergency occurs. Unfortunately the action is time consuming and is often neglected, particularly if the manual facilities are difficult to use. This is an ideal task to be automated as it takes away the drudgery of a repetitive job that often just proves that the system is working correctly. To be acceptable, automatic testing of the emergency lighting must be at least as effective and as safe to operate as manual testing.

The major requirements are as follows:

- The changeover device has to operate correctly and supply the lamp from the battery during the test.
- The tests must be performed at the correct intervals for the required times.
- The result of the test must be reliably indicated.
- Facilities are provided for the test to be done at times of low risk.

The different forms of automatic testing systems are defined and classified by type reference so that the mode of operation is clearly understood.

Type S: self-contained with stand-alone facilities

These units have an initiation circuit, timer, testing control and result indicator built into the self-contained luminaire. They operate independently of other luminaires and require no additional wiring or control panel. Consequently, they are the easiest form of automatic testing to install. While they initiate the tests and indicate the result they still need to be visited once a month to log the result of the test. Because of this they are most used for small to medium premises or where there is already a safety patrol who can readily add the recording to their other duties.

Type P: emergency luminaires with remote panel

By connecting the luminaires to a control panel it can gather the test results at a single point, thus reducing the task of recording results. In these systems the initiation, timing and monitoring circuits are normally in the panel although they can remain in the luminaire and the panel just repeats the test results. Many of these systems offer additional functions. Apart from showing the identification of any faulty luminaires they can even diagnose the component that has failed, to enable service engineers to obtain the correct spares to rectify the luminaire.

Type ER: emergency luminaires with remote panel that records results

These luminaires have the same facilities as type P but in addition the test facility collects the results and data is recorded and logged by the system.

Type PER

These luminaires are as types P or ER but with a collated fault indicator that automatically gives a remote indication of failure of any of the luminaires that have been tested.

Type PERC

These luminaires are as type PER but with the additional feature of a central controller for setting parameters, configuration of the system and the centrally controlled initialization of the test and where the date, time and duration of the test are defined by the central controller.

Safety, construction and installation instructions (4.1)

Manufacturers must identify the classification of the system they are supplying and also the type of luminaires that are suitable to operate with it. The safety and constructional requirements of the test circuits are the same as those used for the luminaires (specified in BS EN 60598-2-22) and for the centrally powered systems (specified in BS EN 50171) so that when they are integrated into products, the protection provided is consistent.

To ensure that the indicated results can be relied on, the test duration periods and their frequency of operation can only be reset by authorized personnel.

Monitoring of the timing circuit (4.2)

Because the system relies on the timing functioning and also on being accurate, if the timing stopped, the user could record the next monthly results not aware that another test had not been performed. To prevent this situation the timer has to monitor its own function, typically by use of a watchdog circuit, so that if the timer fails a fault signal is given.

The automatic test system (ATS) (4.3.1)

The system has to check that each component of the emergency circuit is operational and any faults such as the charge fail indicator must be reported within 24 h. Consequently, a manager sitting next to the panel will be aware of any luminaire or central power unit failures shortly after they occur and so will be able to take remedial action quickly.

Emergency supply (4.3.2–4.3.4)

During the test period the monitoring circuit has to indicate if the emergency supply has failed. This is particularly useful for converted fittings or centrally supplied luminaires, with one lamp being switched from the mains to the emergency circuit and the others on the mains supply where it can be difficult to see visually if a change has been made. In all systems the test circuit has to check that all the changeover devices have operated correctly. Particular requirements are detailed for those luminaires that provide a maintained output without a changeover by continuously powering the inverter circuit when the lamp has to be checked both in the normal mains healthy and in the normal mains failed conditions.

Protection against system part failures and faults (4.4)

Any fault of components or interconnecting wiring faults must not be able to inhibit the operation of the emergency circuits or induce an unwanted test which would leave the system discharged. This ensures that any open circuit or short-circuit faults or line shorting to earth will not affect the operation of the emergency system. Any of these faults must be identified within or during the monthly functional tests.

As with any system, great care must be taken to ensure that the individual components are compatible. For example, many systems monitor lamp current and these need to cover the range of the lamps used, also the number of luminaires and their location zones need to be within the

capabilities of any monitoring panels. Electromagnetic compatibility (EMC) legislation has to be complied with particularly for emissions and immunity from corruption by any other equipment. Many of the interconnections carry sophisticated digital data and the correct transfer of this information must be able to be relied on.

Test of emergency lamp(s) (4.5)

During the test the lamps have to be checked to ensure that they are connected and also operate. This is straightforward for tungsten lamps but fluorescents have to be checked to ensure that current is flowing through the lamp and not just the heaters. The circuit is checked by the test house connecting equivalent rating lamp heaters to the lamp holders instead of a working fluorescent lamp. The test system must then indicate that the lamp is faulty.

Functional test (5.1)

This test simulates a supply failure and activates the changeover circuit to power the control gear and lamps from the battery. The monitoring circuit checks that the lamp is operating and gives a positive signal through the indicator to show that the test was satisfactory. Each of these tests is just for sufficient time to strike the lamp and should not exceed 10 per cent of the rated emergency duration of the system to minimize the discharge from the battery and hence the duration that would be available if an emergency occurred directly after this functional test. By performing this test the operator of the building can be confident that the luminaire works. The only item not checked is the length of time for which the battery will run the fitting. These function tests should be performed at least once a month to detect luminaire failures as quickly as possible with minimum damage to those components that are affected by the test, in particular, the battery and lamps.

Duration test (5.2)

To check the battery capacity available a full discharge is needed. This should be done at least once a year. Provided that good quality approved equipment is correctly used this testing regime will identify the gradual reduction in capacity that occurs prior to sudden loss of power. Obviously, while the test is being performed and the battery is being recharged the luminaires will not be able to provide their designed duration of illumination. Consequently, arrangements have to be made to enable systems to perform this test at times of minimum risk. When commissioning, this test is performed at the start of the timing cycle to check that the system is working correctly.

Protection of a building during the periods of test and subsequent recharge of the emergency lighting system (Clause 6)

Because the duration test is set one year in advance, a number of precautions are necessary to limit the risks that this necessary test imposes. They depend on the facilities provided by the system and whether the building is likely to be occupied or not. The main conditions are given below.

Unoccupied buildings

If it is known that the building will be unoccupied for the test and subsequent 24 h recharge, it is possible to test all the luminaires at once. It is possible to set the time for the duration test a year ahead.

The system requirements to perform the test are as follows:

- It must be possible to be able to set the scheduled test for that date.
- The timer must be sufficiently accurate to do the test at the right time.
- The timer must be able to maintain its timing even for extended outages of supply failure.

Possibly occupied buildings: self-contained luminaires

To protect occupants, alternate luminaires have to be tested and recharged, after which the remainder can be tested. This procedure ensures that no areas of the building will be in total darkness, as at least two luminaires have to illuminate each compartment of the escape route or open areas.

The system requirements to perform the test then are as follows:

- The system must be capable of being set so that alternate luminaires can be duration tested at times that are at least 24 h apart to maintain the same timing accuracy and protection as is needed for buildings that will be unoccupied.
- The timer must be sufficiently accurate to do the test at the right time.
- The timer must be able to maintain its timing even for extended outages of supply failure.

Table 2 Suitable testing procedures for different conditions of occupancy

Suitable system: self-contained luminaires	Known to be unoccupied one year in advance	May be occupied at any time	Known to be unoccupied 24 h in advance
Set to give duration test in a year	✓	✘	✘
Alternately set at least 24 h from next luminaire	✓	✓	✘
Manual initiation of duration test	✘	✘	✓

Possibly occupied buildings: central systems

As there is often only a single battery available it is not possible to test the battery by checking alternate luminaires, but fortunately these systems use stationary batteries which reflect their state of charge by their output voltage. Consequently, it is acceptable to provide dual batteries which can be individually tested while the other is available to power the luminaires. This system gives a high level of security as it also provides cover while batteries are replaced at the end of their life but unfortunately it is costly.

Alternatively, systems can be discharged for two thirds of the rated duration and checked to a higher discharge voltage. If by then the battery voltage is above this value, which is a pre-set figure for the battery type, we can be confident that the full capacity will be available to the lower rated end of the discharge voltage.

This technique ensures that at least one third of duration is always available even immediately after the test. This technique can be used for manual as well as automatic testing.

See Figure 61 for typical voltage discharge curves showing points for testing to two thirds of discharge capacity.

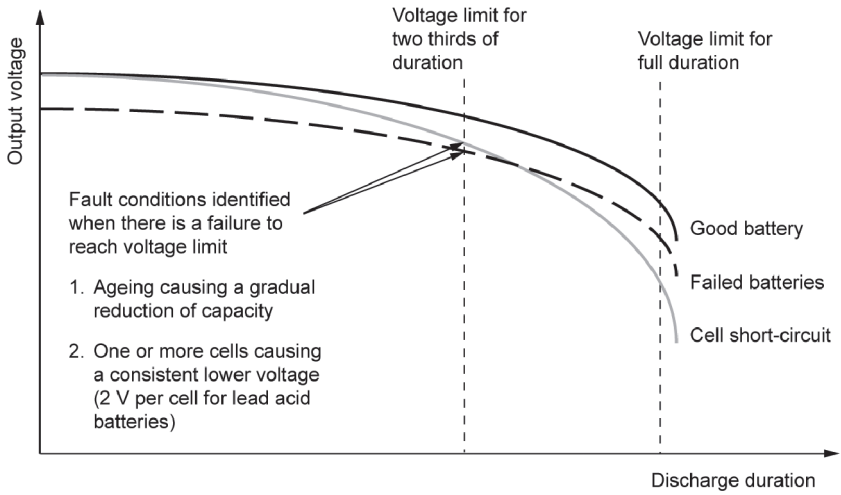

Figure 61 – Typical voltage discharge curves

Table 3 Suitable testing procedures for different conditions of occupancy

Suitable system Central systems	Known to be unoccupied one year in advance	May be occupied at any time	Known to be unoccupied 24 h in advance
Full load test in a year	✓	✘	✘
Dual batteries for alternate luminaires	✓	✓	✓
Manual initiation of duration test	✘	✘	✓
Limited duration test to higher volts	✓	✓	✓

Buildings known to be unoccupied 24 h in advance

For some premises that are hired out, such as town halls, it is impossible to predict in advance when they will be unoccupied. So it is permissible to allow manual initiation of the duration test at a safe time. The timing of the test monitoring and indications of the results must then be automatic.

Timing accuracy (6.2.2)

The timer must have an accuracy of better than 75 s per week over the full temperature range that it is likely to encounter. In practice, the temperature normally tends to be fairly constant so the accuracy is going

to be improved. But even so the worst case is that a test could vary by up to 2 h for each year. This means that when nickel–cadmium batteries are reaching replacement time the total timing variation will be only a maximum of 8 h by which time the battery will have recharged and have at least 2 h duration available.

Protection of timing function (6.2.3)

The systems rely on an accurate timing circuit that is immune to mains supply failures to perform the tests correctly and at the right times. The timing device must not be affected by extended power supply failures of up to seven days. This facility means that if there is a lengthy supply failure, or if the operator inadvertently switches off the supply over a weekend, then the timing will still be maintained. The user will then not be forced to reset the programmed times of the test or worse still, if they neglect this, have the tests being performed at a time of potentially high risk. The manufacturer's instructions have to make it clear that if there has been a supply loss of longer than seven days the system should be recommissioned, including the full duration test. This is particularly important in applications that are only used seasonally, such as holiday establishments, when it is important to ensure that the premises are safe before opening to visitors.

Indication and recording of tests that the equipment has to perform (Clause 7)

It is important that the indication of the test results is logged each month, if they are not printed automatically, and the equipment must ensure that any fault signals are not overridden by a positive signal to a lesser test. For example, if a luminaire fails the full rated discharge test perhaps because there is only 1 h available from a 3 h rated fitting this signal must not be cancelled by a satisfactory result one month later to a functional duration test of 5 min.

There should be at least one system condition indicator if the test control gear is installed in a self-contained luminaire. It can be combined with the charge health indicator, but in all cases the colour coding of IEC 60073 should be followed. This means that healthy conditions should be shown by a green lamp and fault signals by yellow or orange. Dangerous conditions are shown by a red indicator. Operating staff should be conversant with the indications and any other information provided by the system and be able to rectify any faults identified.

Selection of a suitable system

The most useful type of system depends on the format of the building it will be used in, the way it will be operated and the type of emergency lighting it will work with.

It may be difficult to install the wiring needed for a panel-controlled system in an existing building and self-contained independent luminaires may be preferable. Some advanced versions of these systems use handheld beam communicators so that the diagnostic data given on panels can be downloaded and a full record made of the system condition. Systems using radiofrequency and power line are also being developed and can offer reduced installation costs.

Testing modules are available that can be fitted in existing luminaires but generally it is worth installing new fittings as the benefits of fitting the installation tend to outweigh the savings from retaining old luminaires.

New buildings enable any system to be installed easily and matched to appropriate emergency luminaires for the application.

If there are no suitable maintenance staff available a panel system with printer provides a full report and, in the event of a failure, diagnostic systems can identify the component needing to be replaced, as well as site location.

All automatic testing systems reduce the testing burden as the test does not have to be initiated and staff do not need to be trained to either perform the test and interpret the results or be monitored to see that they are keeping to the work schedule. Automatic testing gives a reliable monitoring of the system condition and early warning of any faults that may affect the emergency lighting system.