Special Types of Installation

Certain types of installation demand special consideration when designing and installing the electrical equipment. Part 7 of the 17th edition of the IEE Wiring Regulations sets out the specific needs of some types of special installation and the IEE Regulations contained therein supplement or modify the other parts of the IEE Regulations. These types of special installations are:

- Locations containing a bath or shower (701)
- Swimming pools and other basins (702)
- Rooms and cabins containing sauna heaters (703)
- Construction and demolition site installations (704)
- Agricultural and horticultural premises (705)
- Conducting locations with restricted movement (706)
- Electrical installations in caravan/camping parks and similar locations (708)
- Marinas and similar locations (709)
- Medical locations (710)
- Exhibitions, shows and stands (711)
- Solar photovoltaic (pv) power supply systems (712)
- Mobile or transportable units (717)
- Electrical installations in caravans and motor caravans (721)
- Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses (740)
- Floor and ceiling heating systems (753)

The numbering of this section of the regulations is not sequential. The number appearing after the section number, e.g. 701.32 generally refers to the corresponding part of the regulations from Part 1 to 6, i.e. Chapter 32.

Not all of these installations will be part of the day-to-day work of a designer or electrician, and so the detail described below covers only the more prevalent types encountered.

Two of the special types of installation which were covered in the 16th edition of the IEE Regulations, are now dealt with differently. The section on installations with high protective conductor currents is now covered by IEE Regulation 543.7 of the regulations and highway power supplies are in IEE Regulation 559.10.
7.1 LOCATIONS CONTAINING A BATH OR SHOWER

In rooms containing a bath or shower the risk of electric shock is increased due to the fact that the body is in contact with earth and, as a result of being wet, has reduced electrical body resistance. IEE Regulations Section 701 details the requirements and specifies zones in bath and shower rooms with restrictions on equipment which may be fitted.

Additional protection must be provided for all circuits by the use of RCDs and limitations exist as to the forms of protection which may be used. Supplementary equipotential is generally provided which connects the terminals of all the protective conductors of circuits for class I and II equipments together, along with all accessible extraneous-conductive parts. This supplementary equipotential bonding may be omitted if certain conditions are met although the practicalities and verification of the conditions, and the need for peace of mind, mean it may be prudent to provide equipotential bonding anyway.

Section 701 describes which, if any, accessories and current-using equipment can be installed into which zones. Generally no switches, socket outlets or other electrical equipments may be installed unless certain conditions are met. Switches should be placed such that they are inaccessible to a person in the bath or shower, unless they are supplied by SELV (extra-low voltage) not exceeding 12V a.c. rms (or 30V d.c.), or are part of a shaver unit incorporating an isolating transformer to BS EN 61558. Similarly with socket outlets, none are permitted unless supplied by SELV, not exceeding 12V or are 3m away from the boundary of zone 1.

FIGURE 7.1 Cord-operated switches for use in bathrooms can be obtained in a variety of designs, with or without a neon pilot light and, if needed, with engraved labelling as with the fan isolator shown.
Cord operated switches may be used provided the switch itself is located within the correct zone, also where SELV or PELV is used, the equipment must be provided with basic insulation, and be protected to IPXXB or IP2X.

7.2 SWIMMING POOLS AND OTHER BASINS AND ROOMS CONTAINING A SAUNA

As with bath and shower rooms, increased precautions against electric shock are required in these locations and in certain specified zones within or near them. IEE Regulations Sections 702 and 703 set out the details for swimming pools and sauna heaters, respectively. Requirements include the provision of barriers with appropriate degrees of protection in accordance with BS EN 60529, placing certain equipments outside specified zones, provision of SELV (extra-low voltage) supplies, protective measures such as the use of residual current devices (RCDs) and equipotential bonding and constraints on the type of wiring systems which may be used. In the case of hot air saunas, provision to avoid the overheating of electrical equipment must be made.

There is a duty upon the designer to extend the assessment of general characteristics. Specific examination of these areas and the way in which they may be used must be made. Additional information is contained in the IEE Regulations themselves and in the IEE books of Guidance Notes.

7.3 CONSTRUCTION AND DEMOLITION SITE INSTALLATIONS

Temporary electrical installations on building and construction sites are necessary to enable lighting and power to be provided for the various trades engaged on the site. These temporary installations need to be of a very high standard owing to the exceptional hazards which can exist.

The Electricity at Work Regulations 1989, which applies to permanent installations, also apply to temporary installations on construction sites, so these temporary installations must be of the same standard as those for other installations. Installations are also required to comply with British Standard BS 7375 and the IEE Regulations Section 704 also applies.

The old practice of using brass lamp holders with twisted two-core flexible cord was the cause of many accidents. The use of these in the vicinity of earthed metal or damp floors presented a real hazard, even when connected to extra-low voltage supplies. Apart from the danger of shock there is a danger to the eyes should the lamp be accidentally broken. All portable hand lamps must be properly insulated and fitted with a guard.

Construction site lighting is necessary to cover the following requirements:

1. Lighting of working areas, especially internal working areas where there is no natural light, with a minimum intensity of 20 lux. In cases where
activities include more detailed types of work such as brick or slab laying, the minimum intensity recommended is 50 lux.

2. Walkways, especially where there are uneven floors, minimum intensity 5 lux.

3. Escape lighting, along escape routes, this lighting to be from a supply separate from the mains supply, usually battery operated, minimum intensity 5 lux.

4. Emergency lighting. This to be in accordance with BS 5266 Part 1 and to come on automatically in the event of mains failure. Usually battery operated or from a generating set. Minimum intensity 5 lux.

High-level fixed lighting could be taken from 230V mains supply, but low level and portable lighting should be 110V with centre point earthed via a double-wound transformer.

Power for tower cranes, mixers and other motors over 2kW is usually supplied from a 400V mains supply. Sockets for portable tools and hand lamps should be to BS EN 60439-4, and it is strongly recommended that they are fed from a 110V supply via a double-wound transformer. In vulnerable situations, such as in damp areas, tanks etc., the voltage should be reduced to the SELV voltage (50V a.c).

IEE Regulations Section 704 includes a number of additional and amended regulations which apply to construction sites. Because of the increased risk of hazards which exist in these locations some tightening of requirements, particularly with regard to shock protection, is called for.

A number of BS (British Standards) apply to installations on construction sites. BS 7375 and BS EN 60439-4 cover electricity supplies and equipment,
BS EN 60309-2 applies to plugs, sockets and cable couplers, and certain minimum standards for enclosures are required consistent with BS EN 60529: 1992.

Electrical conductors must not be routed across roadways without adequate mechanical protection, and all electrical circuits must have isolators at each supply point which are capable of being locked in the off position. Additional useful information is contained in Section 704 of the IEE Regulations.

7.4 AGRICULTURAL AND HORTICULTURAL PREMISES

Agricultural installations, which include buildings accessible to livestock, require very special consideration. Horses and cattle have a very low body resistance which makes them susceptible to electric shock at voltages lower than 25V a.c. The IEE Regulations include a number of requirements specific to these applications and these include revised arrangements for Automatic
disconnection of supply, use of extra-low voltage circuits, Supplementary bonding, Accessibility and Selection and erection of wiring.

It is recommended that electrical equipment installed in these areas should have a degree of protection to at least IPXXB or IP2X. Switches and other accessories should be placed out of reach of animals and this generally means that they be placed in enclosures or outside the areas occupied by livestock. In the case of low-voltage systems, the circuits should be protected by a residual current circuit breaker, and for socket outlets this must have an operating current not exceeding 30mA.

As with other areas of high risk from shock currents, modified arrangements are a requirement of the IEE Regulations regarding the times for automatic disconnection and other associated measures. Supplementary equipotential bonding connecting all exposed and extraneous conductive parts must be provided, and this includes any conductive or metal mesh covered floors. Bonding conductors must be mechanically protected and not subject to corrosion.

In some cases, supplies are needed for life support of livestock, and for these separate final circuits must be provided, with an appropriate alternative back-up supply.

Mains-operated electric fence controllers must comply with BS EN 60335-2-76 and BS EN 61000-1 but their installation is not covered by the IEE Regulations.

7.5 ELECTRICAL INSTALLATIONS IN CARAVAN PARKS, CARAVANS AND MOTOR CARAVANS

Under the 17th edition of the IEE Regulations, Caravan and Camping Parks are covered in Section 708 and Caravans and Motor Caravans in Section 721.

Definitions

- The IEE Regulations define a caravan park is an area of land that contains two or more caravan pitches and/or tents.
- A caravan as ‘a trailer leisure accommodation vehicle, used for touring, designed to meet the requirements for the construction and use of road vehicles’. The IEE Regulations also contain definitions of motor caravan and leisure accommodation vehicles.

Caravan Parks

As electrical installations on caravan sites are extremely vulnerable to possibilities of shock due to their temporary nature, special regulations have been made. A socket outlet controlled by a switch or circuit breaker protected by an overcurrent device and a RCD shall be installed external to the caravan, and shall be enclosed in a waterproof enclosure (min. IP44), it shall be non-reversible with provision for earthing BS EN 60309-2.
External installations on caravan parks, although some may only be of a temporary nature, must be carried out strictly to the IEE Regulations in general, and the Electricity Supply Regulations. The preferred method of supply is by underground distribution circuit and the depth of this and degree of mechanical protection are specified. In the case where overhead distribution is to be used, the conductors must be insulated and a minimum height of 3.5m is specified, or 6.0m where vehicle movements could take place.

**Caravan and Motor Caravan Installations**

All mobile and motor caravans shall receive their electrical supply by means of a socket outlet and plug of at least 16 A capacity, with provision for earthing BS EN 60309-2. These sockets and plugs should have the phase, neutral and earth terminals clearly marked, and should be sited on the outside of the caravan. They should be connected to the main switch inside the caravan by cables 25m (±2m) in length. A notice must be fixed near the main switch inside the caravan bearing indelible characters, with the text as given in IEE Regulation 721.514.1. This notice gives instructions to the caravan occupier as to precautions which are necessary when connecting and disconnecting the caravan to the supply. It also recommends that the electrical installation in the caravan should be inspected and tested at least once every three years, and annually if the caravan is used frequently.

Other recommendations are that all wiring shall be insulated single-core cables installed in non-metallic conduit or sheathed flexible cables. Cables shall be firmly secured by non-corrosive clips at intervals not exceeding 250mm for horizontal runs and 400mm for vertical runs. Luminaires shall be mounted direct on the structure; flexible pendants must be suitable for the movement of the vehicle. Protective conductors should be incorporated in the cable containing the circuit conductors or their conduit.

Where automatic disconnection of supply is used, an RCD is to be provided, and the protective conductor arrangements are specified. These must terminate at an earthing terminal connected to the structural metalwork which is connected to the protective contacts of socket outlets, exposed-conductive-parts of electrical equipment and connected to the earthing contact of the caravan inlet.

**7.6 MARINAS AND SIMILAR LOCATIONS**

This new part of the IEE Regulations, Section 709, is not covered in detail by this text, but has similar requirements to those of caravan parks. The treatment of temporary connection of pleasure crafts and house boats is dealt with in a similar way, but with the added external influences of water, corrosive elements, movement of structures, i.e. boats bobbing around and the presence of fuel etc. Diagramatic means of obtaining electricity supplies in Marinas are included in the IEE Regulations.
7.7 MEDICAL LOCATIONS

This is a new section within the IEE Regulations, but is reserved for future use and therefore there are currently no requirements stated within the 2008 edition of the IEE Regulations.

7.8 SOLAR PHOTOVOLTAIC (PV) POWER SUPPLY SYSTEMS

An increasing trend to consider on-site electrical generation from a renewable source is covered by a new section of the IEE Regulations. This specifies requirements for both the d.c. element of current generation and the a.c. side where an a.c. module is provided. The preferred method of protection for the d.c. side is by the use of Class II or equivalent insulation. The installation method is to ensure that there is adequate heat dissipation to cope with maximum solar radiation conditions.

Isolation arrangements are specified as are the increased requirements arising due to external influences such as wind, ice formation and solar radiation.

Other special types of installation which are not covered by this text include:

- Conducting locations with restricted movement (706)
- Exhibitions, shows and stands (711)
- Mobile or transportable units (717)
- Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses (740)
- Floor and ceiling heating systems (753)

Further information for the sections not covered may be obtained by reference to Section 7 of the IEE Regulations and the IEE Books of Guidance Notes.

7.9 OTHER SPECIAL INSTALLATIONS

There are other installations and systems that are not specifically covered by Section 7 of the IEE Wiring Regulations, but which are worthy of consideration. Some of these are covered below.

Emergency Supplies to Premises

The need for emergency supplies in factories, commercial buildings, hospitals, public buildings, hotels, multi-storey flats and similar premises is determined by the fire prevention officer of the local authority concerned, and is also related to the need to provide a minimum level of continuity of supply.

In large installations, it is usual to provide standby diesel driven alternators for essential services. It is unlikely these will be able to supply the full load of the building, and thus some load shedding will be necessary. Because the occupants of the building will not normally carry out this function, some special
circuit provision should be made. The essential loads should ideally be determined at the design stage, and separate distribution arrangements made from the main switchboard. The changeover switching arrangements are usually automatic, and the circuits must be arranged in such a way that the standby power supplies feed only the essential load distribution network.

Wiring to emergency supplies must comply with the IEE Regulations and BS 5266. Recommended systems of wiring are MI cables, PVC/armoured cables, FP cables, PVC or elastomer insulated cables in conduit or trunking. In certain installations the use of plastics conduit or trunking is prohibited, and the enforcing authority should be consulted on this.

**Emergency Escape Lighting**

The object of emergency lighting is to provide adequate illumination along escape routes within 5 s of the failure of normal lighting. BS 5266 deals with the emergency lighting of premises other than cinemas and certain other premises used for entertainment.

If the recommendations of BS 5266 Part 1 are complied with it is almost certain that the emergency lighting system will be acceptable to the local ‘enforcing authority’.

The Fire Protection Act of 1971 indicates the need for escape lighting, but does not make any specific demands. IEE Regulation 313.2 mentions that any emergency supplies required by the enforcing authority should have adequate capacity and rating for the operation specified. BS 5266 Part 1 recommends that emergency lighting be provided in the following positions:

1. Along all escape routes towards and through all final exits, including external lighting outside all exits.
2. At each intersection of corridors, and at each change of direction.
3. On staircases to illuminate each flight of stairs, and near any change of floor level.
4. To illuminate all exit signs, directional signs, fire alarm contacts and fire fighting appliances. (Note: The illumination of signs may be either from within or external to the sign.)
5. All lifts in which passengers may travel.
6. All toilet areas which exceed eight square metres.
7. Over moving staircases or walkways (i.e. escalators and travelators) as if they were part of the escape route.
8. Control, plant, switch and lift rooms.

Emergency lighting must come into operation within 5 s of the failure of the normal lighting, and must be capable of being maintained for a period from 1 to 3 hours (according to the requirements of the local ‘enforcing authority’). The level of illumination should be not less than 0.2 lux measured at floor level on the centre line of the escape route.
Along corridors it is recommended that the spacing of lighting luminaires should have a maximum ratio of 40:1 (i.e. distance between luminaires and mounting height above floor level) and, of course the illumination levels above must also be met.

Alternative methods of providing emergency lighting are as follows:

1. Engine driven generating plants, capable of being brought on load within 5s.
2. Battery powered systems, utilising rechargeable secondary batteries, combined with charger, centrally located to serve all emergency lights.

3. Signs or luminaires with self-contained secondary batteries and charger. The battery after its designed period of discharge must be capable of being re-charged within a period of 24h.

Circuits feeding luminaires or signs with self-contained batteries shall be continuously energised, and steps must be taken to ensure that the supply is not inadvertently interrupted at any time. Switches or isolators controlling these and other emergency lighting circuits must be placed in positions inaccessible to unauthorised persons, and suitably identified.

All wiring for emergency lighting and fire alarms if enclosed in conduit or trunking must be segregated from all other wiring systems (see IEE Regulation 528-01-04). When trunking is used the emergency lighting and fire alarm/circuits, cables must be segregated from all other cables by a continuous partition of non-combustible material.

Multi-core cables should not be used to serve both emergency and normal lightings (BS 5266).

**Standby Supplies**

In addition to emergency escape lighting, it is very often desirable to provide ‘standby supplies’ which will come into operation in the event of a failure of the supply. This lighting is intended to provide sufficient illumination to enable normal work to be carried on. It is very often necessary where there are continuous processes, which must not be interrupted, and in computer installations. In these cases it is also necessary to provide standby power supplies to enable the processes to continue.

**Fire Alarms**

The design of fire alarm systems does not come within the scope of this book, and it is usual for manufacturers of fire alarm equipment or other specialists in this work to design these installations.

Fire alarm systems are covered by British Standard BS 5839. Generally speaking the approved systems of wiring are the same as those for emergency lighting. Wiring installed in conduits or trunking must be segregated from all other types of wiring systems (except emergency lighting).

**Installations in Hazardous Areas**

Hazardous areas mainly consist of places where potentially flammable materials are present. This includes spraying and other painting processes which involve the use of highly flammable liquids, locations where explosive dust
may be present, installations associated with petrol service pumps, and inspection pits in garages.

Electricity at Work Regulation 6 states that electrical equipment which may reasonably foreseeably be exposed to hazardous conditions ‘shall be of such construction or as necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure’.

The Fire Offices Committee has issued recommendations for electrical installations in connection with highly flammable liquids used in paint spraying. Conditions also exist for the granting of petroleum spirit licences in respect to electrical equipment. These conditions require that petrol pumps shall be of flameproof construction, so also shall be switchgear and other electrical control gear. Luminaires within the pump equipment shall be of flameproof construction, but those mounted outside the pump casing shall be of totally enclosed design in which the lamp is protected by a well glass or other glass sealed to the body of the luminaire so as to resist the entry of petroleum spirit vapour. The wiring shall be carried out by insulated cables enclosed in heavy gauge galvanised solid-drawn steel conduit. Conduit boxes within the pump equipment shall be of flameproof construction and galvanised. Alternative wiring may consist of MI cables, copper sheathed with flameproof glands.

**FIGURE 7.6** Fire alarm point and siren wired in MI cable.
The supply circuits for each pump shall be separately protected with over-current protection, and these protective devices shall not be situated within, or on, the pump housing. BS EN 60079-1 gives details of the flameproof enclosures.

Where explosive dusts are likely to be present, flameproof equipment and circuit systems must be used, but the luminaires and conduit fittings and other electrical equipment must also be fitted with dust-tight gaskets to prevent the entry of explosive dusts. Without these dust-tight gaskets the ordinary flame-proof accessory could breathe in explosive dusts between the machined surfaces when changes in temperatures occur.