

EXTRACT FANS IN DWELLINGS

by John Ware

Kitchens and bathrooms now are often fitted with extract fans either to meet the requirements of the Building Regulations or at the owner's request. Such fans will need to be replaced or repaired during the lifetime of the installation. The IET Helpline often receives enquiries relating to two aspects of these fans; the isolation and switching requirements of BS 7671 and the ventilation requirements of the Building Regulations.

In this article we will explain briefly the concepts of isolation and switching and then discuss these functions in relation to extract fans and in an upcoming article we will cover the ventilation requirements placed by Part F of the Building Regulations.

Isolation and switching.

The term isolation and switching, as used in BS 7671: 2001 Requirements for Electrical Installations (The IEE Wiring Regulations) refers to four distinct functions:

- Isolation,
- Switching off for mechanical maintenance,
- Emergency switching, and
- Functional switching.

The concepts of isolation and switching are summarized in Table 1.

Isolation

The definition of isolation, in BS 7671 (The IEE Wiring Regulations) is: '*A function intended to cut off for reasons of safety the supply from all, or a discrete section, of the installation by separating the installation or section from every source of electrical energy*'. Isolation is provided to permit an electrically-competent person to work safely on all or part of an electrical installation. Once electrical equipment has been securely isolated from the source of energy and any electrical energy has been discharged, a skilled or instructed person should be able to safely access parts that are normally live, or may become live, without the risk of danger from electric shock, electric arcing or explosion or from electrically-powered equipment and machines.

The corresponding definition in the Electricity at Work Regulations (EWR) adds the specific requirement that the isolation is to be secure. This

Isolation and switching: The four functions

Isolation:

Purpose: To enable electrical work to be carried out safely on the isolated circuit or equipment
For: An electrically-skilled or supervised person.

Switching off for mechanical maintenance:

Purpose: To enable non-electrical work to be carried out safely on the switched circuit or equipment
For: Non electrically-skilled persons

Functional switching:

Purpose: To enable proper functioning and control of electrical equipment
For: The user of the installation

Emergency switching:

Purpose: To cut off rapidly electrical energy to remove an unexpected hazard
For: Anyone

Table 1: Summary of the four functions of Isolation and Switching

Summary of requirement	Regulation(s) in BS 7671 and the EWR which refer
Every circuit to be capable of being isolated	461-01-01
Neutral conductor to be capable of being isolated (with certain permitted exceptions ¹)	461-01-01 460-01-04
Group of circuits may be isolated by a common means	461-01-01
A means of isolation to be provided as close to the origin of an installation as possible	460-01-02 476-01-01
Means of isolation to be non-automatic	460-01-01
Means of isolation to be suitably positioned or durably marked	461-01-05
Means of isolation not to be inadvertently or unintentionally energized	461-01-02
Means of isolation may need to be secured in the open position	476-02-02
Requirements where there is more than one device to be operated	461-01-03 514-11-01
Circuits containing stored energy may need to be discharged ²	461-01-04
Means of isolation to be secure	EWR (Regulation 12)

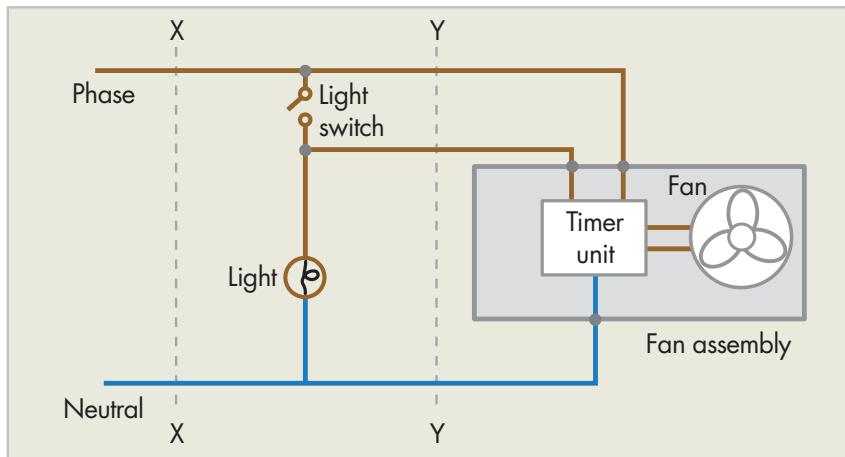
Table 2: Principal requirements in BS 7671 and the EWR applicable to isolation in dwellings

¹ A neutral conductor falls within the definition of a live conductor. With permitted exceptions for TN-S and TN-C-S systems, the neutral conductor is required to be able to be isolated from the corresponding supply conductor. A means of isolation of the neutral conductor in a TN-S or TN-C-S system is not generally required where that conductor can reliably be regarded as being at Earth potential. The neutral conductor (PEN or N) for supplies provided in accordance with the ESQCR 2002 is considered to be connected with Earth by a suitably low resistance. For a TT system, the neutral conductor as well as the phase conductor are required to be provided with a means of isolation.

² Note that motor circuits may include a capacitor such as a start capacitor which would store energy. The stored energy has to be discharged before work can be undertaken on the circuit.

means the isolated equipment cannot be re-energised accidentally or inadvertently.

The procedure of 'Isolation' includes (a) correct identification of the equipment and circuit to be worked on, (b) disconnection, (c) securing the means of disconnection, (d) posting notices and



NOTE: Circuit protective conductors not shown

Figure 1: Insertion of a local isolator in the lighting and extract fan circuit for a windowless bathroom in dwellings

(e) proving dead. In some cases additional precautions will also be needed. Please refer to the HSE publication: Electricity at Work: Safe Working Practices.

Requirements applicable to isolation are given in BS 7671: 2001 Requirements for Electrical Installations and Regulation 12 of the EWR and these requirements are summarized in Table 2.

Isolation of an extract fan

Let us take the case of an extract fan in a dwelling and assume the installation is part of a single-phase TT system. The issue of isolation will arise during the lifetime of the installation when an electrician is called in to repair or replace the extract fan. The electrician will need to isolate the fan from the source of energy in order to work safely on it. As the installation is part of a TT system, both the phase and neutral conductors will need to be isolated.

The main switch in the consumer unit

In many dwellings the main switch of the consumer unit can form a perfectly adequate means of isolation. In such a case, the electrician will switch off the main switch, take precautions that it will not be inadvertently or unintentionally switched back on, and then having verified all the conductors

of the fan circuit are dead, be able to work in safety on the fan. The difficulty that can arise when using the main switch as the means of isolation is that it is often remote from the extract fan and there is a very real risk of someone inadvertently switching the supply back on. The electrician is therefore required to take adequate precautions against this happening by means such as securing the main switch with a padlock or locking the cupboard or door where the consumer unit is located and putting notices.

A circuit-breaker in the consumer unit
In the case of an installation forming part of a TN system where the neutral conductor can be regarded as being reliably connected with Earth, it may not be necessary to disconnect both conductors and safe isolation may be able to be achieved by isolating the phase conductor by means such as switching off and locking off the appropriate circuit-breaker providing the device is suitable for such use. Note that putting a bit of insulation tape over a switched-off circuit-breaker is not sufficient. Once again, part of the isolation procedure is to verify that all conductors are indeed 'dead'.



Figure 2: Three-pole isolator which can be locked off. Courtesy of MK Limited

Local isolator

Often a local isolator, such as a pull cord switch, a switched fused connection unit or a switched device installed outside the bathroom but next to the door leading in to the bathroom is provided. Providing the switch meets the requirements of isolation, the advantages of using such a switch are:

1. The electrician may decide it is safe to isolate the extract fan at this switch leaving the main switch at the consumer unit on thereby permitting operation of other electrical equipment in the dwelling, for example, the lighting circuits and the socket-outlet circuits.
2. Providing the isolator is local to the extract fan the electrician may decide there is minimal risk of it being inadvertently or unintentionally switched back on while he is working on the extract fan because he is next to it and can stop anyone interfering with it. Securing the means of isolation is thereby simplified.

Once again, the conductors that are to be worked on have to be proved to be dead.

Mechanical maintenance

An extract fan should be maintained periodically and such maintenance normally includes cleaning as the fan will almost certainly get dirty. In order for such maintenance to be performed safely, a means of switching off for mechanical maintenance is to be provided (Regulation 462-01-01 refers). The means of switching off is not necessarily intended to provide protection against electric shock but has to reliably stop the fan turning (Regulation 462-01-03 refers).

Switching off for mechanical maintenance, in this case, is to enable non-electrical maintenance to be performed safely without the risk of injury from mechanical movement. The demands of safety are such that the same means of preventing unintentional or inadvertent reclosure of the switch must be provided as for the function of isolation. The means provided for the function of isolation will, in almost all cases, be sufficient to meet the requirements for switching off for mechanical maintenance.

Functional switching

Functional switching is an operation intended to switch 'on' or 'off' or vary the supply of electrical energy to all or part of an installation for normal operating purposes. The purpose of functional switching is to enable current-using equipment, such as an extract fan, to be controlled for normal operating purposes. The control may be manual, such as a simple fan on/off switch or automatic such as a timer circuit or variable such as a speed control.

Emergency switching

The provision of emergency switching requires the identification and assessment of reasonably foreseeable dangers. Regulation 463-01-01 refers. An extract fan in a bathroom or kitchen is unlikely to cause danger such that an emergency switch will be required.

A mains voltage extract fan may be installed in zone 1, 2 or 3 providing the additional requirements listed below are met:			
Requirement	Zone 1 ¹	Zone 2	Zone 3
IP rating	At least IPX4 (Regulation 601-06-01)		The fan has to be suitable for the conditions (Regulation 512-06-01)
RCD protection	30 mA RCD protection is required ² . (Regulation 601-09-02)	Note that Manufacturer's instructions for mains voltage fans may include the recommendation that 30 mA protection be provided. Such instructions should be followed.	
A SELV extract fan may be installed in zone 1, 2 or 3 providing the requirements listed below are met:			
Source	The safety source, such as the transformer, may have to be installed outside of the zones (Regulation 601-08)		
IP rating	At least IPX4 (Regulation 601-06-01)		The fan has to be suitable for the conditions (Regulation 512-06-01)

Table 3: Requirements applicable to a fixed extract fan installed in a location containing a bath tub or shower basin

¹ Fixed current-using equipment such as an extract fan may be installed in zone 1 if (i) it is suitable for the conditions of that zone, (ii) can reasonably only be located in that zone and (iii) RCD protection is provided (See Regulation 601-09-02(iii)).

² The Residual Current Device used is required to have a rated residual operating current not exceeding 30 mA in accordance with Regulation 412-06.

Requirement	Zone 1	Zone 2	Zone 3	Outside the Zones	Outside the bathroom
Local isolator permitted?	Isolator operating at mains voltage not permitted. Only SELV switches are permitted (Regulation 601-08-01)		A local isolator may be installed but it has to be suitable for the conditions (Regulation 512-06-01)		
IP rating	At least IPX4 (Regulation 601-06-01)		Isolator has to be suitable for the conditions (Regulation 512-06-01)		

Table 4: Requirements applicable to a local isolator¹ for an extract fan installed in or adjacent to a location containing a bath tub or shower basin

¹ Note that plate-type switches are unlikely to have a suitable IP rating and will need to be installed in zone 3 or outside the zones. Often such switches are installed on the outside of the bathroom but next to the door leading into the bathroom. Pull cord switches are unlikely to have a suitable IP rating and while the pull cord itself may enter zone 1 or 2, providing it is an insulating pull cord, the body of the switch will have to be installed in zone 3 or outside the zones. Hence, in a bathroom with a ceiling height greater than 2.25 m or 3 m the body of the pull cord switch may be installed in zone 3 or outside the zones (But see Regulation 512-06-01) and the insulating pull cord allowed to enter zone 1 or zone 2 (See Regulation 601-02-01 and Figures 601A and 601B in BS 7671).

Windowless bathrooms.

Windowless bathrooms and toilets have to be fitted with a fan that often includes a timer circuit to ensure the fan continues to run for a period after the light has been switched off. Figure 1 illustrates a typical configuration for a circuit. The timer unit is often part of the fan assembly. A two pole isolator inserted at X-X in the circuit would effectively isolate the fan and timer unit but would also isolate the bathroom light which would result in inconvenience

for the electrician who would then need to provide a light source.

A three-pole isolator inserted at Y-Y in the circuit would be preferable as it would permit the light to be left energized whilst the fan or timer unit was being worked on.

The electrician called upon to work on the timer unit or extract fan has to verify that the correct circuit has been isolated and all the conductors are indeed dead before he starts work as there is a real risk of incorrect wiring in such a circuit.

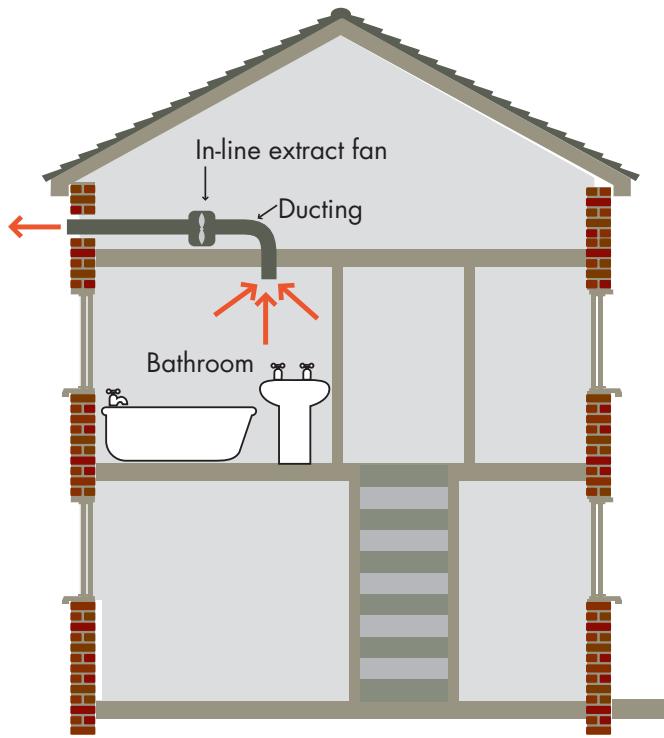


Figure 3: Inline extract fan and ducting

Additional requirements applicable to an extract fan installed in a location containing a bath tub or shower basin in a dwelling

A fixed extract fan can be installed in a location containing a bath tub or shower basin providing the additional requirements listed in Table 3 are met.

The requirements given in Table 4 are required to be met for a local isolator installed in or adjacent to a location containing a bath tub or shower basin.

Supplementary bonding

Where a mains voltage fan or its local isolator, if any, is installed in zones 1, 2 or 3, local supplementary bonding has to be provided connecting together the protective conductor of the fan circuit and extraneous-conductive-parts in these zones (Regulations 601-04-01 and 601-04-02 refer).

Inline extract fans

Inline extract fans providing air extraction through ducting are often installed in the loft above a bathroom to provide bathroom ventilation as illustrated in Figure 3. An extract fan mounted in the loft above the bathroom is not 'in the bathroom' and hence is not subject to the supplementary requirements placed by Section 601 of BS 7671. Note that the fan is, of course, subject to the general requirements contained in the other Parts of BS 7671. ■

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