Fire Alarm Systems

A short guide to fitting them in Churches and Church Halls

Introduction

The majority of churches will not need to consider the installation of a fire alarm system. The need for such a system will be indicated by the Fire Risk Assessment that has to be carried out under current legislation – see the following section. This leaflet has been written for those that think they need a system to explain briefly in plain English what is involved in a relatively technical matter. If your Fire Risk Assessment identifies a risk that may be overcome by the installation of a fire detection system or a sprinkler system, contact the DAC's Consultant on Fire precautions via the Diocesan Office. You should also consult your church architect particularly about the location of equipment and cable runs. The usual authorisation for works will also be required.

Legislative requirements

The Regulatory Reform (Fire Safety) Order 2005 (FSO) came into effect from the 1st of October 2006. Churches and church halls are classified as 'places of public assembly', graded in capacity as small (60 or less), medium (over 60, less than 300), and large - 300 or more. All churches and halls are included, there are no exceptions.

The FSO requires that a 'Fire Risk Assessment' (FRA) is carried out of every building to which the FSO applies. Included in the FRA are the following provisions:

(a) providing adequate means of escape;

(b) giving adequate warning in the event of a fire, including to those who are visually or audibly handicapped.

The government guides to the legislative requirements point out that in older buildings there may be problems in making structural alterations to protect escape routes, and that compensatory factors may be needed. These include fire detection systems which can give a warning of fire when the fire is still in its early stages.

The legislation requires that, if fire alarm systems are required to be installed, they must be checked and maintained to appropriate standards. You also need to be aware that Fire and Rescue Services can now charge for attendence to 'unwanted' (false) fire alarms if they occur too frequently, which is another reason for ensuring your system is correctly designed, installed and maintained.

The role of a Fire Alarm System

The most important function is that of enabling those anywhere in a building to raise an alarm if they discover a fire or to be alerted to such a discovery. This is done by the traditional 'Break Glass' call points placed around the building, and 'Alarm Devices'. These devices are activated from a 'control panel' at some convenient point. For larger buildings the panel will have a number of 'zones' each relating to a certain area of the building to identify quickly where the alarm is coming from. In addition, the ability of fire detectors to automatically raise the alarm when the building is in use may be able to compensate for known but non-remedial structural defects in a building which could affect people's escape.

The second function of a fire alarm system is to protect the property, particularly when it is empty. This will depend on the installation of fire detectors around the building. The empty property protection role will need the fire alarm system to be linked to the outside world in some way.

The components of a Fire Alarm System

The Control Panel

The panel monitors the alarm system's mains supply and the system's wiring, and alerts occupants when a fault develops. This panel usually contains batteries which allow the system to operate for specified periods should there be a mains supply failure; otherwise the panel ensures the batteries are kept charged. (Most fire alarm systems operate at 24 volts DC.) When a detector or call point is operated the panel turns on the warning devices to alert occupants and operates any link to an external monitoring point; the fire service may be called automatically by this link, otherwise the occupants will have to dial '999' themselves, preferably from outside the building.

Call Points

These are the familiar 'red boxes' found in buildings. Originally with a glass front which had to broken with some effort, plastic-coated thin glass or plastic elements allow activation by thumb pressure without potential injury and without risk of glass fragments being scattered. The call points are designed so they need a tool of some sort to reset them (so the operated point can be identified). They must be sited by every exit from the building and certain maximum distances apart. It is often the custom to ensure fire extinguishers are close to a call point to form a recognizable 'fire point' where someone going to get an extinguisher can also raise the alarm.

Fire Detection

Fires are detected by the changes they bring about to the atmosphere in the building. This may be by the heat they generate, and the products of combustion they add such as the smoke particles or more recently the gases they produce, such as carbon monoxide. The heat in a fire causes the products of combustion to rise towards the ceiling. In small buildings there is usually little problem with mounting detectors on or near the ceiling. Complications can arise in large buildings where hot air layers may build up under the ceiling ('stratification') when detection of the fire may be delayed. The use of a ‘hot smoke test’ may be appropriate to confirm this condition and to confirm that the new fire detection system is operating satisfactorily, especially during commissioning.

Detectors can communicate with the control panel in one of two ways - see 'Connections' below.

Types of Detector

(a) Point Detectors

Individual units usually fitted, one to each 100m^2 of floor area. They are graded into different classes on their response to a range of test fires in a room 3m high. The maximum ceiling height they may be used at depends on their class.

Detection is effected through:

- a set temperature being exceeded;
- the temperature increasing rapidly ('Rate of Rise');
- smoke particles affecting the flow of electrical current through an 'Ionisation' chamber;
- smoke particles reflecting light (visible or infra-red) - 'optical' detection;
- sensors sensitive to Carbon Monoxide gas (note that these detectors degrade with age and need to be replaced within 10 years).
- Flame detectors which “look” for a flame. These are not recommended for use in churches.

Recent designs of detectors can combine two or more of these methods to make detectors more sensitive to fires and less sensitive to false alarms - often referred to as 'dual’ or ‘multi-sensor'.

(b) Beam detectors

A beam of light, usually infra-red, is projected across a little below the ceiling of a building and reflected back to a sensor. Smoke particles in the air reduce the amount of light measured by the sensor and thus give the alarm. The system has to cope with building movement and temporary beam blockage.

(c) Sampling detectors

Small diameter pipework runs across or above the ceiling. Small holes are drilled in the pipe or short lengths of flexible tubing are connected to it and project through to the underside of the ceiling. The pipework is brought to ground level at a convenient location, where a pump draws air from the pipework (and thus from the space being protected) and passes it through a chamber where smoke particles are detected by optical or electrical means. This system has the advantage that it can be made very sensitive and is easy to maintain as the works are accessible.

(d) Closed Circuit Television

Where large buildings are covered internally by CCTV cameras, there are now a few systems available in which such cameras can be connected to a computer which analyses the pictures. It also requires that the building be lit continuously by visible or infra-red light. Currently this method of detecting fires is not proven in churches and cannot be recommended.

It should be clear that detectors in categories (b) and (c) may be particularly good for use in high buildings where the maintenance of such units is much easier than a number of point detectors at high level giving the same level of protection.

Alarm Devices

Traditionally large electric bells were used, or in some large buildings rotating sirens powered by electric motors. Electronic sounders were introduced as these used less current to give the same alarm sound level. The most recent developments include 'Voice message' sounders. These give verbal messages, either standard ones or your own; research in the past decades has shown people respond more readily to speech messages rather than unexplained bells and other signals. If the building is fitted with a suitable sound system this may be used to give the fire alarm/evacuate signals rather than specialist devices. But it will need to comply with various requirements for stand-by power and reliability.

In some places it may be necessary to give a 'two-stage' alarm; the first signal sounded is an 'alert' sound, and may be followed by a different 'evacuate' signal to tell all that the building must be cleared.

Visual warning devices, originally designed for work areas with high sound levels, are now much more common under the Disability Discrimination Act to give a fire warning to the deaf.

Connections

The various parts of the fire alarm system need to be connected together for the system to operate properly. There are three ways of doing this.

(a) Simple systems

Each 'Zone' in the building has its own pair of wires powering the detectors. The detecting devices themselves say that there is a fire (or a fault) from their internal circuits, and send this signal down a pair of wires to the control panel which takes the appropriate action to alert the occupiers. Each of the wiring circuits is monitored by an 'End of Line' (EoL) device at the furthest point of the circuit. Sounders may be operated through the same pair of wires or from separate circuits - at least two so that a fault on one does not stop the alarm being given entirely. The sounder circuits are also monitored with EoLs. This technology is well established and at reasonable cost.

(b) Analogue-Addressable systems

A digital system in which each detector (call-points are handled like detectors) is asked in turn ('interrogated') to tell the control panel what it is measuring in terms of what it is

designed to detect. The control panel then works out if there is a significant change since the detector was last asked and takes the appropriate action if there is. Each detector has its own unique 'address' to identify it to the control panel, and wiring is in the form of 'loops' going round the building as convenient. The detectors are sorted out into 'Zones' by programming the control panel, not by the particular wiring loop they are on. Alarm devices are connected to the same loops of wire as detectors/call-points and are monitored as well.

The advantages of this system are:

- improved fire location - the control panel will tell you the specific detector and its location and thus where the alarm is coming from;
- improved fault detection - the system can point out individual detectors, alarm devices or parts of circuits which are faulty.

The ability to program the panel also has benefits in:

- a considerable improvement in reducing false ('unwanted') fire alarms by elimination of temporary false readings or to reduce the sensitivity of parts of the system appropriately;
- enhanced fire detection by comparison of adjacent detectors.

But these advantages are bought only by a considerable increase in the costs of the components of such a system, although the simplified wiring may reduce the installation cost.

(c) Radio Systems

Fixed wiring is replaced by a digital radio link. Under normal conditions each detector transmits its status to the control panel. However when the detector senses a fire it goes into alarm model and continuously transmits to the control panel. If the control panel fails to receive a signal from a detector within about 4 hours it reports the fault. Either simple detectors or analogue-addressable detectors may be used, and the control panel chosen accordingly. Call points and detectors are usually powered by Lithium batteries with a life of five to ten years, although this may be less in cold buildings; the condition of the battery in each device is also monitored via the radio link. Alarm devices may be wired to the control panel, or each may have its own small mains/battery power source. In the latter case the radio system will monitor the power supply and trigger the alarm device when needed.

The advantages are:

- particularly suitable for large buildings where cable runs would be extensive;
- reduced installation time because only the call-points, detectors and alarm devices need to be fixed in place;
- particularly suitable for heritage buildings as there is minimal interference with the structure and little visual intrusion due to the lack of wiring;
- easily altered if need be as cable does not have to be moved.

The disadvantages are:

- high cost, even allowing for the saving on buying wire and installing it;
- need to renew batteries at intervals;
- may not work well in some circumstances.

Fixed Wiring

The fire alarm system must continue to operate even in fire conditions, and so its wiring must be resistant to fire. There are several approved brands of fire resistant cable, but that most favoured for churches is 'Mineral Insulated Copper Cable', abbreviated to MICC. (Electricians often refer to it as 'Pyro' - short for 'Pyrotenax' the brand name of the original MICC supplied in this country.) It is small in diameter and stays in place easily once fixed. It is available in a plastic sheath for protection in damp places; this sheath is available in a 'stone' colour for minimal visual intrusion. It resists flame, heat and mechanical impact to a much higher degree than ordinary PVC covered cable. But it needs special connections at the ends of

each cable length which will increase installation costs. ‘FP200’ is a less expensive cable which is both small and fire-resistant, but will need mechanical protection in some places against impact and similar damage. Both cable types are suitable for both simple and analogue-addressable systems.

Standards for Fire alarm design, installation and Maintenance

British Standard 'BS 5839 Part 1: Fire detection and alarm systems for buildings. Code of Practice for system design, installation, commissioning and maintenance.' This is a technical document and the DCLG Guides give advice based on this BS. The information in the guides should be adequate for most churches and church halls.

An alarm designer/installer should be approved under either the BAFE scheme (British Approvals for Fire Equipment) or by the Loss Prevention Certification Board (LPCB), now part of the BRE Certification system.

Components for fire alarm systems should either be LPCB approved or Kitemarked by BSI.

Church Installations

The following matters should be considered:

- Has the FRA pointed out a structural defect which cannot be remedied and for which an alarm system may be a compensatory factor to ensure safe escape?
- Has the FRA pointed out any area remote from the main body of the church but where people may be at risk and need to be informed of a fire? (Examples: the bell-ringing chamber, a vestry/meeting room)
- Has the FRA pointed out any area where a fire might develop unseen? (Eg storeroom, floor or ceiling cavity)
- Has the FRA pointed out any need to cater for those who are deaf? (Eg should visual beacons be fitted?)
- Has the FRA pointed out any need to consider the type of alarm sounder to be used?
- If automatic detectors are included in the church, how will these be managed to cope with smoke from candles, incense and other legitimate sources?
- To what degree might automatic detectors be affected by heating systems, draughts and 'stratification'?
- If the automatic detectors are to give property protection when the building is empty, will you connect the system to a commercial 'central station' or rely on a telephone dialling system?

Church Hall installations

The following matters should be considered:

- Has the FRA pointed out a structural defect which cannot be remedied and for which an alarm system may be a compensatory factor to ensure safe escape?
- Has the FRA pointed out any area remote from the main hall but where people may be at risk and need to be informed of a fire? (Example: a vestry or meeting room)
- Has the FRA pointed out any area where a fire might develop unseen? (Eg storeroom, floor or ceiling cavity)
- Has the FRA pointed out any need to cater for those who are deaf? (Eg should visual beacons be fitted?)
- Has the FRA pointed out any need to consider the type of alarm sounder to be used?
- Do you expect there to be a risk of malicious operation of call points and if so, what measures to counter this have you considered?

Multipurpose Buildings/linked buildings

Where there is a single multipurpose building, particular attention should be paid to areas which may be in use simultaneously but for unconnected activities and the need to warn all in the building of a fire.

Where a church and its hall are physically joined buildings - for example they have a common entrance, or a linking passageway, you will need to consider the degree to which they need to be interconnected by the fire alarm. Factors include:

- could an activity in the hall set off the fire alarm during a church service?
- likewise, can activities in the church cause an alarm in the hall?
- should only an alarm in the area of the physical link between the two buildings raise the alarm in both?

Your FRA should guide you in making this decision.

Connections with the Outside World

A telephone line can be used to link the alarm system to the outside world. This may be either to a commercial control centre or by an 'auto-dialler' calling one or more numbers. For the first option this may be done by using, for example, BT's 'Redcare' system; it is quite permissible to use such a connection for both fire and security alarms. In the second option the 'auto-dialler' should be connected to an ex-directory line and can be given several numbers to call; one of these may be '999' but many fire and rescue services will no longer accept calls sent this way except in special circumstances. It is best to contact the local Fire and Rescue service (usually the fire safety people - see telephone directory) and ask what their policy is.

Additional information and advice is available from the DAC team:

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