Fire Detection & Alarms

Guide to the use of Surge Arrestors in Fire Detection and Fire Alarm Systems
INTRODUCTION

Fire alarm installers ask fire alarm manufacturers for guidance on external surge arresters as a result of changes to BS 7671 (regulation 443).

To assist FIA member companies, the FIA FDWG5 was tasked with producing a guidance document on the use of external surge arrestors for use with fire alarm systems.

The practical experience of members of the working group is that such devices are not needed and are not used on most fire alarm systems, but surge arrestors are sometimes used with exceptional systems – such as those that are connected across very large sites or between multiple buildings.

The EMC product family standard for fire alarm systems is EN 50130-4.

To date it has always been assumed that compliance with EN 50130-4 ensures that additional surge arrestors are not needed. This has been borne out by FIA members’ experience. However, a simple comparison of EN 50130-4 and BS 7671 indicates that is not the case.

FIA FDWG5 represents the main technical input to FSH12/3 and so the question was raised to national level and FSH12/3 obtained guidance from JPEL/64 with respect to the intent and application of BS 7671 section 443.
TECHNICAL REVIEW

Comparing EN 50130-4 and BS 7671 table 44.3 implies that fire alarm systems sit between category 1 and category 2. BS 7671 advises that category 1 equipment would need external devices and category 2 equipment might need such devices.

However, the tests in EN 50130-4 are intended to ensure that the equipment does not malfunction when subjected to typical interference expected from indirect lightning strikes. In some applications and in some countries much higher levels of voltage withstand might be required.

The voltage withstand limits referenced in BS 7671 refer to the insulation withstand voltage which is tested via the application of DC or mains frequency AC rather than simulated lightning strike characteristic waveforms. Therefore the voltage limits of BS 7671 are really related to the safety design criteria that are applied to ensure that the fire alarm system complies with the low voltage directive, rather than the EMC directive.

The LVD requires that the product is safe. The EN54 series of standards does not cover this and manufacturers generally use EN 60950-1 as the design guide for electrical safety.

Compliance with EN 60950-1 is deemed to mean that the product is safe, and therefore complies with the LVD. Some manufacturers choose to have their products third party tested to EN 60950-1, but all that is required from a legal point of view is that the manufacturer makes a self-assessment and provides a declaration of performance stating how the product meets the legal requirements.

Surge arrestors are generally used to counter the effects of electrical disturbances such as lightning strikes or switching impulses. The waveforms for such effects are described in standards and the lightning characteristics are generally the more severe from an EMC point of view because the rising edges are much faster. Therefore for EMC compliance the surge tests used relate to the characteristics of lightning rather than switching.

From an electrical infrastructure point of view, insulation breakdown can cause a temporary reduction in insulation withstand voltage, such as when arcing takes place in air, or a permanent reduction in withstand voltage such as might occur if a cable were damaged by over voltage.

Surge arrestors are used to reduce the risk of damage from over voltage situations and there is a balance between the cost of using external surge arrestors and the cost of increasing the voltage withstand characteristics of the equipment and the installed infrastructure. The BS 7671 regulations are based on the voltage withstand voltage limits of the equipment.

Fire alarm systems must operate without malfunction in typical applications, and the appropriate limits for this are incorporated in EN 50130-4.

Fire alarm suppliers need to ensure that the equipment provided is fit for purpose and in most cases the fire alarm system is supplied from a dedicated circuit from the electrical distribution board, and installed within a single building.

To comply with the requirements of the LVD, it is expected that most equipment designed to be connected to the mains supply (eg EN 54-4 power supplies), would be designed in accordance with category II of EN 60950-1. There may be occasions where such equipment is installed in situations that demand a higher level of resistance to over-voltage. The manufacturer then has the choice of designing the equipment to comply with a higher over-voltage category, eg category III or IV, or use external surge arrestors to ensure that the equipment is locally protected from over-voltage situations. If the latter case, then the manufacturer should provide some guidance to allow installers and specifier’s to select suitable protection devices.

If cables have to be connected between buildings or outside a building, then the fire alarm system becomes potentially vulnerable from over voltage possibly causing damage and electrical disturbances, which might cause malfunction of the system. In these situations the fire alarm supplier might find it necessary to specify additional protection means to ensure that the system functions as intended. External surge arrestors might be used, but other techniques such as galvanic isolation, use of radio links or optical fibre might be appropriate.

For most UK fire alarm systems (99%) no external devices are used and it is very rare that fire alarm systems are damaged by electrical surges. It would seem therefore that the criteria specified in EN 50130-4 and EN 60950-1 are sufficient for most installations across Europe as well as in the UK.
RECOMMENDATIONS

The fire alarm equipment manufacturer must comply with the law, which requires compliance with all appropriate EU Directives. This usually includes third party testing to any applicable standards such as part of the EN 54 series (CPR) and compliance with standards such as EN 50130-4 (EMCD) and EN 60950-1 (LVD).

However, the manufacturer must decide the level of insulation appropriate when applying the requirements of EN 60950-1, and he might also choose to design for a higher level of protection than is specified in EN 50130-4. This might increase direct costs, but he might justify this by knowing that the equipment is more robust and so there will be less chance of incurring additional after sales costs than compared with minimum legal compliance.

For most fire alarm systems, designing to category II in EN 60950-1 and using the standard limits specified in EN 50130-4, is sufficient to satisfy legal requirements and to ensure that the fire alarm system will operate reliably in all typical commercial and industrial applications where the fire alarm system is installed within a single building. No other protection is needed.

If there is a need to connect systems between buildings, or over very large distances, or if the system cables have to be installed outside the building, or if the building EMC environment is more severe that that covered in the generic EMC standards, special measures of protection might be needed and it is recommended that the manufacturer seeks the advice of a specialist.

When considering the advice needed by installers with respect to external surge arrestors, the manufacturers of such equipment offer excellent technical applications information and it is recommended that the fire alarm manufacturer make use of this resource.

Fire alarm manufacturers might consider drafting some standard in-house rules for the use of external protection devices and might also include such advice in their installation instructions or in separate data sheets if they frequently encounter situations where additional protection is needed.
REFERENCES AND APPLICABLE STANDARDS

This guide is intended to give general awareness of the subject and it is recommended that equipment manufacturers carry out their own investigation and research.

Most manufacturers of external surge arrestors publish useful guidance documents on the application of their equipment and such guides are a good starting point.

The following standards should also be referred to:

• BS 7671:2008 Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
• BS EN 50130-4:2011 Alarm systems. Electromagnetic compatibility. Product family standard. Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems
• BS EN 54-4:1998 Fire detection and fire alarm systems. Power supply equipment
• PD IEC/TR 60664-2-1:2011 Insulation coordination for equipment within low-voltage systems. Application guide. Explanation of the application of the IEC 60664 series, dimensioning examples and dielectric testing
• BS EN 60071-1:1996 Insulation co-ordination. Definitions, principles and rules
• BS EN 60071-2:1997 Insulation co-ordination. Application guide
• PD IEC/TR 60071-4:2004 Insulation co-ordination. Computational guide to insulation co-ordination and modelling of electrical networks
• BS EN 60950-1:2006 Information technology equipment. Safety. General requirements.

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