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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Fire detection and alarm systems, detector and sounder devices

ITU-T Recommendation L.21

(Previously CCITT Recommendation)

ITU-T L-SERIES RECOMMENDATIONS

CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

For further details, please refer to ITU-T List of Recommendations.

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation L.21 was prepared by ITU-T Study Group 6 (1993-1996) and was approved by the WTSC (Geneva, 9-18 October 1996).

NOTES

1. In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

2. The status of annexes and appendices attached to the Series L Recommendations should be interpreted as follows:

- an *annex* to a Recommendation forms an integral part of the Recommendation;
- an *appendix* to a Recommendation does not form part of the Recommendation and only provides some complementary explanation or information specific to that Recommendation.

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Recommendation L.21

FIRE DETECTION AND ALARM SYSTEMS, DETECTOR AND SOUNDER DEVICES

(Geneva, 1996)

1 Introduction

In order to protect property and, when applicable, life, protective fire detection and alarm systems can be installed to initiate a number of different activities:

- detection and location of a fire;
- provision of assistance to contain and/or extinguish the fire;
- emergency evacuation procedures;
- summoning of fire-fighting forces.

It should be noted that a fire detection and alarm system can do nothing to reduce the incidence of fires. It can however reduce the delay between ignition and effective fire-fighting. A satisfactory alarm system for the protection of property will automatically detect the fire at an early stage, raise an effective alarm in time to summon the fire-fighting forces and indicate the location of the fire. An early alarm of fire enhances the safety of personnel by increasing their chances of escape.

Taking into account the risk of fire and action to reduce the magnitude of danger from fire, quick detection is the first criterion to be considered followed by the activation of extinguishing measures.

Detection devices are part of the automatic fire detection and alarm systems. These systems monitor continuously, or at frequent intervals, the physical and/or chemical characteristics of a protected fire area (zone).

The function of detectors is to identify fires as soon as possible and, through the control and indicating equipment, to activate alarms and adopt pertinent measures to extinguish possible fire breakouts, to evacuate personnel and to notify safety and fire-fighting services. These detectors function directly with fire alarm equipment and automatic fire-extinguishing systems, to minimize the damage caused by fire.

2 Detectors

2.1 Automatic detectors

In accordance with functional characteristics (detection technologies used) and technological characteristics (discrete identification or variable threshold detection), the detectors to be installed are classified as follows.

2.1.1 Heat detectors

According to the way in which the sensing is done, they are classified as:

- *Fixed temperature*

  These are designed to operate when they reach a pre-selected threshold temperature.

- *Rate-of-rise of temperature (differential)*

  These are designed to operate when the environmental temperature rises abnormally quickly.

- *Combination*

  To respond to both very slow growing and rapidly developing fires.

2.1.2 Smoke detectors

According to the way in which the sensing is done, they are classified as:

- *Ionization chamber smoke detectors*

  These rely on the reduction of an electric current flowing between the electrodes in an ionization chamber when smoke particles enter the chamber. They are particularly sensitive to smoke containing small particles such as are produced in rapidly burning fires.

– *Optical smoke detectors*

These are designed to operate by detecting the scattering or absorption of light by smoke particles. They are sensitive to the larger particles found in optically dense smoke produced by smouldering fires.

– *Volumetric or beam detectors*

These work on the principle of optical obscuration and detect the presence of smoke in only a small part of the beam. Some optical beam smoke detectors can also sense thermal turbulence from a fire by detecting the refraction of the beam at turbulent interfaces between hot and cold air.

2.1.3 Flame detectors

According to the way in which the sensing is done, they are classified as:

– *Ultraviolet radiation detectors*

These use ultraviolet radiation sensitive cells that see the fire directly or through built-in lenses or reflectors.

– *Infrared radiation detectors*

These use infrared radiation sensitive cells that see the fire directly or through built-in lenses or reflectors. They are designed to respond to the flickering radiation emitted by the diffusion type of flame normally found in fires.

2.1.4 Addressable detectors

These components of the fire alarm system have a discrete identification that can have its status individually identified or that is used to individually control other functions.

2.1.5 Intelligent detectors

These have the capability of modifying automatically their detection thresholds according to the environmental conditions.

2.2 Manual detectors

These manually triggered devices (manual call points) are placed in buildings because they allow an earlier warning to be given than the automatic detection and alarm system if personnel are present at the ignition of a fire.

2.2.1 Manual sounders (audible alarms)

Sounders can be used manually to give an alarm of fire.

Where there are other parts of the building unlikely to be affected by the fire, the system may be arranged that the sounders are only activated manually only in the zone with the fire and in adjoining areas for the evacuation of personnel to safe areas.

3 It is recommended that

3.1 General

As a fire can start almost anywhere within a building and if undetected grow until extinction becomes difficult or impossible, the highest level of property protection is recommended with the detection and alarm system installed throughout the building.

3.2 Circuit design

The design of a fire detection and alarm system should provide reliable facilities for transmission of signals to the control and indicating equipment from manual call points (manual detectors) or automatic detectors and for the transmission of any resultant fire signal to both sounders and ancillary equipment which is operated by the fire detection and alarm system.

An indication should be given of any fault in the wiring circuits or power supply without giving a false fire alarm.

A fault in one zone should not affect the operation of the fire detection and alarm system in other zones of the building. Disruption during maintenance and testing should be minimized. Where sounders use the same wiring as detectors, no alarm sounder should be affected by the removal of a detector for maintenance. Where a sounder is removed for maintenance, a fault warning should appear at the control and indicating equipment.

Where microprocessors are used in fire detection and alarm systems, their memories should be protected against unauthorised interference. Also, their operation should be continuously monitored for accidental corruption, for example by transient interference.

3.3 Detectors

Suitable detectors should be placed in all zones (fire areas) which are to be fire protected and should convey an alarm to the control and indicating equipment either by hard wiring or by wireless.

The combustion characteristics of all materials present in a fire area (zone) should be analysed to ascertain the type or types of detector to be installed.

In accordance with functional characteristics (detection technologies used) and technological characteristics (discrete identification or variable threshold detection) the detectors to be installed are classified as follows.

3.3.1 Heat detectors

These devices should be placed in fire areas (zones) with defined temperature thresholds and where smoke may normally be present, that is in kitchens and diesel engine rooms.

3.3.2 Smoke detectors

These devices should be placed in fire areas (zones) where ignited elements generate smoke before breaking out into flames.

3.3.3 Flame detectors

These devices should be placed in fire areas (zones) to detect flames from ignited elements.

3.3.4 Intelligent detectors

These devices should be placed in fire areas (zones) in buildings of high complexity and with a diversity of combustible elements, equipment and personnel. They may be either smoke or heat detectors.

3.3.5 Manual detectors (manual call points)

These devices should be placed in fire area (zones) frequented by personnel. They should be located on exit routes and floor landings of stairways, located within a specified distance (for example, 30 m) of personnel work places and be easily identifiable against a contrasting background.

3.3.6 Manual sounders (audible alarms)

The acoustic signalling devices of the fire alarm system should be distributed throughout the building so that its signal emitted either automatically or manually would be audible in any place.

In rooms containing customers and service personnel, the acoustic signal should be of lower power, though perfectly audible, because the permanent presence of personnel ensures detection of the alarm at lower power levels. If the loudness level is very high it could induce panic, nervous excitement and confusion in the customers.

The sounder frequencies should preferably be in the range of 500 Hz to 1000 Hz.

Buildings of several floors should have at least one audible alarm per floor.

The wiring of sounder circuits should be arranged so that in the event of a short circuit developing in any part of the circuits due to the fire, at least one sounder will continue to operate. This minimum provision should ensure that a general alarm can be given at the start of a fire and for a significant period thereafter. Where the single sounder is not audible throughout the building, sounder cables likely to resist fire for a sufficient period should be used.

Where the fire detection and alarm system extends to other parts of the building unlikely to be affected by the fire, the system may be arranged such that the alarms sound in the area (zone) with the fire and in adjoining areas, for the evacuation of personnel to safe areas. Or the system may be arranged such that the alarms only sound in the zone with the fire.

It should not be possible to prevent the transmission of the alarm by the act of silencing the alarm sounders nor should it depend on the state of any silencing switch.

3.4 Visual alarms

In areas where high sound levels may persist for more than 30 s, (for example, in diesel rooms with an engine running) visual alarms (for example, in the form of a flashing light) should be used. The wiring of the circuit should be arranged with the same precautions as those described above for sounders (audio alarms).

3.5 Communication with the fire brigade

The responsibility of calling the fire brigade should be both clearly specified and understood. A special telephone line should be routed through the building to avoid areas where fire is likely to start or spread rapidly. The line should be barred from receiving incoming calls and it should only be used for emergency outgoing calls.

Appendix I

United Kingdom experience

Within the United Kingdom, British Standard BS 5839 takes into account the work of ISO/TC 21/SC 3 – Fire detection and alarm systems.

The various parts of the British Standards specification are:

- BS 5839: Part 1 – Fire detection and alarm systems for buildings.
  Part 1 – Code of practice for system design, installation and servicing.

- BS 5839: Part 2 – Fire detection and alarm systems for buildings.
  Part 2 – Specification for manual call points.

- BS 5839: Part 3 – Fire detection and alarm systems for buildings
  Part 3 – Specification for automatic release mechanisms for certain fire protection equipment.

- BS 5839: Part 4 – Fire detection and alarm systems for buildings.
  Part 4 – Specification for control and indicating equipment.

- BS 5839: Part 5 – Fire detection and alarm systems for buildings.
  Part 5 – Specification for optical beam smoke detectors.

British Standard BS 5445 covers parts of EN 54 components of automatic fire detection systems produced by Technical Committee CEN/TC 74. These are:

- BS 5445: Part 5 – Components of automatic fire detection systems.
  Part 5 – Heat sensitive detectors – Point detectors containing a static element.

– BS 5445: Part 7 – Components of automatic fire detection systems.
Part 7 – Specification for point type smoke detectors using scattered light, transmitted light or ionization.

– BS 5445: Part 8 – Components of automatic fire detection systems.
Part 8 – Specification for high temperature heat detectors.

Appendix II

Japanese experience

Japanese Standards relating to Fire Detection and Alarm Systems

Automatic fire alarm system

Fire Law Enforcement Ordinances:	Clause 21
Fire Law Enforcement Regulation:	Clause 23 Clause 24, Article 2

Gas leak fire alarm system

Fire Law Enforcement Ordinances:	Clause 21, Article 2
Fire Law Enforcement Regulation:	Clause 24, Articles 2 to 4

Short circuit fire warning equipment

Fire Law Enforcement Ordinances:	Clause 22
Fire Law Enforcement Regulation:	Clause 24, Article 3

Fire alarm system that notified fire fighting organizations

Fire Law Enforcement Ordinances:	Clause 23
Fire Law Enforcement Regulation:	Clause 25

Emergency warning equipment and installations

Fire Law Enforcement Ordinances:	Clause 24
Fire Law Enforcement Regulation:	Clause 25, Article 2

Japanese Standards relating to Evacuation and Guiding Equipment

Evacuation equipment

Fire Law Enforcement Ordinances:	Clause 25
Fire Law Enforcement Regulation:	Clauses 26 and 27

Emergency lighting and markers

Fire Law Enforcement Ordinances:	Clause 26
Fire Law Enforcement Regulation:	Clause 28, Article 3
Building Standards Law:	Clause 126, Articles 4 and 5

Emergency entrance

Building Standards Law:	Clause 126, Articles 6 and 7

Emergency Elevator

Building Standards Law:	Clause 129, Points 2 and 3 of Article 13

Appendix III

Argentinian experience

IRAM are the initials of National Institute of Rationalization and Materials – Member of ISO (International Organization for Standardization) – COPANT (Panamerican Commission of Technical Rules).

NORMA IRAM 3531:1982	INSTALACIONES FIJAS CONTRA INCENDIO. Sistemas de detección y alarma. Definiciones y descripción de detectores. (ERR.84/10).
NORMA IRAM 3551:1982	INSTALACIONES FIJAS CONTRA INCENDIO. Sistemas de detección y alarma. Aplicaciones.
NORMA IRAM 3552:1984	INSTALACIONES FIJAS CONTRA INCENDIO. Detector de temperatura, puntual.
NORMA IRAM 3554:1987	INSTALACIONES FIJAS CONTRA INCENDIO. Sistemas de detección y alarma. Proyecto y montaje de la instalación.
NORMA IRAM 3557:1988	INSTALACIONES FIJAS CONTRA INCENDIO. DETECTORES. Métodos de ensayo de respuesta al fuego.
NORMA IRAM 3558:1989	INSTALACIONES FIJAS CONTRA INCENDIO. Sistemas de detección y alarma. Tableros de control y señalización.
NORMA IRAM 3582:1990	INSTALACIONES FIJAS CONTRA INCENDIO. DETECTORES DE HUMO, POR IONIZACIÓN, POR LUZ DIFUSA Y POR LUZ TRANSMITIDA. (REV. IRAM 3582: 1982; 1983 y sus modificaciones posteriores).
NORMA IRAM 3657-1:1990	INSTALACIONES FIJAS CONTRA INCENDIO. DETECTORES DE GASES COMBUSTIBLES Y MEZCLAS EXPLOSIVAS. Prescripciones generales.
NORMA IRAM 3659:1991	INSTALACIONES FIJAS CONTRA INCENDIO. DETECTORES DE LLAMA.

Appendix IV

United States experience

IV.1 Building construction

United States model building codes: in the United States, there are several different building codes. Different codes are adopted in different areas of the country. The three major building codes are:

- national building code;
- standard building code;
- uniform building code.

IV.2 Fire prevention

United States model fire prevention codes: in the United States, there are several different fire codes. Different codes are adopted in different areas of the country. The three major fire prevention codes are:

- national fire prevention code;
- standard fire prevention code;
- uniform fire code.

IV.3 Fire system installation and related codes

United States National Standards: National Fire Protection Association (NFPA) – National Fire Codes.

IV.4 Telecommunications Equipment Fire Resistance Standards

United States National Standards: American National Standards Institute (ANSI) Standard T1.307, Fire Resistance Criteria.

Summary of Fire Safety Regulations in the United States

In the United States, little fire protection is federally mandated. Employers are required to provide a safe working environment, but the protection from fire is not specified.

Regulations are mandated by state or local jurisdictions. Rather than actually writing the codes from beginning to end, most jurisdictions elect to adopt one of the three model code series. A series includes building, plumbing, mechanical, and fire prevention regulations. The three model code series are:

1) The National Code series which, among others, includes the National Fire Prevention Code and National Building Code developed and published by the Building Officials and Code Administrators (BOCA).

2) The Standard Code series which, among others, includes the Standard Fire Prevention Code and Standard Building Code developed and published by the Southern Building Code Congress International (SBCCI).

3) The Uniform Code series which, among others, includes the Uniform Fire Code and the Uniform Building Code developed and published by the International Fire Code Institute (IFCI).

Membership in these organizations is open, but voting privileges on code changes and related issues are reserved for registered building and fire officials.

The National Code series is adopted in the north-east and part of the mid-west of the United States. The Standard Code series is adopted by the south-eastern states of the United States. The Uniform Code series is adopted by almost all of the states west of the Mississippi River.

The three model code organizations are moving towards developing one code. A joint organization has been created called the International Code Council (ICC) with the responsibility of developing one unified code. The Board of the ICC is made up of 12 seats with four allotted to each of the model code organizations.

So far, the ICC has developed and published a unified Model Plumbing Code which is now available for adoption. They have plans to come out with unified Model Mechanical, Building and Fire Prevention Codes by the year 2000.

Other organizations also develop and publish standards and codes. These are available for adoption by the Model Code Organizations or by the States directly. The one that develops the fire prevention and protection standards and codes is the National Fire Protection Association (NFPA).

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