AS 1670.1:2018

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Australian STANDARD

Fire detection, warning, control and intercom systems—System design, installation and commissioning

Part 1: Fire

STANDARDS Australia

AS 1670.1:2018

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Fire detection, warning, control and intercom systems—System design, installation and commissioning

Part 1: Fire

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AS 1670.1—1995 and AS 1670.2—1997 revised, amalgamated and designated as AS 1670.1—2004.
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Preface

This Standard was prepared by the Standards Australia Committee FP-002, Fire Detection, Warning, Control and Intercom Systems, to supersede AS 1670.1:2015.

The objective of this revision is to remove many of the legacy Standards superseded by a number of AS 7240 Standards which have been published since 2004 as well as incorporating some corrections and clarifications.

It has also introduced AS ISO 7240.17 for short circuit isolators and AS ISO 7240.18 for input/output devices to replace the requirements for distributed CIE used with AS 4428.1 systems.

All references to smoke alarms and heat alarms have been removed.

This edition also permits the use of two editions of relevant Standards relating to components. See Table 1.8 for the list of relevant editions of the Standards which apply throughout this document. Notes to clauses in this Standard do not form a mandatory part for conformance with this Standard. They are of an advisory nature only and are used to give explanation or guidance to the user on recommended considerations or technical procedures, or to provide an informative cross-reference to other documents or publications.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this Standard.

The terms "normative" and "informative" have been used in this Standard to define the application of the appendices to which they apply. A "normative" appendix is an integral part of a Standard, whereas an "informative" appendix is for information and guidance.

This Standard incorporates commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by "C" preceding the clause number and appears in italics in a box. The commentary is for information and does not need to be followed for conformance with the Standard.

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Australian Standard®

Fire detection, warning, control and intercom systems—System design, installation and commissioning

Part 1: Fire

Section 1 Scope and general

1.1 Scope

This Standard sets out requirements for the design, installation and commissioning of fire detection and alarm systems comprising components conforming to the requirements of the appropriate component Standards.

NOTE 1 Where detection and control and indicating equipment forms part of a smoke control system in accordance with AS 1668.1, specific requirements are specified in Clause 7.

NOTE 2 Where detection and control and indicating equipment forms part of a special hazard system in accordance with AS 4214, the additional requirements are covered in AS 1670.5 Fire — Special Hazards.

NOTE 3 Maintenance requirements for fire detection and alarm equipment are given in AS 1851.

1.2 Application

This Standard requires that detection and occupant warning be provided throughout all areas of the building; however where systems are installed to solely meet the requirements of the NCC, refer to the NCC for areas to be protected.

1.3 Normative references

The following are the normative reference documents in this Standard.

NOTE 1 Documents referenced for informative purposes are listed in the Bibliography.

NOTE 2 See Clause 1.8 for the list of acceptable editions of the listed relevant normative references.

AS 1603.11, *Automatic fire detection and alarm systems, Part 11: Visual warning devices*

AS 1603.13, *Automatic fire detection and alarm systems, Part 13: Duct sampling smoke detectors*

AS 1603.17, *Automatic fire detection and alarm systems, Part 17: Warning equipment for people with hearing impairment*

AS 1668.1, *The use of ventilation and air conditioning in buildings, Part 1: Fire and smoke control in buildings*

AS 1670.1, *Fire detection, warning, control and intercom systems — System design, installation and commissioning, Part 1: Fire*

AS 1670.4, *Fire detection, warning, control and intercom systems — System design, installation and commissioning, Part 4: Emergency warning and intercom systems*

AS 2053, *Conduits and fittings for electrical installations (series)*

AS 2118.1, *Automatic fire sprinkler systems, Part 1: General systems*

AS 2118.4, *Automatic fire sprinkler systems, Part 4: Sprinkler protection for accommodation buildings not exceeding four storeys in height*

AS 2118.6, *Automatic fire sprinkler systems, Part 6: Combined sprinkler and hydrant systems in multistorey buildings*

AS 4029, *Stationary batteries — Lead-acid (series)*

AS 4428.3, *Fire detection, warning, control and intercom systems — Control and indicating equipment, Part 3: Fire brigade panel*

AS 4428.16, *Fire detection, warning, control and intercom systems, Part 16: Emergency warning control and indicating equipment*

AS 7240.2, *Fire detection and alarm systems, Part 2: Control and indicating equipment (ISO 7240-2:2017, MOD)*

AS ISO 7240.3, *Fire detection and alarm systems, Part 3: Audible alarm devices*

AS 7240.4, *Fire detection and alarm systems, Part 4: Power supply equipment (ISO 7240 4: 2017, MOD)*

AS ISO 7240.5, *Fire detection and alarm systems, Part 5: Point-type heat detectors*

AS 7240.6, *Fire detection and alarm systems, Part 6: Carbon monoxide fire detectors using electro-chemical cells*

AS 7240.7, *Fire detection and alarm systems, Part 7: Point-type smoke detectors using scattered light, transmitted light or ionization (ISO 7240 7: 2018, MOD)*

AS ISO 7240.8, *Fire detection and alarm systems, Part 8: Carbon monoxide fire detectors using an electro-chemical cell in combination with a heat sensor*

AS ISO 7240.10, *Fire detection and alarm systems, Part 10: Point-type flame detectors*

AS ISO 7240.11, *Fire detection and alarm systems, Part 11: Manual call points*

AS 7240.12, *Fire detection and alarm systems, Part 12: Line type smoke detectors using a transmitted optical beam (ISO 7240-12:2014, MOD)*

AS 7240.15, *Fire detection and alarm systems, Part 15: Point-type fire detectors using scattered light, transmitted light or ionization sensors in combination with a heat sensor (ISO 7240 15: 2014, MOD)*

AS ISO 7240.17, *Fire detection and alarm systems, Part 17: Short-circuit isolators*

AS ISO 7240.18, *Fire detection and alarm systems, Part 18: Input/output devices*

AS 7240.20, *Fire detection and alarm systems, Part 20: Aspirating smoke detectors*

AS 7240.22, *Fire detection and alarm systems, Part 22: Smoke-detection equipment for ducts (ISO 7240-22:2017, MOD)*

AS ISO 7240.23, *Fire detection and alarm systems, Part 23: Visual alarm devices*

AS ISO 7240.24, *Fire detection and alarm systems, Part 24: Fire alarm loudspeakers*

AS ISO 7240.25, *Fire detection and alarm systems, Part 25: Components using radio transmission paths*

AS 7240.27, *Fire detection and alarm systems, Part 27: Point-type fire detectors using a scattered-light, transmitted-light or ionization smoke sensor, an electrochemical-cell carbon-monoxide sensor and a heat sensor (ISO 7240 27:2018, MOD)*

AS/CA S009 *Installation Requirements for Customer Cabling* (Wiring Rules)

AS 1668.1, *The use of ventilation and air conditioning in buildings, Part 1: Fire and smoke control in buildings*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3013, *Electrical installations — Classification of the fire and mechanical performance of wiring system elements*

AS/NZS 4130, *Polyethylene (PE) pipes for pressure applications*

AS IEC 61672-1, *Electroacoustics — Sound level meters, Part 1: Specifications*

IEC 60331-25, *Tests for electric cables under fire conditions — Circuit integrity, Part 25: Procedures and requirements — Optical fibre cables*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

NCC *National Construction Code of Australia*, (BCA, Volume One and Volume Two)

ISO 8201, *Alarm systems — Audible emergency evacuation signal — Requirements*

EN 54-27, *Fire detection and fire alarms systems, Part 27: Duct smoke detectors*

EN 54-22, *Fire detection and fire alarm systems, Part 22: Resettable line-type heat detectors*

EN 54-28, *Fire detection and fire alarm system, Part 28: Non-resettable line-type heat detectors*

1.4 Definitions

For the purpose of this Standard, the definitions given in the NCC and those below apply.

1.4.1
acoustically separate space
an occupied space such as a room or a part of a contiguous area, where the acoustic properties are different from other parts. These differences may be due to variations in ceiling height and/or width by more than 20 percent or where the floor covering changes from carpet to hard tiles, stone or concrete cement or where the reverberation time changes by more than 30 percent for other reasons

1.4.2
adjacent
side-by-side but not necessarily touching

1.4.3
air damper
a motorized mechanical damper that opens or closes to control air as part of a smoke control system

1.4.4
air-handling plant
a component part of an air-handling system that includes equipment providing air movement, as well as equipment for the purpose of controlling the direction, rate of airflow, division of airflow or condition of air (i.e. concentration level of contaminants, temperature and humidity)

1.4.5
air-handling system
a system for the purpose of directing air in a positive and controlled manner to or from specific enclosures by means of air-handling plant, ducts, plenums, air-distribution devices or automatic controls

1.4.6
air-pressurization system
an air-handling system designed to establish a pressure differential in accordance with AS 1668.1

1.4.7
alarm acknowledgment facility (AAF)
a configuration of FDCIE in conjunction with equipment for occupant use to provide a delay for an occupant to clear nuisance detector activation before the activation is processed as a fire alarm condition

1.4.8
alarm delay facility (ADF)
a configuration of FDCIE used to reduce nuisance fire alarm conditions by providing a local warning which if not cleared after a defined delay, will escalate to a fire alarm condition

1.4.9
alarm investigation facility (AIF)
that part of FDCIE and associated control unit which in the attended mode, delays a fire alarm condition, to provide time for acknowledgment and investigation by an attendant

1.4.10
alarm verification facility (AVF) Type A dependency
a configuration of FDCIE that provides an automatic reset or equivalent function of an initial alarm signal and that only permits a subsequent alarm signal to initiate a fire alarm condition

1.4.11
baseline data
data derived from the final design, installation and commissioning

1.4.12
circulation space
areas within a building that are used for pedestrian travel, that is, a passage way, corridor, hallway, stairway, lobby, atrium, an open plan office, enclosed walkway and mall, shop, areas in a room that provides an exit path from another room, paths of travel to exits in loading docks, designated paths of travel leading to exits from car spaces in car parks, and other paths of travel to exits

1.4.13
combination detector
a fire detector incorporating more than one fire sensor within a single housing with each sensor conforming to a separate Standard

1.4.14
connectable device
a device not conforming to a component Standard listed in Clause 2.1.2, the operation or failure of which will not jeopardize the performance of the FDAS (e.g. door hold-open devices, flow switches, BMCS and printer)

1.4.15
contiguous
sharing a boundary and mutually accessible

1.4.16
cupboard
an enclosure recessed into a wall or fixed to a wall, having a door(s)

1.4.17
customer cabling
as defined by AS/CA S009

1.4.18
designated building entry point (DBEP)
an entry point to a building, which provides firefighters with information identifying the location of the fire alarm

1.4.19
designated site entry point (DSEP)
an entry point to a site, which provides firefighters with information identifying the location of the building from which the fire alarm originated

1.4.20
detection zone
an area protected by one or more detectors which provides a unique common identification at the FDCIE

1.4.21
distributed part of CIE
part(s) of CIE not located within a single cabinet

1.4.22
downstream
in the direction of airflow away from a nominated reference point

1.4.23
duct sampling smoke detector
component that samples the air moving in a duct and detects smoke in the sample

1.4.24
emergency services personnel
term used in place of "fire brigade"

1.4.25
emergency zone
the whole or a subdivision of the premises where the occurrence of an emergency within it will be indicated separately from any other subdivision at the EWCIE and the emergency warning signal or live speech is broadcast separately within the subdivision

1.4.26
enclosure
an individual room, space or part thereof

1.4.27
end of line device (ELD)
a device installed at the end of a transmission path to provide a signal to CIE in order to supervise the transmission path

1.4.28
extra-low voltage customer cables
a cable carrying a voltage defined as extra low voltage (ELV) in AS/CA S009

1.4.29
fire alarm condition
a fire alarm is indicated at the FDCIE

1.4.30
fire brigade panel (FBP)
for the purpose of this Standard a fire brigade panel is defined as any of the following:

(a) An f.b.p. conforming to AS 4428.3.

(b) FDCIE providing individual zone controls and indicators.

1.4.31
fire compartment
as defined by the National Construction Code (NCC)

1.4.32
fire detection and alarm system (FDAS)
equipment including control and indicating equipment, which when arranged in a specified configuration, is capable of detecting and indicating a fire and giving signals for appropriate action

1.4.33
fire detection control and indicating equipment (FDCIE)
component conforming to AS 7240.2

1.4.34
fire fan control panel (FFCP)
that part of the FDCIE designed to provide control and indication of air-handling equipment required to operate in fire mode

1.4.35
fire-isolated
separated by fire-resisting construction

1.4.36
fire-isolated exit
a fire-isolated stairway, a fire-isolated ramp or a fire-isolated horizontal passageway, whether used individually or in combination, which provides egress from a storey or enclosed space to a road or open space

1.4.37
fire mode
the required mode of operation automatically initiated by the FDAS when in the fire alarm condition and intended to initiate smoke control systems within the building

1.4.38
fire-affected zone/compartment
a smoke control zone or fire/smoke compartment where fire or smoke has been detected

1.4.39
hot layer
a buoyant layer of hot smoke gases contained by a ceiling or roof above it and characterized by a relatively clear smoke-free zone beneath it

1.4.40
input/output device
an interface component conforming to AS ISO 7240.18 connected to CIE

1.4.41
kitchen exhaust hood
a component part of a kitchen exhaust system intended for collecting the heat, fumes and other aerosols arising from cooking appliances, and whose installation is required by the National Construction Code (NCC)

1.4.42
level surface
any surface, roof, or ceiling with a slope of less than or equal to 1 in 10

1.4.43
live speech
verbal message delivered by the use of an emergency microphone

1.4.44
low voltage (LV) (power)
the voltage defined in AS/NZS 3000

1.4.45
low voltage (LV) (telecommunications)
the voltage defined in AS/CA S009

1.4.46
low voltage telecommunications transmission path
customer cable carrying telecommunication low voltage as defined in AS/CA S009 (e.g. a 100 V AC audio circuit)

1.4.47
main FDCIE
an FDCIE that has been designated to monitor and indicate at least the general status of other FDCIE

1.4.48
major exhaust system
as defined in AS 1668.1

1.4.49
major supply system
as defined in AS 1668.1

1.4.50
make-up air
replacement air for smoke exhaust systems introduced below the hot layer, usually at ambient temperature/density

1.4.51
mechanical services switchboard (MSSB)
the mechanical services switchboard supplied by mains or emergency power

Note 1 to entry: The MSSB may incorporate a motor control centre (MCC).

1.4.52
minor exhaust system
as defined in AS 1668.1

1.4.53
minor supply system
as defined in AS 1668.1

1.4.54
motor control centre (MCC)
the electrical part of the mechanical services installation that normally controls and monitors mechanical services

Note 1 to entry: The MCC may be incorporated in the mechanical services switchboard (MSSB).

1.4.55
multiple compartment building
a building containing two or more fire or smoke compartments required to have fire-resisting or smoke-resisting separation

Note 1 to entry: A fire-isolated exit, ramp or passageway is considered to be a separate fire or smoke compartment.

1.4.56
multisensor detector
a fire detector, incorporating sensors in one mechanical housing that responds to more than one physical phenomena of fire

Note 1 to entry: Examples of the physical phenomena are smoke and heat, smoke and gas, and heat and gas.

1.4.57
networked FDCIE
FDCIE which receives or transmits information from other FDCIE

1.4.58
non-fire-affected zone
smoke control zone where fire or smoke has not been detected

Note 1 to entry: See Clause 1.4.38, Fire-affected zone/compartment.

1.4.59
occupied space
a space that is readily accessible for occupation, transit or service

1.4.60
optical beam smoke detector
a smoke detector conforming to AS 7240.12

1.4.61
performance solution
as defined in the National Construction Code (NCC)

1.4.62
plant room
a room within a building dedicated for the housing of plant or equipment

1.4.63
protected area
an area of a building equipped with an automatic fire detection and alarm system installed in accordance with this Standard, or in accordance with an automatic fire suppression system standard

1.4.64
protected building
a building equipped with an automatic fire detection and alarm system, throughout, installed in accordance with this Standard, or in accordance with an automatic fire suppression system standard

1.4.65
required
indicates that a statement is mandatory

1.4.66
safety services
safety services, as defined by AS/NZS 3000

1.4.67
separate transmission paths
transmission paths that are separated, so that a foreseeable single event is unlikely to damage more than one of the transmission paths

1.4.68
shall
indicates that a statement is mandatory

1.4.69
should
indicates a recommendation

1.4.70
site
a parcel or allotment of land containing one or more buildings under one ownership or management

1.4.71
sloping surface
any surface, roof, or ceiling with a slope greater than 1 in 10

1.4.72
smoke
a generally visible suspension in air of solid or liquid particles or gases resulting from combustion or pyrolysis and entrained air

1.4.73
smoke compartment
an area within a fire compartment that is required to be separated by barriers such as walls, and/or floors and ceilings having the appropriate resistance to the spread of smoke

1.4.74
smoke control zone
an area or volume as determined for smoke control, which where applicable, is —

(a) a smoke compartment within a building;

(b) a fire compartment; or

(c) a smoke reservoir contained within construction and including the occupied space below it

1.4.75
smoke damper
a device that operates to restrict the passage of smoke through a duct or opening for the passage of air and operates automatically on receipt of a signal from a remote device

1.4.76
smoke exhaust fan
a fan that exhausts smoke in the event of a fire, in accordance with AS 1668.1, also known as smoke spill fan

1.4.77
smoke exhaust system
a special configuration of those elements of an air-handling system that is used to conduct smoke exhaust air, and extends from the most upstream smoke or fire-resistant barrier that is being penetrated to the point of discharge outside the building

Note 1 to entry: Also known as smoke spill system.

1.4.78
smoke reservoir
a volume within the upper portion of a smoke control zone that is capable of collecting and containing a layer of hot buoyant smoke

1.4.79
sole occupancy unit (SOU)
as defined in the National Construction Code (NCC)

1.4.80
sound pressure level (SPL)
for the purposes of this Standard, sound pressure is expressed as the ratio to the reference pressure of 20 μPa at 1 kHz., in A-weighted decibels dB(A)

1.4.81
supervised
monitored for fault conditions in the quiescent state

1.4.82
suppression systems
sprinkler systems, gaseous extinguishing systems or other special hazard systems

1.4.83
transmission path
a connection, external to cabinets, between parts of a FDAS for transmission of information or power

Note 1 to entry: Examples include electrical cables, fibre optic cable and electromagnetic radiation (radio, microwave, and infrared light).

1.4.84
transmission path fault
a condition in the transmission path that prevents the correct transfer of information or power

1.4.85
upstream
in the direction of airflow towards a nominated reference point

1.4.86
zone pressurization system
air-handling system that is required to provide zoned smoke control utilizing a pressurization system designed to establish a pressure differential between the fire-affected compartment and adjacent fire or smoke compartments in accordance with AS 1668.1

1.4.87
zone smoke control dampers
air dampers associated with a particular fire or smoke compartment or zone, which form part of a zone pressurization smoke control system

1.4.88
zone smoke control system
see Clause 1.4.86, zone pressurization system

1.5 Abbreviations

AAD	Audible alarm device
AAF	Alarm acknowledgement facility
ADF	Alarm delay facility
ASD	Aspirating smoke detectors
ASE	Alarm signalling equipment
AVF	Alarm verification facility
AIF	Alarm investigation facility
BMCS	Building management control system
CIE	Control and indicating equipment
DBEP	Designated building entry point
DSEP	Designated site entry point
ECO	Emergency control organization
ELD	End of line device
EICIE	Emergency intercom control and indicating equipment

EWCIE	Emergency warning control and indicating equipment
FBP	Fire brigade panel
FDAS	Fire detection and alarm system
FDCIE	Fire detection control and indicating equipment
FFCP	Fire fan control panel
FSER	Fire safety engineering report
LCS	Local control station
MCC	Motor control centre
MCP	Manual call point
MSSB	Mechanical services switchboard
NCC	National Construction Code (the relevant part of Building Code of Australia)
PSE	Power supply equipment
RASTI	Rapid (or room) acoustics speech transmission index
SCI	Short circuit isolator
SHCIE	Special hazards control and indicating equipment
SOU	Sole occupancy unit
SPL	Sound pressure level
VAD	Visual alarm device
VWD	Visual warning device

1.6 Measurements

1.6.1 Tolerances

If a specific tolerance or deviation limit is not specified in a measurement, requirements or test procedure, then a tolerance of 5 percent shall be applied.

1.6.2 Spacing

When determining the location of detectors, measurement shall be taken from the centre line of the point type detector or ASD sampling point.

1.7 System design

1.7.1 General

The automatic fire detection and alarm system shall be designed to the requirements of Clauses 1 to 6. For smoke control systems, Clause 7 applies. The system design shall include the details and documentation for both installation and commissioning of the system.

NOTE This Standard requires various labels on components of the FDAS. Appendix K provides a check list of lettering heights for reference only.

1.7.2 Baseline data

The design, installation and commissioning documentation shall be provided as validation of the final design. This baseline data will facilitate the routine service of the system and validation of its ongoing performance.

The baseline data shall include, but not be limited to, the following:

(a) Site identifier.

(b) Address.

(c) Building number or name (if applicable).

(d) System scope: an alteration to an existing system or a new system.

(e) Type of system: collective (conventional), addressable, addressable/analogue or combination.

(f) Design reference: AS 1670.1:2018, Deemed to satisfy NCC or performance solution(s).

(g) The Fire Safety Engineering Report (FSER) reference if performance solution(s) is applied.

(h) Evidence that the components used within the system meet the required component Standards.

(i) Evidence that the equipment is compatible in the configuration as installed.

(j) Final design drawings ("as built") showing the installed system layout (building plans), equipment type, locations, reference SPL, zone number, device ID and transmission paths. See example in Appendix D using symbols in Figure D.1.

(k) Systems interface diagram.

(l) Fire compartmentation and smoke control zone drawings where Clause 7 is applicable.

(m) A description of the required operation in each smoke control zone where Clause 7 is applicable.

(n) A cause and effect matrix which shall include the following:

 (i) Detail all smoke detection and smoke control zone input criteria of the system and the resultant output operational requirements of all interfaced systems.

 (ii) Detail the full automatic functionality of the smoke detection and smoke control system from "end-to-end".

 (iii) Be in the form of a document that presents in a grid type cross reference detailing each smoke detection and smoke control zone input (including any suppression system inputs to the FDCIE) on one axis with the corresponding output functionality for each smoke control zone input on the other axis.

 (iv) Identify the design and installation standards, any performance solutions that apply and the last date of revision and the author.

(o) List of all system components, their location, type, unique system designation and descriptor.

(p) List of each system component having a fixed service life, nominating the service date.

(q) List of any connectable devices.

(r) Manuals for all CIE and system components (as applicable).

(s) Aspirating smoke detection design calculations (if applicable).

(t) Building occupant warning system (AS 1670.1) type of system or Grade as applicable;

(u) Emergency warning system (AS 1670.4) type (if applicable).

(v) Amplifier rated output; impedance (Ω) and power (W) (if applicable).

(w) Measured impedance (Ω), power load (W) and reference SPL of each loudspeaker transmission path (if applicable).

(x) Completed Designer's Statement, Installer's Statement and Commissioning Statement.

NOTE See examples in Appendix E, Appendix F and Appendix G respectively.

(y) Power supply requirements including:

(i) Mains nominal voltage and source (if applicable).

(ii) Standby time (72 h or 24 h where externally monitored).

(iii) Standby power source, nominal voltage and capacity and the compensation factor used if installed outside an average temperature of 15°C–30°C.

(iv) System quiescent current including fire alarm monitoring loads (if applicable).

(v) System alarm current, including occupant warning system load.

(vi) Load current of each connectable device transmission path.

(vii) PSE main power source maximum rated load current during quiescent condition and during fire alarm condition (refer to AS 7240.4).

(viii) PSE charger maximum standby battery capacity supported (refer to AS 7240.4).

(z) The service life of the autonomous power source of devices conforming to AS ISO 7240.25.

Copies of documentation and baseline data shall be housed in or adjacent to the FDCIE without interfering with the system wiring. Where this is not possible a label shall be provided on the FDCIE or the FDAS zone block plan identifying the location where it is stored within the building.

1.7.3 Alterations to existing system

Alterations to existing installations shall be designed and installed to the requirements of this Standard. This applies only to equipment and transmission paths which are added, removed, relocated or replaced.

Power supply requirements shall be recalculated and upgraded as necessary to ensure the system can accommodate any additional loads.

The alteration, including detectors, shall be compatible, only used within the limitations detailed in the component conformance documentation, and shall perform the required functions in accordance with this Standard.

NOTE See Appendix A.

Where existing wiring is required to be joined at the FDCIE, fixed terminal strips utilizing clamp-type connectors shall be used. Where these joints are made outside the FDCIE, they shall be housed in a cabinet and labelled "FIRE" in a contrasting colour to the background with lettering size of not less than 5 mm.

In addition to updating the documentation detailed in Appendix A, the zone block plan (see Clause 3.10) shall be revised to include the alterations.

1.8 Application of normative references

Table 1.8 lists previous editions of Standards which may be used to meet the requirements of this Standard. All references in this text to the listed normative references in Table 1.8 may be to either editions to meet the requirements of this Standard.

NOTE For the next edition of this Standard, Committee FP-002 intends to update this list so that the older editions of the listed Standards will no longer meet the requirements of this Standard from 1 May 2022.

Table 1.8 — Table of acceptable editions of Standards

Current edition	Previous edition
AS 7240.2:2018	AS 7240.2—2004
AS ISO 7240.5:2018	AS 7240.5—2004
AS ISO 7240.8:2018	AS 7240.8—2007
AS ISO 7240.10:2018	AS 7240.10—2007
AS ISO 7240.11:2018	AS 7240.11—2008
AS 7240.12:2018	AS 7240.12—2007
AS ISO 7240.18:2018	AS ISO 7240.18:2015
AS ISO 7240.24:2018	AS ISO 7240.24:2015
AS 7240.4:2018	AS 7240.4—2004
AS 7240.7:2018	AS 7240.7—2004
AS 7240.15:2018	AS 7240.15—2004
AS 7240.27:2018	AS ISO 7240.27:2016
AS 7240.22:2018	AS 7240.22—2008

Section 2 System configuration

2.1 Components

2.1.1 General

FDAS components shall conform to at least one of the component Standards listed in the normative references in Clause 1.3 and shall be installed in the format detailed in the conformity documentation including any limitations of use identified and compatibility of the components with CIE.

NOTE Components should be appropriate for the environment in which it is installed. Environmental conditions such as temperature, dampness, dust, corrosion, vibration, shock, flammable atmosphere or explosive atmospheres may be experienced.

Components installed within the FDAS shall be compatible in the configuration in which they are installed.

NOTE AS 7240.13 may be used to confirm the compatibility of components.

2.1.2 Components

The system shall comprise the following:

(a) Fire detectors, selected to suit the particular hazard and risk to life or property, or both, conforming to at least one of the following:

  (i) AS ISO 7240.5 Point-type heat detectors.

  (ii) AS 7240.6 Carbon monoxide fire detectors.

  (iii) AS 7240.7 Point-type smoke detectors.

  (iv) AS ISO 7240.8 Carbon monoxide fire detectors with heat sensor.

  (v) AS ISO 7240.10 Point-type flame detectors.

  (vi) AS 7240.12 Line type smoke detectors using optical beam.

  (vii) AS 7240.15 Point-type smoke detector with heat sensor.

  (viii) AS 7240.20 Aspirating smoke detector (ASD).

  (ix) AS 7240.22 Smoke-detection equipment for ducts.

  (x) AS 7240.27 Smoke detectors with CO and heat sensor.

  (xi) AS 1603.13 Duct sampling smoke detectors.

  (xii) EN 54-27 Duct smoke detectors.

  (xiii) EN 54-22 Resettable line-type heat detectors.

  (xiv) EN 54-28 Non-resettable line-type heat detectors.

(b) Fire detection control and indicating equipment (FDCIE) conforming to AS 7240.2.

(c) Power supply equipment (PSE) conforming to AS 7240.4.

(d) Occupant warning equipment as specified in Clause 3.22 and or supplementary warning equipment for people with hearing impairment in accordance with AS 1603.17.

(e) Manual call points (MCP) in accordance with AS ISO 7240.11, except the colour specified in Clause 3.14.

(f) Visual alarm devices (VAD), in accordance with AS ISO 7240.23 and located in accordance with the area of coverage rating, if installed.

(g) Visual warning devices (VWD) in accordance with AS 1603.11, if installed.

(h) External visual alarm device in accordance with AS ISO 7240.23.

(i) Alarm mimics, if installed, conforming to AS 7240.2 or AS ISO 7240.18. Alarm mimics shall not be able to reset or disable an alarm or silence occupant warning. For light emitting indicator mimics, at least the control of the indicators shall be in accordance with the relevant parts of these Standards.

(j) Input/output devices in accordance with AS ISO 7240.18, if installed.

(k) Short circuit isolators (SCIs) in accordance with AS ISO 7240.17, if installed.

(l) Audible alarm devices (AAD) in accordance with AS ISO 7240.3, if installed.

(m) EWCIE in accordance with AS 4428.16 and associated loudspeakers conforming to AS ISO 7240.24, if installed.

2.1.3 Connectable devices

The operation of the FDAS shall not be reliant on the connectable devices.

Where connectable devices such as data terminals, colour graphic displays and building monitoring and control systems (BMCS) are connected to the FDAS the following requirements shall be met:

(a) Failure of any connectable devices shall not adversely affect the correct operation of the FDAS.

(b) All transmission path connections and interfaces to connectable devices shall be installed in accordance with AS/CA S009.

NOTE AS/CA S009 states that it should be read in conjunction with AS/CA S008.

(c) Connectability of the connectable devices with the FDCIE has been assessed.

NOTE AS 7240.13 may be used as a guide to confirm the connectability of devices.

(d) Connectable devices shall not have remote access to Access Level 3 and Access Level 4 functions as defined in AS 7240.2 without manually enabling Access Level 3 and Access Level 4 directly at the FDCIE.

2.2 Designated entry point

2.2.1 Designated building entry point (DBEP)

A DBEP shall be the primary occupant entry point for each building and identified with an external alarm indication in accordance with Clause 3.8.

For buildings which incorporate either an Fire Control Centre (FCC) or Fire Control Room (FCR) as defined by the NCC, this shall be the DBEP.

NOTE Where a building incoportates an FCC, FCR or multiple primary occupant entry points, the fire authority should be consulted.

At the DBEP the location of a fire alarm shall be indicated on a Fire Brigade Panel (FBP) as defined in Clause 1.4.30. The FBP shall be installed in accordance with Clause 3.9.

2.2.2 Designated site entry point (DSEP)

Where multiple buildings are networked to a main FDCIE monitored in accordance with AS 1670.3, at least one DSEP shall be provided on a site unless each building is individually identified at the fire dispatch centre. Where physical barriers segregate a site, a separate DSEP shall be provided for each segregated area.

NOTE For monitored sites, the location of the DSEP should be agreed with the fire authority.

At the DSEP the building(s) in alarm shall be indicated by at least one of the following means:

(a) An FBP.

(b) A fire alarm mimic panel which does not provide any control functions and identifies the building in fire alarm without exiting the fire appliance.

(c) An external alarm indication in accordance with Clause 3.8 on each protected building within the segregated area. Such an indication shall be clearly visible from the DSEP without exiting the fire appliance.

Only buildings that are readily accessible from the DSEP by the fire appliance shall be indicated.

A plan showing all buildings and vehicle routes on the site shall be at the DSEP. The DSEP shall be shown on the plan for all buildings associated with the DSEP. Only information relevant to the emergency services personnel shall be included on the plan.

2.3 Detection zone limitations

A detection zone shall be not more than 2000 m^2 of contiguous floor area and the longest dimension shall not exceed 100 m and shall be confined to one storey.

Each fully enclosed stairway shall be treated as a separate detection zone regardless of total floor area and storeys covered. See Clause 3.27.9.

A single detection zone of non-contiguous floor area shall have a distance between each adjacent area entrance not exceeding 10 m measured to the centre of the entrance.

Protected areas with no access from inside the building shall be displayed as separate detection zones from those having internal access.

NOTE For a typical example of zone allocation, see Figure 2.3.

The maximum number of detectors in a detection zone shall not exceed 40 unless the identity and the location of all detectors in alarm can be individually displayed on the FBP.

Detectors displayed individually shall not be identified as separate detection zones unless representing the only detector within an enclosure.

Where a separate building forms part of the protected premises, the separate building need not have an FDCIE, provided the entry to the separate building is not more than 100 m from the DBEP where the FDCIE is located and —

(a) it is protected by only a single detection zone that meets all other requirements of this clause; or

(b) the total floor area of a building does not exceed 500 m^2 and each detection zone is displayed on the FBP of the protected premises.

The separate building shall be accessible to the fire appliance from the FDCIE without using another DSEP.

A mezzanine level, open to and accessible from the storey with which it is associated, and treated as part of the detection zone for that storey, the total protected area and the number of detection devices shall not exceed the detection zone limits specified in this Standard.

A concealed space not exceeding 500 m^2 and accessible from the storey with which it is associated may form part of the detection zone for that storey.

The total protected area and the number of detection devices shall not exceed the detection zone limits specified in this Standard.

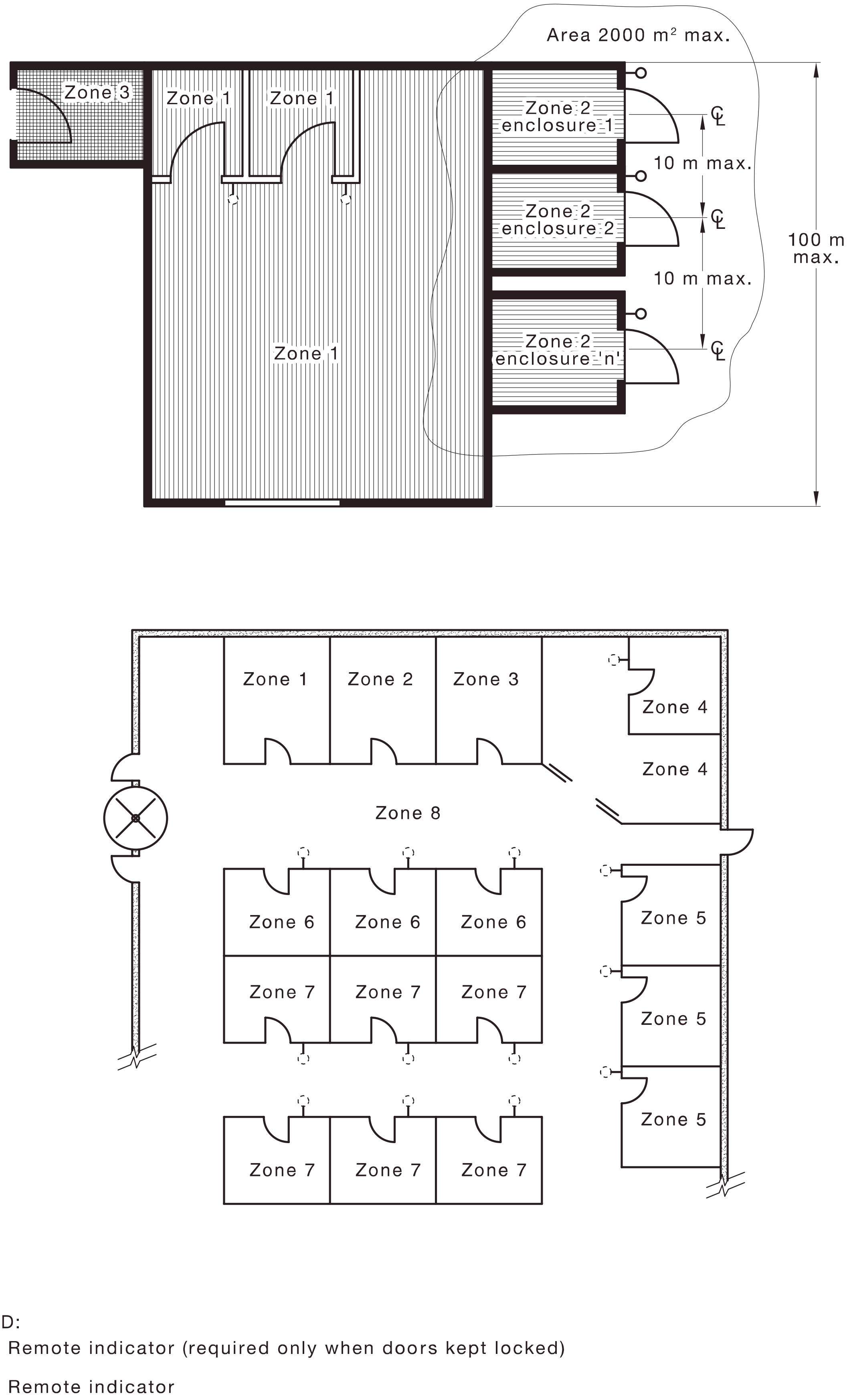

Figure 2.3 — Typical zone allocation for contiguous and non-contiguous areas

2.4 Networked FDCIE

Where FDCIE receives or transmits information to or from other CIE, the following requirements apply:

(a) Where a main FDCIE monitors other FDCIE, the main FDCIE shall display at least a general alarm and general fault. In this case the fault indication shall include the general disablement condition from each of the other FDCIEs.

NOTE Where practicable it is preferred to display the detection zone in alarm, fault and disablement (isolate).

(b) A fire alarm condition on an FDCIE shall be indicated at the main FDCIE FBP or any other FDCIE, where required, within 10 s, and activate any required output signals. Faults, disablements and power supply failure from FDCIE and external EWCIE shall be indicated at the main FDCIE within 100 s.

(c) Where FDCIE monitors an EWCIE, the FDCIE shall display at least a general fault and disablement, from each EWCIE. It is acceptable for the disablement indication to be combined with the general fault indication.

(d) FDCIE that provides only general indications to the main FDCIE shall protect not more than one storey or one separate building.

(e) On any site, not more than two FBP shall need to be interrogated to determine the detection zone in alarm.

(f) A fire alarm condition on an FDCIE shall only be reset or disabled from the main FDCIE or from the FDCIE on which the fire alarm condition was initiated.

(g) Where the main FDCIE indicates only the general condition of another FDCIE the condition shall only be reset at that other FDCIE which shall also clear the general condition the main FDCIE.

(h) FDCIE protecting a building shall be capable of stand-alone operation, including occupant warning without reliance on FDCIE in other buildings.

(i) FDCIE protecting a part of a building and requiring attendance by emergency services personnel shall provide a VAD in accordance with Clause 3.8 at the entrance to the protected area.

(j) FDCIE not requiring interrogation by emergency services personnel shall be labelled FIRE in no less than 20 mm high letters.

(k) All detection zones served by an FDCIE shall be readily accessible from the area served by that FDCIE unless the zone in alarm is identified at the DBEP.

2.5 Distributed parts of CIE

Where parts of CIE are installed in locations remote to the main indicators and controls, the following shall apply:

(a) A single fault in the transmission paths between distributed parts of CIE shall not prevent an alarm signal from other distributed parts of CIE.

(b) A failure of a distributed part of CIE shall not inhibit the correct operation of other distributed parts of CIE.

(c) Labelled FIRE in no less than 20 mm high letters.

2.6 Transmission paths faults

A single transmission path fault shall not prevent the operation of more than one of the following:

(a) One detection zone.

(b) One detection zone indication at the DBEP.

(c) One building alarm indication at the DSEP.

(d) One area of occupant warning covering not more than one level and not more than 2000 m^2.

(e) One Smoke Control Zone including detection and control in accordance with Clause 7.

(f) One addressable output device not forming part of Items (a) to (e).

Where detection devices and occupant warning devices share a common transmission path, the requirements of this clause for Items (a) and (d) are met, provided not more than a total of 40 devices on the transmission paths are adversely affected. This can be any combination of detection devices and occupant warning devices.

Where more than one transmission path is used to meet the requirements of this clause, each transmission path shall be separated in accordance with Clause 1.4.67. Duplicate transmission paths are not required to be separate where they run underground or are protected to WSX3 in accordance with AS/NZS 3013.

A single transmission path fault shall indicate visually and audibly at the main FDCIE and any other FDCIE that receives an alarm via that transmission path. The indication shall be in accordance with the FDCIE Standard.

Section 3 Installation requirements

3.1 General

Components and other equipment shall be installed in locations that will not prejudice their performance and reliability. Components shall be installed so that the correct performance is maintained. Where the sensitivity of fire detectors can be varied, the sensitivity shall be set within the limits of the appropriate Standard to which the fire detectors were assessed.

Access for servicing all components shall be provided.

NOTE 1 Where special installation arrangements are required, the recommendations in the component documentation for that application should be followed. CIE are required to have a minimum rating of IP30 in accordance with IEC 60529 but some hostile environments may need a higher rating.

NOTE 2 Detectors that can be contaminated by construction works should not be fitted unless suitably protected until the construction works are completed.

3.2 Alarm mitigation methods

3.2.1 General

AAF, ADF, AIF attended mode, AVF Type A dependency, Type B dependency, Type C dependency and special hazards dual stage detection shall not be used simultaneously. Limitations of use are specified in the relative clauses.

NOTE 1 Type A, B and C dependencies are described in AS 7240.2.

NOTE 2 Dual stage detection is described in AS 1670.5.

Functions operated by FDCIE software and hardware shall be in accordance with the requirements of AS 7240.2.

NOTE Access levels are defined in AS 7240.2.

I/O devices including AAF and AIF control units which are installed external to the FDCIE shall be in accordance with AS ISO 7240.18.

C3.2 *Residential accommodation is known for its high levels of nuisance alarms caused by cooking, smoking, aerosol spray and steam from the shower, among other things, that may result in unintended activation of smoke detectors.*

Possible solutions are to locate the smoke detector away from potential sources of nuisance alarm, provide adequate air extraction or choose a smoke detection incorporating alarm mitigation technology.

Where these measures are insufficient a number of FDAS configurations are provided to delay the response to transient causes.

AAF provides a trained occupant with an opportunity and means to mitigate the effects of nuisance smoke detector activations by acknowledging the event as a nuisance alarm (see Clause 3.2.2). An acknowledgement period setting of 30 s (maximum allowable time is 60 s) is considered adequate for most residential SOUs. An investigation period of 90 s to clear the cause is considered appropriate for protected areas with normal levels of ventilation and accessibility. For less adequate ventilation, up to the maximum allowable time of 180 s may be required. This often makes it unsuitable for use in short-term residential accommodation where the occupant is not aware of its function.

For SOUs unlikely to have trained occupants, the use of ADF (see Clause 3.2.3) may offer a more effective solution as it does not require acknowledgement, but is backed up by the use of heat detection.

(continued)

For commercial accommodation with a normally attended station, AIF used in the attended mode (see Clause 3.2.4) provides an output signal for the attendant to acknowledge the receipt of an automatic fire detection alarm and to investigate the source of the alarm followed by either a reset of a nuisance alarm or to bypass the delay by the operation of an MCP.

AVF is for general use to automatically mitigate the effect of very short-term events but is rarely effective for residential accommodation.

3.2.2 Alarm acknowledgement facility (AAF)

3.2.2.1 General

Each AAF shall control only one sole occupancy unit.

The AAF control unit shall be located within the sole occupancy unit it serves.

Alarms initiated from the following shall not be subject to AAF:

(a) Heat detection.

(b) MCP.

(c) Networked FDCIE.

(d) Fire detectors installed in hazardous locations.

(e) Fire suppression systems.

The AAF visual indicator on the AAF control unit shall meet the visibility requirement of AS 7240.2 specified for general indicators.

An AAF shall be capable of being associated with one or more detectors.

Each AAF shall operate independently of any other AAF.

The FDCIE shall be capable of operating at least two AAFs simultaneously. If alarms are detected in excess of the maximum number of AAFs that can be processed simultaneously by the FDCIE, then the excess alarms shall not be delayed.

3.2.2.2 AAF sounder

The AAF sounder shall operate when an alarm is detected in at least one associated detector. The sounder shall produce a sound pressure level of at least 75 dB(A) at a distance of 1 m. Where the sounder forms part of an occupant warning system, the sound pressure level shall meet the requirements specified in AS 1670.1 or AS 1670.4.

3.2.2.3 AAF visual indicator

The AAF shall be fitted with a visual indicator. The visual indicator shall be red when lit when an alarm is detected in at least one associated detector. The indicator may flash periodically in a non-alarm state.

Where the indicator forms part of the fire detector, the indicator on the fire detector satisfies the indicator requirements.

3.2.2.4 Acknowledgement period

When an alarm is detected by an associated detector, the fire alarm condition at the FDCIE shall be delayed for an acknowledgement period. The acknowledgement period shall be adjustable at Access Level 3 to a maximum of 60 s, in increments not greater than 30 s.

3.2.2.5 AAF control

The AAF control shall use a momentary action.

When activated during the acknowledgement period, the AAF control shall —

(a) inhibit a fire alarm condition at the FDCIE; and

(b) silence the AAF sounder.

Activation of the AAF control outside the acknowledgement period shall not cause the initiation of an investigation period.

3.2.2.6 Investigation period

An investigation period shall be initiated upon the first activation of the AAF control during the acknowledgement period. Repeated or continuous activation of the AAF control during the alarm investigation period shall not alter the duration of the investigation period. The investigation period shall be adjustable at Access Level 3 from 0 s to 180 s in increments not greater than 60 s.

If the alarm in all associated detectors is cleared during or by the end of the investigation period, then the fire alarm condition is not generated at the FDCIE. When the alarm in the associated detector is cleared, the AAF indicator is extinguished.

If the alarm remains in any associated detector after the conclusion of the investigation period, then a fire alarm condition shall be generated by the FDCIE.

3.2.2.7 Mounting facilities

The AAF control unit shall be designed to facilitate mounting of the control at a height of 1 m from the floor. Suitable mounting hardware shall be provided with the AAF control unit.

3.2.2.8 Marking

The AAF control shall be marked with the words “PRESS TO ACKNOWLEDGE NUISANCE ALARM” or similar in letters not less than 3 mm high. The letters shall be in a contrasting colour to the background.

3.2.3 Alarm delay facility (ADF)

ADF shall only be used with smoke detectors within SOUs of Class 2, 3, and 4 buildings and shall meet the following requirements:

(a) Each ADF shall control only one residential SOU.

(b) The FDCIE shall be capable of operating at least five ADF simultaneously.

(c) Each ADF shall incorporate at least one AAD producing a minimum SPL of 85 dB(A) at 1 m, within the SOU. VADs shall also be activated in SOU designated for the hearing impaired.

Areas served by ADF shall also be protected by heat detectors unless the area is protected by a sprinkler system.

Heat detection shall not be delayed by ADF.

The ADF shall be initiated by an alarm condition on any of the associated smoke detector(s) within the SOU. When an ADF alarm is activated, the delay period shall commence, the visual indicator on the detector in alarm shall illuminate, and the associated AAD within the SOU shall sound.

The delay period shall be adjustable from 0 s to 300 s in increments not greater than 60 s.

If the alarm condition of all associated smoke detectors is cleared before the expiration of the alarm delay period then —

(i) the ADF shall automatically reset without generating a fire alarm condition at the FDCIE;

(ii) the visual alarm indicator on the smoke detector shall extinguish; and

(iii) the AAD shall silence.

If the alarm condition remains in any associated smoke detector after the conclusion of the delay period, a fire alarm condition shall be generated by the FDCIE and the visual alarm indicator on the detector shall latch.

Where the AAD forms part of the occupant warning system it shall meet the requirements of Clause 3.22.

A label shall be provided in a visible place near or adjacent to the SOU exit door in 5mm high letters, indicating that ADF is provided.

EXAMPLE "ALARM DELAY FITTED TO SMOKE DETECTORS. CLEAR SMOKE IF SAFE TO DO SO".

3.2.4 Alarm investigation facility (AIF)

3.2.4.1 General

Alarms initiated from the following shall not be subject to alarm investigation facility delays:

(a) MCP.

(b) Alarm signals between networked FDCIE.

(c) Fire detectors installed in hazardous locations.

(d) Fire suppression systems.

(e) Detection zones that cannot be accessed and reset within the AIF investigation time.

AIF shall be in accordance with the general requirements for Delays To Outputs of AS 7240.2.

Where the FDAS is monitored in accordance with AS 1670.3, approval of the emergency services shall be obtained.

> ***C3.2.4.1*** *AIF has limited acceptance by the emergency services. The implementation of AIF will require the agreement of the fire authorities in all instances.*

3.2.4.2 Operation

Any AIF shall operate in accordance with the following:

(a) The AIF shall only apply to alarms initiated by automatic fire detection devices (not manually operated devices, e.g. MCPs).

(b) The AIF shall have a control to select between unattended and attended modes of operation. The attended mode shall operate a yellow/amber visual indicator. In the unattended mode the AIF shall be disabled and no associated outputs delayed. In the attended mode the AIF shall operate as follows:

    (i) An alarm subject to AIF shall activate the visual alarm indication and alarm sounder of the FDCIE and start the acknowledgement timer while the outputs are delayed.

    (ii) If the acknowledgement timer times out, the delayed outputs shall activate.

    (iii) The acknowledgement time shall be adjustable at Access Level 3 up to a maximum of 30 s.

NOTE This should be set at the value agreed with the emergency service at time of commissioning.

(iv) If the alarm is acknowledged during the acknowledgement time period, the audible alarm indication shall be silenced and the investigation timer shall start.

(v) If the investigation timer times out, the delayed outputs shall activate.

(vi) The investigation time shall be adjustable at Access Level 3 up to a maximum of 300 s.

NOTE This should be set at the value agreed with the emergency service at time of commissioning.

(vii) If a second alarm occurs at any time during the AIF time, the delayed output shall activate.

(viii) If the alarm is reset during any of the AIF times, the AIF timers are cancelled and delayed outputs will not activate.

(c) A manual acknowledgement control shall be provided at the location where the detection zone alarm is displayed. The audible alarm indication (buzzer) silence control of the FBP shall be used for this purpose and or a separate acknowledgement control. The audible alarm shall resound if a fire alarm condition results. If a separate AIF acknowledgement control is provided, then it shall be labelled “AIF ACK”, or “AIF ACKNOWLEDGE”.

(d) A manual control shall be provided to reset the initial alarm during the AIF time.

(e) The reset control of the FBP can be used for this purpose without there being a silenced alarm output.

(f) The AIF function shall be able to be selected or programmed on a zone by zone basis.

3.2.5 Alarm verification facility (AVF) Type A dependency

Where AVF is used, it shall be in accordance with Type A dependency in accordance with AS 7240.2. The AVF shall not solely rely on the operation of two detectors.

NOTE It is recommended that the AVF cancellation time is limited to 300 s.

The following shall not be subject to AVF:

(a) MCPs.

(b) Alarm signals between networked FDCIE.

(c) Detectors used to activate fire suppression systems.

(d) Detectors installed in hazardous areas, e.g. explosive gas or combustible dusts.

(e) Fire suppression systems.

(f) Optical beam smoke detectors where a beam-interrupt fault overrides the alarm state.

(g) Detectors that take more than 60 s to become functional after a reset.

NOTE Since the provision of AVF delays the initiation of an alarm signal, it is desirable that it only be provided where other efforts to eliminate nuisance alarm signals have been unsuccessful.

3.2.6 Type B dependency

Where Type B dependency is used, it shall be in accordance with AS 7240.2.

A fire alarm condition shall be initiated by at least any two adjacent detectors having entered the alarm state.

Detectors shall be located such that the distance from any point of the protected area to detectors to initiate Type B dependency shall not exceed the maximum spacing for the type of detector used. The additional detectors required to initiate a confirmation alarm shall also meet the same spacing requirements.

The following shall not be subject to Type B dependency:

(a) MCPs.

(b) Alarm signals between networked FDCIE.

(c) Optical beam smoke detectors where a beam-interrupt fault overrides the alarm state.

3.2.7 Type C dependency

Type C dependency shall conform with the Type C dependency requirements for FDCIE in accordance with AS 7240.2.

Type C dependency shall not be used where smoke detection is required.

3.3 This has been left blank intentionally

3.4 This has been left blank intentionally

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3.6 Control of connectable devices

3.6.1 General

Transmission paths to connectable devices shall be electrically isolated, fuse protected or current-limited, to prevent a fault from inhibiting the operation of FDCIE functions or the transmission of an alarm signal.

3.6.2 Supervision

Each transmission path shall be supervised by the FDCIE for any fault condition that prevents correct operation. Such faults shall cause the FDCIE to initiate an audible and visible fault indication.

Where devices default to their fire alarm state on loss of a transmission path, they need not indicate a fault on the FDCIE.

3.7 Detector alarm indication

Individual alarm indication shall be provided for each detector and shall continue to indicate until the detector is reset.

Indication shall be provided by one or more of the following means:

(a) An indicator integral with the detector.

(b) An indicator remote from the detector in accordance with Clause 3.16.

(c) Individual alarm indication at the FDCIE.

Where the detector alarm indicator that flashes periodically (for example, when the detector is polled by the FDCIE), the alarm condition indication shall be clearly distinguishable from any other condition.

The indication of alarm at the FDCIE shall be achieved within 10 s.

3.8 External alarm

An external wall mounted VAD shall be located on the front façade of the building or the façade on which the DBEP is present. The VAD should be installed as close as practicable to the DBEP and shall be not more than 10 m from the DBEP.

The VAD shall —

(a) be active when the FDCIE is in the fire alarm condition;

(b) flash red and be visible from the fire appliance approaching from at least two directions;

(c) have a minimum rating of W3–7.5; and

(d) be mounted with a sign with the words “FIRE” in white capital letters on a red background. The lettering height shall not be less than 50 mm using a bold sans-serif font. The colour and material of the sign shall be weather and fade resistant.

NOTE Suitable red and white colours are specified in ISO 3864 series.

3.9 Control and indicating equipment (CIE)

3.9.1 Location

CIE shall be installed in a location conforming with the following requirements:

(a) FDCIE serving other than the detection zone in which it is installed shall be installed in an area not used for the storage of combustible materials.

(b) The CIE shall always be installed in an area protected by the FDAS except where it is installed external to the building. See Clause 3.1.

(c) Operation of the CIE shall not obstruct the evacuation of the building.

(d) CIE shall be located in an area that presents a low risk of damage to the equipment and injury to personnel in an emergency.

(e) FBP, EWCIE and FFCP shall —

  (i) not be mounted in any room containing sprinkler control valves, pumps or motors; and

  (ii) have controls and indicators not less than 750 mm and not more than 1850 mm above floor level; and

  (iii) have unobstructed access to controls and indicators.

(f) Ambient light level in the vicinity of the CIE shall be such that visual indications can be clearly seen, controls easily operated and any instructions or legends can be easily read.

3.9.2 Covering door

Where the FDCIE is obscured by a door, that door shall be marked in a contrasting colour to the general colour scheme with the words “FIRE PANEL” in letters not less than 50 mm high. There shall be no other lettering on the door. The door shall only be lockable where the emergency services personnel have been provided with a key.

Where the door reduces the FDCIE sounder sound level below the FDCIE requirement, means shall be provided to give the required sound level outside the covering door.

3.9.3 Clearance

A minimum clearance of 1 m in front and 0.5 m to each side shall be maintained from CIE cabinets that require operation by emergency service personnel, as shown in Figure 3.9.3.

Where the door opens to at least 135° the 0.5 m hinge side clearance may be reduced accordingly.

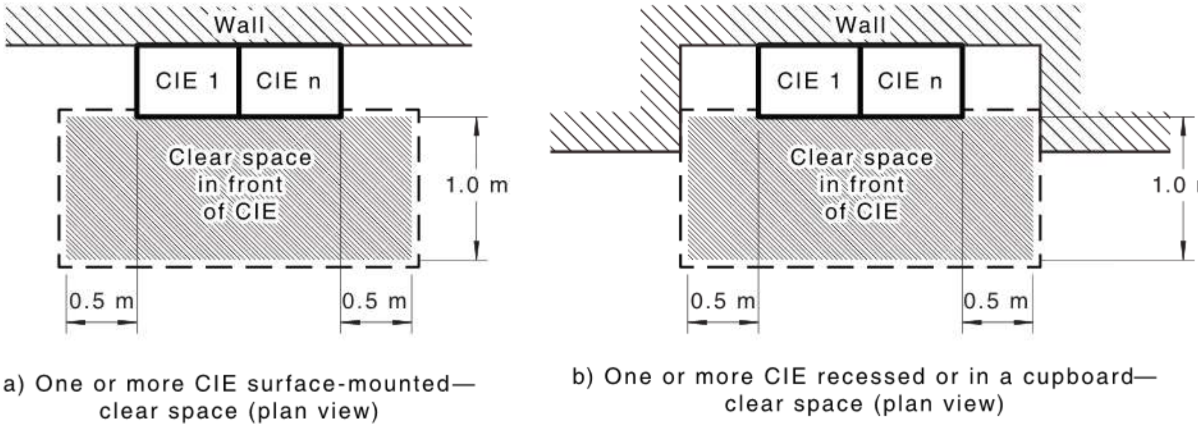

Figure 3.9.3 — Control and indicating equipment — Personnel workspace

3.10 Zone block plan

A zone block plan of the installation shall be securely mounted and easily accessible at FBP. The plan shall be in the form of a permanent diagram that is water resistant and fade resistant. The lettering shall be a minimum of 3 mm and shall include the following information:

(a) The layout of the building in which the FDAS is installed.

(b) The area covered by each zone.

(c) The location of all FDCIE, SHCIE, FFCP and EWCIE.

(d) The location of the FBP and marked “YOU ARE HERE”.

(e) The location of any fire suppression system controls.

(f) The location of the building’s main electrical switchboard.

(g) The year of original installation and the date of the latest revision to the block plan.

(h) A notice stating, “In the event of a fire ring 000 to ensure fire service response” except the lettering height shall be not less than 5 mm.

(i) Location where baseline data are stored. A label on the FDCIE meets this requirement.

(j) Statement identifying the design criteria used including NCC references, NCC referenced Standard(s) and performance solution as applicable.

The plan shall be installed in the correct orientation of the building.

3.11 Carbon monoxide (CO) fire detector labelling

Where CO fire detectors are installed, a clearly visible label shall be provided on or immediately adjacent to the FDCIE, and FBP. Lettering height shall be a minimum of 5 mm and in a contrasting colour.

The label shall include the following text:

(a) NOTE: CO FIRE DETECTORS INSTALLED.

(b) IN CASE OF ALARM, CHECK AREA THOROUGHLY. IF NO FIRE IS APPARENT, CHECK ADJACENT AREAS.

(c) SPECIAL MAINTENANCE REQUIREMENTS APPLY. REFER TO THE DETECTOR DOCUMENTATION.

3.12 Fire suppression system alarms

3.12.1 Alarm output to FDCIE

The alarm initiating devices from each suppression system shall be indicated as a separate latching detection zone at the FDCIE.

Flow switches initiating systems such as smoke control or EWIS are alarm initiating devices.

Flow switches and pressure switches shall be provided with time delay facilities to prevent nuisance activation, due to surges in the water supply, latching on the FDCIE (see Clause 7.4).

3.12.2 Consultation between parties

Where suppression systems are connected to the FDCIE, the FDCIE shall implement the functions specified by the cause and effect matrix which shall be provided as part of the suppression system design.

C3.12 *Coordination between designers to this Standard and designers of the suppression system to AS 2118 is necessary to ensure that required overall FDAS operation is achieved.*

3.12.3 Fire suppression system control

The control of any suppression system other than those in accordance with the AS 2118 series shall be provided by a separate SHCIE in accordance with AS 1670.5.

3.13 Equipment cabinets

3.13.1 Fire isolation and mechanical protection

Any distributed parts of FDCIE, or input/output devices using a transmission path required to be fire-rated shall be either fire isolated from occupied space or protected by a steel or cast iron cabinet of no less than 1 mm gauge.

SCI using a transmission path which is required to be fire-rated shall be fire isolated from occupied spaces. This is not required when such equipment is installed within a fire isolated plant room, a fire isolated sprinkler valve room or adjacent to the FDCIE.

Mechanical protection of equipment shall be to at least the same degree as required for the transmission path used. See Clause 3.26.

3.13.2 Labelling

Interface devices or isolation relays external to the CIE cabinet shall be installed within a protective cabinet and shall be marked or labelled with the words “FIRE” in letters not less than 5 mm high in a contrasting colour to the background.

3.14 Manual call point (MCP)

3.14.1 General

MCPs may be used for the following functions:

(a) To initiate a fire alarm condition.

(b) To initiate building occupant warning system.

(c) To initiate non-evacuation emergency signal.

(d) As an electric door lock release.

(e) For the operation or inhibition of other functions.

MCPs shall be mounted between 750 mm and 1200 mm above floor level and a clear space of 300 mm on both sides and 600 mm directly in front shall be provided in an arc in front of the MCP.

Where MCPs are subject to outdoor use, they shall conform to the solar radiation test of AS ISO 7240.11.

3.14.2 MCP for fire alarm

MCPs intended to initiate a fire alarm condition shall be red.

The activation of an MCP shall not extinguish a previously lit visual alarm indicator.

At least one MCP shall be installed in a clearly visible and readily accessible location in the circulation space of the main entrance of the building and shall initiate a fire alarm condition.

Red fire alarm MCP not connected to a fire alarm monitoring centre shall have a label on or adjacent to MCP with the words “After activation CALL 000”.

3.14.3 MCP for emergency evacuation

An MCP required to initiate emergency evacuation shall be white.

The front face shall be marked with the word “EVACUATE” in letters not less than 5 mm high.

3.14.4 MCP for non-evacuation emergencies

An MCP required to initiate warning of other emergencies not intended to initiate the immediate evacuation of occupants shall not be red, white or green.

The front face shall be marked with the word “EMERGENCY” in letters not less than 5 mm high and labelled with the specific emergency as applicable. Alternatively the specific emergency may be marked on the front face.

3.14.5 MCP for electric lock release

An MCP required for emergency release of electric locks shall be green.

The front face shall be marked with the words “DOOR RELEASE” in letters not less than 5 mm high.

3.14.6 MCP for operation or inhibition of other function

An MCP required for operation or inhibition of any other function shall not be red, white or green.

The front face shall be clearly labelled to indicate its function in letters not less than 5 mm high.

3.14.7 Operation of MCP for fire alarm and emergency

MCP shall require two distinct actions. This requirement shall be met by either —

(a) an MCP in accordance with AS ISO 7240.11 Type B; or

(b) an MCP in accordance with AS ISO 7240.11 Type A, fitted with a user operable protective cover or flap.

3.15 Power supply equipment (PSE)

3.15.1 General

All parts of the FDAS shall use PSE conforming to AS 7240.4 except components using radio transmission paths shall conform to AS ISO 7240.25.

Where more than one PSE is used, each PSE shall be provided with its own PSE fault indication. A fault shall indicate at the associated FDCIE; and at least a general fault shall indicate at a main FDCIE.

Where the power supply is shared with other CIE, it shall include overload protection and the means to individually disconnect the power to each CIE. Separate overload protection and disconnect facilities are not required for a AS 4428.16 Grade 3 EWCIE.

The PSE shall provide at least two power sources for the supply of power to the FDAS: the main power source and the standby power source.

3.15.2 Main power source

All PSE including the standby power source charger shall be connected to the AC mains in accordance with AS/NZS 3000. This connection is not considered to be a transmission path.

The PSE main power source shall be capable of operating the FDAS.

Switching from one main power source to another main power source shall not cause any change in status or indications, other than those relating to the PSE.

3.15.3 Standby power source

The system shall be provided with a standby power source capable of operating the system if the main power source becomes unavailable.

The standby power source shall consist of rechargeable stationary batteries in accordance with the relevant part of AS 4029 or as listed in the CIE conformity documentation referred to in Clause 2.1.1 as suitable and compatible with the CIE and PSE.

Where the standby power source is remote from the FDCIE cabinet, the standby power source shall be protected for overload at the source. This connection is not considered to be a transmission path.

3.15.4 Power supply equipment rating

All devices, facilities or equipment, external or internal, that utilize the FDAS PSE in either the quiescent state or alarm state shall be used in the calculations of the power source rating.

The quiescent load of the FDAS shall include any connectable devices and all fault and disablement indication loads.

The worst case of the following loads shall not exceed the power supply equipment rating:

(a) The total load of the FDCIE with five detection devices in alarm state in each of the two detection zones including all loads that will operate in the fire alarm condition, such as occupant warning systems if sharing the PSE, or the quiescent load of the FDAS including battery charging, whichever is greater.

(b) Where the system is a suppression system, and the SHCIE serves a single suppression risk, the load shall be calculated in accordance with Item (a) above. Where the SHCIE serves multiple risks, then the load shall be calculated on the two highest load risks in an activated state, or 20 percent of the total connected systems in an activated state whichever is the greater, unless varied by the suppression system design.

The requirement of the PSE including battery support shall apply to an integral PSE and any external PSE that supply power to the systems.

PSE shall be capable of operating the system continuously at maximum load with the standby source disconnected.

3.15.5 Standby power source capacity

The capacity of the standby power source shall be such that in the event of failure of the PSE main power source the standby power source shall be capable of maintaining the system in normal working (quiescent) condition for at least 72 h, after which sufficient capacity shall remain to provide power for the main power source load determined in Clause 3.15.4 for 30 min.

Where the PSE produces a power supply failure signal and this signal is continuously monitored externally either on site or remotely, the minimum standby requirement may be reduced to 24 h.

The power supply failure signal is when the power supply voltage falls to the minimum operating voltage of the FDAS, or the final voltage of standby power source battery whichever is the greater.

3.15.6 Battery capacity calculation

When calculating battery capacity, allowance shall be made for the expected loss of capacity over the useful life of the battery. A new battery shall be at least 125 percent of the calculated capacity requirements, based on a loss of 20 percent of its capacity over the useful life of the battery.

The battery capacity requirement shall be determined as follows:

(a) Determine the quiescent load current I_Q.

(b) Determine the alarm current I_A.

(c) Determine the capacity de-rating factor (F_C) of the battery when discharged at the alarm load rate taking into account the minimum operating voltage of the connected CIE and the battery manufacturer's data. Where more than one CIE is connected to the battery, the highest minimum operating voltage of any of the CIEs shall be used. A value of two for F_C shall be deemed to satisfy these requirements.

(d) The 20 h discharge battery capacity (C_{20}) at 15°C to 30°C shall be determined as follows:

$$C_{20} = 1.25((I_Q \times T_Q) + F_C(I_A \times T_A)) \qquad 3.15.6$$

where

C_{20} = battery capacity in Ah at 20 h discharge rate

I_Q = total quiescent current

T_Q = quiescent standby power source time (72 h or 24 h)

F_c = capacity de-rating factor

I_A	=	total current in alarm state
T_A	=	alarm load standby power source time (normally 0.5 h)
1.25	=	compensation factor for expected battery deterioration

Where the load fluctuates, the worst case average over the required period shall be used.

Where the average battery temperature is outside 15°C to 30°C the battery data shall be used to determine any further compensation factor to be applied.

NOTE 1 For examples of power source calculations see Appendix C.

NOTE 2 Normally energized connectable devices, such as door holders, may be disconnected when the system is operating from the standby power source.

NOTE 3 The use of alternative power sources such as UPS or generators is outside the scope of this Standard.

3.15.7 PSE selection

The PSE shall be selected to provide the main power source requirements in Clause 3.15.4 and be rated for the battery capacity determined in Clause 3.15.6.

3.15.8 Batteries

3.15.8.1 Battery location

The battery cabinet shall be such that the batteries are readily accessible for inspection.

Battery cabinets shall be secured from unauthorized persons by a locked door. The key shall be identical with other keys required for access to the control and indicating equipment or located within the CIE enclosure.

Batteries shall not be stacked without the provision of supporting shelves unless they are designed to be installed in that configuration.

3.15.8.2 Battery wiring

Where the battery cabinet is not adjacent to the PSE cabinet, battery cabling external to the cabinet shall have a minimum rating of WS51W, in accordance with AS/NZS 3013, with the mechanical rating upgraded dependent upon the risk of mechanical damage.

The battery shall not be tapped for intermediate voltages.

The connecting leads to the battery shall be clearly identified to reduce the possibility of reverse connections to the battery.

NOTE For mechanical protection requirements, see Appendix B.

3.16 Remote indicators for fire detectors

3.16.1 General

All remote indicators shall be labelled with the wording “FIRE” and a location descriptor.

NOTE Examples of location descriptions of remote indicators are as follows:

(a) In roof.

(b) In concealed space.

(c) In cupboard.

(d) In room.

(e) Return air.

(f) Supply air.

Remote indicators for rooms, cupboards or similar spaces shall be installed adjacent to the door giving access to the detector(s). The indicator shall be visible from the path of normal entry to the door.

Where a common remote indicator for multiple detectors within a single room or sole occupancy is used the requirements for integral indicators shall still be met.

Where the integral indicator cannot be seen a remote indicator shall be provided.

3.16.2 Concealed spaces

Remote indicators are required for concealed spaces unless the detector location is indicated at the FDCIE or the concealed space is accessible and —

(a) has a height exceeding 2 m and is trafficable by personnel; or

(b) is beneath removable flooring (such as computer flooring).

Remote indicators shall be installed in an accessible area as close as practicable to the detector.

Where a detector is mounted under removable flooring such as in a computer room and the detector location is not indicated at the FDCIE, a label shall be affixed to the ceiling or ceiling grid immediately above the detector indicating the location of the detector below.

3.16.3 Restricted emergency service access

Where detectors are installed in areas to which fire service access is restricted, each area shall be identified by one of the following:

(a) A separate detection zone.

(b) An individual identification at the FBP.

(c) A labelled remote indicator installed outside the entry to the area (see Figure 2.3).

NOTE Examples of restricted access may include the following locked areas: residential SOUs, shops (in arcades, malls and plazas), vaults, strongrooms, lift motor rooms, lift shafts, cool rooms, freezers, cupboards and electrical switch rooms.

3.16.4 Air-handling system

Integral alarm indicators on smoke detectors located in air-handling systems shall be clearly visible. Where this condition cannot be met, remote indicators shall be provided.

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3.19 Smoke and fire door control

3.19.1 General

Where smoke doors, fire doors and fire shutters are held open but are required to be self-closing, they shall close in accordance with the following:

(a) The automatic closing operation shall be initiated by the activation of a smoke detector. The detectors shall be located on each side of the fire wall or smoke wall not more than 1.5 m horizontal distance from the opening.

If smoke detectors are not suitable for the atmosphere, any other detector deemed suitable in accordance with this Standard shall be used, see Appendix M.

(b) Where any other required suitable fire alarm system, including a sprinkler system, is installed in the building, activation of the system in a fire or smoke compartment separated by the fire or smoke wall shall also initiate the automatic closing operation.

NOTE 1 For detectors required in egress paths, see Clause 3.27.

NOTE 2 Detectors installed to release fire and smoke doors on a single level and located within a common circulation space may be connected to a single detection zone.

(c) Non-latching manual release switches shall be provided for door hold-open devices and shall be visible and accessible with the door(s) in the open position. The release switch shall be labelled "DOOR RELEASE" unless it is integral with the hold-open device. The lettering height shall be a minimum of 5 mm and in a contrasting colour.

(d) Where more than one door panel is fitted to one opening, one switch shall release all door panels simultaneously.

NOTE In some situations, a door release delay may be required to ensure the safe operation of the door.

3.19.2 Sliding fire doors and fire shutters

If a doorway in a firewall is fitted with a sliding fire door or a fire shutter that is open when the building is in use, it shall be controlled by the FDAS. On alarm, the following shall apply:

(a) The door/shutter shall be released by deactivation of an electromagnetic device.

(b) The closing sequence shall be delayed for 10 s to 15 s following the activation of the warning system detailed in Item (c) below.

(c) An AAD shall be located near the doorway, and a VAD flashing red be located on each side of the doorway. The VAD shall be selected for a minimum direct view distance of 5 m.

(d) Signs shall be installed on each side of the doorway located directly over the opening stating "WARNING — SLIDING FIRE DOOR" or "WARNING – FIRE SHUTTER" as appropriate, in capital letters not less than 50 mm high in a colour contrasting with the background.

Where the door/shutter forms part of a smoke control system in accordance with Clause 7, smoke detectors shall be used.

Where the door/shutter closes on loss of mains power the normal closing sequence including operation of the AAD and VAD is required.

Where any other required suitable fire alarm system, including a sprinkler system complying with NCC, is installed in the building, activation in either fire compartment separated by the firewall shall also de-activate the electromagnetic device and activate the warning system.

3.20 Electric lock release

Where doors are released upon a fire alarm condition, the control shall meet the requirements of Clause 3.6.1.

3.21 Suppression system monitoring devices

Monitoring devices such as valve tamper switches shall be indicated at the FDCIE. This indication shall be a supervisory condition and clearly distinguishable from a fire alarm condition.

3.22 Building occupant warning systems

3.22.1 General

One of the following shall provide occupant warning of a fire alarm condition:

(a) An Emergency Warning System (EWS) installed in accordance with AS 1670.4.

(b) An occupant warning system comprising at least one of the following:

(i) An EWCIE in accordance with AS 4428.16, connected to compatible loudspeakers conforming to AS ISO 7240.24.

(ii) Audible alarm devices conforming to AS ISO 7240.3.

NOTE 1 AS ISO 7240.24 does not apply to active loudspeakers.

NOTE 2 AS 1670.4 allows the use of an alert emergency warning signal.

Where using building occupant warning systems in accordance with Item (b) above, Clauses 3.22.2 to 3.22.5 apply.

3.22.2 Evacuation signals

The evacuate signal shall be broadcast simultaneously to all occupied space of the building and shall —

(a) not be preceded by an alert signal without the approval of the ECO and unless loudspeaker transmission paths have been installed in accordance with AS 1670.4;

(b) broadcast to all occupied space simultaneously unless loudspeaker transmission paths have been installed in accordance with AS 1670.4 and phased in accordance with the emergency management plan;

(c) be in accordance with ISO 8201;

(d) not be subject to any time delay after the occurrence of a fire alarm condition;

(e) be synchronized throughout an area and adjacent area except where the sound pressure level from an adjacent area is at least 30 dB lower; and

(f) include words “Fire” and “Evacuate”, or a pre-recorded speech message, where an EWCIE is used.

NOTE 1 It is recommended that the tone be 520 Hz as specified in AS 4428.16.

NOTE 2 It is recommended that AADs include a voice message.

3.22.3 Audibility of signals

The following shall apply in assessing the audibility of signals:

(a) Throughout each acoustically separate space, the minimum SPL shall exceed the typical ambient SPL by at least 10 dB, and in any case be not less than 75 dB(A) and maximum SPL shall not exceed 105 dB(A).

NOTE Where permitted by the NCC the audible evacuate signal may be adjusted in volume and content to minimize trauma consistent with the type and condition of occupants.

(b) The typical ambient SPL during regular high activity time periods shall be used.

(c) Within an acoustically separate space, the difference between the minimum SPL and maximum SPL shall not exceed 15 dB.

(d) One reference SPL shall be selected at a location for each loudspeaker transmission path. The SPL shall be recorded as the baseline data for the area covered by that loudspeaker transmission path.

(e) Competing sound reinforcement systems that are likely to produce an average SPL of more than 75 dB(A) shall shut down.

(f) All SPL values shall be determined in accordance with Appendix H.

(g) Systems provided with live speech facilities shall be checked for speech intelligibility.

NOTE To provide more even sound level distribution and direct sound to provide better intelligibility, it is recommended that loudspeakers with a hemispherical coverage angle of approximately 120° are installed on a grid equal to twice the ceiling height with the loudspeakers near walls or windows at a distance equal to the ceiling height. For other polar patterns an acoustic engineering design should be carried out.

3.22.4 Visual alarm signals

Visual alarm devices shall be installed as follows:

(a) Areas designated for persons with hearing impairment, shall be provided with VAD to indicate a fire alarm condition.

(b) VAD shall be used in the following areas where —

  (i) the average A-weighted sound pressure level of the background noise is higher than 85 dB;

  (ii) the wearing of hearing protection devices is required (refer to AS 1269);

  (iii) an audible warning is not allowed or desirable; and

  NOTE Examples of areas requiring a visual warning where an audible warning may not be provided are audio recording and broadcast studios, surgical theatres.

  (iv) live speech is provided and speech intelligibility requirements are not met.

  NOTE VWD may only be used to supplement the occupant warning.

(c) VADs shall meet the following conditions:

  (i) VAD shall be synchronized in any location within the building where more than one VAD is visible.

  (ii) VAD shall have a label on or next to the device with the words “FIRE” or “EVACUATE” in letters not less than 15 mm height in a contrasting colour to the background.

(d) VAD shall be installed in accordance with spacing detailed in the conformance documentation throughout the area of coverage. In car parks the area of coverage is limited to the circulation spaces.

NOTE When designing emergency warning systems for people with hearing impairment a combination of visual, tactile or other emergency warning devices should be included.

3.22.5 Intelligibility

At all places within the emergency zone where live speech is provided and the ambient SPL (noise) is less than 85 dB(A) as determined using the method in Appendix H, and the reverberation time (T_{60}) is less than 1.5 s speech intelligibility shall be not less than 0.7 on the Common Intelligibility Scale (CIS).

Speech intelligibility need not be measured if —

(a) the live speech signal to noise ratio is greater than 10 dB; and

(b) the reverberation time (T_{60}) is less than 1.5 s evidenced by an acoustic report to AS 2107; and

(c) loudspeakers are spaced not further apart than the twice mounting height from the floor; or

(d) where VAD are installed to Clause 3.22.4.

Speech intelligibility shall always be met within a 6 m radius of the approach to a required exit (as defined in the NCC).

If speech intelligibility test results do not give a CIS score directly, Appendix I shall be used to convert speech intelligibility values to a CIS score.

NOTE 1 Methods of measuring speech intelligibility are given in Appendix J.

If using the STI method, for the purpose of this Standard the STI-PA method using eight frequencies in the audio spectrum shall be considered equivalent to the STI method.

NOTE 2 An STI of 0.5 is equivalent to a CIS score of 0.7.

NOTE 3 To provide more even sound level distribution and direct sound to provide better intelligibility, it is recommended that loudspeakers with a hemispherical coverage angle of 120° are installed on a grid equal to twice the ceiling height with the loudspeakers near walls or windows at a distance equal to the ceiling height. For other polar patterns an acoustic engineering design should be carried out.

3.23 Components using radio transmission paths

Radio transmission paths shall meet the requirements of AS ISO 7240.25.

3.24 Cabling systems

3.24.1 General

Customer cabling, including ELV power supply wiring of the FDAS, shall be kept separate and distinct from all other systems unless forming part of the EWS, EIS, EWIS or FDAS and shall be in accordance with the requirements of AS/CA S009.

NOTE 1 The loudspeaker transmission path carrying LV (telecommunications) requires separation from ELV wiring and mains power wiring (LV power) in accordance with AS/CA S009.

Externally energized circuits at voltages in excess of extra low voltage, except the power source for FDCIE, shall not enter any FDCIE cabinet.

Where the various component parts of the CIE, including the power supply equipment and batteries, are installed in separate locations, they shall be connected so that the wiring is supervised.

NOTE 2 In areas prone to severe lightning activity, CIE may require additional surge protection for wiring external to the building. This may include lightning suppression systems associated with the general building wiring.

3.24.2 Conductors

Conductors shall be stranded and insulated. Two-core cables used for customer cables shall have a minimum cross-sectional area of 0.75 mm^2 for each conductor. Customer cables having three or more cores shall have a cross-sectional area of not less than 0.4 mm^2 for each conductor.

Where stranded and solid core data-type cables are installed between networked FDCIE and distributed parts of FDCIE within the FDAS, the total cross-sectional area of all the conductors within the cable shall not be less than 1.5 mm^2.

Fibre optic data-type cables shall only be installed between networked FDCIE, SHCIE and distributed parts of FDCIE within the FDAS or FDCIE and EWCIE.

The maximum voltage drop shall not cause any equipment to be operated at a voltage less than the minimum specified by the equipment documentation.

3.24.3 Cable marking

For ELV transmission paths not installed within cable conduit, the outer sheath of a cable shall be coloured red with contrasting marking “ELV Fire” at intervals not exceeding 2 m.

For LV telecommunication transmission paths not installed within conduits, the outer sheath of the cable shall be red with a white stripe with contrasting marking “LV Fire” at intervals not exceeding 2 m.

Specialist cables, including optical fibre and multicore, that are not available with the marking in this clause shall have permanent red markers of at least 25 mm in width spaced at intervals of not more than 2 m along the cable length when not installed in conduit, and clearly marked ELV Fire or LV Fire at the point of termination.

3.24.4 Terminations

Wiring to all devices shall be supervised to the extent that removal of any device from the transmission path will cause a fault signal to be displayed at the FDCIE. See Clause 3.6.2.

Connecting facilities provided by the devices shall be used without modification.

Where incoming and outgoing conductors of the same potential share a common terminal they shall be independently clamped.

Devices required to operate at voltages above ELV shall be in accordance with the appropriate requirements of AS/CA S009.

3.24.5 Stress on conductors

Conductors shall be so supported and connected that there will be no undue mechanical stress on the conductors or the terminals to which they are connected.

3.24.6 Joints

Joints shall be in accordance with the requirements of AS/CA S009, and the following:

(a) Made in a junction box located in an accessible space.

(b) All junction boxes shall be clearly identified on the “as-installed” drawings.

(c) Cables joined shall be labelled within the junction box.

(d) The junction box shall be marked “FIRE” in letters not less than 5 mm in height in a contrasting colour to the background.

(e) Cables joined in a junction box shall be provided with strain relief.

(f) Joints in fire-rated transmission paths shall be either fire-isolated from occupied space, protected by a steel or cast iron cabinet of no less than 1 mm gauge using ceramic terminal blocks, or using a fire-rated jointing kit for the cable type installed.

NOTE Where cables need to be extended when equipment is being replaced or relocated, a junction box may be provided adjacent to the existing location.

3.25 Transmission path supervision

Transmission paths external to the cabinet shall be supervised for faults that prevent the transmission of signals on any path. Transmission paths between FDCIE and the following components shall be included:

(a) PSE.

(b) Detectors.

(c) Other initiating devices (e.g. MCP and special function switches).

(d) Loudspeakers.

(e) VAD, VWD, AAD and tactile alarm devices.

(f) Connectable devices. (e.g. annunciator panels, suppression system monitoring device).

(g) FFCP-MCC interfaces.

(h) Input/output devices.

(i) Other networked FDCIE.

(j) Distributed parts of FDCIE.

(k) Non-latching supply air smoke detectors.

(l) EWCIE external to the FDCIE cabinet.

(m) Fire suppression systems initiating devices (e.g. pressure switches, flow switches).

(n) Fire suppression system actuating devices (e.g. agent release).

(o) Smoke detectors initiating zone pressurization systems.

(p) External alarm device (e.g. VAD).

3.26 Transmission path protection

Transmission paths shall be protected against mechanical damage to a minimum of WSX1 in accordance with AS/NZS 3013.

NOTE 1 Mechanical protection may be required to be upgraded according to the risk of damage. See Appendix B.

Where installed underground, the transmission path shall also be installed in accordance with the requirements for underground wiring (refer to AS/CA S009).

The transmission path to or between the following equipment shall be fire-rated:

(a) PSE.

(b) FFCP to MCC interface.

(c) Between networked FDCIE.

(d) Distributed parts of FDCIE.

(e) Non-latching supply air smoke detectors.

(f) EWCIE external to the FDCIE cabinet.

(g) Fire suppression initiating devices (e.g. pressure switches and flow switches).

(h) Fire suppression actuating devices (e.g. agent release).

(i) Smoke detectors initiating zone pressurization systems (smoke control).

(j) Input/output devices that form part of smoke control systems or fire suppression systems excluding valve tamper, fault monitoring and test solenoids.

The transmission path is considered to meet the fire rating requirement where it is installed in a fire isolated stairway, having an FRL not less than -/120/120, or underground or embedded in a concrete slab. Where SCIs are required they shall be protected to at least the same degree as the transmission paths they connect to. The protective housing in Clause 3.13 is not intended to meet this requirement.

NOTE 2 See Appendix B.2 for examples of addressable transmission paths for smoke control.

Wiring system elements shall be rated WS5XW as defined in AS/NZS 3013.

Where fibre optic cables are used, they shall conform to IEC 60331-25 with a minimum of 120 min flame application time. The cable support systems shall meet WS5X in accordance with AS/NZS 3013.

The support systems shall be attached to a part of the building with the FRL of not less than 120/–/–. Where this is not available the support system shall be attached to a structural member with highest structural adequacy.

The transmission paths shall be dedicated to the FDAS functions, including systems installed to other parts of the AS 1670 and AS 2118. Where shared, the transmission path shall be protected in accordance with the highest protection rating required by these Standards.

3.27 Location of detectors

3.27.1 General

Detectors shall be provided throughout all areas of the building except as detailed in Clause 3.28 and where detection is installed in accordance with Clause 7.

Detection shall be installed in the locations specified in the NCC.

NOTE Detection may be provided to meet special requirements, for example, early warning or risk management.

Photoelectric smoke detectors in accordance with AS 7240.7, AS 7240.15, AS 7240.20 or AS 7240.27, or CO fire detectors shall be installed in all sleeping areas.

CO detectors shall not be the only detectors in sole occupancy units.

Photoelectric smoke detectors with a band 1 response threshold value shall be installed in circulation spaces leading to exits.

The following considerations shall apply in determining the location of detectors to be installed:

(a) Where an area is divided into sections by walls, partitions or storage racks reaching within 300 mm of the ceiling (or the soffits of the joists where there is no ceiling), each section shall be treated as a room, and shall be protected.

(b) A clear space for access of at least 300 mm radius, to a depth of 600 mm, shall be maintained from the detector or sampling point. Minor building structure and services occupying this space shall not exceed 25 percent of the clear space provided it does not prevent access to the detector. This does not include items such as sprinkler heads, speakers and recessed light fittings.

(c) Indicators shall be visible from the path of normal entry to the area.

(d) Detectors shall be installed so that the “on” or “off” condition of the alarm indicator shall be discernible from a trafficable area.

NOTE Additional protection may be required where any special structural features or conditions exist. See Appendix M for guidance on the selection of detectors.

> ***C3.27.1*** *In situations where the use of smoke detectors results in nuisance alarms, other approaches may be required. For example:*
>
> *(a) Relocation of the detector.*
>
> *(b) Use of other types of detectors (see Appendix M). The use of heat detectors in lieu of required smoke detectors is not recommended.*
>
> *(c) Use of AAF, ADF, AIF, AVF Type A dependency or Type B dependency in accordance with this Standard.*

3.27.2 Accessible service tunnels

Accessible service tunnels, not fire-isolated, between buildings or sections thereof shall be protected (see Clause 3.16.3).

3.27.3 Air-handling systems

Air-handling systems not requiring conformance with Clause 7 of this Standard shall meet the following requirements:

(a) *Return-air system* Buildings with a return air-handling system serving more than one enclosure shall be provided with at least one of the following:

  (i) Smoke detectors located in accordance with Clause 5.

  (ii) Smoke detectors located in accordance with Clause 7.

  (iii) Smoke detectors installed adjacent to each return/relief/economy air inlet to cover all likely smoke migration paths.

  (iv) Duct sampling smoke detectors to sample air from the common return air inlets.

  NOTE The effect of dilution may prevent early detection by a common return air detector for several compartments if smoke is only entering the duct from a single compartment.

(b) *Supply-air system* Air-handling plant supplying air to more than one fire compartment within the building shall have a latching duct sampling smoke detector installed in the supply air duct, as close as practicable to the plant, to detect smoke downstream from the supply air fan.

(c) *Exhaust system* Ducts that are used for exhausting cooking fumes, flammable vapours, lint material and the like shall have at least one detector at the furthest practicable downstream point of the duct.

NOTE Detectors for this application should be carefully selected to suit the environment so that nuisance alarms are minimized. A fully sealed heat detector would normally be used.

The operation of any detector required in Items (a), (b) and (c) above shall initiate a fire alarm condition and shut down the air-handling equipment.

Each detector mounted in an air-handling system shall indicate as a separate detection zone.

Duct sampling smoke detectors shall be used for monitoring air in ducts.

Duct sampling probes shall be mounted perpendicular to the radial axis (centreline) of any bend, corner, or discharge of a centrifugal fan, or the pods of a duct attenuator, or the widest section of a duct expansion joint, unless the sampling probe can be installed downstream in a straight section of ductwork at a distance of at least six times the duct width from any of these.

The duct sampling probe shall enter the duct from the side of highest air velocity. If it traverses the full width of the duct this need not apply (see Note 1).

The duct sampling smoke detector housing shall not be installed where it cannot be accessed without moving the duct.

NOTE 1 The highest air velocity and smoke density will typically occur near the outside surface after a bend or near the outside surface of the duct furthest from the axis of a centrifugal fan.

NOTE 2 Duct sampling probes should not be installed downstream any closer than three times the duct width from the nearest bend, corner, centrifugal fan, junction or attenuator.

NOTE 3 The suitability of the smoke detector for this type of application should be determined from the product's documentation.

NOTE 4 The sampling inlet probe and the holes in the probe should be arranged according to the product's installation instructions.

NOTE 5 The duct sampling probe should sample at least two thirds of the duct section.

NOTE 6 See Appendix L for an example of duct sampling smoke detector location and orientation.

Detectors installed in air-handling systems shall be provided with permanent indelible labels, stating zone designation, affixed adjacent to the detectors.

3.27.4 Concealed spaces

3.27.4.1 General

Protection shall be provided in all concealed spaces; except for the exclusions provided in Clause 3.28. Access for maintenance of detectors in concealed spaces shall be provided. Where personnel entry to the concealed space is required, the access dimensions shall be not less than 450 mm × 350 mm.

3.27.4.2 Electrical equipment

Where a concealed space contains electrical lighting or power equipment that is fully within the concealed space and is connected to an electrical supply in excess of extra low voltage, a detector shall be mounted on the ceiling of the concealed space within 1.5 m measured horizontally from the equipment. Where the ceiling is sloping, the detector shall be located on the higher side of the ceiling.

Detection is not required when the electrical light fittings are not rated above 100 W and power equipment with moving parts not rated above 100 W and other power equipment not rated above 500 W.

For the purpose of this Standard, electrical wiring installed in accordance with AS/NZS 3000 and any housings of light fittings not deemed combustible that protrude into a false ceiling are not regarded as electrical equipment.

NOTE The detector used in the protection of the equipment in concealed spaces does not necessarily constitute protection of the concealed space.

3.27.5 Cupboards

Any cupboard that has a volume exceeding 3 m^3 shall be protected. Cupboards divided by partitions or shelves into separate areas of less than 3 m^3 volume do not require detectors.

Cupboards with a volume in excess of 1 m^3 and containing electrical or electronic equipment having voltages greater than extra-low voltage shall be protected internally. The requirements of Clause 3.27.1(b) do not apply.

NOTE For electrical cubicles not requiring protection, see Clause 3.28.

3.27.6 Intermediate horizontal surfaces

Protection shall be provided under intermediate horizontal surfaces, including ducts, loading platforms, and storage racks with its minimum horizontal dimension in excess of 3.5 m and whose under-surface is in excess of 800 mm above the floor.

If the side of the duct or structure is in excess of 800 mm from the wall or other ducts or structures, detectors shall be provided at the highest accessible point on the ceiling.

Where a concealed space is formed above or below the intermediate surface, such as ducts above false ceilings, Clause 3.28 shall apply.

3.27.7 Open grid ceilings

The space above the open grid ceiling shall be protected.

Detectors are not required on the underside of open grid portions of the ceiling, where the open grid portions have not less than two-thirds of the total ceiling area open to the free flow of air and have detectors installed on the ceiling above the open grid.

Where any solid portion of the ceiling has a minimum horizontal dimension in excess of 3.5 m, Clause 3.27.6 shall apply.

Where flame detectors are used, they shall be installed above and below the open grid ceiling.

3.27.8 Sole occupancy units (SOUs)

Alarm indication from each SOU shall meet the requirements of Clause 3.16.3.

Detectors shall be located in accordance with the NCC.

Where an SOU incorporating a sleeping area consists of one main room and water closet/shower/bathroom (which is not used for other purposes, e.g. laundry), only one smoke detector is required in the main room provided that the total area of the whole unit is less than 50 m^2. The water closet/shower/bathroom and the ceiling space containing a fan coil unit (where installed) need not be protected.

NOTE The location of the detector should take into account airflows and airstream.

CO fire detectors shall not be substituted for required smoke detectors in SOUs.

3.27.9 Stairways and horizontal passageways

Pressurized stairways and horizontal passageways shall be protected in accordance with Clause 7.

Fully enclosed stairways shall have photoelectric smoke detectors installed within the stairway at each floor level having access to the stairway. Each stairway shall be a separate zone and each detector shall indicate the access level to the stairway.

Internal stairways open to a protected area shall have photoelectric smoke detectors installed on each level, zoned to indicate the same floor level as the protected area.

Non-pressurized fire-isolated horizontal passageways shall have photoelectric smoke detectors in accordance with Clause 5.

3.27.10 Transportable buildings

Any building that is manufactured to be transportable, not used for the transport of goods, and is utilized for storage or offices, located within the protected building and with an internal volume greater than 10 m^3, shall be protected as if part of the building.

3.27.11 Vertical shafts and openings

Vertical risers, lift shafts, and similar openings between storeys, that exceed 0.1 m^2 in area shall be protected within the riser at the top. Detectors shall be serviceable without entering the shaft. In addition the following shall apply:

(a) Where vertical shafts penetrate any storey and are not fire-isolated from other areas, a detector shall be located on the ceiling of each storey not more than 1.5 m horizontally distant from the vertical shaft that penetrates the storey above.

(b) Any ceiling that contains openings exceeding 9 m^2 and permitting free travel of fire between storeys shall have detectors located within 1.5 m of the edge of the opening, and spaced not more than 7 m apart around the perimeter of the opening. Such detectors are regarded as part of the general protection for the area below the opening. If the opening is less than 0.5 m from a wall, no detectors are required between the wall and the opening.

The requirements of Clause 3.27.1(b) need not apply.

3.28 Locations where detectors are not required

Detectors are not required in the following locations:

(a) *Air locks* — opening on both sides into protected areas, provided that they are less than 3.5 m^2 in area, do not contain electrical equipment, are not used for the storage of goods or for access to cupboards and are not used as washrooms.

(b) *Concealed spaces* — as follows (see Clause 3.27.4):

  (i) Concealed spaces that are less than 800 mm high, do not contain electrical lighting and power equipment and are not used for storage.

  (ii) Concealed spaces to which there is no access and that are fire-isolated with a minimum fire-resistance level 60/30/–.

  (iii) Concealed spaces to which there is no access and that are less than 350 mm high, irrespective of construction.

  (iv) Concealed spaces that are less than 3 m^3, do not contain electrical lighting and power and are not used for storage.

(c) *Open* — verandas, balconies, colonnades, breezeways, open-sided covered walkways, overhanging roof areas, ramps, and the like including those used for egress or access and not used for the storage of goods or as a car park.

(d) *Cupboards containing water heaters* — if a cupboard, opening off a protected area is solely for the use of a water heater and does not exceed 3 m^3 in volume, protection is not required.

(e) *Exhaust ducts* — in ducts exhausting from toilets, or rooms containing single ironing and laundry facilities.

(f) *Sanitary spaces* — any water closet or shower-recess or bathroom, with a floor area of less than 3.5 m^2 and opening off a protected area.

(g) *Skylights*:

(i) With an opening on the ceiling of less than 1.5 m^2 and not used for ventilation.

(ii) Installed in areas not requiring detection (such as sanitary spaces).

(iii) Of less than 4.0 m^2 area, have a recess height of not more than 800 mm and is not used for ventilation.

(iv) With an opening on the ceiling of less than 0.15 m^2 (regardless of whether it is used for ventilation or not).

(h) *Switchboards* — any non-recessed or freestanding switchboard or switchboard cubicle protected by the normal protection of the area in which it is contained.

3.29 Combination detectors

Where a combination detector is installed and one or more of the sensing elements is intended to be disabled at any time, detectors shall be installed in accordance with the spacing requirements for the remaining active element or combination of elements.

3.30 Commissioning of system

On completion of the installation of the system the correct operation of all system components shall be confirmed in accordance with the final design and installation requirements.

The results of commissioning shall be recorded as itemised in the baseline data in Clause 1.7.2. (See Appendix A.)

Section 4 Heat detectors

4.1 Point-type heat detectors

4.1.1 General

Each detector shall be installed so that no part of the sensing element is less than 15 mm or more than 100 mm below the ceiling or roof.

Where roof purlins inhibit the free flow of heat to the detector, the detector shall only be installed on the purlin where the purlin extends no further than 300 mm from the roof.

NOTE 1 Infrared scans of a building have shown heat pockets at apices of roof structures due to solar radiation. Therefore, to obtain effective fire detection, the detectors should be located below these pockets.

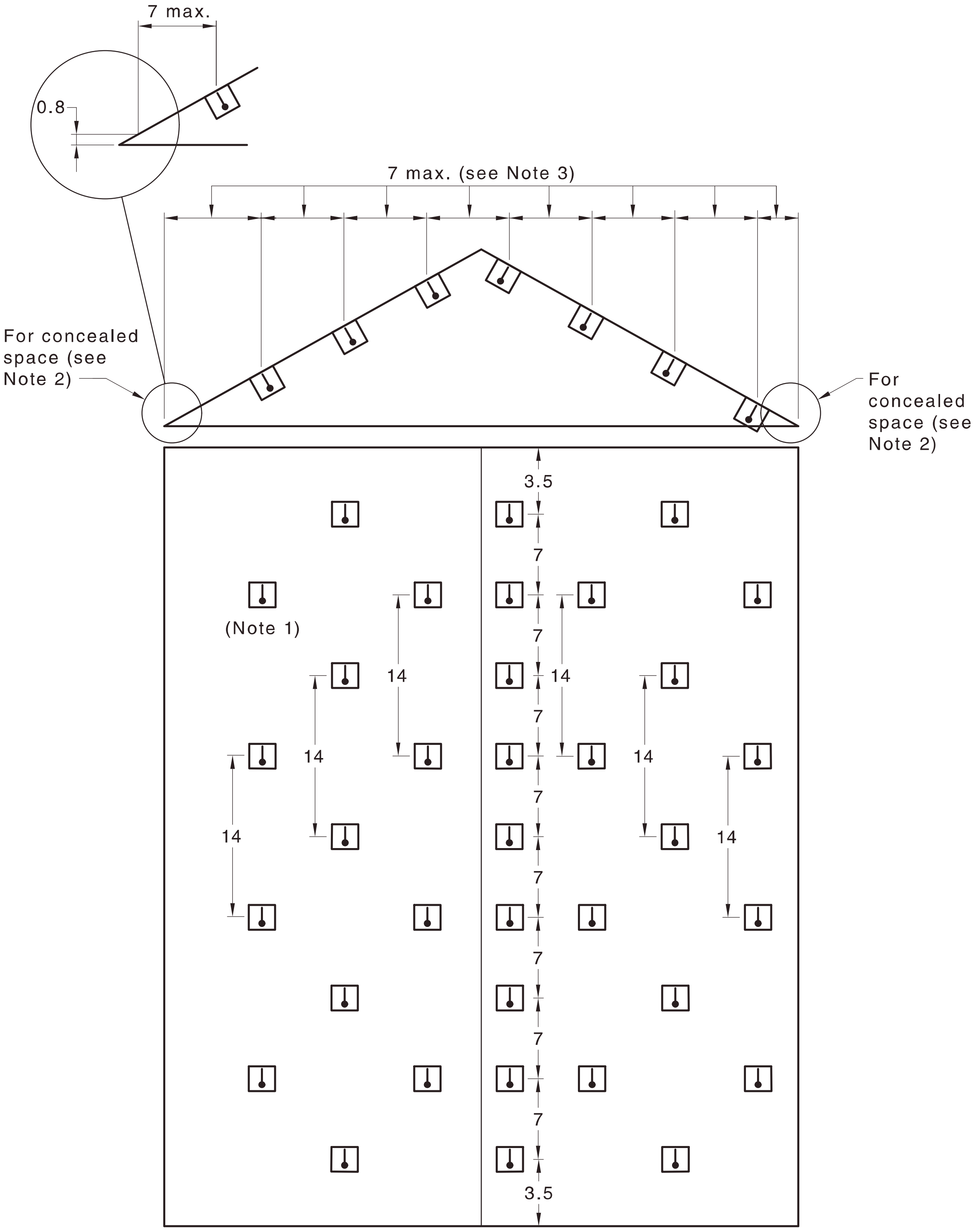
Detectors shall be installed between 0.5 m and 1.5 m of the highest point of the ceiling (see Figure 4.1.3); however, where the ceiling is constructed with beams or joists or a step, the detector shall only be installed on the underside of the beam or joist provided it is no more than 300 mm from the ceiling.

Areas protected with a sprinkler system in accordance with AS 2118.1, AS 2118.4 or AS 2118.6 do not require the installation of heat detectors.

NOTE 2 The type of detector for use in various locations is described in Appendix M.

NOTE 3 Where the height of the ceiling is greater than 6 m, it is recommended that a detector with greater sensitivity be considered.

Dimensions in metres



NOTE 1 Alternate rows offset.

NOTE 2 See Clause 4.1.6.

NOTE 3 Apex detector to conform with Clause 4.1.3. See also Figure 4.1.3.

Figure 4.1.1 — Maximum heat detector locations for sloping surfaces

4.1.2 Spacing between detectors for level surfaces

For level surfaces, detectors shall be arranged so that the distance from any point on the ceiling of the protected area to the nearest detector does not exceed 5 m (see Figure 4.1.2). In addition, the distance between any detector and the nearest detector to it shall not exceed 7 m.

Where detectors are installed in an area of less than 100 m^2, the detectors installed in a staggered grid, shall meet the following:

(a) Be arranged within 3.5 m of the wall.

(b) Have at least one detector located within 3.5 m of each wall.

(c) Be within 7 m of each other in any direction.

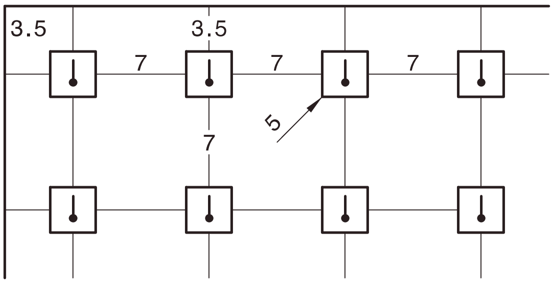


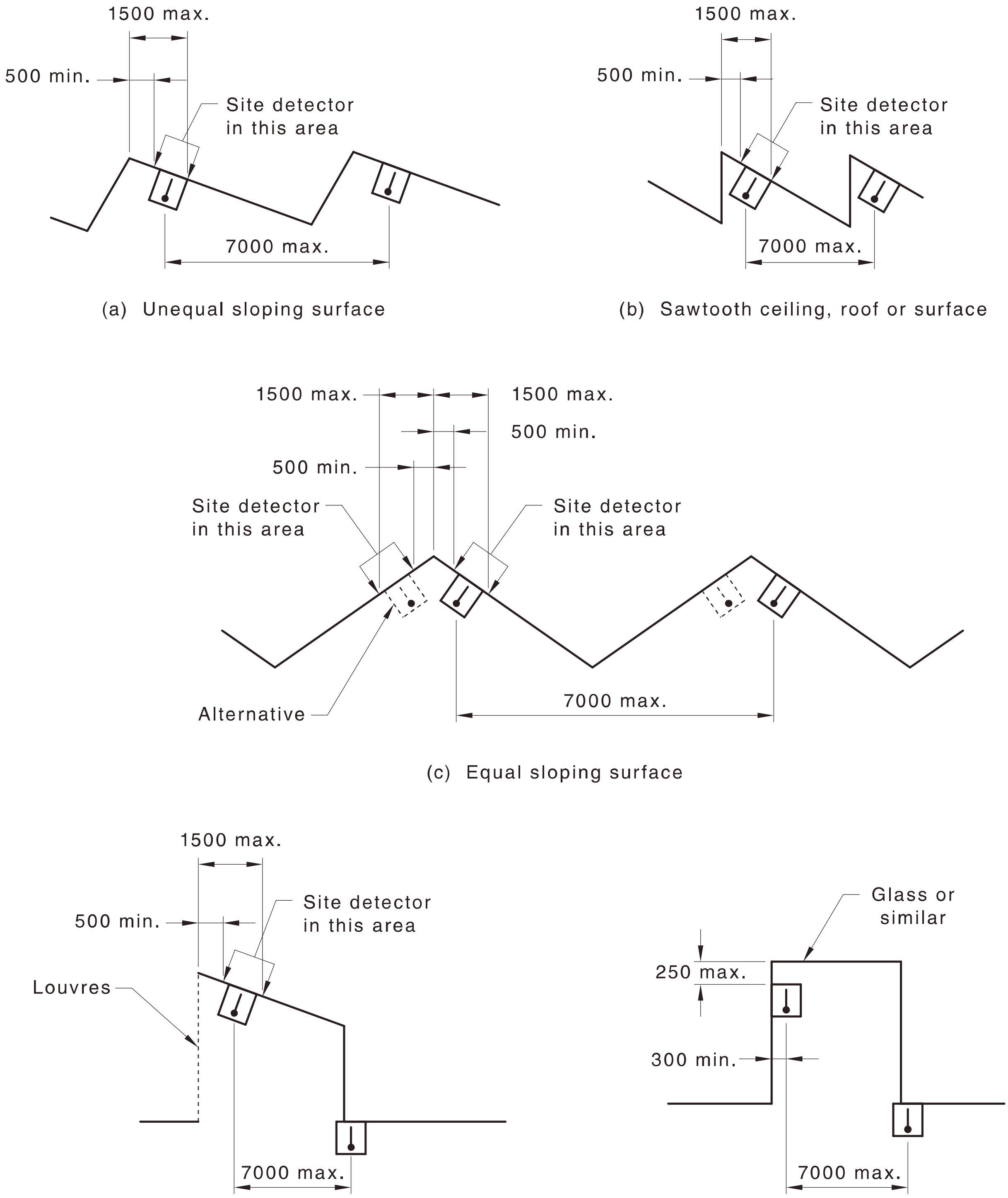
Figure 4.1.2 — Maximum detector spacing on a square grid — Level surfaces

4.1.3 Spacing of detectors for sloping surfaces

This clause (4.1.3) applies to all sloping surfaces including curved surfaces such as barrel-vaulted ceilings.

Detectors shall be installed between 0.5 m and 1.5 m from the apex and spaced longitudinally at a maximum of 7 m between detectors. Lower rows of heat detectors shall be no more than 7 m apart, measured horizontally from adjacent rows, the outside wall or partition. The spacing between heat detectors within lower rows shall only be extended up to 14 m, provided that the detectors are offset equally between the detectors on the adjacent rows (see Figure 4.1.1).

Dimensions in millimetres



(a) Unequal sloping surface

(b) Sawtooth ceiling, roof or surface

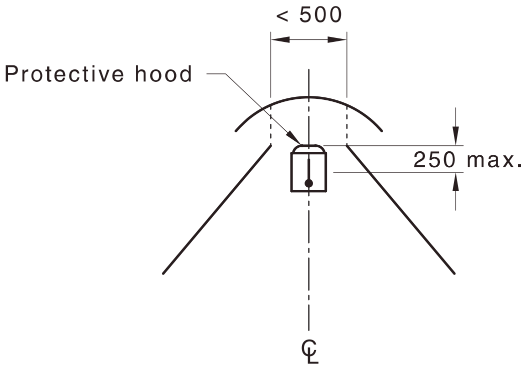
(c) Equal sloping surface

(d) Louvred ceiling or roof with louvred riser

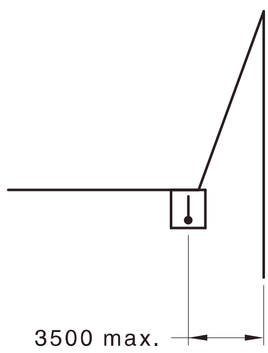
(e) Ceiling, roof or surface with skylight

Figure 4.1.3 — (in part) Design criteria for point-type and line-type detectors

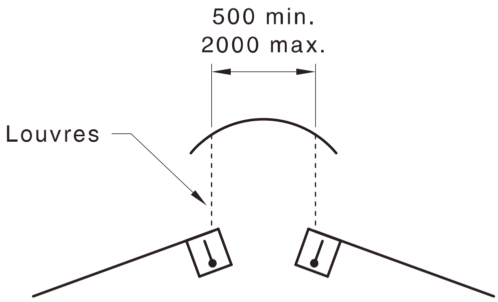
Dimensions in millimetres



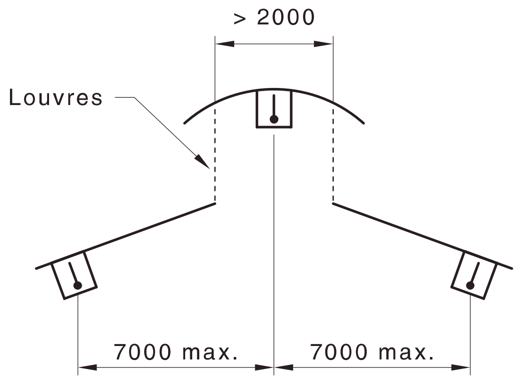
(f) Ventilated ridge



(g) Narrow apex



(h) Narrow ridge vent



(i) Broad ridge vent

Figure 4.1.3 — (in part) Design criteria for point-type and line-type detectors

4.1.4 Spacing from walls, partitions, or air supply openings

The distance from the nearest row of detectors to any wall or partition shall not exceed 3.5 m, or be less than 300 mm (see Figure 4.1.2). Detectors shall not be installed closer than 400 mm to any air supply opening.

4.1.5 Reduced spacing

Where the ceiling of the protected area is segmented by beams, joists, or ducts, and the vertical depth of such members is greater than 300 mm, spacing between detectors shall be reduced by 30 percent in the direction perpendicular to the direction of segmentation.

NOTE For all types of heat detector, closer spacing may be required to take account of special structural characteristics of the protected area.

4.1.6 Spacing in concealed spaces requiring protection

Concealed spaces for which protection is required under Clause 3.27.4 shall be protected in accordance with Clauses 4.1.1 to 4.1.6, subject to the following exceptions:

(a) Concealed spaces with level upper surfaces in excess of 2 m high shall have detectors spaced in accordance with Clause 4.1.2 and Clause 4.1.4.

(b) For concealed spaces with level upper surfaces less than 2 m high and having downward projections, such as beams and ducts not exceeding 300 mm from the upper surface of the space, the spacing between detectors shall not exceed 10 m, and the distance between any wall or partition to the nearest detector shall not exceed 5 m.

Where downward projections exceed 300 mm, the spacing of detectors shall be in accordance with Clause 4.1.2 and Clause 4.1.5.

(c) For concealed spaces with apices, the lowest row of detectors shall be located not more than 7 m measured horizontally towards the apex from a position where the vertical height, between the upper and lower surfaces of the space, is 800 mm (see Figure 4.1.1 and Figure 4.1.3).

4.2 Line-type heat detectors

Installations of line-type heat detectors shall conform with the appropriate requirements of Clauses 4.1.2 to 4.1.5, and with the following requirements:

(a) The maximum area covered by each line-type heat detection device shall be in accordance with the area limitation specified in Clause 2.3.

(b) All line-type heat detectors shall be installed so that they are not subject to mechanical damage.

(c) The heat-sensing portion of the line-type heat detectors shall not be installed in more than one detection zone unless precautions are taken to prevent incorrect detection zone identification and to ensure that a single fault does not affect more than one detection zone.

(d) Line-type heat detectors shall be disposed throughout the protected area so that there is not more than 7 m between any two adjacent lines and within 3.5 m of any wall or partition. In the roof bays, there shall be a line-type heat detectors for each apex, even where these apices are less than 7 m apart.

NOTE See Appendix M, Paragraph M3.

(e) Where the line-type heat detector is made up of a number of individual elements, each element shall be considered as a point-type detector for spacing purposes.

(f) Line-type heat detector elements shall be in accordance with Clause 3.24 except for the requirements of Clause 3.24.2 and Clause 3.24.3.

NOTE Line-type heat detectors were previously called linear heat detectors.

Section 5 Smoke and carbon monoxide (CO) fire detectors

5.1 Spacing and location

5.1.1 General

The opening to the sensing element for ceiling-mounted point-type detectors shall not be located less than 25 mm below the ceiling, roof or apex unless they have been assessed for less than 25 mm and in any case not more than 300 mm below the ceiling, roof or apex.

For ceiling heights exceeding 4 m, the sensing element shall not be more than 600 mm below the ceiling roof or apex.

The maximum height of point type smoke detectors above the floor shall not exceed 12 m. For height above 12 m ASD or optical beam smoke detection shall be used.

NOTE 1 Where the ceiling or roof height is more than 12 m from the floor, the detector type and location requires additional engineering considerations of the smoke plume within the building environment.

NOTE 2 The effect of thermal barriers should be considered in selecting the location of detectors or sampling points.

Carbon monoxide (CO) fire detectors shall be installed in accordance with the spacing requirements for point type smoke detectors.

NOTE 3 For guidance, see Appendix M.

The maximum spacing and location of detectors shall be in accordance with the requirements of Clauses 5.1.2 to 5.1.6 and Figures 5.1.1(A) to 5.1.1(F).

NOTE 4 The types of detectors for use in various locations is described in Appendix M.

Optical beam smoke detectors spaced in accordance with Figure 5.1.1(C) shall be mounted not less than 25 mm and not more than 600 mm below the ceiling or roof unless the spacing between beams is reduced to half the mounting height of the beam above the floor.

> ***C5.1.1*** *The requirements for the reduced spacing of optical beam smoke detectors has taken into account the likely spread of a smoke plume as a function of height.*

NOTE 5 Care should be taken to ensure that beam receiver units are not exposed to strong light, especially direct sunlight.

NOTE 6 Additional optical beam smoke detectors may be installed in vertical spaces, e.g. atria, at lower levels.

5.1.2 Spacing between detectors for level surfaces

For level surfaces, detectors shall be arranged so that the distance from any point on the level surface of the protected area to the nearest detector does not exceed 7 m, [see Figure 5.1.1(A)]. In addition, the distance between any detector and the nearest detector to it shall not exceed 10 m.

For optical beam smoke detectors, the distance between beams shall not exceed 14 m [see Figure 5.1.1(C), part (b)], and be not more than 7 m from wall. The transmitters, receivers and reflectors shall not be more than 3.5 m from any end wall or smoke curtain.

Aspirated systems shall be so arranged that sampling points have the same maximum spacing as that required for point-type smoke detectors.

Where detectors are installed in an area of less than 200 m^2, the detectors installed in a staggered grid, shall meet the following:

(a) Be arranged within 5 m of the wall.

(b) Have at least one detector located within 5 m from each wall.

(c) Be within 10 m of each other in any direction.

Dimensions in metres

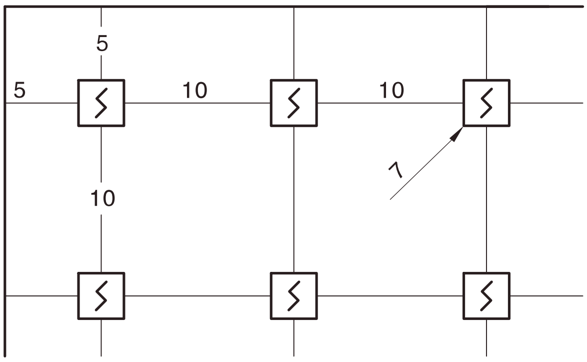
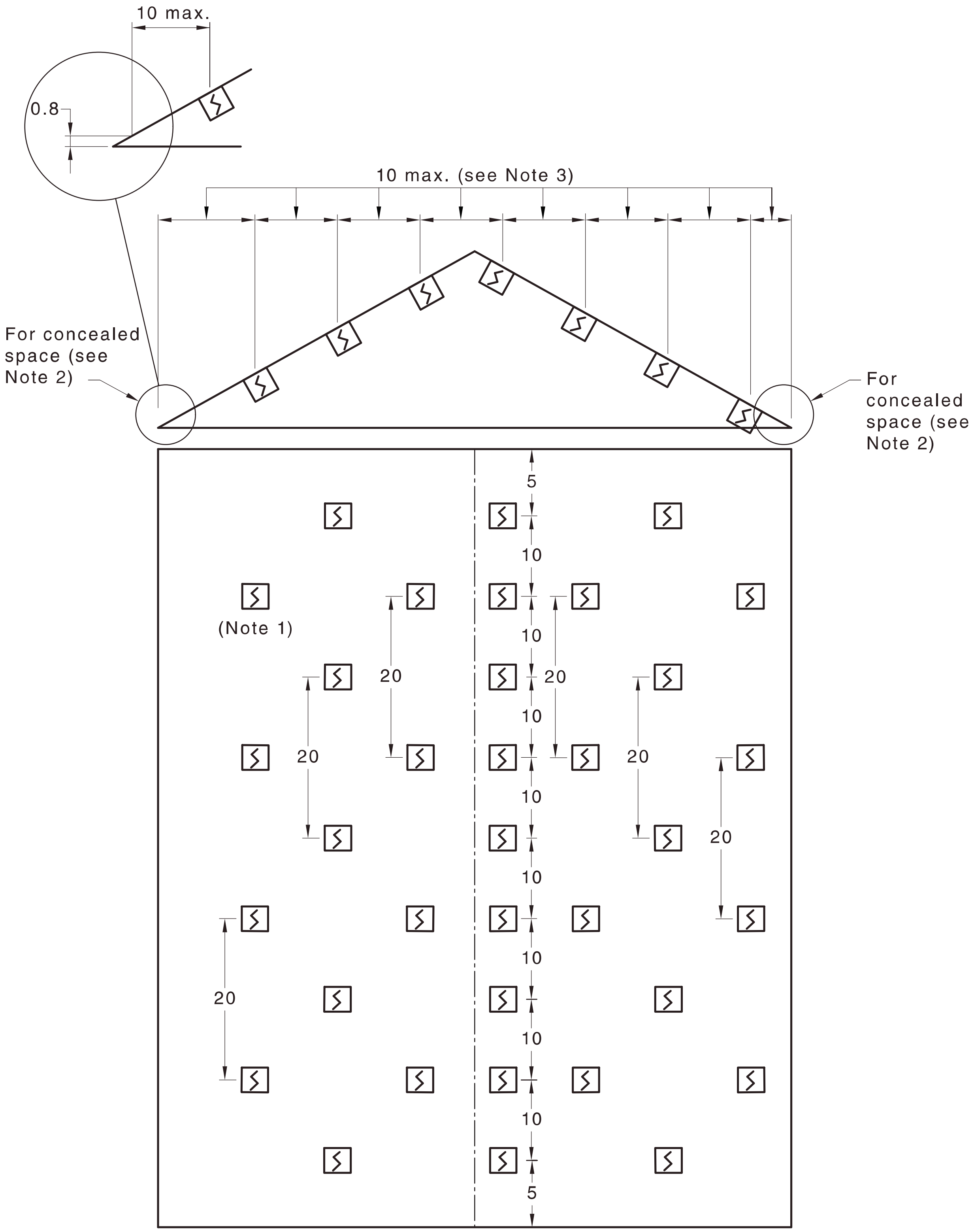


Figure 5.1.1(A) — Maximum smoke detector spacing on a square grid — Level surfaces

Dimensions in metres

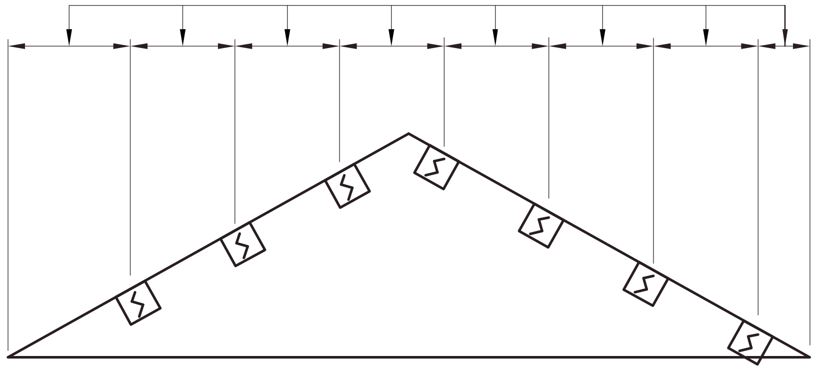


NOTE 1 Alternate rows offset.

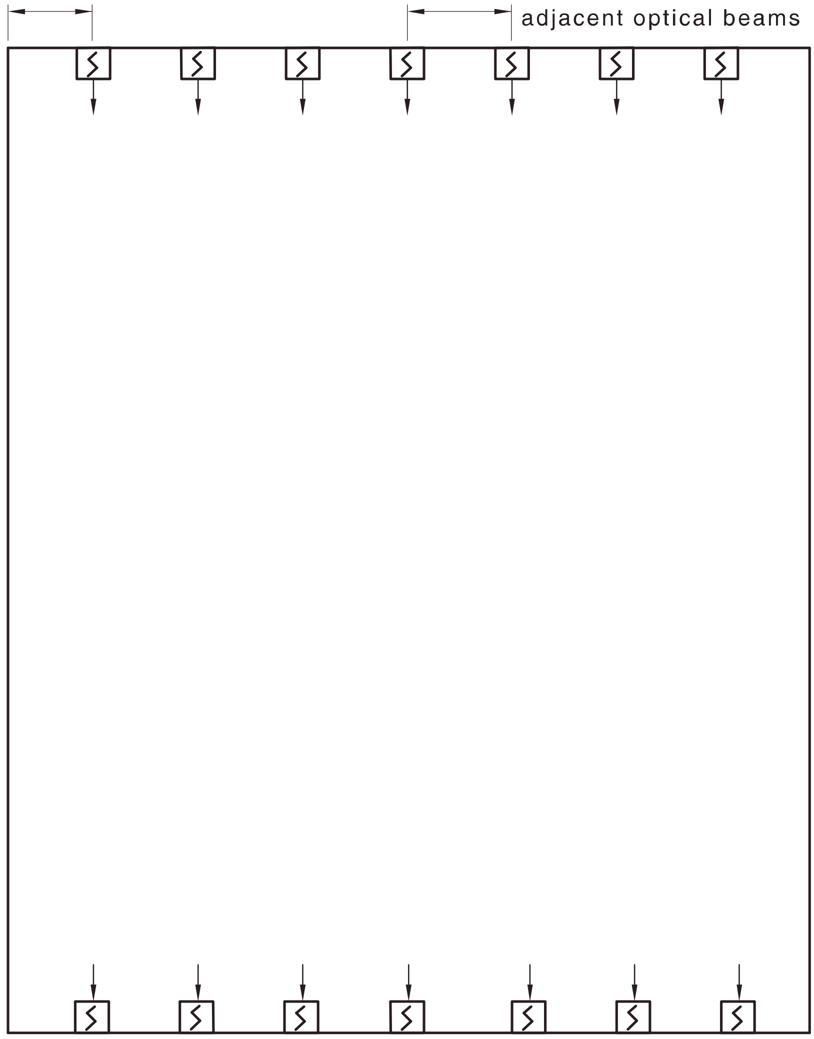
NOTE 2 See Clause 5.1.7.

NOTE 3 Apex detector to be in accordance with Clause 5.1.3 and Figure 5.1.1(C) and Figure 5.1.1(D).

Figure 5.1.1(B) — Detector locations and maximum spacing for sloping surfaces — Point-type smoke detectors and ASD systems smoke detector



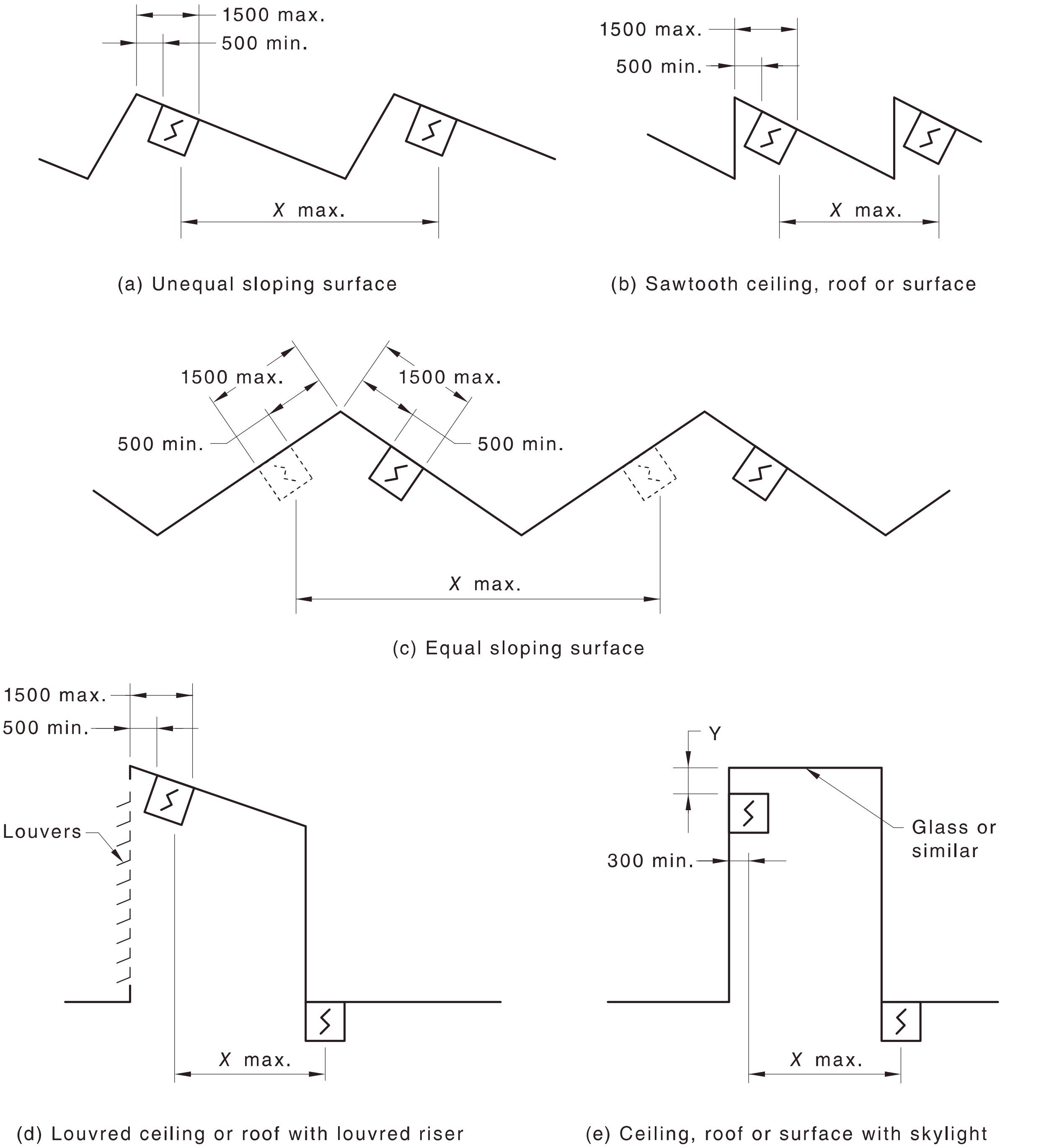
(a) Optical beam smoke detector on sloping surface



(b) Optical beam smoke detector on level surface

Figure 5.1.1(C) — Detector locations and maximum spacing — Optical beam smoke detectors

Dimensions in millimetres



Key:

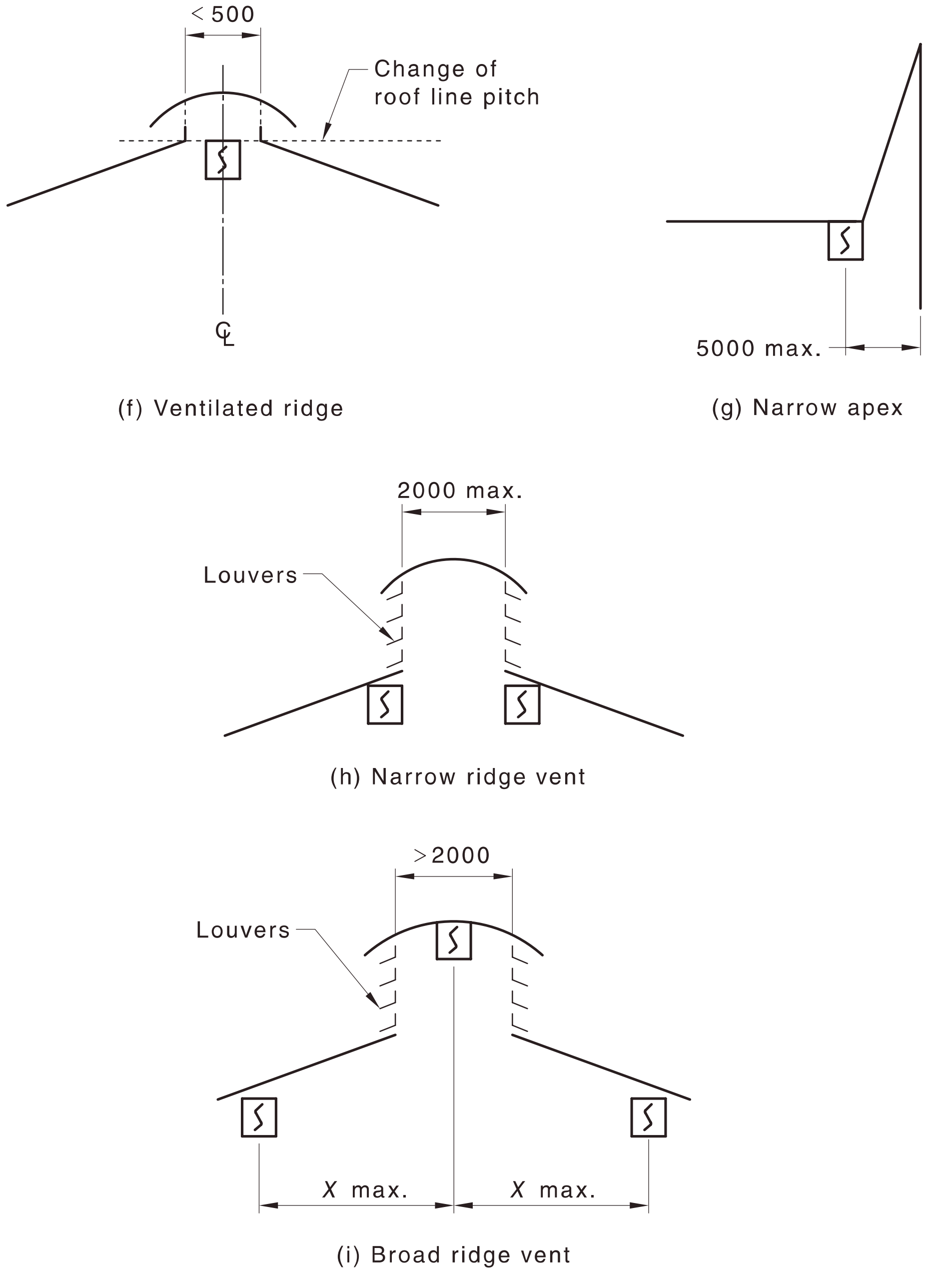
X = 10 000 for point type detectors and ASD

X = 14 000 for optical beam smoke detectors

Y = For ceiling heights between 4 m and 12 m, the detection sensing element should be between 25 mm and 600 mm below the ceiling

NOTE Infrared scan of a building has shown heat pockets at apices of roof structures due to solar radiation; therefore, to obtain effective fire detection the detector should be located below these pockets.

Figure 5.1.1(D) — Detector locations of smoke detector point-type, optical beam smoke detector and ASD — Apex of ceiling, roof or surface



Key:

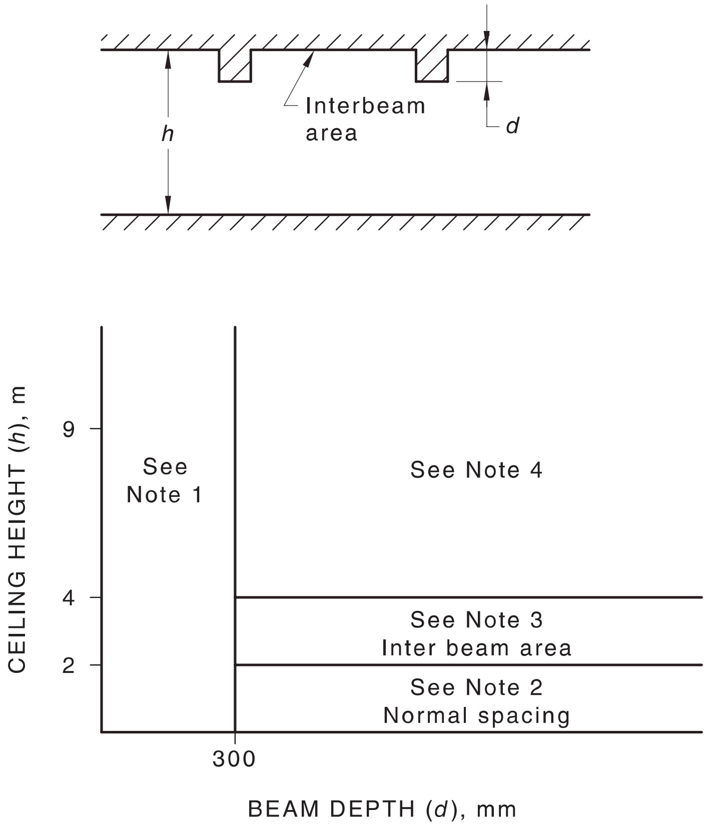
X = 10 000 for point type detectors and ASD

X = 14 000 for optical beam smoke detectors

Y = For ceiling heights between 4 m and 12 m, the detection sensing element should be between 25 mm and 600 mm below the ceiling

NOTE Infrared scan of a building has shown heat pockets at apices of roof structures due to solar radiation; therefore, to obtain effective fire detection the detector should be located below these pockets.

Figure 5.1.1(E) — Locations of smoke detector (point-type, optical beam smoke detector and ASD) – Apex of ceiling, roof or surface



NOTE 1 See Clause 5.1.6 (a).

NOTE 2 See Clause 5.1.6 (b).

NOTE 3 See Clause 5.1.6 (c) and Clause 5.1.6 (d).

NOTE 4 See Clause 5.1.6 (e) and Clause 5.1.6 (f).

Figure 5.1.1(F) — Design criteria for point-type detectors and ASD in structures with deep beams

5.1.3 Spacing between detectors for sloping surfaces

This Clause (5.1.3) applies to all sloping surfaces including curved surfaces such as barrel-vaulted ceilings.

Detectors shall be installed between 0.5 m and 1.5 m from the apex and spaced longitudinally at a maximum of 10 m between detectors. Lower rows of smoke detectors shall be no more than 10 m apart, measured horizontally from adjacent rows, the outside wall or partition. The spacing between smoke detectors within lower rows shall only be extended up to 20 m, provided that the detectors are offset equally between the detectors on the adjacent rows [see Figure 5.1.1(B)].

Optical beam smoke detectors on sloping ceiling, the distance between detector beams and side walls shall not be extended to more than 14 m [see Figure 5.1.1(C), part (a)].

5.1.4 Spacing from walls, partitions, and air supply openings

The distance from the nearest row of detectors to any wall or partition shall not exceed 5 m [see Figure 5.1.1(A)] or be less than 300 mm.

Detectors other than optical beam smoke detectors shall not be installed closer than 900 mm to any air-supply opening.

Where ceiling fans are installed, CO fire detectors or smoke detectors other than optical beam smoke detectors shall not be installed closer than 400 mm to the outside circumference of the blades of the fan.

5.1.5 Areas of high air exchange rates

For areas of high airflow with mechanical ventilation, detectors shall be spaced at least in accordance with Table 5.1.5.

Table 5.1.5 — Smoke detection selection

Air exchange per hour	Detector spacing	Minimum sensitivity	Smoke detector Type	Component Standards
< 15	Normal	Standard	Point	AS 7240.7, AS 7240.15, AS 7240.27
		Class C#	ASD	AS 7240.20
15–20	30 % reduction	Standard	Point	AS 7240.7, AS 7240.15, AS 7240.27
		Class C#	ASD	AS 7240.20
20–30	50 % reduction	Standard	Point	AS 7240.7, AS 7240.15, AS 7240.27
		Class C#	ASD	AS 7240.20
30–60	50 % reduction	Class B#	Multipoint ASD	AS 7240.20
> 60	50 % reduction	Class A#	Multipoint ASD	AS 7240.20

\# denotes the sensitivity limits detailed in AS 7240.20

NOTE For certain applications such as computer rooms and data centres where asset protection is an important consideration, additional or specific measures should be considered.

5.1.6 Location of detectors on level surfaces with deep beams

Where level surfaces are compartmented by building features that could have the effect of restricting the free flow of smoke, the detectors shall be located so that early detection is ensured, subject (for point-type detectors) to the following [see Figure 5.1.1(E)]:

(a) For areas with deep beam depth not exceeding 300 mm, the spacing of detectors shall be in accordance with Clause 5.1.2 and Clause 5.1.4.

(b) For areas with ceiling height not exceeding 2 m and deep beam depth exceeding 300 mm the spacing of detectors shall be in accordance with Clause 5.1.2 and Clause 5.1.4.

(c) For areas with ceiling height greater than 2 m and not exceeding 4 m, deep beam depth exceeding 300 mm, and the inter-beam area less than 4 m^2, detectors shall be mounted on the underside of the beams and spaced in accordance with Clause 5.1.2 and Clause 5.1.4.

(d) For areas such as Item (c) above, where the inter-beam area is equal to or greater than 4 m^2, at least one detector shall be placed in each inter-beam area, and the spacing shall be in accordance with Clause 5.1.2 and Clause 5.1.4.

(e) For areas with ceiling heights equal to or greater than 4 m and deep beam depth exceeding 300 mm, and the inter-beam area less than 9 m^2, detectors shall be mounted on the underside of the beams and spaced in accordance with Clause 5.1.2 and Clause 5.1.4.

(f) For areas with ceiling heights equal to or greater than 4 m and deep beam depth exceeding 300 mm, and the inter beam area equal to or greater than 9 m^2, detectors shall be placed in the inter beam areas and the spacing shall be in accordance with Clause 5.1.2 and Clause 5.1.4.

5.1.7 Spacing in concealed spaces requiring protection

Concealed spaces for which protection is required under Clause 3.27.1 shall be protected in accordance with Clauses 5.1.2 to 5.1.6, subject to the following:

(a) For concealed spaces with level upper surfaces in excess of 2 m high, the detectors shall be spaced in accordance with Clause 5.1.2 and Clause 5.1.4.

(b) For concealed spaces with level upper surfaces not exceeding 2 m high and having downward projections, such as beams and ducts not exceeding 300 mm from the upper surface of the space, the spacing between detectors shall not exceed 15 m, and the distance between any wall/partition to the nearest detector shall not exceed 10 m. Where downward projections exceed 300 mm, the spacing of detectors shall be in accordance with Clause 5.1.6(b).

(c) For concealed spaces with apices, the lowest row of detectors shall be located not more than 10 m measured horizontally towards the apex from a position where the vertical height, between the upper and lower surfaces of the space, is 800 mm [see Figure 5.1.1(B)].

5.2 Aspirating smoke detectors

5.2.1 General

An aspirating smoke detector shall not cover an area greater than could be covered by a single detection zone (2000 m^2) or a 40 point type smoke detector, whichever is the smaller area.

ASD sampling points shall be installed in accordance with the spacing requirements for point type smoke detectors.

NOTE There is no limitation to the maximum number of sampling points/holes which may be provided within the area.

For the purposes of assessing the requirements for remote indicators, ASD sampling points within restricted or locked access areas or sole occupancy units shall be treated as if they were separate point type detectors.

Piping used for sampling systems and capillary tubes, shall be in accordance with the following:

(a) Metal pipe shall provide mechanical protection equal to WSX2 and upgraded to address the risk. (See Appendix B.)

(b) Where subject to mechanical damage, sampling pipes shall be of a type that has a mechanical strength equivalent to heavy-duty PVC conduit in accordance with AS 2053.

(c) Where not subject to mechanical damage, sampling pipes shall be of a type that has a mechanical strength equivalent to light-duty PVC conduit in accordance with AS 2053.

(d) Capillary tubes shall be in accordance with AS/NZS 4130.

5.2.2 Design

The design shall be such that it can be easily maintained to ensure the pipe network and sampling point orientation does not jeopardize the long term reliability and performance of the system.

The design shall be in accordance with the following:

(a) The design of the aspirating smoke detector pipe network, including sampling hole numbers and sizes, shall be in accordance with the data supplied by the manufacturer.

(b) The flow fault supervision shall be in accordance with the manufacturer's product requirements. Where compartments are designed with a single sample point the ASD shall produce a fault indication on the FDCIE when a fault exists which affects the correct sampling of that point.

(c) The number of air-sampling points within an enclosure shall have an aggregate sensitivity equal to or greater than a single point-type smoke detector that could be used to cover the same area.

(d) ASD system and individual hole-sensitivity (static sensitivity) shall be determined by the use of a design tool provided by the manufacturer.

(e) The time taken for a system to transport a sample from a protected area shall not exceed (see Appendix N or Appendix M):

(i) Class A 60 s.

(ii) Class B 90 s.

(iii) Class C 120 s.

(f) The ASD airflow fault shall be indicated both audibly and visually at the FDCIE.

NOTE For areas with high airflow, see Clause 5.1.5.

5.2.3 Installation requirements

Installation requirements shall be as follows:

(a) All sampling pipes including capillaries shall be red in colour or alternatively have a visible red stripe at least 2 mm wide, longitudinally along the pipe length.

(b) The sampling pipes, excluding capillaries less than 2m in length shall be marked with the words “FIRE DETECTION SYSTEM — DO NOT PAINT”, which describes the purpose, in letters not less than 5 mm in height at intervals not exceeding 2 m.

(c) The sampling pipe shall be orientated such that all identifying markings are clearly visible when installed. Joints shall be airtight and permanently bonded.

(d) Where the ASD sampling pipe is concealed and capillary tubes are fitted the visible sampling points connected to the ends of the capillary tubes shall have clearly identifiable markings of not less than 1900 mm^2, with the words “FIRE DETECTION SYSTEM — DO NOT PAINT”, in letters not less than 3 mm high.

(e) Sampling points shall not be painted or coated with any substance that will reduce the size of the opening and shall be free of burrs. The position of all sampling points shall be marked so their location is identifiable.

(f) Capillary tubes used to branch from the main sampling pipe shall be fixed at both ends so that the joints have a withdrawal force of not less than 100 N.

(g) The pipe network shall be installed in accordance with AS/NZS 3000 for conduit.

(h) Sampling points shall be not more than 600 mm below the ceiling.

NOTE The lower limit of the mounting position of the sampling point may be changed to suit individual applications as determined by smoke tests.

(i) The power supply for an aspirating smoke detector (including air pumps, sensing heads, indicators and similar) shall be in accordance with the requirements of Clause 3.15.

NOTE Where the ASD is mounted outside the protected area and the potential exists for pressure differentials to occur between the sampled and exhausted air then the exhaust outlet should be returned back to the protected area to minimize airflow faults.

Section 6 Flame detectors

6.1 Location

Flame detectors shall be located so that their field of view is not blocked by structural members of buildings or other objects.

Flame detectors placed in environments likely to lead to the depositing of particles on the lens, shall have baffles or purging equipment fitted to ensure that the detector's sensitivity is retained between service periods.

6.2 Spacing

Detectors shall be spaced to ensure that the risk areas are protected with a minimum of shadowing or blind spots.

NOTE 1 Where significant unprotected areas exist because of the presence of objects such as aircraft, equipment, or storage racks, additional detectors to cover these areas should be installed.

NOTE 2 The operating principles of flame detectors (infrared or ultraviolet) need to be understood to enable the correct selection and location of a particular device to suit the risk and the level of protection required. Particular attention has to be given to the manufacturer's installation instructions for the type of detector selected. The type of detector for use in various locations is described in Appendix M.

Section 7 Smoke control systems

7.1 General

The NCC specifies the buildings to which the various smoke control systems apply.

NOTE AS 1668.1 provides detailed information on smoke control systems to which this clause applies.

This clause sets out the requirements for smoke detection, initiation and control of the following air-handling systems required to operate in fire mode:

(a) Car park ventilation systems (refer miscellaneous systems).

(b) Supply air systems.

(c) Kitchen hood exhaust systems.

(d) Shutdown system.

(e) Zone pressurization systems (zone smoke control systems).

(f) Hot layer smoke control.

(g) Fire-isolated exit pressurization.

(h) Lift shaft pressurization systems.

Detection and control shall also be in accordance with all other clauses of this Standard except where varied by this clause.

7.2 System objectives

The smoke control system shall perform the following functions:

(a) Automatic initiation and control of air-handling equipment required to operate in fire mode.

(b) Provide manual controls to override operation of the air-handling equipment in both fire mode and non-fire mode.

(c) Indicate the operating status of the air-handling equipment that is required to operate in fire mode.

(d) Automatically respond to the spread of smoke outside the smoke control zone of origin.

7.3 Consultation between parties

The fire detection and smoke control system design shall be compatible with the mechanical system. The FFCP shall implement the functions specified by the cause and effect matrix which shall be provided as part of the mechanical services design.

> ***C7.3*** *It is typically necessary for designers of initiation systems for smoke control in accordance with this Standard and designers of smoke control systems in accordance with the requirements of AS 1668.1 to coordinate, such that required system operation is achieved.*

7.4 Automatic initiation of smoke control systems

7.4.1 General

Smoke control systems shall be automatically initiated by smoke detectors in accordance with this Standard. Other fire detection or suppression systems shall initiate smoke control systems in accordance with Table 7.4.

Detection zones shall be arranged to provide a single initiation signal for each smoke control zone. A detection zone shall not protect more than one smoke control zone.

Where flow switches are used to initiate smoke control systems, time delays shall be used to prevent momentary activation of the flow switch from initiation of the incorrect smoke control zone. (See Clause 3.12.)

NOTE The time delay may be set in the range of 45 s to 60 s but should be verified at the time of commissioning.

Table 7.4 — Initiation of smoke control systems

System (as defined byAS 1668.1)	Measures		
	Smoke detection in accordance with this Standard	Sprinklers where installed	MCP where installed to initiate a general fire alarm condition
Miscellaneous systems	Required	Required	Supplementary
Shutdown systems	Required	Required	Required
Zone pressurization systems	Required	See Note 1	Shall not be used (Note 2)
Hot layer smoke control systems	Required	See Note 1	Shall not be used (Note 2)
Fire-isolated exit pressurization systems	Required	Required	Required
Air purge systems	Required	Required	Required
Lift shaft pressurization systems	Required	Required	Required

NOTE 1 Fire sprinkler systems shall not initiate zone pressurization systems or zoned hot layer smoke control systems unless the sprinkler system is zoned identically to the smoke control zone initiating the smoke control system.

NOTE 2 MCPs shall not initiate zone pressurization systems or zoned hot layer smoke control systems.

C7.4 *Where fire sprinklers inadvertently activate zone pressurization systems outside of the area affected by the fire event, the smoke control system may act to spread smoke throughout the building and not contain or restrict it. The proper operation of zone pressurization systems relies on accurate identification of the fire location and reliable interfaces.*

The use of manual call points is not appropriate to initiate zone pressurization systems and zoned hot layer smoke control systems as this may cause smoke control systems to operate in a different zone to that of the fire-affected smoke control zone due to activation of the manual call point from another part of the building as a means of raising a fire alarm. Fire sprinkler systems should be designed to only serve within the bounding perimeters of smoke or fire compartments, or have other means of determining a specific compartment where applicable for smoke control activation. Liaison is necessary during design to ensure that smoke control systems and their zoning are understood for FDCIE alarm response.

Smoke detection systems are required to provide timely operation of the smoke control system before the fire has developed to sufficient intensity to operate a heat detector or sprinkler system. The early detection of smoke is considered an essential element of the smoke control system.

7.4.2 Other fire safety systems and system control

Activation of fire sprinkler systems and MCPs shall only initiate common building smoke control systems such as system shutdown, air purge (for legacy systems), lift shaft pressurization and fire-isolated exit pressurization.

Fire sprinkler systems shall only initiate zone pressurization systems and zoned hot layer smoke exhaust systems where the sprinkler system is either serving that smoke control zone as an individual system or alternatively has specific zoning associated with and serves the smoke control zone (e.g. flow switch initiation for a sprinkler area that is identical to the smoke control zone for that area).

MCPs shall not initiate zone pressurization systems (zoned smoke control systems) or zoned hot layer smoke control systems.

7.5 Automatic smoke detection for system control

7.5.1 General

The following requirements shall apply:

(a) Automatic smoke detectors shall be connected to FDCIE.

(b) Smoke detectors shall be —

 (i) photoelectric point-type;

 (ii) photoelectric smoke detection equipment for ducts;

 (iii) photoelectric aspirating smoke detector (ASD); or

 (iv) optical beam smoke detectors which respond to light obscuration.

 Detection of smoke in a duct or chamber shall be accomplished with duct sampling equipment or aspirated smoke detection.

(c) Detectors shall be spaced not more than 15 m apart and not more than 7.5 m from —

 (i) any wall, bulkhead or curtain within the circulation space;

 (ii) the perimeter of the circulation space in car parks.

(d) Optical beam smoke detectors shall be spaced in accordance with Clause 5.1.2.

(e) Detector sensitivity shall meet the general requirements of the applicable component Standard.

(f) Detection of smoke in a duct or air handling plenum shall be accomplished with duct sampling smoke detectors or ASD. Where ASD is used it shall have a minimum of two sampling points per sampled area.

(g) Where AVF or similar delays are used, the delay shall not exceed 60 s.

(h) AVF shall not be applied to supply air and outdoor air smoke detection.

NOTE For areas where contaminants such as theatrical smoke may be present smoke detectors combining photoelectric and carbon monoxide sensing may reduce nuisance alarms.

7.5.2 Detector location

7.5.2.1 General

Smoke detectors and ASD sampling points shall be ceiling-mounted in accordance with this Standard and arranged at natural collection points for hot smoke having due regard to the ceiling geometry and its effect on smoke migratory paths via circulation spaces.

Where optical beam smoke detectors are provided they shall be installed in accordance with this Standard.

Where tenancy fit-outs using floor to ceiling height partitions occur, smoke detectors shall be located to cover all circulation spaces formed by the tenancy fit out.

7.5.2.2 Detection in circulation spaces

Smoke detection shall be provided in circulation spaces to automatically initiate the following:

(a) Car park ventilation systems.

(b) System shutdown.

(c) Zone pressurization.

(d) Fire isolated exit pressurization.

(e) Lift shaft pressurization.

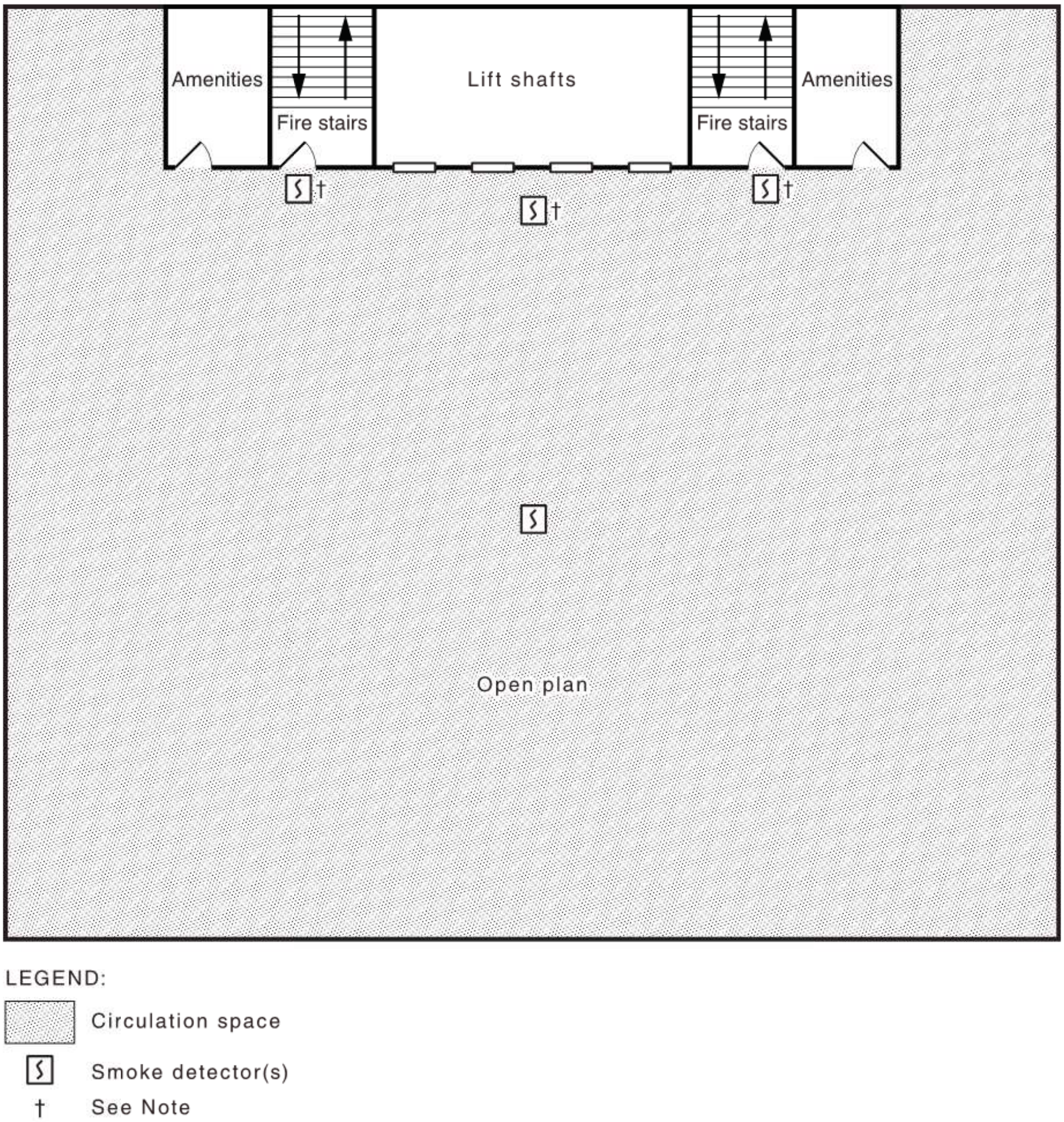
NOTE 1 For examples of circulation spaces, see Figures 7.5.2.2(A) to 7.5.2.2(C). Detector locations are only indicative.

NOTE 2 Heat detectors do not meet this requirement.

Smoke detection need not be provided in rooms that open directly into circulation spaces, except for the following:

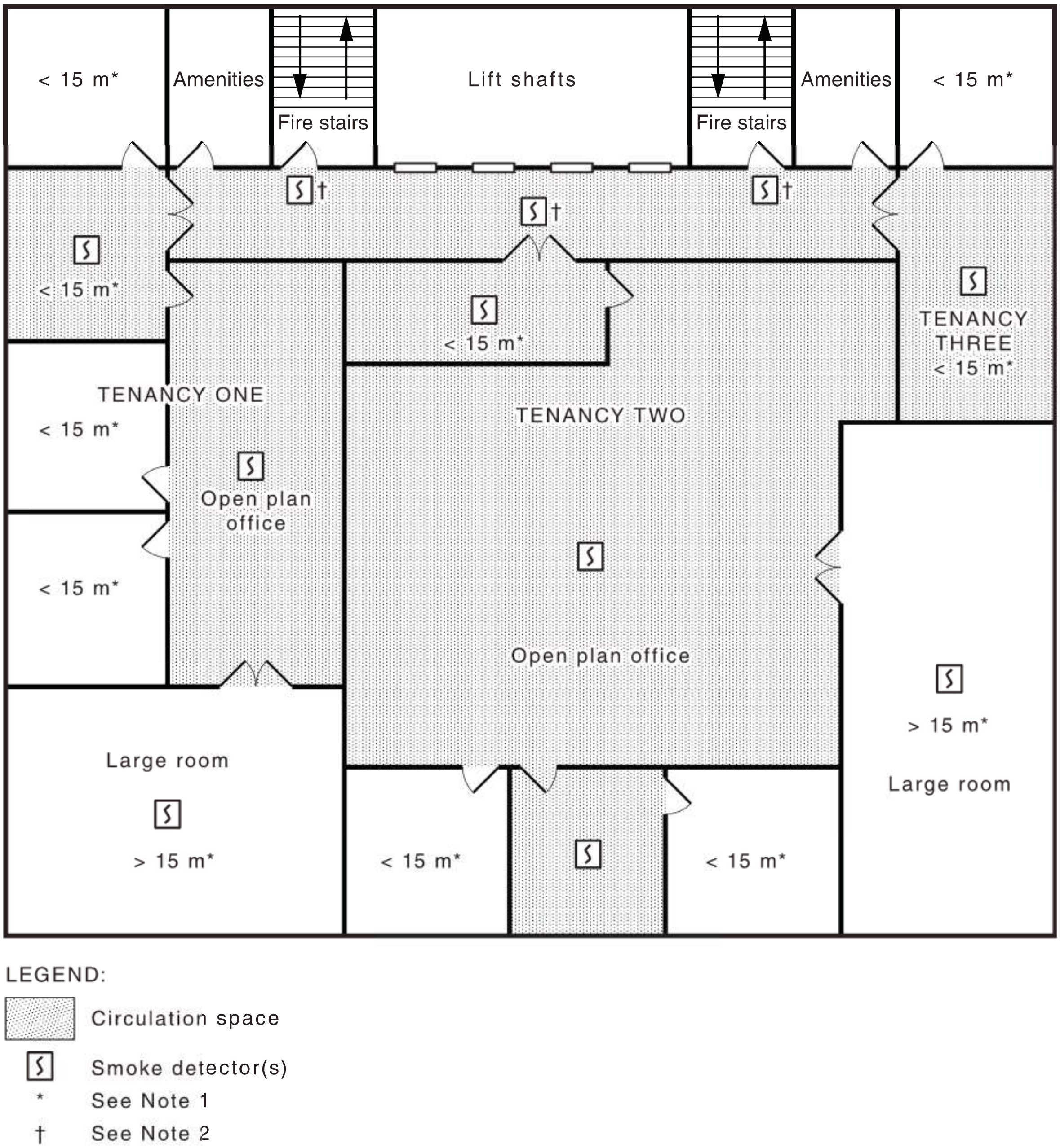
(i) Rooms that have a dimension of 15 m or more in any direction on the horizontal plane shall have detection provided in the room in accordance with Clause 7.5. Detection is not required in any area not used by occupants for an extended period of time such as a storeroom with a floor area less than 30m2, a sanitary compartment, plant room or the like.

(ii) Rooms that open directly into fire-isolated pressurized exit paths shall have detection provided in the room in accordance with this section.



NOTE See Clause 7.5.4.

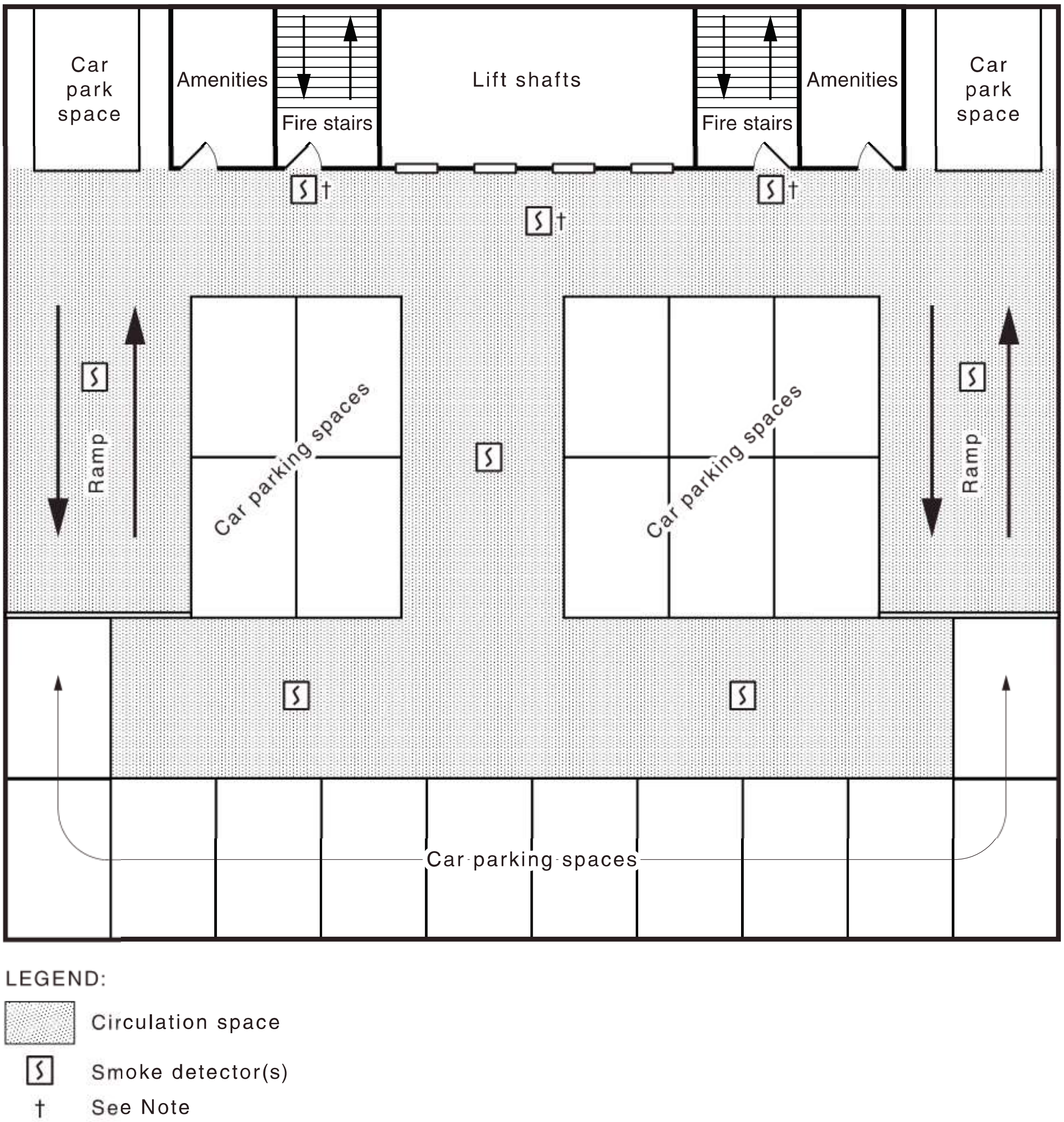
Figure 7.5.2.2(A) — Indicative detector locations example — Open plan floor — No fitout



NOTE 1 See Clause 7.5.2.2.

NOTE 2 See Clause 7.5.4.

Figure 7.5.2.2(B) — Indicative detector locations example — Multiple tenant floor layout



NOTE See Clause 7.5.4.

Figure 7.5.2.2(C) — Indicative detector locations example — Car park

7.5.2.3 Detection in hot layer smoke control systems

Smoke detection provided to automatically initiate hot layer smoke control systems shall be located throughout the smoke control zone served by the hot layer smoke reservoir.

7.5.3 Relative sensitivity of detectors

In zoned pressurization systems and zoned hot layer smoke exhaust systems where there is a possibility of smoke migration to adjacent areas, all protected space smoke detectors shall be set to sensitivities such that any difference will not adversely affect the operation of the system.

> ***C7.5.3*** *A mix of detector sensitivities (including point/multi-point type) in different smoke control zones could result in the air-handling plant serving a non-fire-affected smoke control zone, operating as if it*

(continued)
was the fire-affected smoke control zone. Where in-duct or air-handling plant enclosure smoke detection is installed (as compared to the circulation space) a mix in detector sensitivity is not considered to be a problem as shutdown of the air-handling plant will still occur even though full building fire mode has not been initiated.

7.5.4 Location of detectors at doors to pressurized exits and lift landing doors

Where an exit pressurization or zone pressurization system is installed the following shall apply:

(a) A smoke detector shall be located in the circulation space adjacent to each required exit door, so that the horizontal distance of the smoke detector from the door opening is not less than 0.3 m or not greater than 1.5 m.

Where the exit door is at the end of a circulation space formed by floor to ceiling height partitions and there is no other door within 1.5 m of the exit door, the smoke detector spacing shall be not less 1.5 m and not more than 3 m as shown in Figure 7.5.4(A) and Figure 7.5.4(B).

(b) Lift landing areas shall be protected by smoke detector(s). Detectors shall be located so that the horizontal distance is not less than 1.5 m and not more than 3 m from any lift door.

(c) Where a fire-isolated exit pressurization system is installed in accordance with AS 1668.1, smoke detectors need not be installed within the pressurized exit path.

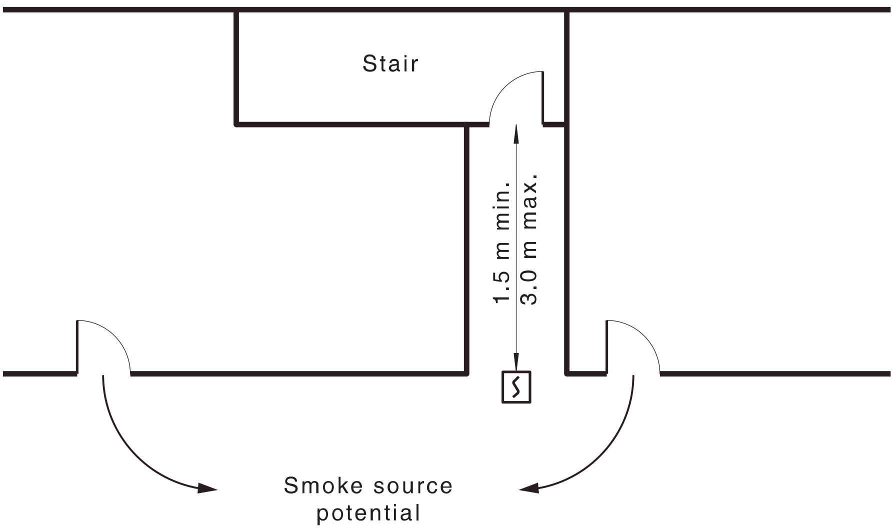


Figure 7.5.4(A) — Detector locations — Exits

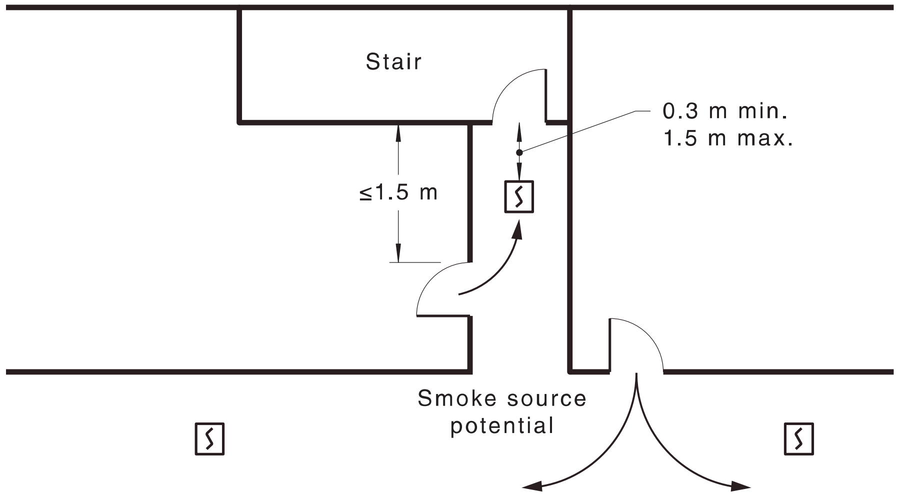


Figure 7.5.4(B) — Detector locations-exits

7.6 Miscellaneous systems

7.6.1 Scope

This section sets out the requirements for miscellaneous air-handling systems that do not form part of a smoke control system.

7.6.2 General

When fire mode is initiated, air-handling systems not designed to operate in fire mode shall shutdown in accordance with this section.

7.6.3 Special purpose systems

Special purpose air-handling systems, such as those serving computers, operating theatres and refrigerated plant rooms, need not shutdown.

7.6.4 Single enclosures

Air-handling system(s) serving a single enclosure not required to be shutdown shall be provided with supply air detection where required by the mechanical design.

> ***C7.6.4*** *The intent of an exemption for single enclosures is to simplify the installation of systems, while preventing the spread of smoke to principle evacuation paths.*

7.6.5 Exhaust systems

7.6.5.1 Minor exhaust systems

Minor exhaust systems protected with fire dampers are not required to shut down in the fire mode. Minor exhaust systems protected with subducts shall operate in fire mode.

7.6.5.2 Major exhaust systems

Where a major exhaust system does not form part of a smoke control system, they are considered to unduly contribute to the spread of smoke and shall be treated as a central air-handling system in accordance with AS 1668.1 or be a system incorporating shut down in accordance with AS 1668.1.

C7.6.5.2 Major exhaust systems cover those systems not classified as minor. In most instances it is likely that these systems will be designed for smoke control. Where not so designed, they have the capacity to allow an unacceptable quantity of smoke to spread between compartments, and smoke dampers are, therefore, required to maintain the integrity of compartmentalization and close off the openings on detection of smoke.

7.6.6 Supply air systems

7.6.6.1 Minor supply air systems

Minor supply-air systems are not considered to unduly contribute to the spread of smoke and are not required to shut down in fire mode.

Where a system operates in the event of fire, supply air detection shall be provided in accordance with this section (Clause 7).

C7.6.6.1 Where a system is designed to shut down in fire mode, supply air smoke detectors are not required. If the system is allowed to operate in fire mode, then supply air smoke detectors are required.

7.6.6.2 Major supply air systems

Major supply systems are considered to unduly contribute to the spread of smoke and shall be treated as part of a smoke control system(s) incorporating shutdown.

C7.6.6.2 In most instances major supply air systems will be designed for smoke control. Where not so designed, they have the capacity to allow an unacceptable quantity of smoke to spread between compartments and smoke dampers are therefore required to maintain the integrity of compartmentalization and close off the smoke leakage path.

7.6.7 Exhaust duct heat detectors

Exhaust duct detection shall be in accordance with Clause 3.27.3(c).

7.6.8 Car park ventilation systems

7.6.8.1 General

Car parks and loading docks where ventilation systems are installed in accordance with AS 1668.2 and are served by lifts or fire isolated pressurized exit paths shall have smoke detection in circulation spaces and at each required exit and lift landing door in accordance with this section.

7.6.8.2 Override control

To enable manual control, fans that are not required to shut down on initiation of fire mode in the car park shall be provided with control switches and indicators at the designated building entry point. Signage should be located at the car park entry indicating the location of the control switches.

Each control switch and indication shall form part of an FFCP, with operating and maintenance instructions provided in accordance with this section. Indication is not required for switches controlling additional air-moving devices installed in accordance with AS 1668.2 (such as a jet fan).

Where an additional air-moving device installed in accordance with AS 1668.2 is a fan (such as a jet fan), a separate switch shall be provided to enable restart and manual control. Where more than one fan is utilized in a fire compartment, they shall be controlled by a common switch. Where there are multiple fire compartments, a switch shall be provided for each fire compartment.

All control switches and accompanying indications shall be provided in accordance with this section.

7.6.8.3 Supply air smoke detectors

Supply air smoke detection shall be provided in accordance with this section.

7.6.8.4 Operation in fire mode

Where automatic fire detection or suppression is provided in the car park, activation of any of these systems shall cause the ventilation system to operate at full ventilation rate.

Supply air systems shall shut down upon the detection of smoke in the supply air. Supply air systems shall restart on clearance of the smoke from the detector in accordance with the requirements of this Standard.

Where an additional air-moving device installed in accordance with AS 1668.2 is a fan (such as a jet fan), such fans shall shutdown when any of the following occurs:

(a) On initiation of fire mode.

(b) Activation of a sprinkler system in the car park.

(c) Activation of the jet fan smoke detection system.

7.6.8.5 Jet fan smoke detection

Jet fans shall be provided with Class A ASD smoke detection in the area of air jet influence.

NOTE The location of the ASD sampling point should be in accordance with its installation instructions for jet fan applications.

7.7 Supply air systems

Where air handling equipment is used to provide supply air, makeup air or outside air in fire mode, the following is required:

(a) A smoke detector shall be located downstream of the air filter and supply air fan of each air-handling plant and upstream of the first branch take-off or, where this is not possible, either within the outdoor/return air mixing chamber upstream of the supply air fan, or within each supply air duct emanating from the air handing plant. See Figure 7.7.

(b) Each detector mounted in an air-handling system shall indicate as a separate detection zone.

(c) Duct sampling smoke detectors shall be used for monitoring air in ducts.

(d) Duct sampling probes shall be installed as specified in Clause 3.27.3.

(e) Detectors installed in air-handling systems shall be provided with permanent indelible labels, stating detection zone designation, detector ID and air handling equipment identifiers affixed adjacent to the detectors.

(f) The supply air smoke detector alarm condition shall be indicated on the FFCP by either —

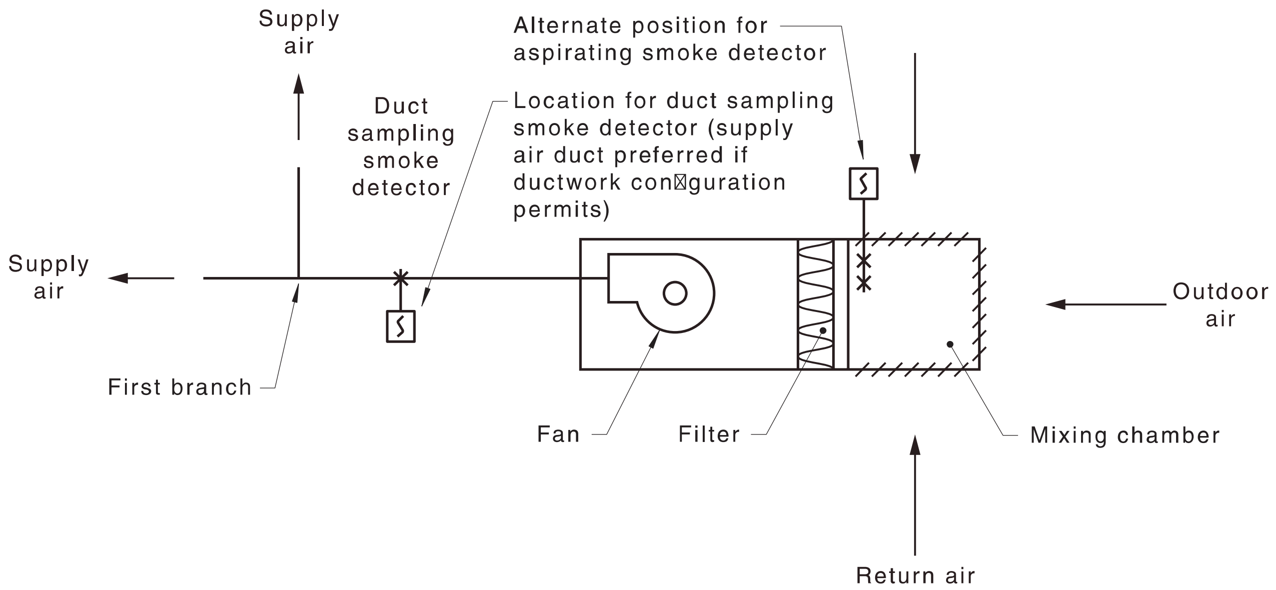
  (i) flashing the red “fan running” indicator; or

  (ii) flashing a separate dedicated red indicator grouped with the related fan indicators.

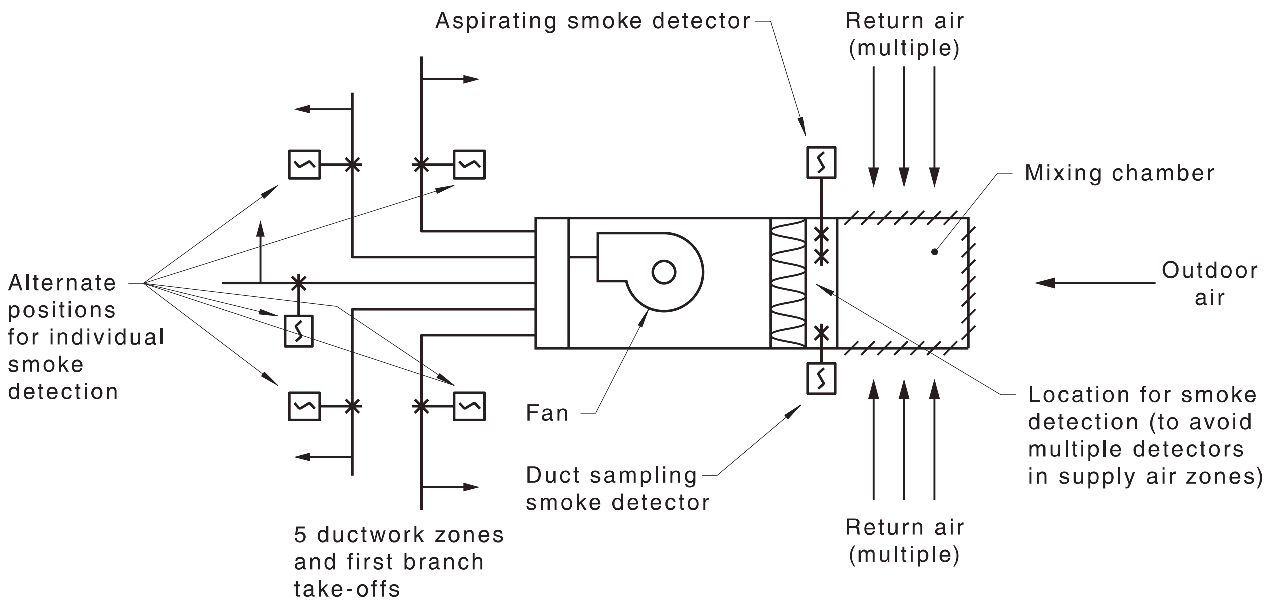
  The function of the indicator shall be clearly labelled or described in the operating instructions.

(g) A supply-air detection alarm shall not activate a fire alarm condition on the FDCIE. The detector alarm shall only stop the associated supply air fan.

(h) After the detector has been in the non-alarm state for a continuous period of not less than 60 s and not more than 90 s, the FDCIE shall initiate a control signal to restart the supply air fan. AVF shall not be applied to this detection zone.



(a) AHU single duct discharge



(b) AHU multiple duct discharge

NOTE A choice for location of the smoke detector is available to assist with the ease of access according to configuration of air-handling plant ducting arrangements.

Figure 7.7 — Detector location — Supply air

7.8 Kitchen exhaust hood systems

7.8.1 General

Where kitchen exhaust hood systems form part of, or are used to assist, required smoke control systems, the requirements of this section for fans operating in fire mode shall apply.

7.8.2 Operation under fire conditions

On initiation of fire mode, if the kitchen exhaust hood system is already operating, it shall not be shut down. Where a kitchen exhaust hood system includes a dedicated supply air system, the supply air system is not required to shut down in the event of a fire.

On activation of any installed exhaust duct heat detector or separately monitored sprinkler head, any dedicated supply air system shall stop but the exhaust hood system need not shut down.

NOTE 1 Where a kitchen exhaust hood system includes a dedicated supply air system, the supply air system may stop in the event of a fire.

NOTE 2 Control and indication on the FFCP (with applicable wiring protection) is not required unless the kitchen exhaust forms part of the building's fire and smoke control strategy.

NOTE 3 This operation does not require wiring protection in accordance with Clause 3.26 where there is no FFCP. It is accepted that loss of voltage in these system due to failure or isolation of a non-essential power circuit will result in the system ceasing operation.

7.8.3 Override control

Where kitchen exhaust hood systems are required to form part of a smoke control system they shall be provided with controls and indicators at the FFCP to enable manual control.

7.9 Shutdown systems — Operation in fire mode

Except as required for miscellaneous systems, all air-handling systems not required to operate in the fire mode shall automatically shut down on initiation of fire mode.

Smoke dampers installed in these air-handling systems shall automatically close on initiation of fire mode or loss of power.

7.10 Zone pressurization systems

7.10.1 Operation in fire mode

Smoke control zones shall be initiated by an alarm condition in any detection zone serving the smoke control zone.

Spread of smoke beyond the smoke control zone of origin shall activate any smoke control zones where smoke is detected.

Components of the air-handling system shall be controlled and monitored in accordance with this section.

7.10.2 Override control

All smoke control fans shall have override control switches and indicators located on the FFCP in accordance with this section.

Where dampers are not interlocked with fans and serve a smoke control zone they shall have at least a common override control switches located on the FFCP in accordance with this Clause 7.

Where dampers are interlocked with fans, separate damper override control switches are not required.

7.11 Hot layer smoke control systems

7.11.1 System arrangement

Smoke detection shall be provided throughout the space in accordance with this Standard and zoned so that at least one smoke control zone protects each smoke reservoir.

Activation of each smoke control zone shall initiate the smoke exhaust and make up air provisions for the reservoir it protects.

> ***C7.11.1*** *For the purposes of this section, the main features of a hot layer smoke control system arrangement are that the smoke is collected in a hot layer under and within the bounding construction of smoke reservoirs.*

7.11.2 Operation in fire mode

Hot layer smoke control systems shall be initiated by the alarm condition of the fire-affected smoke control zones. Components of the air-handling system required to operate in fire mode shall be controlled and monitored in accordance with this section.

Spread of smoke outside the smoke control zone of origin shall activate the smoke exhaust mode in other smoke control zones as the smoke spreads to these locations.

Except as required for miscellaneous systems of AS 1668.1, all air-handling systems not required to operate in fire mode shall automatically shut down on initiation of fire mode.

7.11.3 Override control

All smoke control fans shall have override control switches located on the FFCP in accordance with this section.

7.12 Ancilliary smoke/fire control equipment operation

Where automatic smoke or fire curtains, automatic louvres or automatic doors form part of the smoke control system, they shall be treated as components of the smoke control system, and shall be installed, and configured for control in accordance with this section.

Wiring systems for these components shall also be in accordance with this clause (7.12).

Where deployment of ancillary equipment is adversely affected by system air pressures and air velocities with the air handling systems in fire mode, the operation of air handling systems of those parts adversely affecting the ancillary equipment shall be delayed until the ancillary equipment is deployed.

Where the operation of ancillary equipment is motorized or failsafe, the ancillary equipment shall operate to their respective required positions within a time period consistent with the requirements of AS 1668.1. Time delays allowed by this Standard shall have elapsed prior to signal transmission to initiate the operation of the ancillary equipment.

> ***C7.12*** *The delay between receipt of the signal and component change in operation will include inherent delays of the control equipment and any specific delays necessary for reliable operation.*

7.13 Fire isolated exit pressurization systems

7.13.1 Operation in fire mode

Air pressurization fans shall be controlled in accordance with Table 7.13.1.

Table 7.13.1 — Operational requirements for fire-isolated exit pressurization fans

Initiating conditions[a]	Fan operating status
Actuation of —	
(a) any circulation space detection zone required by this section	Start
(b) any building automatic fire sprinkler, smoke detection system, or manual call point	Start
(c) supply air detection zone required by this clause	Stop
(d) automatic reset of the supply air smoke detector	Restart

[a] Initiating conditions (a), (b), (c) and (d) represent the transmission of a signal to the air pressurization control system. Time delays specified by this Standard shall have elapsed prior to signal transmission. Delays between receipt of the signal and system operation will include the inherent delay of the control equipment and any special delay necessary for reliable operation, for example, opening/closing of air dampers prior to fan initiation. Within these limitations such delays shall not exceed 60 s.

7.13.2 Override control

All exit pressurization fans shall have override control switches and indicators located on the FFCP in accordance with this section.

7.14 Lift shaft pressurization system

7.14.1 General

Where lift shafts are required to be pressurized, they shall incorporate smoke detectors as follows:

(a) One detector located at the top of the shaft or group of shafts within the overrun area.

(b) One detector located at the bottom of the shaft or group of shafts within the pit area with additional mechanical protection upgraded where required to meet the potential hazard identified.

NOTE Appendix B may be used as a guide.

(c) One detector located in the lift motor room if that motor room forms part of the pressurization system.

(d) Each detector shall indicate as an individual detection zone on the FDCIE.

NOTE See Figure 7.14.1(A) and Figure 7.14.1(B).

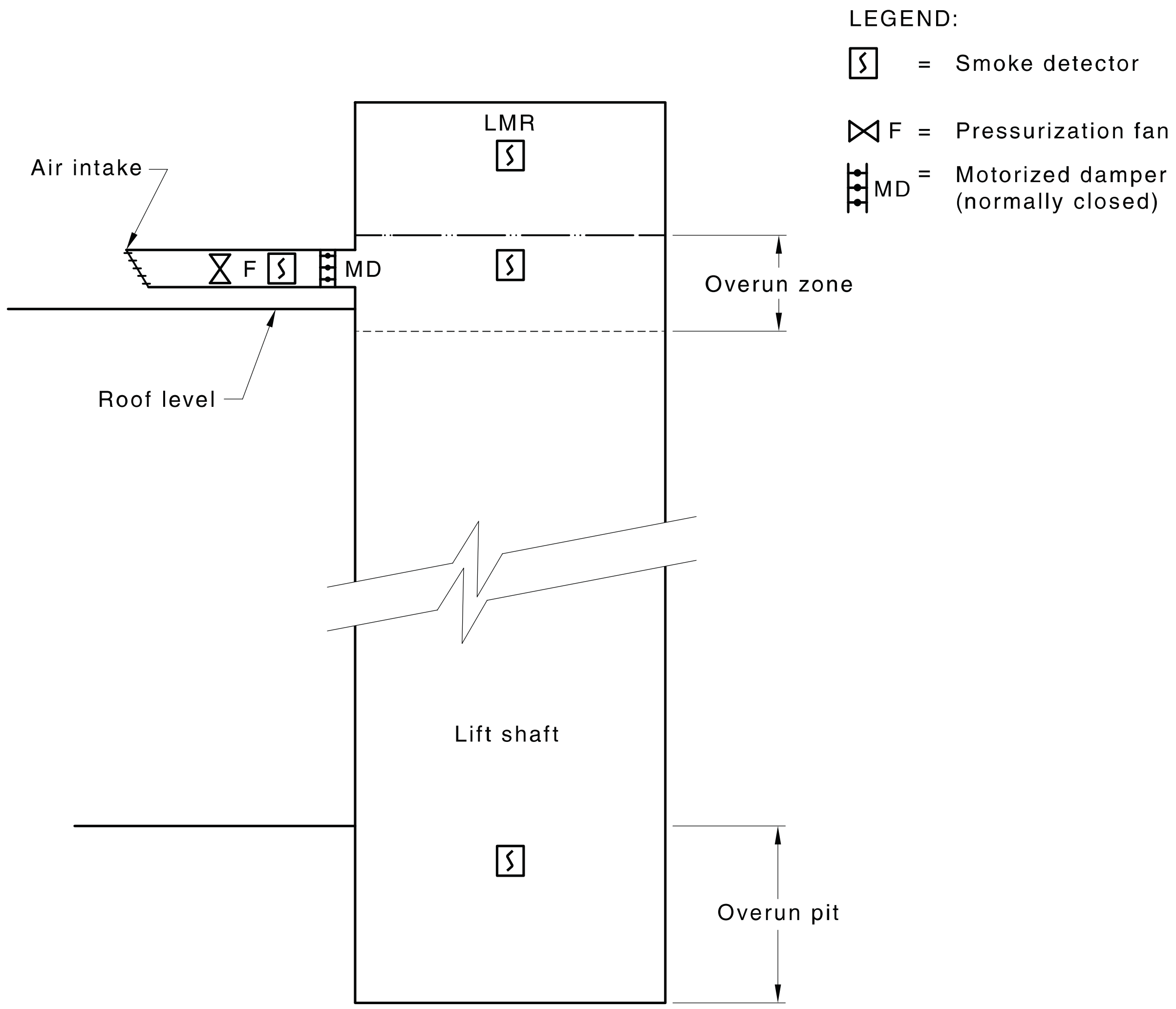


Figure 7.14.1(A) — Typical lift shaft direct pressurization system

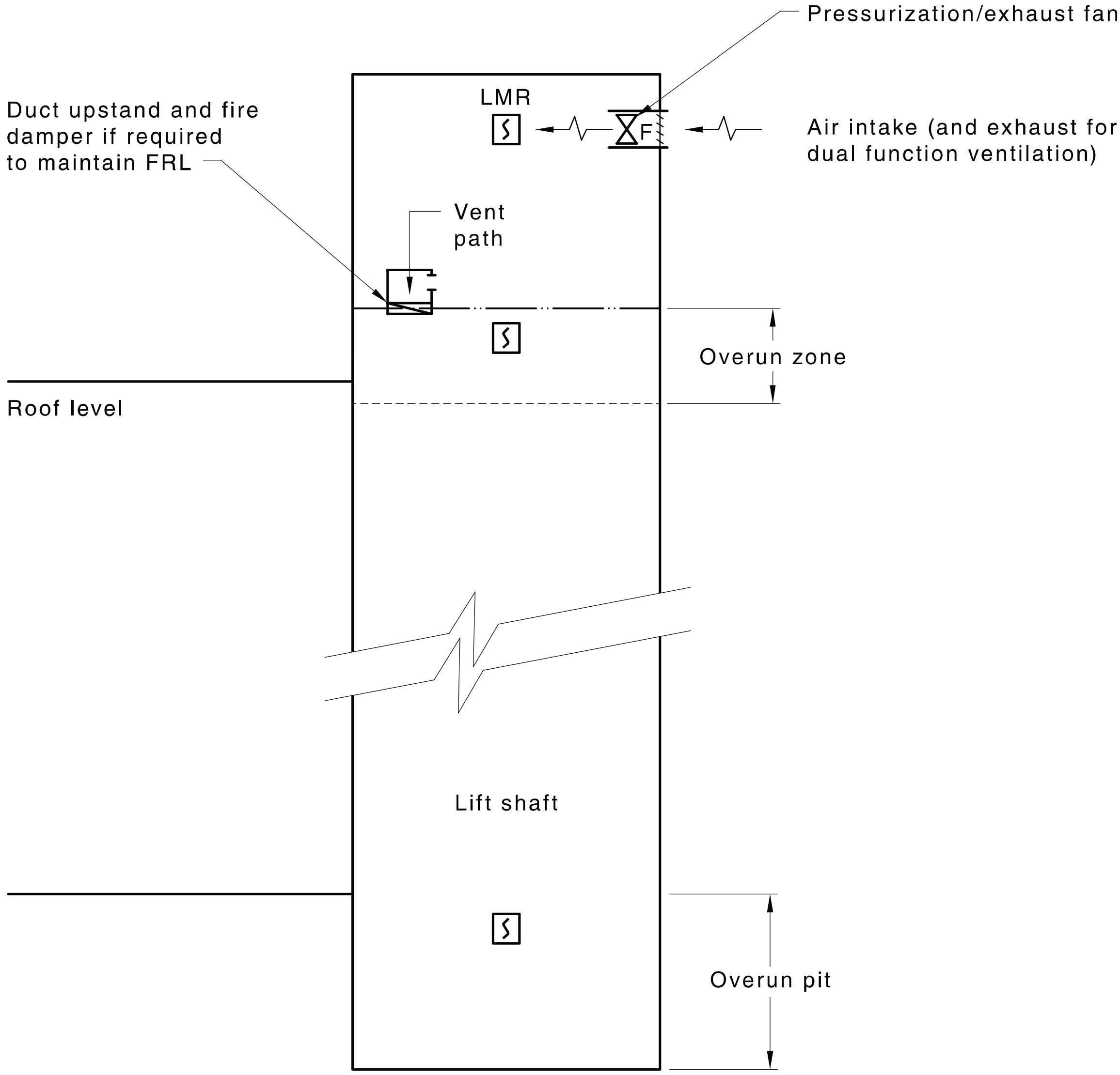


Figure 7.14.1(B) — Typical lift shaft indirect pressurization system

7.14.2 Supply air smoke detectors in fans

A detector shall be installed to sample air supplied by each fan in the pressurization system in accordance with this section.

7.14.3 Operation in fire mode

The lift shaft pressurization fan shall —

(a) automatically operate to provide air pressurization at initiation of fire mode;

(b) open the normally closed motorized damper used for direct pressurization; and

(c) stop, if smoke detectors installed within the lift shaft or lift motor room are activated and if smoke detectors installed to sample air provided by each lift shaft pressurization fan are activated.

> ***C7.14.3*** *If practicable, the lift shaft pressurization fan should operate to exhaust the lift shaft rather than simply stop when smoke is detected.*

7.14.4 Override control

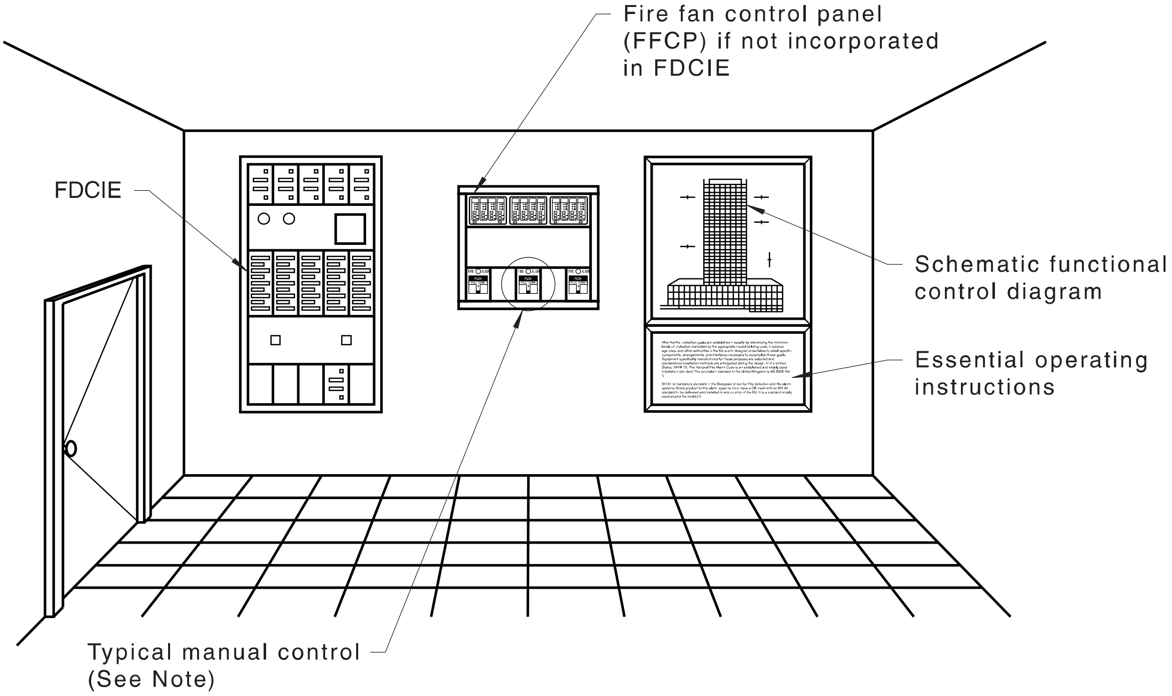
The lift shaft pressurization fan and exhaust fan shall have override control switches and indicators located on the FFCP in accordance with this section.

7.15 Fire fan control panel (FFCP)

7.15.1 Location

The FFCP shall be incorporated into or located adjacent to the FBP and constructed in accordance with the FDCIE requirements in Clause 2.1.

NOTE An example is shown in Figure 7.15.1.



NOTE FFCP (see Figure 7.15.3) may be incorporated with the schematic functional control diagram provided as part of the mechanical design.

Figure 7.15.1 — Example layout — Fire fan control panel and schematic functional control diagram

7.15.2 Function

A fire fan control panel (FFCP) shall be provided to perform the following functions:

(a) Control the automatic operation of the air-handling equipment (fans and zone smoke control dampers) during fire mode, in accordance with the requirements of this Standard.

(b) Control of zone smoke control dampers located within a smoke control zone that is served by a central ventilation system.

(c) Provide manual controls to override the automatic operation of the ventilation systems in accordance with the requirements of this Standard, except for systems incorporating system shutdown for smoke control.

(d) Indicate the status of the air-handling equipment, except for systems incorporating system shutdown for smoke control.

The FFCP shall provide manual control of the functions of each item of air-handling equipment such as, supply air fan, exhaust fan, smoke-spill fan and zone smoke control dampers required to operate in the fire mode, except for minor exhaust and supply systems. Air handling equipment which is not required to operate in fire mode is not required to have manual control or indicators.

7.15.3 Manual controls

The mode selected by the control switch shall be clearly indicated by means of the position of the switch or visual indication associated with the switch.

Each fan, relief damper or set of zone smoke control dampers required to be controlled by the FFCP shall be served by a three position control on the FFCP and meet the following conditions:

(a) Controls serving fans shall be labelled “OFF, AUTO, ON”.

(b) Dampers interlocked with fans shall not be separately controlled.

(c) Controls serving zone smoke control dampers only shall be labelled “NON-FIRE, AUTO, FIRE”. Where central supply air and smoke exhaust fan(s) are used, and damper(s) are configured to provide smoke control to single compartments, then one control is sufficient to be employed for operation of all the dampers serving each compartment.

When the damper zone trip is activated automatically or via the manual control to control the zone smoke dampers, the “FIRE” indicator on the damper control shall be lit.

NOTE This indication is confirmation of an output signal from the FDCIE and does not require any wiring between the dampers and the FFCP. This is not intended to confirm the physical operation of the damper(s).

(d) The “ON” or “FIRE” position of these three position controls shall not be located between “AUTO” and “OFF” or “NON-FIRE” positions. Controls, indicators and labelling shall be arranged in a consistent manner and type throughout the FFCP.

NOTE Examples are shown in Figure 7.15.3.

(e) Controls shall be operable at all times, that is, whether the air handling system is in fire mode or normal mode.

(f) Where multiple fans are installed and they are required to operate as if they were a single fan, then a single control will meet the control requirements for the group of fans provided that each fan has a dedicated contactor. A single control shall not be used where multiple fans serve a pressurized exit.

(g) Where a system incorporates motorized dampers required to direct supply air or limit smoke exhaust to a certain area, it is essential that the design incorporates fan start delays to enable motorized dampers to drive to their set position. The mechanical services design shall incorporate these delays in the mechanical board.

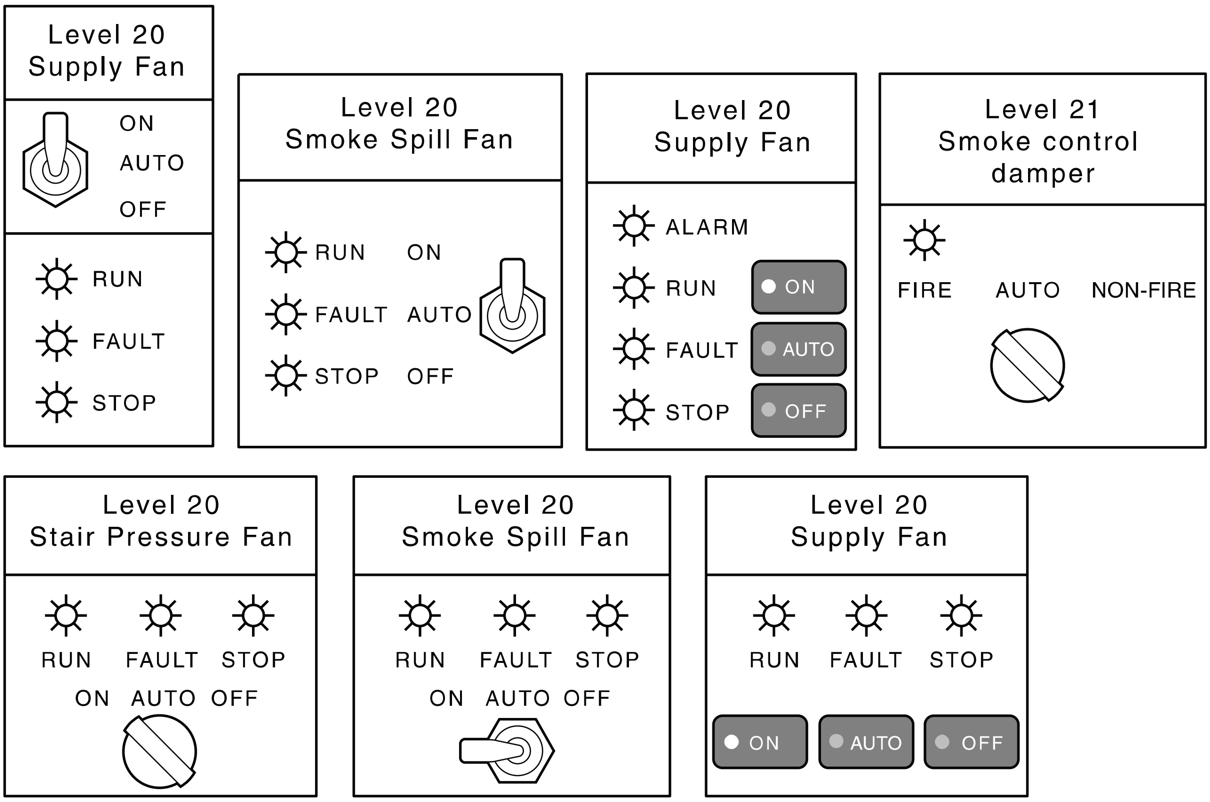


Figure 7.15.3 — Examples of typical FFCP indicators and override control layout

7.15.4 Fire mode reset

The air handling system shall remain in fire mode once initiated by the FDAS. The air handling system fire mode shall not reset when the FDCIE fire alarm condition is reset. Where the system is shutdown only and no FFCP is provided, this need not apply.

A fire mode light-emitting indicator shall be provided on the FFCP to indicate that the FDAS has initiated fire mode. The fire mode indicator shall be red when lit.

A separate reset control shall be provided on the FFCP for resetting the air handling system from fire mode. This control shall be inhibited while the FDCIE is in fire alarm condition.

The fire mode indicator and reset control shall be clearly labelled "FIRE MODE RESET" in letters of not less than 5 mm height in a contrasting colour to the background, and where more than one is provided they shall be logically grouped together on the FFCP.

Air handling plant that is shutdown in fire mode shall remain shut down until the fire mode is reset.

Doors, louvers, smoke curtains and fire curtains or the like required to operate as part of the smoke control system shall remain in their respective fire mode state until the fire mode is reset.

C7.15.4 *A smoke control system in conformance with this Standard is intended to operate automatically in the event of a fire, to restrict the spread of smoke into areas within the building, in accordance with the objectives of AS 1668.1. If, however, the automatic control functions have been compromised by fire damage, smoke leakage or faulty operation, it is the intention that emergency personnel can take manual control of the system.*

On-off override controls are specified for each supply air and each smoke-exhaust fan to permit manual control by authorized personnel.

(continued)

Manual controls are also specified for those sets of dampers serving each smoke control zone of a zone pressurization system (i.e. the supply air dampers and the return air dampers in each compartment). In essence, the manual override "FIRE" or "NON-FIRE" for these dampers carries out the same function as an "alarm" or "non-alarm" from the smoke detectors serving that zone. In the case of a zone pressurization system using individual air-handling systems, manual override of the fans, with the usual damper interlocks, will usually provide adequate override control of zone pressurization or exhaust, without separate control of the dampers.

The manual override controls do not raise a fire alarm condition.

While each fan (or set of fans operating as a single fan) and each set of zone smoke control dampers are to be provided with manual override controls, the normal mode air-handling plant dampers (outdoor air dampers, relief air dampers or recycle air dampers), the shut-off system dampers and lift shaft pressurization dampers are not required to be provided with direct manual override controls. Indirect control of these latter groupings of dampers may occur as a secondary benefit of interlocks and fan start delays. In the interests of keeping the FFCP as simple as possible, it is recommended that the number of separate damper override switches is kept to a minimum, except where the characteristics of a project require greater control to overcome perceived special risks.

The requirement for a separate smoke control reset switch allows the reset of the FDAS without affecting the status of the smoke control system.

7.15.5 Fan status indicators

For each fan required to operate in fire mode the following visual indications shall be provided on the FFCP. These shall be steady when lit, and labelled as follows:

(a) RUN: Red when lit — indicating fan running (see also Clause 7.7 for supply air alarm indication).

(b) FAULT: Yellow/amber when lit — indicating fan fault.

(c) STOP: Green when lit — indicating fan stopped.

Where multiple fans are controlled by a single manual control where permitted [see Clause 7.15.3(e)], there shall be one red (fan running) indicator, one green (fan stopped) indicator and one yellow/amber fault indicator to indicate the status of each fan.

Indicators shall be logically grouped adjacent to each manual control with a label identifying the fan or zone smoke control damper set being monitored. The status of all fans shall be indicated at all times. An indicator test facility shall be provided.

7.15.6 Fault indication

Visual fault indication shall be provided at each control to indicate any of the following conditions —

(a) Airflow does not correspond to the actuating control signal.

(b) There is a fault in the transmission path between the FFCP and the air-handling equipment MCC interface that prevents the correct transfer of signals.

(c) There is a failure of one or more phases of the electricity supply to the MCC serving the fan(s).

Fault conditions (b) and (c) shall operate the general fault at the FDCIE, fault condition (c) shall identify the MCC affected by phase failure. Where the FFCP is not adjacent to or integrated with the FDCIE an audible indication shall be provided at the FFCP.

7.15.7 Notices and labels

The function and operation of each switch and indicator shall be clearly labelled to meet the legibility requirements of the FDCIE. The label shall clearly identify the equipment being controlled by equipment name, function and area served.

In addition to the above, the following label shall be provided on the FFCP in lettering not less than 5 mm in height in a contrasting colour to the background:

"THESE CONTROLS SHALL ONLY BE OPERATED BY AUTHORIZED PERSONNEL".

7.15.8 Operating instructions

The following items shall be prepared as part of mechanical service design:

(a) *Instructions*

A set of essential instructions for starting, operating and stopping each air-handling system shall be permanently displayed in a position readily observable by any person operating the FFCP.

(b) *Diagram*

A schematic diagram showing the functional air-side operating arrangement for each air handling plant shall be permanently displayed adjacent to the operating instructions in a readily accessible position for viewing.

NOTE Adequate operating instructions and a complete functional air-handling schematic for air-handling systems are essential aids for regular operating personnel.

7.16 This has been left blank intentionally

7.17 System interface

7.17.1 General

The interface between the FFCP and MCC shall be in accordance with the requirements of Clause 2.6, Clause 3.25 and Clause 7.18.

NOTE For indicative arrangements, see Figure 7.17.1.

7.17.2 Low level interface

A low-level interface shall meet the following conditions:

(a) Control signals from the FFCP to the MCC interface shall —

  (i) use electromagnetic relays;

  (ii) provide voltage free contacts rated for the required current and voltage to switch the MCC controls;

  (iii) not switch control voltages that exceed ELV as defined AS/CA S009; and

  (iv) not provide power to operate the MCC control inputs.

(b) The FFCP shall monitor the status of voltage free contacts at the MCC interface, which shall signal the following:

  (i) Each fan stopped/running status.

(ii) Power-phase failure at each MCC providing power to air-handling equipment which is required to operate in fire mode.

See Clause 7.15.6(c).

NOTE 1 The MCC relay contacts should be suitable for switching the typically low current (less than 10 mA) of the FFCP interface equipment inputs.

NOTE 2 The coil to contract dielectric strength of all relays should not be less than 2500 V AC.

7.17.3 High level interface equipment

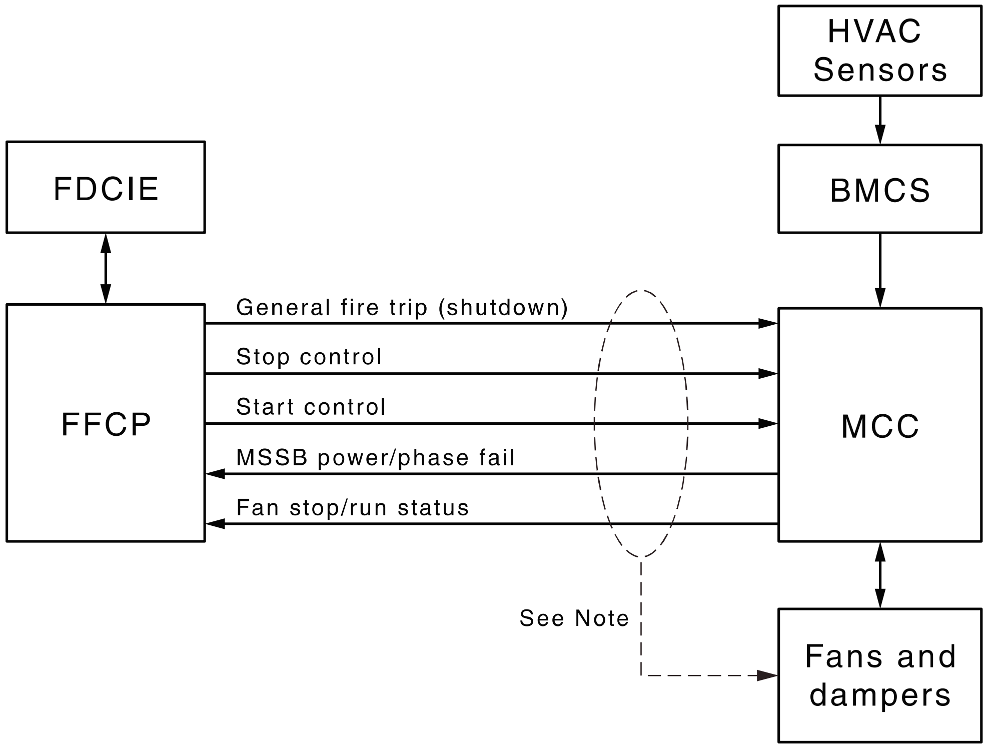
A high level interface (data protocol) between the FFCP and the MCC shall transmit the signals and controls specified for the low level interface.

The high level interface shall provide electrical isolation and withstand not less than 2500 V AC.

The high level interface shall be independent of the building management control system (BMCS).

7.17.4 Interface cabinet

The MCC interface shall be mounted in a separate or segregated cabinet.



NOTE See Clause 7.18 (i).

Figure 7.17.1 — Indicative interface diagram

7.18 Transmission paths

Transmission paths to equipment serving more than one smoke control zone shall have a redundant transmission path. Transmission paths to the following equipment forming part of the smoke control system shall meet the requirements of Clause 2.6, Clause 3.13, Clause 3.24, Clause 3.25 and Clause 3.26. These include:

(a) Supply air detectors.

(b) FFCP and the MCC interfaces.

(c) Smoke detectors installed to initiate zone pressurization systems except for that section of the transmission path which is within the smoke control zone which it serves need not be fire-rated.

(d) Equipment forming part of the smoke control system, e.g. dampers, motorized doors and ventilation louvers.

The following requirements shall also be met:

(i) Signals from the FFCP to the MCC interface shall be transmitted to the MCC which serves the fan(s) or damper(s) required to operate in fire mode or directly to the fan(s) and damper(s). (See Figure 7.17.1.)

(ii) Where the FFCP to MCC interface equipment is installed within 3 m of the MCC and both are within the same fire compartment that part of the transmission path is not required to be fire-rated and is not required to be supervised.

(iii) Where a transmission path serves multiple smoke control zones and has non-fire-rated devices connected to it, SCIs are required at the first and last device within each smoke control zone. Where the devices within a smoke control zone are connected to a spur (T off) an SCI shall be used to ensure that single fault will only result in the loss of the transmission path to that smoke control zone. (See Figures B2.1 and B2.2 in Appendix B.)

(iv) Where a transmission path passes through multiple fire compartments and that transmission path has non-fire resistant devices connected to it, SCI shall be installed at the boundary between the fire compartments containing the non-fire-resistant devices.

(v) Where a transmission path is installed entirely within a plant room, or exit path that is fire isolated from the occupied spaces by a construction having FRL not less than -/120/120 that portion need not be fire-rated.

(vi) Where a transmission path is installed within a stairway that is fire isolated from the occupied spaces by a construction having FRL not less than -/120/120 that portion need not be fire-rated.

Transmission paths to equipment intended to shut down in fire mode need not be supervised or fire-rated provided the equipment shuts down on loss of the transmission path and need not be in accordance with Clause 3.25 and Clause 3.26.

7.19 Documentation

7.19.1 Design documentation

Design documentation in respect to smoke detection and smoke control equipment shall meet the requirements of Clause 1.7.2.

7.19.2 Operating and maintenance instructions (as-installed documentation)

Each smoke control system shall be provided with operating and maintenance instructions.

As-built plans shall be provided, identifying the true location of all smoke detection and control systems interfaces.

7.19.3 Smoke control operating instructions

A concise set of essential instructions for operating the FFCP shall be permanently displayed adjacent to the FFCP.

These instructions shall also be adjacent to the smoke control schematic diagram provided by mechanical service design.

Appendix A
(informative)

Commissioning

A.1 General

On completion of the installation of the automatic fire detection and alarm system, all equipment and components should be checked to ascertain that it has been installed and interconnected in accordance with the system design documentation and relevant Standards. System commissioning should be in accordance with Paragraph A2 and Paragraph A3.

Where alterations are made to an existing system only the relevant parts affected should require commissioning.

A.2 Commissioning documentation

Prior to the commencement of commissioning the following documentation and baseline data should be available:

(a) A statement detailing the system design criteria, including date of publication of any Standard and the NCC which applies and detail any exceptions included in the design.

NOTE For an example of a form for a system designer's statement, see Appendix E.

(b) A statement detailing that the system has been installed to the design Standard specified and has been carried out to the required Standards, including any exceptions included in the design.

NOTE See Appendix F.

(c) Date of initial system installation, if applicable.

(d) Table of any changes to the approved design nominating the date, scope of the change, and person(s) performing the change.

(e) "As installed drawings" covering the system or alterations, as applicable. Standard symbols, as given in Appendix D, should be used. Examples are shown in Figure D2 and Figure D3. The drawings should detail —

(i) the location, type, unique circuit designation and interconnection of all system components installed in accordance with this Standard;

(ii) a system schematic wiring diagram detailing all transmission paths and the location of any end of line devices (ELD);

(iii) the location of system interface termination points such as BMCS, motor control centres (smoke control), security system (door release), nurse call systems, lifts, automatic doors, sprinklers, gaseous extinguishing systems, safety services and other ancillary control functions); and indicate that they are correctly connected;

(iv) access points to any protected concealed spaces; and

(v) the location of any building plant reset control.

(f) Manuals for all CIE and system components, as applicable, to enable their correct operation.

(g) Where aspirating smoke detection is incorporated within the system, the design calculations.

(h) System interface schedule.

(i) Cause and effect matrix for the system detailing all system interface functions.

(j) Power supply equipment rated output.

(k) System quiescent current.

(l) System full alarm current, including occupant warning system load.

(m) Required battery capacity.

(n) Load current of each connectable device transmission path powered from the FDAS.

(o) Amplifier rated output; maximum load impedance (Ω) and power (W).

(p) Measured impedance (Ω), power load (W) and reference SPL of each loudspeaker transmission path.

(q) Table of each supplementary warning device.

(r) Table of each system component having a fixed service life, nominating the service life expiry date.

(s) Table of all system components, their location, type, unique system designation and descriptor.

The system as finally installed may not be the same as that originally proposed in the initial design. This may be due to changes in building functionality, occupancy, design or construction. The documentation provided to the commissioning agent has to reflect the design as installed, with all changes made during the installation/construction process duly incorporated.

A.3 Checks and functional assessment

At the completion of the commissioning, a report should be provided by the commissioning agent. The report should record the outcomes of the following checks and functional assessments as applicable:

(a) *Equipment*

Check that all equipment —

(i) is listed in the table of system components;

(ii) meets the referenced component Standard;

(iii) has been located, installed and interconnected in accordance with the system design documentation and the requirements of this Standard; and

(iv) is installed in an environment for which they are suitable.

(b) *Detectors*

Check that all detectors and other devices used in the system are —

(i) compatible with the relevant parts of FDCIE; particularly ensure that the allowed number of detectors and other devices for each transmission path are not exceeded;

(ii) not set to a sensitivity outside that prescribed in the referenced component Standard;

(iii) in accordance with the requirements of Clause 3.11 (where CO fire detectors are incorporated in the system); and

(iv) are activated when tested and correctly indicate on the detectors and at the FDCIE.

NOTE The type of detector for use in various locations is described in Appendix M.

(c) *Networked FDCIE*

Check that the requirements of Clause 2.4 are met.

(d) *Distributed parts of CIE*

Check that the requirements of Clause 2.5 are met.

(e) *Zone block diagram*

Check the zone block plan is adjacent to the FBP and reflects the correct detection zone layout as defined in the design documentation.

(f) *Mains power*

Check that —

(i) the mains power for the system is connected in accordance with AS/NZS 3000;

(ii) the isolating switch disconnects all active conductors;

(iii) the five operations of the mains isolating switch do not cause an alarm to be indicated on the system; and

(iv) a fault is indicated within 90 min of mains power being removed.

(g) *Standby power source*

Check that —

(i) the standby power source is of a suitable type and capacity in accordance with the requirements of Clause 3.15.5 and the design documentation;

(ii) the float voltage, charger type and setting is correct and in accordance with the battery specifications and design requirements; and

(iii) the date of battery manufacture is recorded.

(h) *Battery temperature and voltage*

Allow the system to operate in the quiescent state for a period of not less than 24 h. At the end of this period measure the temperature of the battery space. Check that the battery voltage corresponds to that specified by the battery documentation for the measured temperature.

(i) *Cabling*

Check that the cabling is in accordance with Clause 3.24.

NOTE This may be done through a random inspection of each type of wiring system specified in the design documentation or required by this Standard including fire rating requirements.

(j) *Detection zone limitations*

Check that the detection zone limitations in Clause 2.3 are not exceeded.

(k) *Detection zone parameters*

Measure and verify that detection zone transmission path parameters specified in the FDCIE specification are met.

NOTE Where the connected components could be damaged by the insulation resistance or other tests, other appropriate tests to ensure that the wiring is satisfactory should be applied.

(l) *Radio Transmission Paths*

Check that actuating devices using radio transmission paths meet the requirements of the referenced Standards in Clause 1.3, including that the receiver responds to alarm, tamper, low standby power signals and gives a fault signal when the supervisory signal condition is absent.

(m) *Operation of fault and alarm signals*

Conduct an appropriate test on each detection zone transmission path and check that fault and fire alarm signals are correctly detected and indicated as the correct detection zone. Also check that other required indicators and relevant outputs of the FDCIE operates as intended.

(n) *Transmission path short-circuit isolators (SCI)*

Check the operation of short-circuit isolation for each detection zone.

(o) *Transmission path protection*

Check that transmission paths are protected in accordance with Clause 3.26 and upgraded where required by the system design documentation.

(p) *Alarm Mimic panel*

Check the correct operation of all alarm mimic panels, annunciators, and the like.

(q) *Detection zone controls*

Operate the controls provided for each detection zone to check for correct operation.

(r) *Alarm verification facility (AVF)*

Check that the AVF has been implemented correctly, in accordance with Clause 3.2.5.

(s) *FDCIE response to fire detection device operation*

Check that each device, detector or sensor operates when tested with a medium suitable for the device type and that the alarm has indicated on the correct detection zone at the FDCIE and, if applicable, at the tested device.

(t) *Fault response time*

Test each detection zone transmission path and check that the response to a fault is indicated on the FDCIE in not less than 100 s.

(u) *Alarm response time*

Test at least one detector in each detection zone transmission path and check that the response to the alarm is indicated on the FDCIE in not less than 10 s or the period specified when dependency on more than one alarm signal is used.

(v) *Supervisory signal response time*

Test at least one supervisory device in each detection transmission path and check that the response to the supervisory device is indicated on the FDCIE in not less than 100 s.

(w) *Alarm acknowledgement facility (AAF)*

Check that any alarm acknowledgement facility operates correctly, in accordance with Clause 3.2.2.

(x) *Alarm delay facility (ADF)*

Check that any alarm delay operates correctly, in accordance with Clause 3.2.3.

(y) *Alarm investigation facility (AIF)*

Check that any alarm delay operates correctly, in accordance with Clause 3.2.4.

(z) *Occupant warning system*:

(i) Check that output to the building occupant warning system at the FDCIE operates within 3 s of the fire alarm condition and that the occupant warning system operates within the time specified with the requirements of AS 4428.16 or AS ISO 7240.3 as applicable.

(ii) Check the sound pressure level meets the requirements of Clause 3.22 in each occupied space.

(iii) Record on the "as-installed" drawings the SPL achieved for the reference location of each loudspeaker transmission path.

(aa) *External alarm indication*

Check that the external alarm indication is visible from the main approach to the building and is adjacent to the designated building entry point.

(bb) *Designated site entry point*

Check that each building can be identified from the DSEP by at least one of the means specified in Clause 2.2.2.

(cc) *Manual call points*

Check —

(i) the correct operation of each MCP;

(ii) that the activation of MCP on the same transmission path as other detection devices does not cause existing detector alarm indications to be extinguished; and

(iii) that MCPs are not subject to alarm dependency.

(dd) *Smoke and fire door release*

Check the operation of each device.

(ee) *Suppression system*

Check that each suppression system flow/pressure switch is connected to the FDCIE as a separate detection zone.

(ff) *Flame detectors*

Check that —

(i) the number and type of detectors provide adequate protection of the area;

(ii) there are no "blind" spots in areas protected;

(iii) detectors are rigidly fixed;

(iv) detector lenses are clean and adequately protected from dust and extraneous radiation sources; and

(v) the detector responds to a flame source or simulated flame.

(gg) *Aspirating smoke detectors*

Measure and record the transport time (TT) from the most disadvantaged sampling point for each sampling pipe or branch.

(i) Visually inspect every sampling point to ensure it is not obstructed.

(ii) Check the response of all capillary sampling points using a test medium placed at each sampling point.

(iii) Check the operation of all alarm threshold settings and indicators using a test medium on at least one sampling point as follows:

(A) The operation of remote indication of alarm and fault signals.

(B) The operation of airflow failure indicators.

(C) The operation of the system (signal) failure indicators.

(D) The isolate and reset functions.

(E) The fault and alarm test facilities.

(hh) *Duct sampling smoke detectors*

Check that —

(i) the alarm indicator is clearly visible from a trafficable area;

(ii) the duct air velocity exceeds the minimum velocity specified for the unit; and

(iii) if the velocity does not exceed the minimum specified for the unit, the measured differential pressure is at least the minimum specified for the unit.

(ii) *Connectable device control functions*

Test each connectable device by operating the detection zone facility or facilities associated with the connectable device and check for the correct operation of the connectable devices.

(jj) *Detection zone descriptions*

Check that all detection zones have been correctly labelled and that the detection zone is immediately apparent from the labelling or correctly described on an alphanumeric display.

(kk) *Cause and effect matrix*

Check the overall system performance is as specified in the cause and effect matrix.

(ll) *Systems interface testing*

Prior to any interface testing, check that all systems listed in the system interface schedule are complete and operable. This will involve checking that all systems interfaces to the FDAS [e.g. BMCS, motor control centres (smoke control), security system (door release), nurse call systems, lifts, automatic doors, sprinklers, gaseous extinguishing systems, safety services and other ancillary control functions] are correctly connected.

The systems interface tests should confirm —

(i) the automatic "end-to-end" operation of all interfaced systems;

(ii) the manual "end-to-end" operation of all interfaced systems; and

(iii) the correct indication of operation on the FBP, FDCIE, FFCP, EWCIE, EICIE, FFCP or SHCIE as applicable.

NOTE The "end-to-end" test should include the activation of associated detection devices to confirm that all required functions operate correctly in accordance with the system interface matrix.

A.4 Baseline data, test results and documentation

The following documentation should be provided upon completion of the commissioning tests:

(a) As-installed drawings covering the whole system.

(b) Designer's statement.

NOTE See Appendix E.

(c) Installer's statement.

NOTE See Appendix F.

(d) Commissioning statement and report.

NOTE See Appendix G.

(e) System design documentation (i.e. baseline data) as required by Clause 1.7.2.

Appendix B
(informative)

Wiring systems

B.1 Protection against mechanical damage

B.1.1 General

The areas indicated in Paragraphs B1.2 to B1.7 are not intended to be considered as a rigid list to be adhered to with no deviations; rather they should be considered as a guide to the types of areas and causes of damage to be encountered. Details of ways to achieve this grade of protection can be found in AS/NZS 3013.

B.1.2 WSXX

Areas where physical damage is considered to be unlikely.

Examples of these areas are:

(a) Masonry riser shafts with strictly limited access.

(b) Non-trafficable ceiling void areas.

(c) Inaccessible underfloor areas.

(d) Underground installation in accordance with AS/CA S009.

(e) Internal domestic and office situations where cabling is mounted on walls at heights above 1.5 m.

B.1.3 WSX1

Areas where physical damage by light impact is considered possible.

Examples of these areas are:

(a) Internal domestic or office situations where cable is mounted on walls at heights below 1.5 m.

(b) Trafficable ceiling void areas where access to building services for maintenance purposes is required.

B.1.4 WSX2

Areas where physical damage by impact from manually propelled vehicles is possible.

Examples of these areas are:

(a) Passageways and storerooms in domestic, office and commercial locations where hand trucks and barrows may be used, and cables are mounted at a height of less than 1.5 m.

(b) Plant rooms where only minor equipment is installed.

(c) Workshops where repair and maintenance on small equipment and furniture or the like is carried out, and cables are mounted at a height of less than 2.0 m.

B.1.5 WSX3

Areas where physical damage by impact from light vehicles is possible.

Examples of these areas are:

(a) Car parks and driveways where cars and other light vehicles are present and cables are mounted at a height of less than 2.0 m.

(b) Storage areas where manually operated devices such as pallet trucks may be operated and cables are mounted at a height of less than 2.5 m.

B.1.6 WSX4

Areas where physical impact from vehicles with rigid frames or rigid objects, the weight of which does not exceed 2.0 t, is possible.

Examples of these areas are:

(a) Small delivery docks where the cabling is mounted below a height of 3.0 m.

(b) Warehouses with pallet storage up to 3.0 m and whereforklift trucks are used.

(c) Heavy vehicle workshops.

B.1.7 WSX5

Areas where physical damage from impact by laden vehicles or objects the laden weight of which exceeds 2.0 t.

Examples of these areas are:

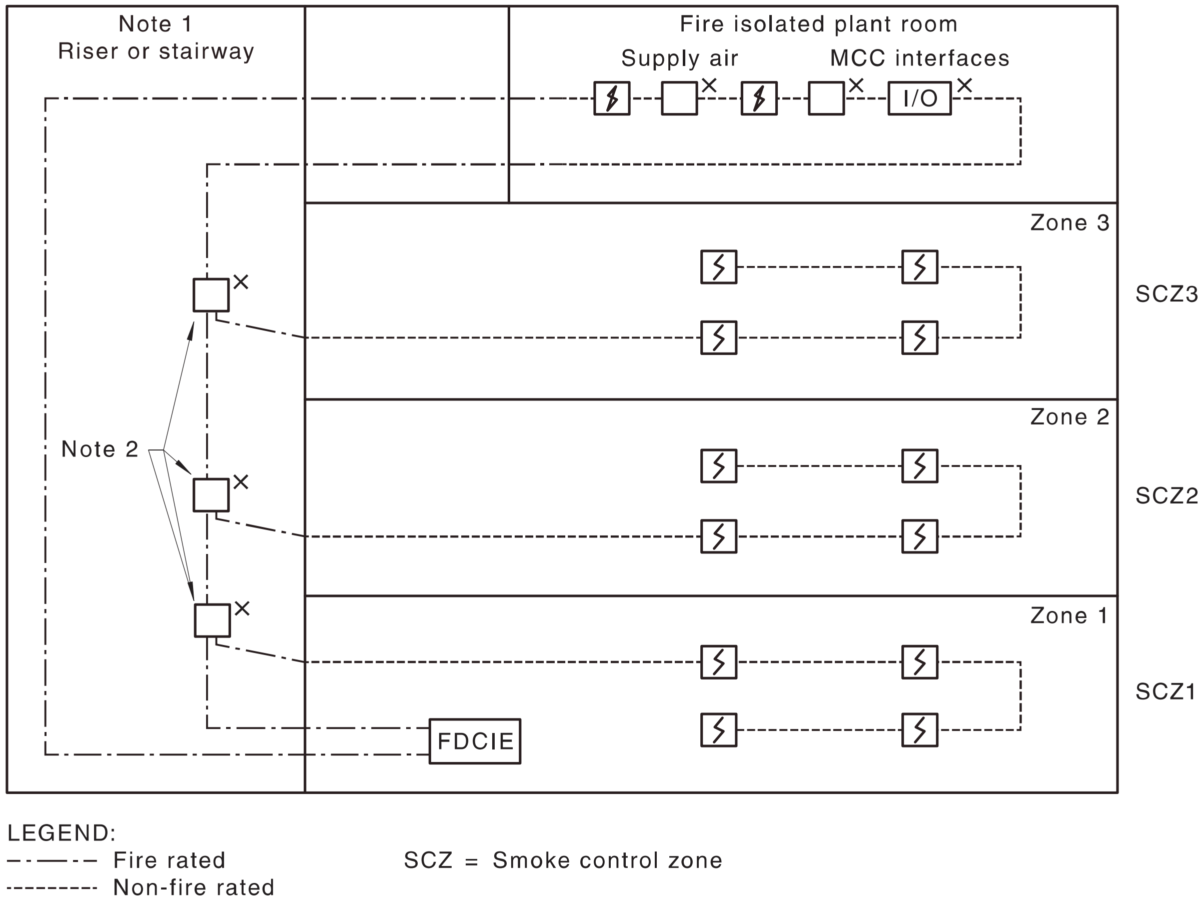
(a) Loading and delivery docks.

(b) Fabrication and maintenance areas for medium to heavy engineering.

(c) Large high pile storage warehouses with forklift trucks.

B.2 Examples of addressable loop wiring for smoke control

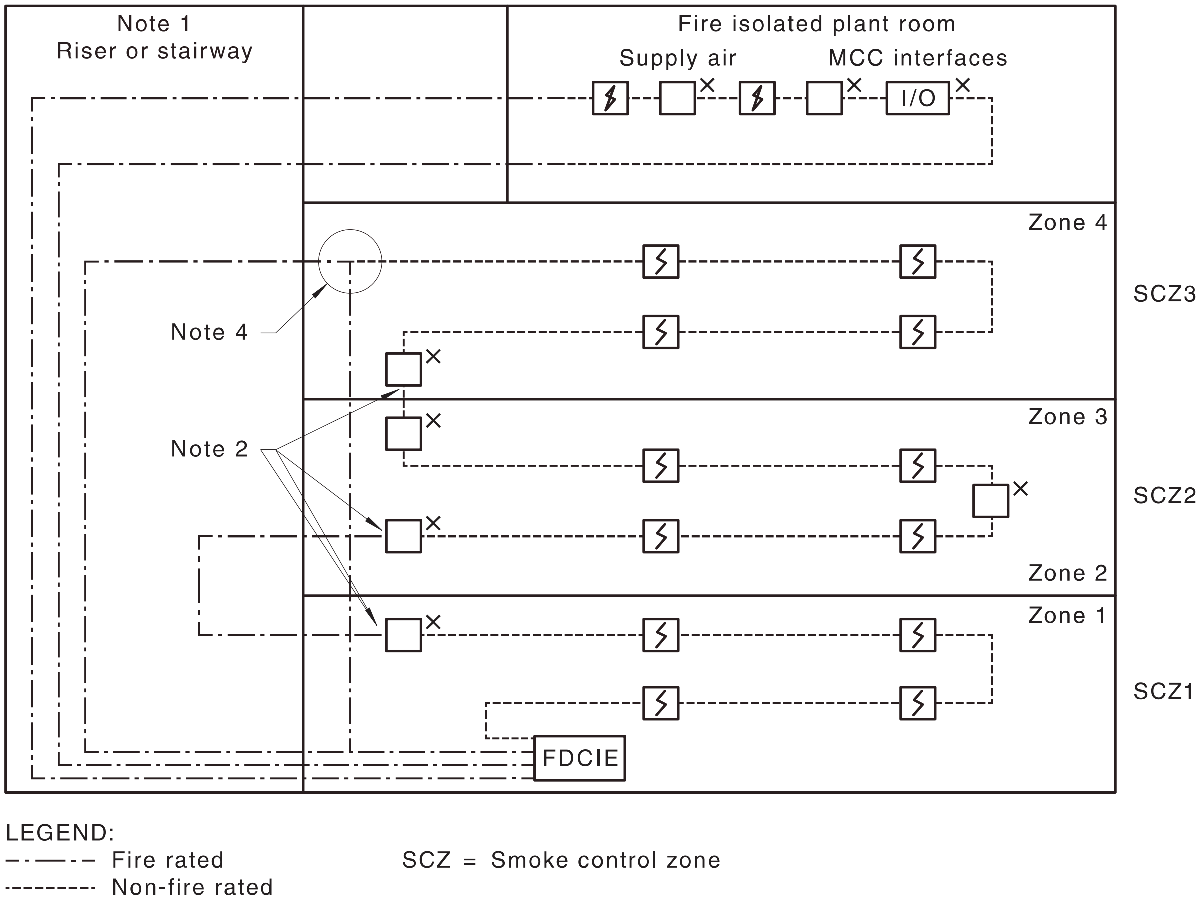
Figures B2.1 to B2.2 show examples of addressable loop wiring for smoke control.



NOTE 1 Where the riser is a fire isolated stairway the transmission paths may not be required to be fire rated and SCI are not required to be fire-isolated.

NOTE 2 SCIs should be fire-isolated from occupied spaces. Additional SCIs may be required where other services such as sprinkler flow switches are served by the transmission path.

Figure B.2.1 — Example of addressable loop wiring for smoke control



NOTE 1 Where the riser is a fire isolated stairway the transmission paths may not be required to be fire rated.

NOTE 2 The SCI either side of the transition point may be installed at the nearest detector on the transmission path or use an inbuilt SCI or isolator base.

NOTE 3 Transmission paths crossing occupied space may be required to be fire rated.

NOTE 4 Alternative fire-rated transmission paths are shown.

Figure B.2.2 — Example of addressable loop wiring for smoke control

Appendix C
(informative)

Power source calculation examples

C.1 Battery capacity calculations

C.1.1 Typical FDAS I_Q calculation

Item	Unit current mA	Quantity	Total current mA
FDCIE:			
All internal fitted items	200.0	1	200.0
EWCIE	50.0	1	50.0
Detectors and field devices:			
VAD and VWD	20.0	6	120.0
Hard contact devices Smoke Flame I/O devices Optical beam smoke	0.0 0.1 0.25 2.0 180.0	60 50 4 2 4	0.0 5.0 1.0 4.0 720.0
ASD[a]	200.00	1	200.0
Connectable devices (normally energized)	50.00	2	100.00
Alarm Signalling Equipment Air-conditioner relays Electric locks	20.0 100.0 100.0	2 1 1	40.0 100.0 100.0
Total I_Q (mA)			1640.0
Total I_Q (A)			1.64

[a] Start-up currents should be allowed for in the PSE calculations below.

NOTE 1 Ampere (A) = 1000 milliamperes (mA).

C.1.2 Typical FDAS I_A calculation

All following alarm currents are the values in addition to any quiescent value:

Item	Unit current mA	Quantity	Total current mA
Total FDAS I_Q Detection zones AAD/VAD EWCIE ASD (Alarm Signalling Equipment) External alarm	— 100.0 80.0 1000.0 300.0 200.0 100.0	— 2 2 1 1 1 1	1640.0 200.0 160.0 1000.0 300.0 200.0 100.0
Gross I_A (mA)			3600.0
Less loads that de-energize on alarm			
Air-conditioner relays	100.0	1	100.0

Item	Unit current mA	Quantity	Total current mA
Electric locks	100.0	1	100.0
Total load in alarm, I_A (mA)			3400.0
Total load in alarm, I_A (A)			3.4

Required battery capacity at end of battery life $= (I_Q \times 24\text{ h}) + F_c(I_A \times 0.5\text{ h})$

$= (1.64 \times 24) + 2(3.4 \times 0.5)$

$= 42.76$ Ah

therefore required new battery capacity $= 42.76 \times 1.25$

$= 53.45$ Ah

C.2 Main power source calculations

C.2.1 Power supply requirement

Choose the greater of —

(a) I_{PA} *(power supply alarm state)* = I_A + Non-battery-backed ancillary alarm loads:

Item	Unit current mA	Quantity	Total current A
I_A	—	—	3.4
Non-battery-backed connectable device alarm loads:	0	0	0
Loads energized on alarm	50.0	4	0.2
			3.6

or

(b) I_{PQ} *(power supply quiescent state)* = I_Q + non-battery-backed quiescent loads.

Item	Unit current mA	Quantity	Total current A
I_A	—	—	1.64
Non-battery-backed quiescent loads:			
Loads energized in quiescent	50.00	4	0.20
			1.84

If the main power source is separate from the battery charger the required main power source rating = 3.6 A.

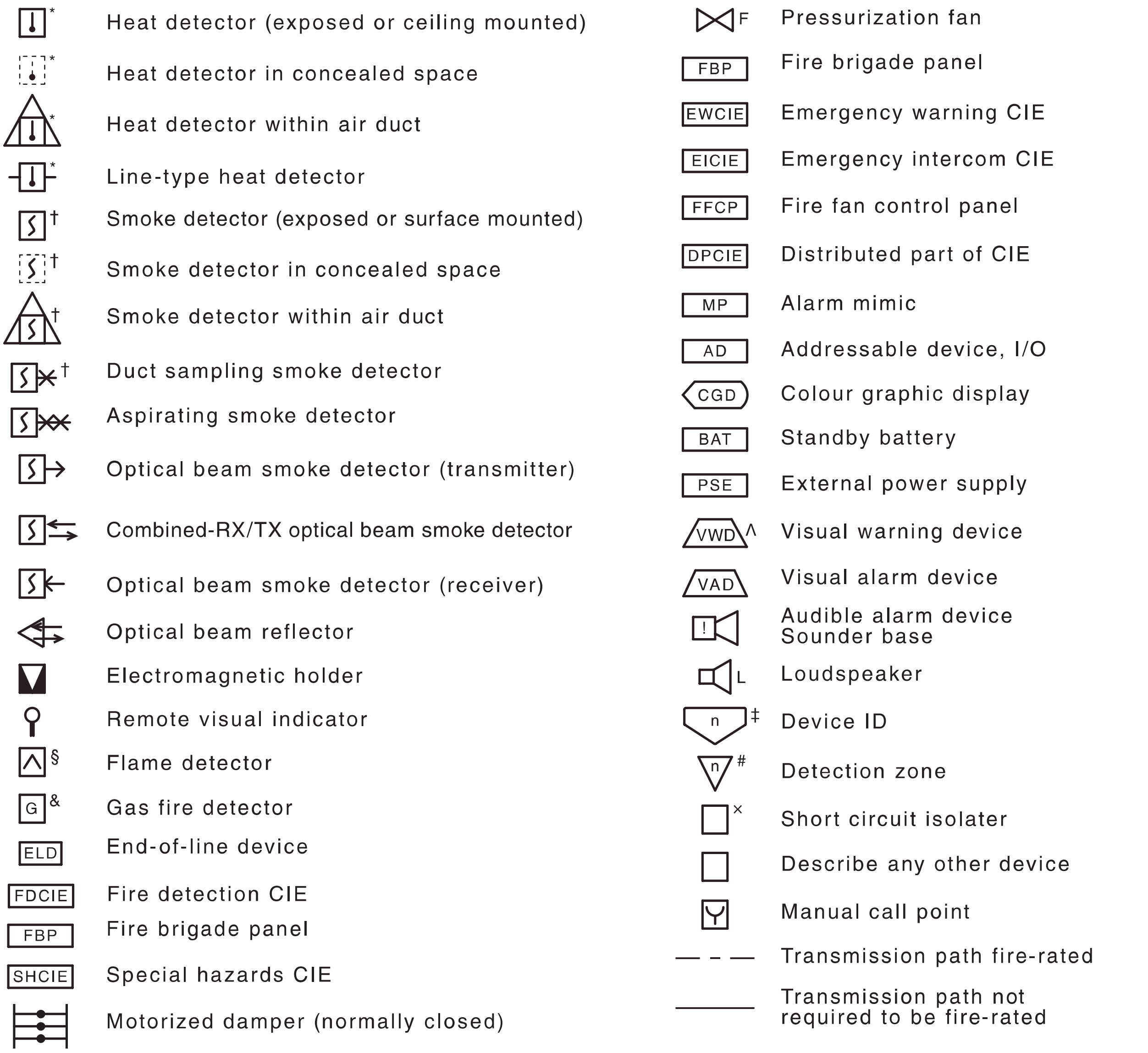
Where the PSE is also used as the charger, the battery capacity support has to be added to the minimum PSE requirements to obtain the minimum overall PSE rating. In this example the PSE should be rated to support the minimum required battery capacity of 54 Ah.

If the nearest battery capacity available is 65 Ah, the PSE should be rated to charge the battery in accordance with AS 7240.4.

Appendix D
(normative)

Drawings and symbols

Figure D.1 defines the component symbols to be used and examples are shown in Figures D.2 and D.3.



LEGEND:

* Indicate grade of AS 7240.5 heat detector

† Type of smoke detector, e.g., I = ICSD, P = Photoelectric, PM = Photoelectric multisensor

& Type of gas fire detector, e.g., CO

§ Type of flame detector, e.g., IR = Infra-red, UV = Ultraviolet

! Substitute type of detectors when AAD is a detector's sounder base

L Loudspeaker type, e.g. H = horn, B = box, S = sphere. None if ceiling surface or recessed.

× Short cicuit isolator. Add × external to any other device to indicate in-built SCI. A box with × inside or the letters SCI is for transitional used only until April 2022 when external × is required.

^ Indicates fixed words displayed on VWD

‡ Substitute device ID as displayed on the FBP in the fire alarm condition (border options)

Substitute detection zone number

NOTE 1 For combination detectors (CD) indicate all sensor types.

NOTE 2 A box with X or the letters SCI to indicated SCI is for transitional use only until April 2022.

Figure D.1 — Symbols

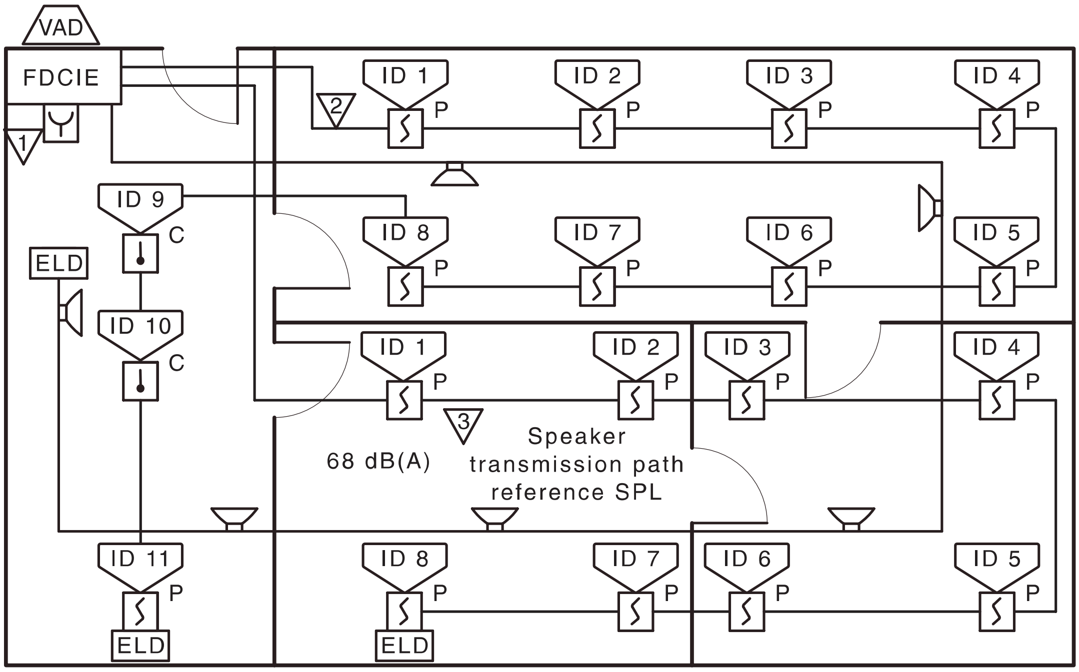


Figure D.2 — Typical collective single line drawing

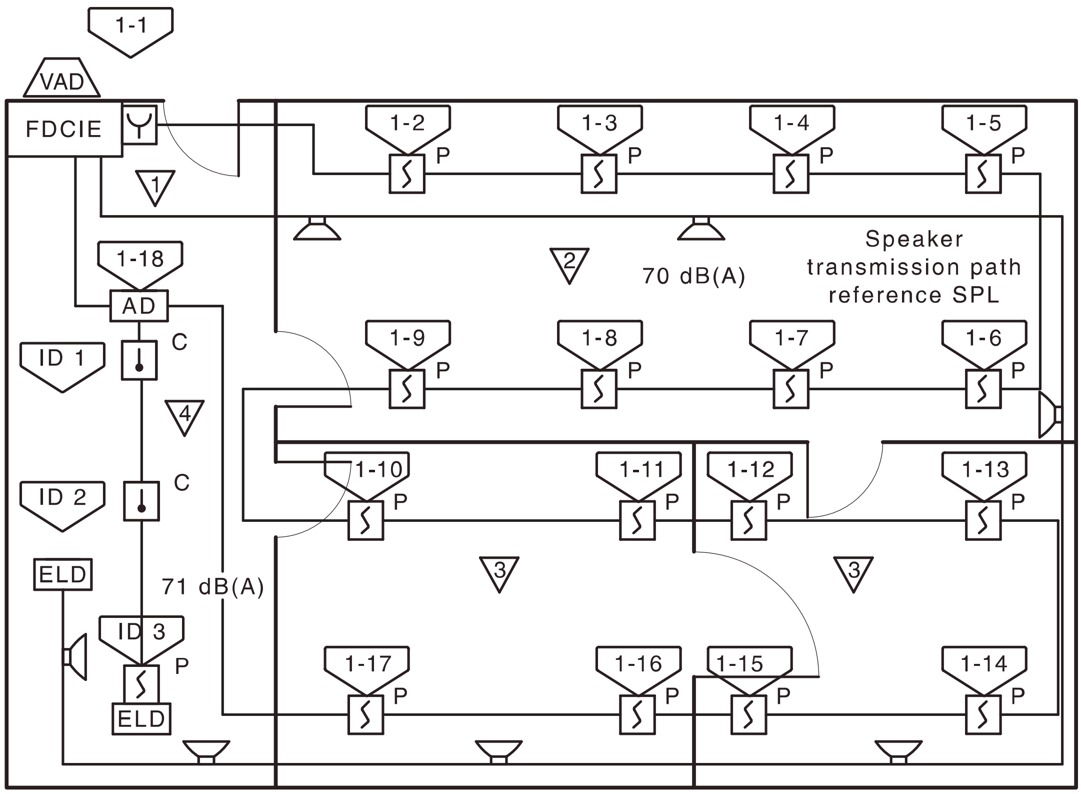


Figure D.3 — Typical addressable single line drawing

Appendix E
(informative)

Designer's statement

(Include all information as applicable)

I/We confirm *name and/or company* have provided the design, *reference*, for an automatic fire detection and alarm system located at *site name, building name if applicable* address.

The system is an alteration to *an existing system, a new system* and includes equipment of the following type(s): *collective (conventional), addressable, analogue-addressable or any combinations*.

The design criteria is *AS 1670.1:2018*, *Deemed to satisfy provisions of NCC, a performance solution* provided by *engineer's name/company; fire safety engineering report (FSER) report reference*.

A. We certify the equipment used within the system design:

(a) Is in accordance with the referenced equipment Standards.

(b) Is located in an environment for which it is appropriate.

(c) Is compatible with the relevant parts of CIE.

B. We have provided the following design documentation:

(a) Design drawings showing the system layout (building plans), equipment type, location and designation.

(b) Systems interface diagram.

(c) Cause and effect statement for each system interface function.

(d) Table of all system components, their location, type, unique system designation and descriptor.

(e) Table of each system component having a fixed service life, nominating the service life expiry date.

(f) Table of any connectable equipment.

(g) Manuals for all CIE and system components (as applicable).

(h) Aspirating smoke detection design calculations (if applicable).

(i) Type of occupant warning equipment.

(j) Amplifier rated output; maximum load impedance (Ω) and power (W) (if applicable).

(k) Calculated impedance (Ω) and power load (W) of each loudspeaker transmission path (if applicable).

(l) Table of each supplementary warning device.

(m) Details of fire alarm monitoring requirements.

(n) Power supply requirements including —

(i) Power supply source (mains), nominal voltage.

(ii) Standby power source type, nominal voltage and capacity required.

(iii) System quiescent current (mA), including ASE loads if applicable.

(iv) System alarm current (mA), including ASE and occupant warning system loads.

(v) Load current of each ancillary circuit.

(vi) Standby time (h).

(vii) Alarm time (min).

I/We confirm the design includes any changes required during the installation of the system and that the system meets the design Standard required.

On and on behalf of company:

Name:

Position:

Signature:

Date:

Appendix F
(informative)

Installer's statement

(Include all information as applicable)

I/We confirm name and/or company have installed an automatic fire detection and alarm system into a building located at site name, building name (if applicable), *address*.

The system installed is an alteration to *an existing system, a new system* and includes equipment of the following type(s): *collective (conventional), addressable, analogue-addressable, or any combination*.

The system design documentation was provided by *design reference no.*.

The design criteria is *AS 1670.1 — 2018*, *Deemed to satisfy provisions of NCC*, *a performance solution* provided by *engineer's name/company; fire safety engineering report (FSER) reference*.

We certify that:

(a) The system is installed to the design documentation including all amendments.

(b) The design documentation has been updated to include all installation detail, including but not limited to: zoning, device location, device type, transmission/circuit paths, location of all junction boxes and location of all end of line devices (ELD).

(c) The cabling meets the requirements of AS 1670.1:2018.

(d) Mains wiring meets the requirements of AS/NZS 3000 and the location of the essential service switch board is indicated on the zone block plan.

Cable provider's license number:

On and on behalf of company:

Name:

Position:

Signature:

Date:

Appendix G
(informative)

Commissioning statement

(Include all information as applicable)

I/We *Name and/or company* have commissioned the automatic fire detection and alarm system located at *site name, building name if applicable* address on behalf of *name and/ or company/address*.

The system is an alteration to *an existing system, a new system* and includes equipment of the following type(s): *collective (conventional), addressable, analogue addressable or any combination*.

The design statement has been provided by *name and/or company/address*.

The installer's statement has been provided by *name and/or company/address*.

The design criteria is AS 1670.1 — 2018, Deemed to satisfy provisions of NCC, a performance solution provided by *engineer's name/company; fire safety engineering report (FSER) reference*.

We certify that the installed system —

(a) meets the design Standard specified;

(b) is correctly installed;

(c) meets the cause and effect matrix requirements;

(d) meets the system interface requirements;

(e) commissioning report is provided; and

(f) the baseline data are provided (see Clause 1.7.2).

On and on behalf of company:

Name:

Position:

Signature:

Date:

Appendix H
(normative)

Sound pressure level measurements

H.1 General

This procedure applies to sound pressure level (SPL) measurements to be carried out in each acoustically separate space within each occupied space.

H.2 SPL measurements required

The following measurements shall be taken within each acoustically separate space or room with any doors closed if provided:

(a) Background noise level.

(b) Minimum SPL of warning signals.

(c) Maximum SPL of warning signals.

(d) Minimum live speech SPL.

H.3 Locations of SPL measurements

Prior to taking any reading, confirm that the amplifier line voltage matches the approved design. The voltage shall be record in the baseline data.

The following shall apply:

(a) The minimum SPL shall be measured at a location near the centre of the area approximately half way between two loudspeakers. If there is only one loudspeaker, the location shall be measured half way between a loudspeaker and the furthest corner of a room.

(b) The maximum SPL shall be measured directly in front of the loudspeaker with the highest power setting. Where loudspeakers are mounted at different ceiling heights, a measurement location shall be selected within each area of different ceiling height.

NOTE This may be directly below a ceiling mounted speaker.

(c) The background noise shall be measured at the same location as the minimum SPL.

(d) All SPL reading shall be measured at 1.5 m above the floor.

NOTE The amplifier line voltage shall not be changed without repeating all required SPL reading for that amplifier. Individual loudspeaker SPL shall only be adjusted by the facility provided at the loudspeaker.

H.4 SPL measurement details

The following shall apply:

(a) The warning signal SPL measurement shall be taken during the temporal pattern “ON” phase using a sound-level meter conforming to AS IEC 61672.1, Class 2 or better.

(b) The SPL measurements shall be measured outside a peak occupied period unless there is no peak period identified.

(c) Background noise shall be measured during the normally occupied period or a typical peak occupied period whichever measures the highest.

(d) The background noise SPL recorded shall be based on the average reading over a 60 s period. The average value need only be determined visually from the reading on the SPL meter as an estimate unless it is capable of electronic averaging over the period.

(e) The minimum warning signal SPL shall be the least of the values measured where more than one location is measured within the area.

(f) The maximum warning signal SPL shall be measured for each different type of loudspeaker used, and each area with a different ceiling height.

(g) The minimum live speech SPL shall be measured at the location determined to have the minimum warning signal SPL in each acoustically separate space as follows:

  (i) A sound source adjusted to an SPL of 92 dBA at 20 mm from the source shall be placed 20 mm from the emergency microphone while the microphone control (PTT) is activated.

  (ii) The sound source shall use the speech intelligibility “talk box” and STI-PA test tone, or alternatively a loudspeaker in a housing with a frequency response of not less 400 Hz to 4 kHz (±3dB) and a pink noise source, true in the range not less than 200 Hz to 8 kHz.

A location shall be selected for each loudspeaker transmission path where both the warning signal SPL and live speech SPL were measured. These values shall be recorded in the baseline data.

NOTE A suitable location is where the minimum reference warning signal SPL is recorded.

Appendix I
(normative)

Measurement of speech intelligibility

I.1 Choice of measurement

The intelligibility of speech shall be measured, and the requirements for reliable results shall be satisfied. The results shall then be converted to the CIS according to the relevant curve(s) given in Figure I.1.

NOTE One of the methods listed in Appendix J should be used.

I.2 Status of the sound system

Usually, the whole emergency zone will be in operation for all measurements. If measurements are carried out with the emergency zone in a special status, this shall be stated with the results.

I.3 Number of measurements and calculation of the results

The measurements shall be made at a sufficient number (n) of representative points, which shall be detailed in the system specification, in each area of coverage. The arithmetical average (I_{AV}) of the intelligibility values on the CIS scale, and the standard deviation (σ) of the results, shall be calculated. The quantity I_{AV} - σ shall exceed the CIS limit value specified in Clause 3.22.5.

If the result is within ± σ of the limit, the measurements shall be repeated, preferably at a larger number of points.

The mean value of intelligibility, and its 95 percent confidence interval, over the whole area of coverage shall be calculated, taking into account the shape of the statistical distribution of the results of the measurements.

I.4 Sound pressure level (SPL)

The C-weighted SPL for the measurement shall be equal to the L_{Ceq} measured for not less than 16 s at the measuring point when the system is in normal operation as an emergency warning system.

NOTE 1 If the RASTI method is used, A-weighting may be used for both measurements instead of C-weighting.

NOTE 2 Linear response may be used instead of C-weighting, only if the results are reliable.

I.5 Ambient noise level

The A-weighted ambient noise level (the residual noise level) in the absence of the test signal (the residual noise) shall be measured, in decibels (with reference to 20 μPa), over a period sufficient to reasonably represent the residual noise at the time of the intelligibility test. Measurements of the equivalent A-weighted SPL shall be made at representative points over the area of coverage. The positions, duration and time of measurements shall be reported, together with a note of any unusual circumstances which might affect the validity of the measurements.

Where it is impractical to determine the ambient noise level, it shall be taken from AS 1055.1.

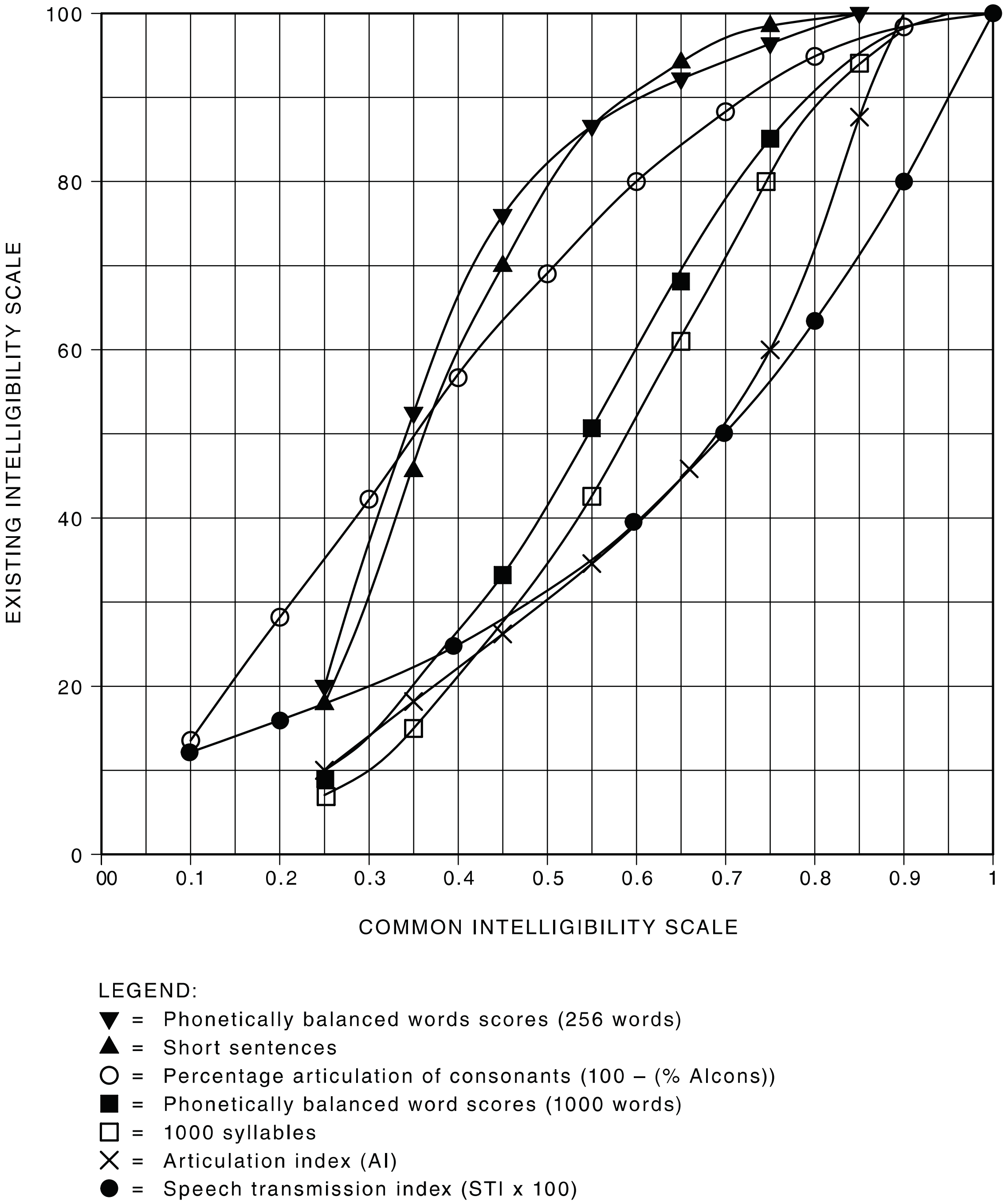


Figure I.1 — Conversion of existing intelligibility scales to the common intelligibility scale

Appendix J
(informative)

Methods of measuring speech intelligibility

J.1 General

A number of methods of measuring speech intelligibility have been proposed, and several are mentioned in national and international Standards. Work on this subject is continuing. Pending completion of this work, the examples of the available methods herein, provide information on the correlation between them, and their limitations, either directly or by reference to normative referenced Standards. This appendix provides the procedures that should be used.

It is recommended to choose, if possible, the method of measurement that gives the greatest discrimination in the range of intelligibility being investigated, taking into account the standard deviation to be achieved and the gradients of the relative curves. For example, STI has the greatest discrimination at high values of intelligibility, while a 256 word phonetically balanced word score has the greatest discrimination at low values.

J.2 Methods of measurement

J.2.1 Speech transmission index (STI)

The STI is derived by calculation from measurements of the modulation transfer function (MTF), and a number of computer-based measuring systems offer this facility. However, the details of the carriers and modulation frequencies to be used, and the weights given to them in the calculations, have not as yet been standardized.

NOTE Weighting values that are intended to be used, unless there is a reason to the contrary, are given in IEC 60268-16.

J.2.2 Rapid (or room) acoustics speech transmission index (RASTI)

The RASTI results from a simplified method of determining the STI, using two octave-band noise carriers and four or five modulation frequencies.

NOTE A description of this method is given in IEC 60268-16.

J.2.3 Phonetically balanced (PB) word scores

The PB word score method depends on the transmission of specially chosen words, selected from a known population, to a panel of listeners.

NOTE For all types of subjective test involving room acoustics, the test words should be embedded in carrier phrases as this produces representative reflections and reverberation during the presentation of the test words.

J.2.4 Modified rhyme test (MRT)

The MRT method also uses a panel of listeners.

J.2.5 Articulation index (AI)

The AI is determined by measuring the sound pressure levels of the wanted speech signals and the ambient noise. It is calculated after making corrections for masking, frequency and amplitude distortion of the speech signal, reverberation and the presence of visual clues.

NOTE Additional information is given in ANSI S3.5.

J.2.6 Articulated loss of consonants

The articulated loss of consonants, usually expressed as a percentage with the symbol $\%AL_{\text{cons}}$ can be determined from the results of transmission tests, using specially chosen simple words.

NOTE 1 Further information can be obtained from Peutz, V.M.A, *Articulation loss of consonants as a criterion from speech transmission in a room*, J.Aud.Eng.Soc., Vol 19, pg 12, December 1971.

NOTE 2 AL_{cons} does not use test words in carrier phrases and omits vowels. This leads to erroneous results in the presence of reverberation or peak clipping.

J.3 Limitations of the methods

J.3.1 General

All the foregoing methods can give misleading results unless the measurement procedure is carried out very carefully and in strict accordance with the relative Standard. Furthermore, it is essential that the ambient noise level at the time of measurement is very similar to that which occurs under normal operating conditions, or an appropriate correction is made to the raw data of the test results.

J.3.2 Speech transmission index (STI)

Generally, STI methods are not suitable for testing systems introducing frequency shifts or frequency multiplication or using vocoders.

With some measuring versions (refer to IEC 60268-16) the results are meaningful only if —

(a) the system does not use any amplitude compression, expansion or non-stationary temporal processing; and

(b) the total harmonic distortion of a sinusoidal signal giving the same sound pressure level at the measuring position as the STI test signal does not exceed 17 percent (corresponding to approximately 1 dB of compression of a pink-noise signal due to peak clipping).

J.3.3 RASTI

The results are meaningful only if the requirements given in IEC 60268-16 are satisfied. In general, RASTI is suitable for room acoustics with direct sound transmission between loudspeaker and listener. Only in specific conditions (i.e. substantially linear systems) can the method be applied to emergency warning systems.

J.3.4 Phonetically balanced (PB) word scores (256 and 1009 population)

It should be noted that, because the method is based on the reception of words by listeners, there are no limitations with respect to the characteristics of the emergency warning system or those of the environment.

J.3.5 Articulation index

The limitations applying to this method are given in ANSI S3.5.

J.3.6 Articulation loss of consonants

It should be noted that, because the method is based on the reception of words by listeners, there are no limitations with respect to the characteristics of the emergency warning system or those of the environment. If, however, another method of measurement is used, there may be limitations in these respects.

J.4 Correlation of the results of the various methods

In order to specify a single figure for the intelligibility requirements of a system, and to compare results of different measurements, much work has been done to determine relationships between the results of the various methods of measurement. In most cases, these relationships are now firmly established and accepted, despite being subject to a degree of uncertainty or statistical variation. For the purposes of the present Standard, it has been found necessary to correlate the results of each of the foregoing methods to a new scale, termed the common intelligibility scale (CIS). An essential requirement, due to the aforementioned uncertainty, is that the gradient of each correlation curve is neither too small nor too great, as each of these conditions exaggerates the uncertainty in the correlation.

The correlations that have been determined are given in Figure I.1.

Appendix K
(informative)

Lettering checklist

Table K.1 is summary of lettering height requirements in accordance with this Standard.

Table K.1 — Lettering heights

Clause	Item	Lettering words	Height in mm
1.7.3	Alterations terminal cabinet	FIRE	5
2.4	FDCIE not used by emergency services personnel	FIRE	20
2.5	Distributed part of CIE	FIRE	20
3.2.2.8	AAF	Press to acknowledge nuisance alarm	3
3.2.3	ADF	Alarm delay fitted, etc.	5
3.8	External alarm VAD	FIRE	50
3.9.2	FDCIE covering door	FIRE PANEL	50
3.10	Zone block plan	General lettering	3
3.10	Zone block plan	Ring 000	5
3.11	FDCIE and FBP	Instruction if CO fire detectors are used	5
3.13.2	Interface cabinet label	FIRE	5
3.14.3	MCP used for emergency evacuation	EVACUATE	5
3.14.4	MCP used for non-evacuation emergency	EMERGENCY	5
3.14.5	MCP used for electric door release	DOOR RELEASE	5
3.14.6	MCP used for other functions	Word identifying its function	5
3.19.1 (c)	Door release switch	DOOR RELEASE	5
3.19.2	Fire door/ shutter warning	WARNING, etc.	50
3.22.4	VAD Label	“FIRE” or “EVACUATE”	15
3.24.6	Joint junction box	FIRE	5
5.2.3 (a)	ASD sampling pipes	FIRE DETECTION SYSTEM-DO NOT PAINT	5
5.2.3 (b)	ASD capillary tube > 2 m	FIRE DETECTION SYSTEM-DO NOT PAINT	3

Table K.1 *(continued)*

Clause	Item	Lettering words	Height in mm
7.15.4	FFCP fire mode indicator and switch	FIRE MODE RESET	5
7.15.7	FFCP label	THESE CONTROLS, etc.	5

Appendix L
(informative)

Recommended orientation of duct sampling smoke detector probes

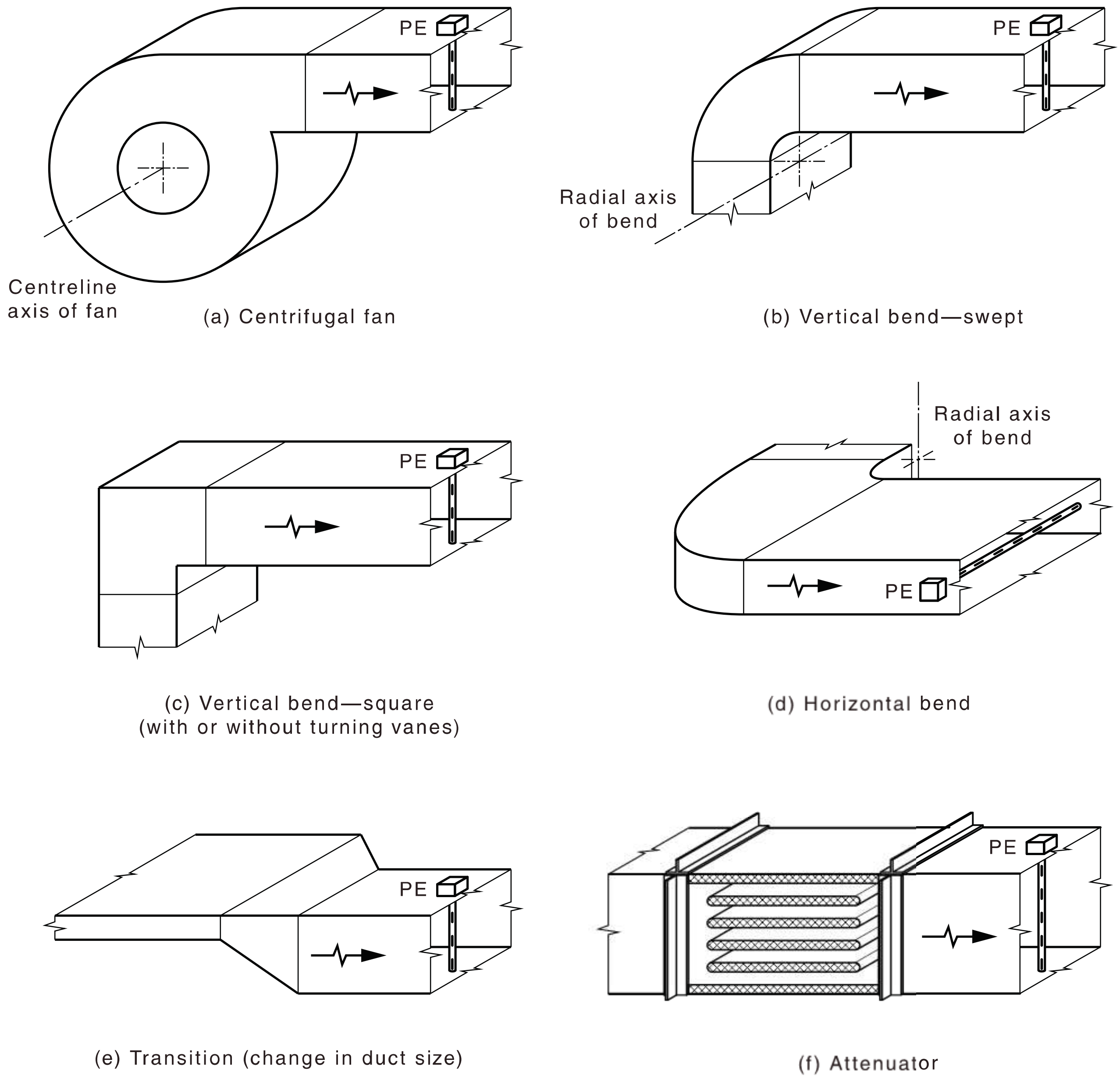
Distribution of smoke within ventilation and air-conditioning ductwork is dependent on the airflow velocity profile across the duct. In regions of high velocity airflow, smoke density will generally be higher than in regions of low velocity due to higher effective entrainment or centrifugal separation of smoke particulates.

In long, straight sections of ductwork conveying air, the airflow velocity profile will be uniform. That is, airflow velocity measured across any particular axis of the duct will be constant except near the duct perimeter, where boundary layer effects will result in reduced velocity. However, immediately downstream of a fan or duct fitting (e.g. bend, transition, attenuator) the airflow velocity will be highly non-uniform and consequently, the distribution of any smoke in the duct at that point will also be non-uniform.

To ensure reliable detection of smoke within ducts, sampling smoke detector probes should be located in long, straight sections of ductwork, at a considerable distance downstream of fans or duct fittings, so the velocity profile at the location of the detector will be uniform. As a pragmatic solution, any location greater than six times the duct width downstream of a fan or duct fitting is considered to have a reasonably uniform airflow velocity profile across the duct.

When building geometry, duct layout or maintenance access to the smoke detector, prevent installation of the sampling probe in long, straight sections of duct or at least six duct widths downstream of a fan or duct fitting, then the smoke detector probe is to be located in accordance with Clause 3.27.3, so it samples the full spectrum of smoke density (airflow velocity) across the duct. Examples of installations in accordance with Clause 3.27.3 are shown in Figure L.1.

Where the length of the sampling probe does not cover the full cross-section of the duct, it is critical that it is installed with the probe entry located on the side where the airflow velocity (hence smoke density) is highest. This point is annotated PE in the following diagrams. In the case of sampling probes being installed downstream of attenuators, the location of the probe entry point is not so critical, provided that the probe is oriented at right angles to the pods of the attenuator.



LEGEND:

→ Air flow direction

PE Probe entry location

Figure L.1 — Recommended locations for supply air duct sampling smoke detectors

Appendix M
(informative)

Guidance for the selection of detectors

M.1 Introduction

The recommendations given in this appendix should be applied with due regard to the attributes of each type of detector and its prime function for life safety and property protection. Hazardous areas may require special consideration.

The fire detection and alarm system should operate before the escape routes become smoke-logged to such an extent that occupants will have difficulty finding their way out of the building.

Premises where people sleep require different criteria for the selection of the detection and alarm system to those premises where occupants are continuously supervising the area. Smoke detectors would normally provide a suitable level of protection for occupants within these areas.

M.2 General notes on detectors

Fire detectors are designed to detect one or more of four characteristics of a fire:

(a) Heat.

(b) Smoke.

(c) CO.

(d) Flame.

No one type of detector is most suitable for all applications and the final choice will depend on individual circumstances. In some premises, it may be useful to combine different types of detectors to achieve the best results.

The likely fire behaviour of the contents of each part of the building, the processes taking place and the design of the building should be considered. The susceptibility of the contents to heat, smoke and water damage should also be considered.

The following list includes typical areas, including suggested detection devices that should be given special consideration:

(i) *Laundry/bathrooms* — CO or heat with normal temperature duty and fixed temperature operation.

(ii) *Kitchens* — Heat or CO.

(iii) *Kitchen exhaust duct* — Special purpose fixed temperature.

(iv) *Electrical risers* — Smoke.

(v) *Vertical service shaft* — Smoke or CO.

(vi) *Autoclave/sterilizer areas* — CO, aspirating or heat with normal temperature operation or high temperature duty and fixed temperature operation.

(vii) *Roof spaces* — ASD or point type photoelectric smoke detectors.

(viii) *Concealed spaces* — ASD or point type photoelectric smoke detectors.

(ix) *Cold rooms/freezers* — Aspirating, optical beam smoke detectors or heat with normal temperature duty and fixed temperature operation.

(x) *Flammable liquid stores* — Heat with normal temperature duty and rate-of-rise operation, smoke, flame.

(xi) *Car parks* — Heat with normal temperature duty and rate of rise operation.

(xii) *Air ducts* — Smoke.

(xiii) *Fume cupboards* — Special purpose fixed temperature.

(xiv) *Spray painting booths* — Heat and flame.

(xv) *Boiler room/furnace* — Heat with high temperature operation and fixed temperature operation.

(xvi) *Stables* — CO or heat.

(xvii) *Stages, discotheques or rides (where theatrical smoke is used)* — CO or heat.

(xviii) *High ceilings* — Smoke or CO.

Notwithstanding the above, fire detection devices specifically designed for particular applications may also be suitable.

In any automatic fire detection system, the detector has to discriminate between a fire and the normal conditions existing within the building. The system chosen should have detectors that are suited to these conditions and provide the earliest reliable warning. Each type of detector responds at a different rate to different kinds of fire. With a slowly developing smouldering fire, a smoke detector would probably operate first. A fire that rapidly evolves heat with very little smoke could operate a heat detector before a smoke detector. With a flammable liquid fire, a flame detector could operate first.

In general, smoke detectors give appreciably faster responses than heat detectors, but care has to be taken in their selection and location.

Heat and smoke detectors are suitable for use in most buildings. Flame detectors are mainly suitable for supplementing heat and smoke detectors in high compartments provided that an unobstructed view is possible, and for special applications such as outdoor storage and chemical processes employing flammable liquids.

The choice of fire detector may also be affected by the environmental conditions within the premises. In general, heat detectors have a greater resistance to adverse environmental conditions than other types of detectors.

All fire detectors will respond to some extent to phenomena other than fire and, therefore, care in the choice of detectors and their location is essential.

M.3 Heat detectors

M.3.1 General

There are two main forms of heat-sensitive detector. One is the point-type of detector, which is affected by the hot gas layer immediately adjacent to it. The other is the line-type of detector, which is sensitive to the effect produced by heated gases along any portion of the detector line.

There are two main types of heat-sensitive element in each form as follows:

(a) *Rate-of-rise temperature elements* which are designed to operate when their temperature rises abnormally quickly especially from a low ambient temperature.

(b) *Fixed-temperature (static) elements* which are designed to operate when they reach a preselected temperature.

A rate-of-rise detector will normally respond to the presence of fire conditions faster than a fixed-temperature type because of its ability to sense rapid increases in temperature. Accordingly, the use of rate-of-rise detectors is preferred for general protection of areas.

Where a building's environmental conditions are not conducive to the use of rate-of-rise detectors due to normally occurring rapid temperature increases, consideration should be given to the installation of fixed-temperature-type detectors to reduce the incidence of spurious alarms.

Where the ceiling height exceeds 9 m, heat detectors are not generally suitable, and the location, sensitivity and type of detector selected should be specially considered.

Heat detectors are not usually suitable for the protection of places where large losses could be caused by small fires, for example, computer rooms. Before final selection of a detector, an estimate should be made of the likely extent of the possible damage before operation of the heat detector.

Attention of designers is drawn to the size to which a fire needs to develop before detection. Heat detectors mounted on higher ceilings require a larger fire size before the fire is detected (see Table M.1).

Table M.1 — Increased fire size required for equivalent heat detector effectiveness based on ceiling height

Heat detector mounting height m	Fire size ratio required for equivalent detection performance
3	1
6	5.5
9	15.5

M.3.2 Application

Table M.2 defines the AS ISO 7240.5 grades. Detectors with a suffix "S" to their class do not respond below the minimum static response temperature applicable to their classification, even at high rates of rise of air temperature. Detectors with a suffix "R" to their class incorporate a rate-of-rise characteristic which meets the response time requirements for high rates of rise of air temperature even when starting at air temperatures substantially below the typical application temperature.

Table M.3 describes the approximate equivalent AS ISO 7240.5 heat detector grades to the previously used AS 1603.1 Types.

Table M.2 — AS ISO 7240.5 heat detector classification gradings

Detector class	Typical application temperature °C	Maximum application temperature °C	Minimum static response temperature °C	Maximum static response temperature °C
A1	25	50	54	65
A2	25	50	54	70
B	40	65	69	85
C	55	80	84	100
D	70	95	99	115
E	85	110	114	130
F	100	125	129	145
G	115	140	144	160

Table M.3 — AS 1603.1 and AS 7420.5 heat detector gradings

AS 1603.1 Type	Approximate equivalent AS 7420.5 Grades
A (58°C to 88°C)	A1R, A2R, BR
B (58°C to 88°C)	A1S, A2S, BS
C (88°C to 132°C)	CR, DR, ER
D (88°C to 132°C)	CS, DS, ES

M.4 Smoke detectors

M.4.1 General

Operation of all types of smoke detectors depend on combustion products entering the sensing-chamber or light beam.

Since the detectors are usually mounted on the ceiling, response time depends upon the nature of the fire. A hot fire will drive the combustion products up to the ceiling rapidly. A slow smouldering fire produces little heat, therefore the time for smoke to reach the detector will be increased. Flaming fires can burn more cleanly and the thermal turbulence can cause dilution, reducing the response by photoelectric detectors; while a smouldering fire can cause a dense plume of smoke to reach the detector causing a more rapid response to the fire.

There are two smoke-sensing principles commonly used for smoke detectors as follows:

(a) Photoelectric point-types that operate on the scattering or absorption of light by smoke particles in a light beam. Photoelectric point-type smoke detectors respond quickly to smoke that is optically dense and are, therefore suitable for general application.

(b) Ionization point-type smoke detectors that operate on the change in current flowing through an ionization chamber upon entry of smoke particles. Ionization point-type smoke detectors respond quickly to smoke containing small particles normally produced by clean-burning fires, but may respond slowly to optically dense smoke containing large particles, which may be produced by smouldering materials.

Photoelectric detectors shown to have a flat response (i.e. can respond to a wide range of fire types) are preferred to ionization detectors due to environmental problems associated with the disposal of the radioactive source in the ionization detectors. Detector response to fires may be further improved by the use of multisensor detectors, where the smoke detection element is enhanced by heat or another element. Ionization detectors should only be used for special applications where photoelectric detectors or multisensor detectors are unsuitable.

Detectors in accordance with AS 7240.7 are required to respond to a range of test fires that include both optically dense particles and clean burning fire. Photoelectric detectors that are in accordance with AS 7240.7 are shown to have a wide range of response and are suitable for general use.

Duct sampling smoke detectors draw air from the duct to the smoke-sensing chamber.

The optical beam smoke detector will respond when the light path at the receiver is obscured. It is important, therefore, that the light path be kept clear of obstacles at all times. Optical beam smoke detectors are effectively linear detectors working on the obscuration principle. Some optical beam smoke detectors can also detect thermal turbulence by refraction of the beam at turbulent interfaces between hot and cold air.

M.4.2 Application

M.4.2.1 General

Smoke detectors other than those incorporating heat detection, do not readily detect burning alcohol and other clean-burning liquids that do not produce smoke particles. This may not always be a disadvantage because a fire will frequently involve other combustible materials at an early stage. Multi-sensor detectors may be suitable for such risks. Flame detectors should also be considered.

Where production or other processes are producing smoke or fumes that may trigger the smoke detector, an alternative type of detector should be considered.

Physical or electronic filtration of the air drawn through the sensing chamber of aspirating detectors may reduce alarms caused by pollution and dust particles.

M.4.2.2 Location considerations

Additional smoke detectors may be required in special circumstances. Ceiling shape and surfaces, ceiling height, configuration of contents, burning characteristics and ventilation are some of the factors that should be considered.

In extreme environments the selection of smoke detectors should be confined to those capable of withstanding the environmental conditions.

M.4.2.3 Ceiling surfaces

Some typical ceiling surfaces where the use of smoke detectors should be evaluated are as follows:

(a) *Smooth ceiling*

Heated air and smoke usually rise. When they reach smooth ceilings, they travel along the ceiling. As these products flow along the ceiling, their concentration decreases as the distance from the source increases.

(b) *Other ceilings*

Where deep beams or other obstructions form pockets in the ceiling, the products collect in the pocket and, if sufficient products are being generated, will eventually “spill over” into adjacent pockets.

(c) *Sawtooth, sloping, open joist, beam construction, or other shaped ceilings*

These will need to receive special consideration as smoke usually travels in a longitudinal direction at the highest point.

(d) *High ceilings*

In high ceilings, such as high rack storage warehouses, it may be necessary to install detectors at more than one level to take advantage of the higher concentrations near the floor to provide a faster response. For atria-type constructions smoke detection at several levels may be necessary because of stratification. Natural or forced ventilation may affect the ability of smoke to reach detectors at high ceiling levels.

M.4.2.4 Stratification

Smoke released from slow burning or small fires may not be hot enough to penetrate the normally heated air that collects at the ceiling. This is especially true in warehouses with metal roofs and inadequate ventilation. During the day the air under the roof is heated by the sun, and a thermal barrier exists, which prevents warm combustion products from reaching the ceiling. The smoke will then stratify at a level beneath the ceiling. Generally, at night this condition will not exist. Detectors may be required at two levels; one group at the ceiling level and another some distance below the ceiling.

M.4.2.5 Airflow

Smoke can be diluted by airflow caused by up-draughts, open windows, forced ventilating systems, or air-conditioning systems.

It may be necessary to conduct air circulation observation tests in a room to ensure proper placement of detectors.

For air-conditioned facilities and other facilities where forced ventilation is present, it is good practice to take advantage of air currents to transport smoke to a detector. However, in such situations, smoke dilution and high airflow may cause the detector to respond slowly.

The effects of airflow on the detector and the movement of smoke where detectors are installed near air ducts and in air-conditioned rooms may affect the location of the detectors.

M.4.2.6 Ducts

Smoke detectors used for sensing smoke in air-handling ducts should be installed where the best sample of smoke can be obtained. Air-sampling probes are necessary to achieve an adequate response. Installation of air-sampling probes should be in accordance with the manufacturer's recommendations and tests should be conducted to ensure satisfactory sampling of the ducted air.

M.4.2.7 Special considerations

The location of smoke detectors should take into consideration areas where nuisance operation or non-operation is likely.

Some typical locations where the use of smoke detectors should be carefully evaluated are as follows:

(a) In the vicinity of certain materials, such as polyvinyl chloride, which when smouldering produces mainly large particles.

(b) Areas where gases may be present from exhausts and normal manufacturing processes.

(c) Kitchens and other areas subject to cooking fumes.

(d) Near openings, such as doors, windows, or other inlets, where the introduction of outside industrial gases or products of combustion may occur.

(e) Areas where the detector is subject to movement and excessive vibration, in particular where optical beam smoke detectors are used.

(f) Dusty areas or in areas where particulate matter, such as aerosols, could enter the detector.

(g) Areas subject to high velocity air current.

NOTE A sampling type detection system may be more suitable.

(h) In areas where high concentrations of tobacco smoke are expected.

(i) In areas where steam or condensation vapour is expected.

M.5 Multisensor detectors

Multisensor detectors conforming to AS 7240.15 or AS 7240.27 may provide improved detection performance compared to single sensor smoke detectors. Where multisensor detectors are selected, consideration needs to be given to the way the heat sensor in the detector influences the alarm condition decision and the test fires that the detector passed.

M.6 Aspirating smoke detectors (ASD)

M.6.1 General

ASD systems are most often an integral part of the overall fire detection and alarm system particularly when used as an alternative to point-type or optical beam smoke detectors. The detection sensitivity of such systems is frequently tailored to the particular application to achieve the performance capability desired without being susceptible to nuisance alarms.

Various technologies are used to measure the levels of combustion products in air passing through an ASD sensing chamber. Some ASDs use sensitive versions of the technologies used in conventional ionization and light scattering type smoke detectors. Other types of ASD use a laser or other bright source to optimize the light scattering technique. While still others use focused laser beams and cloud chamber techniques to determine the level of combustion products within an air sample. Manufacturer's literature explains the sensor technology they use together with the particular benefits and advantages of particular applications.

Most ASD systems differ from point-type smoke detectors in that they operate in a much higher sensitivity range than typical point type smoke detectors and are designed to detect a slowly developing fire where the ignition source is likely to be overheated materials or components that are likely to smoulder for a period of time before significant heat is produced, and perhaps minimal smoke. This generally allows plenty of time for human intervention or automatic intervention by the operation of warning systems or other ancillary control equipment.

While many times more sensitive than the point-type smoke detector, the nuisance alarm rate of ASDs remains low. This apparent dichotomy comes from its immunity to the major sources of nuisance alarms, dust, draughts and electrical interference.

M.6.2 ASD selection

There are many motivations for deploying an ASD system. The following are some examples intended to assist in the classification and therefore specification of ASD systems:

(a) Extreme/harsh environments.

(b) Restricted/difficult access.

(c) Exceptional ceiling/roof heights.

(d) Aesthetics.

(e) Risk of mechanical damage.

(f) Hazardous environments.

(g) High air movement areas.

M.6.3 ASD configuration

ASDs primarily consist of a central detection unit which uses a fan to draw in a sample of air from the protected area through its network of pipes. The sampling chamber may be based on a nephelometer that detects the presence of smoke particles suspended in air by detecting the light scattered by them in the chamber. The resulting sensitivity is several hundred times more sensitive than conventional smoke detectors.

Aspirating systems typically comprise a number of small-bore pipes laid out in the area to be protected with holes drilled at intervals in the length of pipe. Air is drawn into the pipe using the suction pressure of a fan or air pump and drawn back to the detector for analysis. On receipt of the smoke sample alarms are generated and enunciated accordingly. Capillary pipes or tubes may also be connected to the main trunk pipe-work to allow for special applications, for example, electrical cabinet sampling and concealed spaces. Capillary tubes are also used to connect the main trunk pipe-work to ceiling nozzles for applications that require a more aesthetic appearance.

A system design tool is used to verify the design of the pipe-work with regard to the contribution from each sampling hole (and hence the effective sensitivity at each point) and the time taken for each sample to reach the detector. The aspirating sample pipe network may be designed and installed to achieve varying levels of sensitivity.

M.6.4 Sensitivity classes

(a) *Class A — Very high sensitivity*

For the earliest indication of smoke so that evasive measures can be initiated before any significant damage is incurred in areas containing high airflow (e.g. computer rooms/data centres), valuable assets, critical or strategically important artefacts or operations.

(b) *Class B — Enhanced sensitivity*

For reliable smoke detection in applications where smoke is difficult to detect (e.g. to combat smoke dilution where there are significant air flows or where the ceiling is higher than normal).

(c) *Class C — Normal sensitivity*

As an alternative to point or optical beam smoke detectors for a variety of physical reasons (e.g. maintenance access, building deflection, dilution of smoke, and obstructions to line of sight). An ASD system designed to give equivalent performance to point detection systems conforming to AS 7240.7 and other multisensors that include a smoke sensor.

M.6.5 Sample hole sensitivity

Where such systems are installed and are intended to be in accordance with the appropriate Standard, it is important to ensure that the installed performance of each hole (or group of holes if more than one hole is specified to be equivalent to a point detector), is equivalent to (or exceeds) the minimum performance requirements of a point detector.

The detector sensitivity is shared over the network of sampling points associated with it. The aggregation effect of these systems allows smoke from a number of sampling points to be drawn through the detector and collectively the concentration is sufficient to raise an alarm.

The sensitivity of each individual air sampling point (assuming that all sampling points have been designed to provide a balanced system) can be estimated using the following simple calculation:

Individual sampling point sensitivity = Smoke sensing element sensitivity × Number of sampling points

For example, a detector with a 0.1 percent obscuration/m sensitivity smoke sensing element and a total of 40 balanced sampling points can be estimated to be equivalent to a 4 percent obscuration/m sensitivity point type smoke detector at each sampling point equivalent.

M.6.6 Alarm thresholds

In many applications where ASD is integrated within a fire alarm system, it may be desirable to notify personnel within special areas or if located remotely for the need to investigate a potential alarm. Staged alarm threshold levels can be set with most ASD systems.

Typically three stages of alarm are provided and used as follows:

(a) *First stage* — Raising a local signal only for personnel working in an area to investigate.

(b) *Second stage* — Raising a pre-alarm condition at the CIE, which alerts security personnel to investigate.

(c) *Third stage* — "Fire" alarm raising a fire condition at the CIE to initiate evacuation procedures.

In some systems, a fourth stage alarm is available which may be interfaced into an automatic extinguishing system.

The intent of each alarm stage has to be carefully matched to the sensitivity (response threshold) and building operation.

M.6.7 Flow sensing

All aspirating detection systems need to have some form of flow sensing capability. The purpose of which is to detect if a blockage or a broken pipe (which would prevent smoke from being sampled from the intended areas) has affected the air sampling pipe-work. The normal flow conditions should be measured at the time of commissioning. Systems that have multiple flow sensors are able to provide better resolution and earlier detection of reduction or increases in flow. Systems that provide flow sensing on a per pipe basis are preferable. ASD flow sensors are also based on a number of different technologies.

M.6.8 Dust filters, detection and rejection

Most aspirating systems have some form of dust filtration management. They may be capable of removing lint and the majority of large dust particles before the sampled air enters the detector, or may have some facility for dust rejection. Some systems provide dust discrimination within their software, avoiding nuisance alarms caused by the dust particle entering the detection chamber. These measures reduce problems caused by contamination and nuisance alarms caused by high dust levels. One example of dust rejection is by causing the air to flow or move through a labyrinth of relatively large apertures. The larger particles come into contact with the material of the filter and become bonded; smaller particles (such as those in smoke) pass through with no measurable reduction in concentration. Small proportions of the larger dust particles (in the order of 10 µm to 20 µm) do pass through. A large particle in the laser beam path can cause large amounts of light scattering, which could be misinterpreted as a large smoke signal.

M.6.9 Applications

Aspirating detection systems are now widely used in a variety of applications and environments, including adverse or harsh environments where site conditions cause unusual effects. Many diverse areas can be protected with ASD since hot air can be cooled down, cold air warmed up, dusty air filtered and dirty air recognized as part of normal operating conditions and contaminated air returned to where it was sampled from.

In applications with high ceilings or roof structures, such as aircraft hangars, warehouses and atria, a fire is likely to produce a smoke plume that dilutes rapidly as the smoke rises. Air currents and stratification within the building would also affect the smoke plume. At high levels, the smoke concentrations could be quite low and may not be sufficient to activate a point type smoke detector or optical beam smoke detector. Aspirating systems have proven to be very effective in detecting smoke in areas of large open spaces.

Some examples where ASD can be used are as follows:

(a) *High airflow applications*

Telecommunications facilities, computer rooms, clean rooms, or any area where air-conditioning maintains positive pressure, smoke often becomes highly diluted and can be carried to the exhaust without ever reaching point type detectors. High airflow applications can impair the sensitivity of point type detectors, and in some cases, be the cause of nuisance alarms. The sensitivity of aspirating detectors is not affected in these environments.

(b) *Large open space*

Warehouses, hangars and similar large open space areas are ideally suited to ASD. Typically these applications have high ceiling/roof structures where smoke dilution, stratification and other influences can impact standard forms of smoke detection. ASD systems can be designed to effectively cater for smoke detection in these spaces.

(c) *Refrigeration facilities*

Apart from the low temperature operating range for point type detectors, the main problem in cold stores is from condensation and icing. These problems can be avoided by the use of an ASD system.

(d) *Aesthetic applications*

Some applications require hidden detection because of aesthetics. Where concealment of pipe networks is a requirement, the main trunk pipe sections can be hidden within the fabric of the building. Sampling points with smaller bore flexible tube can then be used. These tubes are normally terminated with a very small air-sampling nozzle. The air-sampling nozzle can also be fabricated to a design and in a material that best enables concealment.

(e) *Harsh/dirty/dusty environments*

These areas can be protected by the use of ASD systems that are designed for these environments and contain some appropriate form of dust recognition or dust filtering techniques.

M.7 Carbon monoxide (CO) fire detectors

M.7.1 General

For the purpose of this appendix, the guidance and applications given apply to CO fire detectors in accordance with AS 7240.6 and AS ISO 7240.8.

The CO fire detector sensor may have a limited service life because, as the sensor ages, it may become less sensitive. Detectors should be maintained strictly in accordance with the manufacturer's requirements.

M.7.2 Application

M.7.2.1 General

CO fire detectors are suitable for a broad range of fire detection applications. These detectors may be better suited to applications where other smoke detection techniques are prone to nuisance alarms, for example, dust, steam and cooking vapours.

CO fire detectors react promptly to slow smouldering fires involving carbonaceous materials because CO does not solely depend on convection, but also moves by diffusion.

CO fire detectors may not be suitable for fires involving —

(a) clean burning liquids;

(b) combustible metals;

(c) certain self-oxidizing chemicals; and

(d) non-carbonaceous materials.

M.7.2.2 Stratification

CO fire detectors may be less affected by stratification.

M.7.2.3 Airflow

Air movement does not significantly affect the response of the CO fire detector; however, while CO gas has greater mobility than smoke, it can be diluted by ventilation systems and hence the same considerations as for smoke detectors should be taken into account.

A recirculating system confined to a single room has little effect on dilution as this is similar to the natural diffusion of the CO gas.

M.7.2.4 Ducts

CO fire detectors are not considered suitable for use with duct sampling equipment due to CO dilution.

M.7.2.5 Special considerations

The location of CO fire detectors should take into account areas where nuisance operation or non-operation is likely.

Some typical locations where the use of CO fire detectors should be carefully evaluated are as follows:

(a) In areas where CO gas may be present from exhausts and normal manufacturing processes. Examples include car parks, car park return air plenums, loading docks.

(b) In heavy smoking or incense burning areas. Generally, cigarette smoke will not have sufficient CO present to cause alarms even though smoke may be clearly visible; however, the CO level should be measured before installing CO fire detectors.

(c) Where the environment has a high level of film-forming mists that may block the diffusion barrier of the sensing element.

M.8 Flame detectors

M.8.1 General

Most flame detectors are optical, electronic sensors tuned to operate and respond to ultraviolet and infrared radiation, which is outside the visible solar spectrum. There is commonality between ultraviolet and infrared detectors in the following areas:

(a) They are both “line-of-sight devices”. The input radiation has to be optically viewed for the sensor to respond. A typical sensor cone of vision is ± 45° measured from the detector’s direct line of sight (tangent).

(b) Radiation is transmitted at the speed of light. Hence, flame detectors are the preferred detection devices for early warnings, high risk, and fire extinguishing/explosion suppressant systems.

(c) Detectors are tuned to selected bandwidths. The sensors’ lens/bandpass filter allows radiation to be received at the detector only at the selected narrow frequency allocation.

(d) Radiated power received is proportional to the radiation source and inversely proportional to the distance squared:

$$\text{Size of radiation source (pan fire)} = \frac{\text{Power radiated}}{\text{Distance squared}}$$

Thus a radiation sensor may sense a 1 m^2 pan fire at a distance of 10 m. If the distance is increased to 20 m the pan fire will have to increase to 4 m^2. In practice most radiation detectors are designed to detect modulated energy in a limited range of frequencies (typically 1 Hz to 20 Hz). Modulated energy does not follow this equation and therefore the performance of a radiation detector will not follow this equation. Actual detector performance will vary according to the manufacturer and the detection algorithms used.

M.8.2 Radiation sources and inhibitors

M.8.2.1 General

In understanding the differences between the detector technologies it is important to understand not only the sources of different radiation but also the materials and circumstances that can inhibit the radiation source. Knowledge of the likely inhibitors on an application is also important when designing a system.

M.8.2.2 Radiation sources

The flame detector identifies the origin and the type of radiation that is emitted, whether it is ultraviolet or infrared. Information on radiation from different sources is given in Table M8.2.2. Looking at each source of radiation in turn, as follows:

(a) *Fires*

Fires are a rich source of ultraviolet and infrared radiation. Hydrocarbon combustion produces infrared radiation, peaking at 2.7 µm and 4.3 µm within the infrared spectrum. The 4.3 µm (CO_2 spike/emission band) is caused by hot carbon dioxide gases emitted during the hydrocarbon combustion process. Hydrogen and metal fires, which are non-organic, produce infrared at 2.7 µm and ultraviolet at 0.1 µm to 0.35 µm but no infrared radiation at the 4.3 µm peak used by infrared flame detectors.

(b) *Ambient temperature*

Ambient temperature relates directly to infrared radiation; all objects with a temperature in excess of 0Kelvin (−273°C) radiate infrared energy due to molecular movement. Ambient temperature values and the ambient temperature profiles will vary for every detector location.

(c) *Black-body radiation*

Black-body radiation is a heat energy that emits radiation due to a temperature differential between the source and its surroundings. Solar energy at the earth's surface contains little infrared radiation at the infrared 4.3 µm band due to the atmospheric absorption in the CO_2 absorption emission band; however, solar energy can heat objects that will radiate what is then termed black-body radiation at 4.3 µm.

(d) *Solar radiation*

The sun radiates energy across the electromagnetic spectrum, and is an enormous source of ultraviolet and infrared radiation.

(e) *Metal fires*

In general, metal fires will generate ultraviolet radiation with a negligible amount of infrared. Other non-carbon fires will also generate ultraviolet radiation as follows:

Table M.8.2.2 — Radiation from non-carbon fires

Fire types	Ultraviolet	Infrared
Hydrogen	Yes	No
Sulfur	Yes	No
Magnesium	Yes	No
Ammonia	Yes	No

(f) *X-ray and gamma radiation*

Both types of radiation have the ability to penetrate detector housings. With an ultraviolet detector, this radiation may cause the detector to function in a manner similar to that initiated by ultraviolet radiation. In some instances, this can give rise to nuisance alarms with ultraviolet detectors.

(g) *Lightning*

Lightning, the richest source of ultraviolet radiation, is the product of atmospheric disturbances and electrical storms. An electrical arc discharging to earth can flash from cloud to cloud ionizing the atmosphere, the abundant ultraviolet will trigger and activate sensors and initiate a series of nuisance alarms. Detectors designed for outdoor use are normally compensated with an internal time delay of 3 s or more, to override the lightning time duration. This also clearly reduces the detector response time.

(h) *Arc welding*

Arc welding is a primary source of ultraviolet radiation. It is a frequent source of nuisance alarms, caused by the initiation of an electric current discharging to produce an electric arc. The arc mechanism produces high transient switching signals right across the frequency spectrum.

The welded area reaches temperatures of 3500°C. The heated metal forms a secondary source of infrared radiation. Infrared detectors, although more immune to alarms from welding sources, can still give nuisance alarm indications if the welding process is carried out in relatively close proximity to the detector and the detector does not include other mechanisms to protect it from such potential alarm sources.

M.8.2.3 Radiation inhibitors

There are external influences, whose presence can have a detrimental effect on the ability of the detector to flame radiation. These items are chemical vapours and gases, known as inhibitors; they have the ability to absorb radiation. Their presence within the detectors' cone of vision can nullify or reduce the input from fire radiation, rendering the detector inoperable. Likewise a soiled window lens, oil, mist, ice, water, or smoke will impair the radiation signal to the line of sight device.

M.8.3 Ultraviolet flame detection techniques

M.8.3.1 Detection principles

Detectors that operate under the principle of ultraviolet detection have been in the marketplace for about 30 years. Ultraviolet detection technology has probably not evolved as far as infrared detection technology over the same period of time. While there are some applications that are still most suited to ultraviolet detection, the previous discussion highlights some limitations due to the fundamental principles of detection.

M.8.3.2 Advantages

The advantages of ultraviolet flame detection methods are as follows:

(a) *Solar blind*

The effect of ozone in the atmosphere of the earth is such that it absorbs incidents of ultraviolet radiation from the sun. Ozone tends to absorb ultraviolet radiation of lower frequency and so ultraviolet flame detector transducers are able to operate in an area of the waveband where there is little to no ambient ultraviolet radiation present. The detectors are therefore inherently solar blind.

(b) *High temperature*

The main advantage for detectors that utilize ultraviolet detection principles is their resistance to giving nuisance alarms for high temperature heat sources. Special ultraviolet flame detectors can operate at an ambient temperature of approximately 110°C, however, these special high temperature detectors are relatively expensive.

(c) *Metal-based fires*

Detection principles of ultraviolet flame detection techniques make them suitable for the detection of both hydrocarbon fires and less common metal-based fires.

(d) *Fast operation*

The detectors can operate very quickly, but the ability to do so may increase the number of nuisance alarms from the device. Nuisance alarms cost money and can result in loss of confidence in the fire-detection system. The advantage of speed with these detectors can be exploited if precautions are taken to minimize interference from external nuisance alarm sources.

M.8.3.3 Limitations

The limitations of ultraviolet flame detection methods are as follows:

(a) *Nuisance alarm sources*

Ultraviolet flame detection methods are sensitive to arc welding, electrical arcs, X-rays and lightning. Although it is possible to eliminate nuisance alarms from lightning and electrical arcs by the inclusion of additional time delay processing in the detector circuitry, elimination of nuisance alarms from arc welding and X-rays is much more difficult to achieve. The detector's sensitivity to these nuisance alarm sources can be a significant problem.

(b) *Ultraviolet inhibitors*

The main inhibitors of ultraviolet propagation are oil mists or films, heavy smoke or hydrocarbon vapour and water films or ice. All of these phenomena can significantly reduce the intensity of the ultraviolet signal if present in the flame detection path.

(c) *High current*

The sensing elements used by ultraviolet detection methods require relatively high currents and thus it is not practical to design intrinsically safe variants.

(d) *Failure modes*

Ultraviolet detectors can sometimes have characteristic failure modes. Ultraviolet detectors can become sensitive to ambient light or solar radiation, or break into free oscillation (runaway). The detector tube can become insensitive or the tube circuit can malfunction.

(e) *High cost*

The technology used in these detectors means that they are typically more expensive than infrared detectors.

M.8.4 Single-channel infrared detectors

M.8.4.1 Detection principles

The combustion of hydrocarbons typically produces two main peaks at 2.7 µm (radiation emitted by water vapour) and 4.3 µm (radiation emitted by CO_2). CO_2 in the atmosphere of the earth absorbs infrared radiation at this later frequency. Infrared flame detectors can respond to solar radiation permeating the earth's atmosphere and it is therefore important that infrared flame detectors are designed to such an extent that they are completely solar blind.

Non-hydrocarbon fires such as metals do not produce CO_2 in the combustion process. Such fires are in general better suited to infrared flame detectors operating at the 2.7 μm wavelength.

Infrared flame detectors are often able to capitalize on another phenomenon of fire, that is, flicker. The determination of flame flicker allows an infrared flame detector to reduce the probability of giving a nuisance alarm in the presence of black-body radiation. Although the ability to determine the flicker characteristic is essential for an infrared flame detector, it is not enough on its own to reduce a detector's ability to detect nuisance alarms. Most single-channel infrared flame detectors detect flame flicker within a 1 Hz to 20 Hz waveband.

M.8.4.2 Advantages

The advantages of single-channel flame detectors are as follows:

(a) *Solar blind*

Most single-channel infrared detectors presently on the market are solar blind, using filtering techniques.

(b) *Cost*

Low cost single-channel devices are available, but have limited applications, especially following recent developments in infrared flame detection technology.

(c) *Reasonable nuisance alarm immunity*

Infrared flame detectors are generally immune to arc welding and X-rays. Flicker analysis reduces nuisance alarms from steady black-body sources.

(d) *Low current*

Very low current detectors can be produced, which allow intrinsically safe detectors to be produced.

M.8.4.3 Limitations

The limitations of single-channel flame detectors are as follows:

(a) *Solar blindness*

Some single-channel flame detectors are not solar blind. This restricts their use to indoor environments, where there is no direct sunlight or reflected sunlight in the optical path of the flame detector.

(b) *Black-body radiation*

Single-channel infrared detectors can be sensitive to black-body radiation. The sensitivity of these devices can be influenced by the introduction of black-body radiation into the detector's field of view, leading to possible generation of nuisance alarm conditions. Such sources could be from powered equipment that generates sufficient heat to cause the problem. Other conditions can arise from human or other movements in the detectors field of view. The normal operating principle is such that the detector responds to relative changes in infrared, and thus a large infrared source that does not flicker may mask an infrared source that does flicker. Therefore, a real fire condition could be missed under these conditions.

(c) *Limited range*

Single-channel infrared detectors have a limited range. This range can be further restricted by the introduction of contaminants on the lens of the detector.

(d) *No window test*

Single-channel infrared flame detectors typically do not provide any means of monitoring the lens clarity, and so the effectiveness of the detector may go unchecked between routine servicing.

M.8.5 Ultraviolet/infrared (single-channel) flame detectors

M.8.5.1 Detection principles

Combining the technologies of single-channel ultraviolet and infrared detection methods can alleviate some of the problems, but combined sensors can still have limitations. Each application needs to be analysed so that the best available detection combination can be selected. Ultraviolet/infrared detectors contain two sensors and give an alarm only when both ultraviolet and infrared light are detected, thus eliminating many of the causes of nuisance alarms. Unfortunately, they are also blinded by everything that blinds either ultraviolet or infrared, and this results in reduced reliability.

M.8.5.2 Advantage

The ultraviolet/infrared sensors can result in the elimination of nuisance alarms from a single source, whether it is infrared or ultraviolet, thus generating fewer nuisance alarms. The detectors can often have a number of pre-set configuration options to tailor the detector to suit typical applications.

M.8.5.3 Limitations

The limitations of ultraviolet/infrared flame detectors are as follows:

(a) *Complex system design*

Application of the detectors requires careful consideration. All possibilities of single source excitation from nuisance alarm sources have to be accounted for. Once these are established, it should be ensured that neither of these single sources occurs at the same time. This may be difficult to predict.

(b) *High nuisance alarms in some applications*

If the detector has to be programmed not to give an alarm indication because of the presence of an ultraviolet or infrared source, the detector will tend to behave like a single-channel ultraviolet or infrared detector. For example, in an aircraft hangar where welding or X-rays are being used, the ultraviolet sensitivity may have to be reduced to increase the reliability of the detector. The action of reducing a detector's ultraviolet sensitivity may induce the device to behave like a single-channel infrared flame detector.

(c) *High cost*

Detectors that employ both ultraviolet and infrared sensing elements are relatively expensive. This is mainly due to the ultraviolet sensing element.

(d) *Limited range*

The maximum flame detection range of the devices is limited by single-channel infrared technology. The range of a detector may have a significant influence on the number of devices required to provide an area with adequate coverage.

M.8.6 Dual-channel infrared flame detectors

M.8.6.1 Detection principles

Single-channel infrared flame detectors process the received signal to determine the flicker content. Most flames flicker when they are burning, especially organic and hydrocarbon-based fires with a regular supply of oxygen. If the flicker content is caused by something other than a genuine fire source, the single-channel infrared detector may give a nuisance alarm. In order to overcome this problem, dual-channel infrared detectors are designed with an additional infrared sensor. This additional sensor is tuned to a frequency that measures the background infrared radiation level within a detector's field of view. This background sensor does not respond to the CO_2 emission band. Using signal-processing techniques, the two signals are correlated and the device decides if a true fire alarm condition is present.

Typical parameters used in these dual-channel infrared flame detectors are as follows:

(a) Ratio of the reference sensor to the CO_2 emission band sensor.

(b) Correlation between the sensors.

(c) The relative amplitude of received signal from each sensor.

(d) The flicker frequency of each sensor.

M.8.6.2 Advantages

The advantages of dual-channel infrared flame detectors are as follows:

(a) *Low nuisance alarms*

These devices produce fewer nuisance alarms than either single-channel ultraviolet or infrared detectors. Dual-channel infrared flame detectors are generally immune to arc welding and X-rays. They are normally solar blind. Flicker analysis reduces nuisance alarms from steady black-body sources.

(b) *Low power*

Dual-channel infrared detectors are typically lower power than detectors using ultraviolet technology. This reduces installation costs and allows intrinsically safe variants to be produced.

(c) *Low cost*

The absence of ultraviolet detection technology and low power consumption enables lower cost detectors to be produced.

M.8.6.3 Limitations

The limitations of ultraviolet/infrared flame detectors are as follows:

(a) *Detection range*

The detection range is better than single-channel infrared but not as good as ultraviolet or triple infrared.

(b) *Loss of sensitivity in some applications*

The choice of frequency for the second (background) sensor may result in difficulties for the detector to determine the difference between hot background infrared sources and relatively cold background sources. A large black-body source, which does not flicker, may mask a smaller source that does flicker. There is the possibility that a real fire condition may not be detected under these conditions.

People in close proximity to the sensor can adversely affect detector performance. The detector may interpret the natural heat of the body as an infrared source. The detector may also detect the movement of people as a flicker characteristic. The overall result could be a nuisance alarm condition.

The detector may interpret a very smoky fire, with a low flame content, as a large black-body. A large black-body signal may swamp the CO_2 emission band sensor, and the detector may fail to produce a fire alarm condition.

(c) *Metal and non-organic fires*

Dual-channel infrared flame detectors are not suited for the detection of metal or non-organic fires.

(d) *High temperature*

Like other infrared detectors, they are not suited for the extreme temperatures that some ultraviolet sensors can operate in. Normal maximum continual operating temperatures are between 70°C and 80°C.

M.8.7 Triple-channel infrared flame detectors

M.8.7.1 Detection principles

Triple-channel infrared detectors monitor the infrared spectrum at three chosen frequencies. One sensor monitors the CO_2 emission bands at 4.3 μm. The other two frequencies are used to monitor the background infrared level. They are normally chosen at frequencies on either side of the CO_2 emission band. The main objective of using the two background frequencies on either side of the emission band is to allow the detector to more accurately predict the amount of black-body radiation present in the field of view.

The detector can account for the differences in hot and cold black-body radiation present — a function that cannot be accurately predicted by dual-channel infrared detectors. The detector can detect fires in the presence of black-body radiation. This can vary significantly depending on the design of the detector. In particular some detectors may be less sensitive to genuine fire conditions than others, particularly in the presence of black-body radiation from a cold black-body. Using signal-processing techniques, the three signals are correlated and the device decides if a true fire alarm condition is present.

Typical parameters used in triple-channel infrared flame detectors are as follows:

(a) Ratio of the reference sensors to the CO_2 emission band sensor.

(b) Correlation between the sensors.

(c) The relative amplitude of received signal from each sensor.

(d) The flicker frequency of each sensor.

M.8.7.2 Advantages

The advantages of triple-channel infrared flame detectors are as follows:

(a) *Very low nuisance alarms*

These devices typically produce fewer nuisance alarms than any of the other detectors discussed. Triple-channel infrared detectors are solar blind, immune to arc welding and X-rays and generally provide much better performance in the presence of both steady and modulating black-bodies, both hot and cold.

(b) *Longer range*

The range of the detector is increased substantially. This normally reduces the number of detectors required to give the necessary coverage for an area.

(c) *Latest technology*

As these detectors tend to be using the latest microprocessor technology, more self-checking and testing routines are included. The detectors can thus alert the control system to an increased number of possible detector status conditions, for example, fire alarm conditions, pre-alarm, electronics fault and dirty window fault.

The new detector technologies available tend to have increased radio frequency interference protection to meet more stringent current and future requirements.

(d) *Low power and cost*

As with all infrared detectors these devices are inherently lower power and lower cost, which reduces overall installation costs.

M.8.7.3 Limitations

The limitations of triple-channel infrared flame detectors are as follows:

(a) *Metal and non-organic fires*

Triple-channel infrared flame detectors are not suited for the detection of metal or non-organic fires.

(b) *High temperature*

Like other infrared detectors, they are not suited to the extreme temperatures that some ultraviolet sensors can operate in. Normal maximum continual operating temperatures are between 70°C and 80°C.

Appendix N
(informative)

ASD sensitivity classes

For the purposes of definition, there are three sensitivity classes that relate directly to those specified in AS 7240.20. (See Table N.1.)

Table N.1 — AS 7240.20 sensitivity classes

Class A	**Very high sensitivity** An ASD system with very high sensitivity that is capable of providing very early warning of a potential fire condition. Such systems are particularly relevant for high-risk areas where staged responses to the multistage alarm conditions are justified to ensure minimum down time of the protected area after a fire-related incident.
Class B	**Enhanced sensitivity** An ASD system with enhanced sensitivity, for applications where an additional degree of confidence is required for the protection of a particular risk. The enhanced capability of such systems is often required to compensate for other risk factors in the protected area such as unusually high ceilings or significant air flows.
Class C	**Normal sensitivity** An ASD system designed to give equivalent performance to a system of point detectors in accordance with AS 7240.7, AS 7240.15 or AS 7240.27.

The sensitivity class relates to the “ASD system” (see AS 7240.20 — 2012, Clause 4.2) and the corresponding test fires and includes any dilution due to the “sampling device”. It does not relate to the sensitivity of the detector without dilution.

Bibliography

The following are the informative documents referenced in this Standard. Documents referenced for normative purposes are listed in Clause 1.3.

AS 1670.3, *Fire detection, warning, control and intercom systems — System design, installation and commissioning — Fire alarm monitoring*

AS 1670.5, *Fire detection, warning, control and intercom systems — System design, installation and commissioning, Part 5: Fire — Special Hazards*

AS 1851, *Maintenance of fire protection equipment*

AS 4214, *Gaseous fire extinguishing systems*

AS 7240.13, *Fire detection and fire alarm systems, Part 13: Compatibility assessment of system components*

AS/NZS 1269.0, *Occupational noise management, Part 0: Overview and general requirements*

AS/NZS 2107, *Acoustics — Recommended design sound levels and reverberation times for building interiors*

ISO 3864 (series), *Graphical symbols — Safety colours and safety signs*

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