Essential Safety Measures - Fire & Smoke Control of Mechanical Services

Antony Rickards

Building Compliance
What we will cover….

Victorian Building Regulations
• Maintenance Requirements
• Responsibilities
• Adoption of AS1851-2012

Smoke Control Features of Mechanical Systems
• Building Code of Australia – Part E
• Australian Standards AS1668.1
• Comparison & Changes between AS1851-2005 & AS1851-2012

System Interface Testing
• Functional Testing
• Performance Testing
• Industry observations
What are Essential Safety Measures?

They are the fire & life safety systems required in buildings and places of public entertainment being a Class 1b, 2, 3, 4, 5, 6, 7, 8 or 9 buildings.

This includes residential, commercial, industrial & public buildings to ensure the safety of occupants in the event of a fire or an emergency and to prevent loss of life and injury.

Examples: fire compartmentation, fire sprinklers, fire alarm & detection systems, emergency lights, exit signs, paths of travel to exits, portable fire extinguishers, fire hydrants, fire hose reels, fire doors, smoke doors, heat & smoke control systems, etc.
**When are Essential Safety Measures required?**

Essential Safety Measures are required to be installed in line with the National Construction Code (Building Code of Australia Vol 1) and relevant Australian Standards.
Are Essential Safety Measures required to be maintained? Yes

- Part 12 of the Victorian Building Regulations
- Owners are responsible for maintenance certification of the whole building
- Maintenance schedule nominated on the Occupancy Permit (This may be any version of AS1851)
- Issue Annual Essential Safety Measures Report (AESMR)
- Documentation to be available for Council within 24hrs
Are Essential Safety Measures required to be maintained? Yes

- Part 12 of the Victorian Building Regulations

- Reg. 1205A
- Compliance with AS 1851—2012 taken to be compliance with earlier standards

- This is a new Regulation allowing for the adoption of AS1851-2012

- We would recommend to the Owner they get an updated schedule prepared and issued if they are adopting AS1851-2012.
  - Provides an updated accurate schedule with correct frequencies
  - Can be referred to in contracts
  - Referenced on the AESMR
  - Meeting your Insurance obligations
Smoke Control Features of Mechanical Systems

• National Construction Code 2016

• Building Code of Australia – Volume 1 Class 2 to 9 buildings
Smoke Control Features of Mechanical Systems

- Building Code of Australia
- Part A0 APPLICATION
- Must meet the Performance Requirements
- Performance Solution
- Deemed-to-satisfy
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- PERFORMANCE REQUIREMENTS
- Fire Engineering Report

PART E2

SMOKE HAZARD MANAGEMENT

PERFORMANCE REQUIREMENTS

EP2.1
In a building providing sleeping accommodation, occupants must be provided with automatic warning on the detection of smoke so they may evacuate in the event of a fire to a safe place.

Application:
EP2.1 only applies to a Class 2, 3, 9a or 9c building or Class 4 part of a building.

EP2.2
(a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that—
   (i) the temperature will not endanger human life; and
   (ii) the level of visibility will enable the evacuation route to be determined; and
   (iii) the level of toxicity will not endanger human life.
(b) The period of time occupants take to evacuate referred to in (a) must be appropriate to—
   (i) the number, mobility and other characteristics of the occupants; and
   (ii) the function or use of the building; and
   (iii) the travel distance and other characteristics of the building; and
   (iv) the fire load; and
   (v) the potential fire intensity; and
   (vi) the fire hazard; and
   (vii) any active fire safety systems installed in the building; and
   (viii) fire brigade intervention.

Limitation:
EP2.2 does not apply to an open-deck carpark or open spectator stand.
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- Deemed-to-Satisfy Provisions
- Prescriptive requirements

**PART E2 SMOKE HAZARD MANAGEMENT**

Deemed-to-Satisfy Provisions

E2.0 Deemed-to-Satisfy Provisions

(a) Where a Deemed-to-Satisfy Solution is proposed, Performance Requirements EP2.1 to EP2.2 are satisfied by complying with—

(i) E2.1 to E2.3; and
(ii) in a building containing an atrium, Part G3; and
(iii) in a building in an alpine area, Part G4; and
(iv) for additional requirements for Class 9b buildings, Part H1.

(b) Where a Performance Solution is proposed, the relevant Performance Requirements must be determined in accordance with A6.7.

E2.1 Application of Part

(a) The Deemed-to-Satisfy Provisions of this Part do not apply to—

(i) any open deck carpark; or
(ii) any open spectator stand; or
(iii) a Class 8 electricity network substation with a floor area not more than 200 m², located within a multi-classified building.

(b) The smoke exhaust and smoke-and-heat vent provisions of this Part do not apply to any area not used by occupants for an extended period of time such as a storeroom with a floor area less than 30 m², sanitary compartment, plant room or the like.

E2.2 General requirements

(a) A building must comply with (b), (c), (d) and—

(i) Table E2.2a as applicable to Class 2 and 9 buildings such that each separate part complies with the relevant provisions for the classification; and
(ii) Table E2.2b as applicable to Class 6 and 9b buildings such that each separate part complies with the relevant provisions for the classification.

(b) An air-handling system which does not form part of a smoke hazard management system in accordance with Table E2.2a or Table E2.2b and which recycles air from one fire compartment to another fire compartment or operates in a manner that may unduly contribute to the spread of smoke from one fire compartment to another fire compartment must—

(i) be designed and installed to operate as a smoke control system in accordance with AS/NZS 1686.1; or
(ii) incorporate smoke dampers where the air-handling ducts penetrate any elements separating the fire compartments served; and
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- Table E2.2a GENERAL PROVISIONS
- Fire-Isolated Stairs & Air Pressurisation

Table E2.2a GENERAL PROVISIONS

<table>
<thead>
<tr>
<th>FIRE-ISOLATED EXITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A required—</strong></td>
</tr>
<tr>
<td>(a) fire-isolated stairway, including any associated fire-isolated passageway or fire-isolated ramp serving—</td>
</tr>
<tr>
<td>(i) any storey above an effective height of 25 m; or</td>
</tr>
<tr>
<td>(ii) more than 2 below ground storeys, not counted in the rise in storeys in accordance with C1.2; or</td>
</tr>
<tr>
<td>(iii) an atrium to which Part G3 applies; or</td>
</tr>
<tr>
<td>(iv) a Class 9a building with a rise in storeys of more than 2; or</td>
</tr>
<tr>
<td>(v) a Class 9c building with a rise in storeys of more than 2; and</td>
</tr>
<tr>
<td>(b) fire-isolated passageway or fire-isolated ramp with a length of travel more than 60 m to a road or open space,</td>
</tr>
<tr>
<td>must be provided with—</td>
</tr>
<tr>
<td>(c) an automatic air pressurisation system for fire-isolated exits in accordance with AS/NZS 1668.1; or</td>
</tr>
<tr>
<td>(d) open access ramps or balconies in accordance with D2.5.</td>
</tr>
</tbody>
</table>
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- Table E2.2a GENERAL PROVISIONS
- Buildings more than 25m effective height
- Buildings Less than 25m effective height
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- Table E2.2a GENERAL PROVISIONS
- Air Pressurisation
- Smoke detection & alarm
- Sprinkler Systems
- Zone Smoke Control
- Smoke Exhaust system
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- Table E2.2b SPECIFIC PROVISIONS

<table>
<thead>
<tr>
<th>Class 6 BUILDINGS (not containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit)</th>
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<tbody>
<tr>
<td>(a) Where the floor area of a Class 6 part of a fire compartment is more than 2000 m², the fire compartment, must be provided with—</td>
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<tr>
<td>(i) an automatic smoke exhaust system complying with Specification E2.2b; or</td>
</tr>
<tr>
<td>(ii) automatic smoke-and-heat vents complying with Specification E2.2c, if the building is single storey; or</td>
</tr>
<tr>
<td>(iii) if the floor area of the fire compartment is not more than 3500 m² and the building—</td>
</tr>
<tr>
<td>(A) is single storey, an automatic smoke detection and alarm system complying with Specification E2.2a; or</td>
</tr>
<tr>
<td>(B) has a rise in storeys of not more than 2, a sprinkler system complying with Specification E1.5.</td>
</tr>
</tbody>
</table>

(b) The provisions of (a) do not apply to—

- a Class 6 sole-occupancy unit that—
  - has a floor area of not more than 2000 m²; and
  - is single storey with a main public entrance opening to a road or open space; and
  - is separated from other parts of the fire compartment by construction, including openings, penetrations and junctions with other building elements, that prevents the free passage of smoke; and
- parts of any other classification that are smoke separated from a Class 6 part by construction complying with (i)(C).

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<td>(a) Where the floor area of a Class 6 part of a fire compartment is more than 2000 m², the fire compartment, including the enclosed common walkway or mall, must be provided with—</td>
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<tr>
<td>(i) an automatic smoke exhaust system complying with Specification E2.2b; or</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
| (iii) if the floor area of the fire compartment is not more than 3500 m² and the building has a rise in storeys of not more than 2, a sprinkler system complying with Specification E1.5.

Class 6 Retail >2000sqm
Class 6 Retail >3500sqm
Enclosed Malls
Class 9b Assembly Buildings
Nightclubs
Theatres
Halls
Cinemas

Table E2.2b SPECIFIC PROVISIONS

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<th>CLASS 6 BUILDINGS</th>
<th>IN FIRE COMPARTMENTS MORE THAN 2000 m²</th>
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- a Class 6 sole-occupancy unit that—
  - has a floor area of not more than 2000 m²; and
  - is single storey with a main public entrance opening to a road or open space; and
  - is separated from other parts of the fire compartment by construction, including openings, penetrations and junctions with other building elements, that prevents the free passage of smoke; and
- parts of any other classification that are smoke separated from a Class 6 part by construction complying with (i)(C).
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2

SPECIFICATIONS

- Spec E2.2a Smoke Detection and Alarm Systems

SPECIFICATION E2.2a SMOKE DETECTION AND ALARM SYSTEMS

Deemed-to-Satisfy Provisions

1. Scope

This Specification describes the installation and operation of automatic smoke detection and alarm systems.

2. Type of system

A required automatic smoke detection and alarm system must comply with the following:

(a) Class 2 and 3 buildings and Class 4 parts of a building:

(i) Subject to (ii), a Class 2 and 3 building and Class 4 part of a building must be provided with—

(A) a smoke alarm system complying with Clause 3; or

(B) a smoke detection system complying with Clause 4; or

(C) a combination of a smoke alarm system complying with Clause 3 within sole-occupancy units and a smoke detection system complying with Clause 4 in areas not within the sole-occupancy units.

(ii) A Class 3 building must be provided with a smoke detection system complying with Clause 4 if it—

(A) has a Class 3 part located more than 2 storeys above ground level; or

(B) accommodates more than 20 residents and is used as a residential part of a school or accommodation for the aged, children or people with a disability.

(b) Class 5, 6, 7, 8 and 9b buildings: A smoke detection system complying with Clause 4.

(c) Class 9a health-care building:

(i) Where 6 or less bed patients are accommodated—

(A) a smoke alarm system complying with Clause 3; or

(B) a smoke detection system complying with Clause 4.

(ii) Where more than 6 bed patients are accommodated, a smoke detection system complying with Clause 4.

(d) Class 9c building: A smoke detection system complying with Clause 4.
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2

SPECIFICATIONS

- Spec E2.2b Smoke Exhaust Systems

Smoke Exhaust Capacity

Smoke Exhaust Fans

SPECIFICATION E2.2b  SMOKE EXHAUST SYSTEMS

Deemed-to-Satisfy Provisions

1. **Scope**
   This Specification describes the requirements for mechanical smoke exhaust systems.

2. **Smoke exhaust capacity**
   (a) Smoke exhaust fans must have a sufficient capacity to contain the smoke layer—
       (i) within a smoke reservoir formed in accordance with Clause 4 and not less than 2 m above the highest floor level; and
       (ii) above the top of any openings interconnecting different smoke reservoirs.
   (b) Exhaust rates must be determined in accordance with Figure 2, with the height measurement taken from the lowest floor level to the underside of the smoke layer.

3. **Smoke exhaust fans**
   Each smoke exhaust fan, complete with its drive, flexible connections, control gear and wiring must—
   (a) be constructed and installed so that it is capable of continuous operation (exhausting the required volumetric flow rate at the installed system resistance) at a temperature of 200°C for a period of not less than 1 hour; and
   (b) in a building not fitted with a sprinkler system, be capable of continuous operation at a temperature of 300°C for a period of not less than 30 minutes; and
   (c) be rated to handle the required volumetric flow rate at ambient temperature to be capable of exhausting cool smoke during the early stages of a fire and to allow routine testing; and
   (d) have any high temperature overload devices installed, automatically overridden during the smoke exhaust operation.
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- SPECIFICATIONS
- Spec E2.2b Smoke Exhaust Systems
- Smoke Exhaust Rates
Smoke Control Features of Mechanical Systems

- Building Code of Australia – Part E2
- SPECIFICATIONS
- Spec E2.2b Smoke Exhaust Systems
- Smoke Exhaust Fan locations
- Make-up air
- System control / activation
- Reference AS1668.1

5. **Smoke exhaust fan and vent location**
   Smoke exhaust fans and vents must be located—
   (a) such that each smoke reservoir is served by one or more fans with the maximum exhaust rate at any one point limited to avoid extracting air from below the smoke layer; and
   (b) to prevent the formation of stagnant regions resulting in excessive cooling and downward mixing of smoke; and
   (c) at natural collection points for the hot smoky gases within each smoke reservoir having due regard to the ceiling geometry and its effect on the migratory path of the smoke; and
   (d) away from the intersection of walkways or malls; and
   (e) to ensure that any voids containing escalators and/or stairs commonly used by the public are not used as a smoke exhaust path; and
   (f) to discharge directly to outdoor with a velocity of not less than 5 m/s, at a suitable point not less than 2 m from any air intake point or exit.

6. **Make-up air**
   (a) Low level make-up air must be provided either automatically or via permanent ventilation openings to replace the air exhausted so as to minimize—

7. **Smoke exhaust system control**
   (a) Each smoke exhaust fan must be activated sequentially by smoke detectors complying with Specification E2.2a and arranged in zones to match the smoke reservoir served by the fan(s).
   (b) Subject to (c) and (d), an air handling system (other than individual room units less than 1000 L/s and miscellaneous exhaust air systems installed in accordance with Sections 5 and 6 of AS/NZS 1668.1) which does not form part of the smoke hazard management system must be automatically shut down on the activation of the smoke exhaust system.
   (c) In a single storey fire compartment, air handling systems in all non fire-affected zones may operate on 100% outdoor air to provide make-up air to the fire-affected zone.
   (d) Within a multi-storey fire compartment, air handling systems in all non fire-affected zones and storeys must operate at 100% outdoor air to provide make-up air to the fire-affected storey via building voids connecting storeys.
   (e) Manual override control and indication together with operating instructions for use by emergency personnel must be provided adjacent to the fire indicator panel in accordance with the requirements of clauses 4.11 and 4.13 of AS/NZS 1668.1.
   (f) Manual control for the smoke exhaust system must also be provided at a location normally used by the stage manager in a theatre.
   (g) Power supply wiring to exhaust fans together with detection, control, and indication circuits (and where necessary to automatic make-up air supply arrangements) must comply with AS/NZS 1668.1.

8. **Smoke detection**
   A smoke detection system must be installed in accordance with Specification E2.2a to activate the smoke exhaust system.
Smoke Control Features of Mechanical Systems

- AS/NZS1668.1 – 2015
- The use of ventilation and air conditioning in buildings
- Part 1: Fire and smoke control in buildings
Smoke Control Features of Mechanical Systems

- AS/NZS1668.1 – 2015
- The use of ventilation and air conditioning in buildings
- Part 1: Fire and smoke control in buildings
Smoke Control Features of Mechanical Systems

- AS/NZS1668.1 – 2015
- Fire Protection of Openings;
- Fire Dampers,
- Sub-Ducts,
- Fire Resistance Levels (FRL)

**Protection above fire dampers required to prevent ignition of combustible material except where fire dampers and insulation criteria of Clause 3.2.3.2**

Fire dampers may be mounted in the floor at the top of the shafts (except where a smoke-exhaust system is installed) (see Clause 3.2.3.2)

Smoke-exhaust shafts may be extended through highest storey served except where required for smoke-exhaust (see Clause 3.7.1)

Fire dampers required for return or recycle openings in smoke-exhaust duct (see Clauses 8.5.1.4 and 11.7.1)

Fire dampers required for supply air systems (see Clause 3.2)

Fire dampers required for fire dampers required for supply air systems (see Clause 3.2)

Fire dampers may be mounted in the floor at the top of the shafts, except where a smoke-exhaust system is installed (see Clauses 3.2.3.2 and 3.3.3)

Fire dampers required for fire dampers required for smoke-exhaust (see Clause 3.2)

Sub-Ducts required for smoke-exhaust systems (see Clause 3.7.4)

Fire dampers required for fire dampers required for smoke-exhaust systems (see Clause 3.7.4)

Fire damper may be omitted from entry to shaft on one level (see Clause 3.2.3.2(a))

NOTE: Fire dampers are at the top or bottom of a shaft are omitted where the shaft forms a common compartment with a plant room or connected compartment.

**FIGURE 3.1 TYPICAL ARRANGEMENT FOR PROTECTION OF OPENINGS FOR AIR-HANDLING SYSTEMS SERVING MORE THAN ONE COMPARTMENT**
Smoke Control Features of Mechanical Systems

- AS/NZS1668.1 – 2015
- Smoke Exhaust Fans
- Sprinkler protected building;
  - Shall operate for a period of not less than 2 h with a smoke exhaust air temperature of 200°C.
- Non-Sprinkler protected building;
  - Shall operate for a period of not less than 30 min with a smoke exhaust air temperature of 300°C.
Smoke Control Features of Mechanical Systems

- AS/NZS1668.1 – 2015
- Stair Pressurisation
- Door opening force
- Air flow velocities
- Floor Pressure differentials
- Max Noise levels

- Measuring air flow rates
Smoke Control Features of Mechanical Systems

• AS/NZS1668.1 – 2015
• Fire Mode Operation
• Shutdown
• Zone Pressurisation
• Smoke exhaust
• Supply Air
• Relief Air
• Make-up Air
• Air Dampers; Open/Close

Figure 8.1 Zone Pressurization System—Typical Installation with Plant Room Above Spaces Being Served
AS1851-2005 Vs AS1851-2012

**Maintenance of fire protection systems and equipment:**

Prepared by the Standards Committee FP001
Developed as a means of satisfying the OHS and Building Regulations, for the relevant state legislation.

**AS 1851 Part 1-16** Superseded suite of Standards.

**AS1851-2005** was published on 5 September 2005 and amalgamated previous editions of AS1851 and is designed to be read as one document. Contains 19 Sections.

**AS1851-2012** was published on 3 December 2012 and was produced as a simplified and consolidated version of AS1851-2005. Contains 14 Sections. This also allowed for a reduction and consolidation of service regimes one of which was to save water through testing of wet fire systems.
AS1851-2005

- Maintenance activities are required on all Essential Services assets with detailed reporting at asset level.
- It is an integrated approach addressing all measures that require System Interface Testing of related services in one routine.
- Reporting requirements were increased and must be transparent and auditable.
- Warden training was introduced as an additional item covered by AS1851.
AS1851-2005

Stage 1: System inspection & test routines

Stage 2: Maintenance reporting & functionality records

Stage 3: Annual inspection, testing, reporting and defect rectification

Stage 4: Annual System Interface Test and defect rectification

Stage 5: Annual Condition Report and defect rectification
Updated AS1851: A new title for 2012

From:
Maintenance of Fire Protection Systems and Equipment

To:
Routine Servicing of Fire Protection Systems and Equipment
**AS1851-2012**

*Baseline data...*

- There is now an understanding of the requirement for the standard of performance to which a system has been designed.

- This is the criteria to which it must perform.

- Examples of baseline data include; Size, Capacity, Speed, Volume, Type, Make, Age, Length, etc.

- Where required baseline data is available, the routine service result shall be verified against it.

- Where required baseline data is unavailable, its unavailability shall be recorded and reported as a non-conformance.
AS1851-2012

Annual survey:

The specification must be auditable and measurable as there is now a more detailed requirement to comply with AS4655 – Standard for Essential Services Auditing. This audit must be completed annually by an independent organisation, this cannot be performed by the maintenance provider.

Extract from AS1851-2012…

Routine service (maintenance) is concerned with the principle that a system will continue to perform to the approved design when routine service is conducted on a pre-determined and regular basis. Surveys are scripted activities in the routine service schedules as a check for any component degradation or building changes that may impact on system performance. The survey requirements of this Standard do not require auditing to AS 4655, *Fire safety audits*. 
AS1851-2012

Systems Interface Testing (Appendix D)...

• This is a better definition for the old AS1851-2005 requirements for the system functionality testing and system interface control test.

• The intent of this new requirement is to ensure there is an 'end to end' test of all of the integrated safety measures to ensure they work concurrently.

• An informative appendix was added to provide examples of how these tests should be performed and how they should be documented.
System Interface Testing

- AS 1851-2012
- System Interface Test;
- Functional Testing
- Manual Override Controls
- Ancillary actions:
  - Door release
  - EWIS cascade
  - FFCP correct indication

- Performance testing;
- Air Flow Rates

- Fire Matrix
System Interface Testing

- AS 1851-2012
- System Interface Test;
- Functional Testing
- Manual Override Controls
- Ancillary actions;
  - Door release
  - EWIS cascade
  - FFCP correct indication
- Performance testing;
- Air Flow Rates

- Manual override controls
System Interface Testing

- AS 1851-2012
- System Interface Test;
- Functional Testing
- Manual Override Controls
- Ancillary actions;
  - Door release
  - EWIS cascade
  - FFCP correct indication
- Performance testing;
- Air Flow Rates
- Performance solution on delayed EWIS
System Interface Testing

- AS 1851-2012
- System Interface Test;
- Functional Testing
- Manual Override Controls
- Ancillary actions;
  - Door release
  - EWIS cascade
- Performance testing;
- Air Flow Rates
- Motorised window for make-up air
System Interface Testing

- AS 1851-2012
- System Interface Test;
- Functional Testing
- Manual Override Controls
- Ancillary actions;
  - Door release
  - EWIS cascade
- Performance testing;
- Air Flow Rates

- Measuring exhaust air flow rates
Industry Observations

- None or limited baseline data
- No fire matrix present
- Some fire matrix only have mechanical operation lacking the ancillary interface testing requirements
- Functional Testing completed without performance testing
- Contracts only include functional testing and exclude performance testing
Industry Observations

- Mechanical contractors with DA-19 knowledge only and no AS1851 knowledge

- Lack of preparation and inadequate equipment for conducting interface testing; eg. Access, scissor lifts, testing equipment

- A lack of reporting & recording of results provided from the mechanical contractor during the interface testing.

- Annual compliance statements or condition reports incorrectly presented and referencing the wrong standards

- Defecting items based on current design standards rather than the applicable standard at the time of construction
Questions?

Thank-you